POLITECNICO
MILANO 1863

School of Industrial and Information Engineering
Master of Science in Management Engineering

Smart Home ecosystems: a model to identify value creation and strategic approaches

Supervisor: Prof. Eng. Angela Tumino
Co-supervisor: Eng. Giorgia Elisabetta De Bernardi

Master graduation thesis by:
Alessandro Corio 859180
Andrea Dell'Acqua 858733

Academic Year 2016/2017

Questa va per te che hai lottato per me.

TABLE OF CONTENTS

EXECUTIVE SUMMARY I

1. INTRODUCTION 1
1.1 The Concept of Smart Home 1
1.2 Features and Functionalities of the Smart Home 3
1.3 Smart Home Market 4
1.4 Barriers to Smart Home Adoption 6
1.5 Smart Home and Data 7
2. LITERATURE REVIEW 10
2.1 Introduction to the State-of-the-art Analysis 10
2.2 Papers Search 13
2.2.1 Sources 14
2.1.2 Publication Years 14
2.1.3 Search Keywords 15
2.3 Selection Criteria 16
2.3.1 Analysis Unit 16
2.3.2 Papers Focus 16
2.3.3 Sampling Number 17
2.4 Process Subjectivity Analysis 18
2.5 Reference Sample for the Analysis 18
2.6 Classification for Research Method 20
2.7 Classification for Topic 21
2.8 Literature on Smart Home 24
2.8.1 Strategy 24
2.8.2 Technology 26
2.8.4 Market 28
2.8.5 General 30
2.9 Literature on Internet of Things 31
2.9.1 Strategy 31
2.9.2 General 36
2.10 Literature on Data 38
2.10.1 Internet of Things 38

2.10.2 Strategy 39
2.10.3 Business Model 40
2.11 Final Structure of the Database 41
3. OBJECTIVES & METHODOLOGIES 43
3.1 Objectives 43
3.2 Methodologies 44
3.3 Objective and Methodologies Summary Table 45
4. SMART HOME SOLUTIONS ANALYSIS 47
4.1 Database Structure 47
4.3 Reference Sample 52
4.4 The Actual Market 57
4.5 Industry Trends 65
5. SMART HOME ECOSYSTEM: BUSINESS MODELS EVOLUTION AND VALUE OF DATA 69
5.1 From Value to Value Network 69
5.1.1 Value and Value Chain 70
5.1.2 Value Network 72
5.1.3 From Value Network to Ecosystem 75
5.2 Smart Home Ecosystem 76
5.2.1 Business Ecosystem Definition 77
5.2.2 Smart Home Ecosystem Evolution 80
5.2.3 Smart Home Ecosystem Peculiarities 82
5.2.4 Smart Home Platform 85
5.3 Smart Home Roles and Actors 89
5.3.1 Network Perspective on Smart Home 90
5.3.2 Roles in the Value Network 91
5.3.3 Smart Home Ecosystem Layers Model 94
5.3.4 Smart Home Actors 97
5.3.5 Strategic Positioning 102
5.4 Business Model and Competence Innovation 103
5.4.1 Strategy Definition in Smart Home 103
5.4.2 Business Models and Smart Home 105
5.4.3 Competences and Smart Home 108
5.4.4 Transformation Intensity Matrix 110
5.5 Value of Data 112
5.5.1 Smart Home and Data Gap 113
5.5.2 Data Relevance in Smart Home 114

5.5.3 Strategic Application and Implication Of Data 116
5.5.4 Data Valorisation Model 117
6. ACTORS ANALYSIS AND MODELS APPLICATION 123
6.1 Actors Selection 123
6.2 Telcos 125
6.2.1 Introduction 125
6.2.2 Characteristics 126
6.2.3 Competitive Strategies and Related Business Models 133
6.2.4 Business Strategies in the Ecosystem Layers Model 139
6.2.5 Data Usage Purposes 140
6.2.6 Data Usage Purposes in Data Valorisation Model 142
6.2.7 Business Strategies and Data Usage Matrix 143
6.2.8 Conclusion 145
6.3 Energy Utilities 147
6.3.1 Introduction 147
6.3.2 Characteristics 147
6.3.3 Competitive Strategies and Related Business Models 153
6.3.4 Business Strategies in the Ecosystem Layers Model 158
6.3.5 Data Usage Purposes 160
6.3.6 Data Usage Purposes in Data Valorisation Model 162
6.3.7 Business Strategies and Data Usage Matrix 163
6.3.8 Conclusion 164
6.4 Appliance Manufactures 166
6.4.1 Introduction 166
6.4.2 Characteristics 167
6.4.3 Competitive Strategies and Related Business Models 173
6.4.4 Business Strategies in the Ecosystem Layers Model 178
6.4.5 Data Usage Purposes 179
6.4.6 Data Usage Purposes in Data Valorisation Model 181
6.4.7 Business Strategies and Data Usage Matrix 182
6.4.8 Conclusion 184
6.5 Ecosystem Layers Model and Data Valorisation Matrix 185
6.5.1 Actors' Matrixes 185
6.5.2 Generalised Model 191
7. CONCLUSIONS 193
7.1 Conclusions and Implications 193

7.2 Future Developments 195

BIBLIOGRAPHY 198

SITOGRAPHY 210

ACKNOWLEDGEMENTS 212

LIST OF FIGURES

Figure 1: Ecosystem Layers Model V
Figure 2: Smart Home Ecosystem VI
Figure 3: Transformation Intensity Matrix VII
Figure 4: Data Valorisation Model VIII
Figure 5: Energy Utilities Ecosystem Layers Model X
Figure 6: Energy Utilities Data Valorisation model XI
Figure 7: Energy Utilities Competitive Strategies and Data Usage Purpose Matrix XI
Figure 8: Energy Utilities Transformation Intensity Matrix XII
Figure 9: Energy Utilities Ecosystem Layers and Data Valorisation Methodologies Matrix XII
Figure 10: types of Smart Home functionalities, Balta-Ozkan N. et al. (2013) 4
Figure 11: literature analysis macro-categories 13
Figure 12: papers distribution among years 15
Figure 13: papers distribution for macro-category 18
Figure 14: papers distribution for typology 20
Figure 15: papers distribution for research method 21
Figure 16: Smart Home papers distribution for topic 22
Figure 17: Internet of Things papers distribution for topic 23
Figure 18: Data papers distribution for topic 23
Figure 19: Nest value network, Mäkinen S. J. (2014) 24
Figure 20: Nest learning thermostat innovations, Mäkinen S. J. (2014) 25
Figure 21: Smart Home energy environment, Fernández M. R. et al. (2015) 27
Figure 22: connectivity standards, Samuel S. S. I. (2016) 28
Figure 23: drivers and barriers, Balta-Ozkan N. et al. (2014) 29
Figure 24: general Smart Home management model, Stojkoska B. L. R. et al. (2016) 30
Figure 25: steps for creating a Smart Home, Mennicken S. and May H. E. (2012) 31
Figure 26: relative importance of building blocks, Dijkman R. M. et al. (2015) 32
Figure 27: business model framework for IoT applications, Dijkman R. M. et al. (2015) 32
Figure 28: business model framework for IoT context, Turber S. et al. (2014) 33
Figure 29: improved business model canvas, Uchihira N. et al. (2016) 34
Figure 30: value creation in a generic IoT ecosystem, Westerlund M. et al. (2014) 35

Figure 31: IoT multi-sided markets, Keskin T. and Kennedy M. D. (2015) 36
Figure 32: value of IoT technology for the industry, Kaliczyńska M. and Dąbek P. (2014)..... 37
Figure 33: roles of IoT components in offering portfolio, Gerpott T. J. and May S. (2016) 37
Figure 34: competitive intelligence collaborative analysis model, Di J. et al. (2014)..... 39
Figure 35: value creation traditional view versus big data view, Furtado L. et al. (2016)..... 39
Figure 36: reverse use of customer data, Saarijärvi H. et al. (2014)..... 40
Figure 37: database for paper analysis..... 41
Figure 38: geographic distribution of Smart Home solutions..... 52
Figure 39: Smart Home solutions for continent 53
Figure 40: Smart Home solutions for relevant countries..... 53
Figure 41: distribution of offers among different types of companies..... 54
Figure 42: relevant mergers and acquisitions (2013-2017) for Smart Home-related companies 55
Figure 43: distribution of offers among sub-domains 56
Figure 44: business model typologies..... 57
Figure 45: pricing model typologies..... 59
Figure 46: pricing model typologies among company typologies..... 61
Figure 47: sale channel typologies (1) 62
Figure 48: sale channel typologies (2) 62
Figure 49: distribution channels and relative diffusion 63
Figure 50: distribution channel diffusion among company typologies..... 64
Figure 51: diffusion of Smart Home solutions over time according to their sub-domains 65
Figure 52: the Value Chain..... 71
Figure 53: five-step methodology, Peppard J. and Rylander A. (2006)..... 73
Figure 54: smart connected product systems, Porter M. (2014)..... 75
Figure 55: core business, extended enterprise and business ecosystem, Moore J.F. (1996) 78
Figure 56: the evolutionary stage of a business ecosystem, Moore J. F. (1999)..... 80
Figure 57: Roger's innovation bell curve 81
Figure 58: multi-sided business model 86
Figure 59: platform functioning..... 87
Figure 60: platform trade-offs, Schreieck M. (2017) 88
Figure 61: generic Smart Home value network (1), Ehrenhard M. et al (2014)..... 91
Figure 62: generic Smart Home value network (2), Ehrenhard M. et al (2014)..... 92
Figure 63: Ecosystem Layers Model 95

Figure 64: Smart Home Ecosystem 97
Figure 65: relevant paper about Internet of Things business model, Jua J. et al (2016) 104
Figure 66: business model canvas 106
Figure 67: business model categories 107
Figure 68: competence categories 109
Figure 69: Transformation Intensity Matrix 111
Figure 70: Data Valorisation Model 118
Figure 71: internal and external value in Data Valorisation methodologies 120
Figure 72: mobile radio technologies classification 126
Figure 73: Telcos Ecosystem Layers Model 139
Figure 74: Telcos future Ecosystem Layers Model 140
Figure 75: Telcos Data Valorisation Model 142
Figure 76: Telcos future Data Valorisation Model 143
Figure 77: Telcos Competitive Strategies and Data Usage Purpose Matrix 144
Figure 78: Telcos Transformation Intensity Matrix 145
Figure 79: Average battery pack price, Electrek 148
Figure 80: Energy Utilities Ecosystem Layers Model 159
Figure 81: Energy Utilities future Ecosystem Layers Model 159
Figure 82: Energy Utilities Data Valorisation Model 162
Figure 83: Energy Utilities future Data Valorisation Model 162
Figure 84: Energy Utilities Competitive Strategies and Data Usage Purpose Matrix 163
Figure 85: Energy Utilities Transformation Intensity Matrix 164
Figure 86: Appliance Manufacturers Ecosystem Layers Model 178
Figure 87: Appliance Manufacturers future Ecosystem Layers Model 178
Figure 88: Appliance Manufacturer Data Valorisation Model 181
Figure 89: Appliance Manufacturers Competitive Strategies and Data Usage Purpose Matrix. 182
Figure 90: Appliance Manufacturers Transformation Impact Matrix 184
Figure 91: Telcos Ecosystem Layers and Data Valorisation Methodologies Matrix 186
Figure 92: Energy Utilities Ecosystem Layers and Data Valorisation Methods Matrix 188
Figure 93: Appliance Manufacturers Ecosystem Layers and Data Valorisation Methods Matrix 189
Figure 94: general Ecosystem Layers and Data Valorisation Methods pattern 191

LIST OF TABLES

Table 1: objective and methodologies summary III
Table 2: Energy Utilities SWOT analysis IX
Table 3: objective and methodologies summary 45
Table 4: Telcos SWOT analysis 132
Table 5: Telcos competitive strategy summary 138
Table 6: Energy Utilities SWOT analysis 153
Table 7: Energy Utilities competitive strategy summary 158
Table 8: Appliance Manufacturers SWOT analysis 173
Table 9: Appliance Manufacturers competitive strategy summary 177

EXECUTIVE SUMMARY

Introduction

"Smart Home is the integration of technology and services
through home networking for a better quality of living."
Robles R. J., Kim T. (2010)

Smart Home is taking a leading role in Internet of Things (IoT) universe. The importance of the home in people's lives is a great advantage for the affirmation of this sector, as the customers can easily obtain visible benefits on the daily routine. In addition, the applications for the Smart Home are configured as an ideal interface to introduce the individual in the other IoT applications like Smart Metering, Smart Grid, Smart Car and Smart City, acting as a leading industry for enhancing the awareness on the advantages of the Internet of Things.

According to the esteem of Internet of Things Observatory of Politecnico di Milano, last year the Italian Smart Home market showed a significant development, with an evolution both on the demand side and on the supply side. In 2017, the market for smart and connected solutions for the houses recorded, in Italy, a high growth rate: + 35% compared to the previous year, reaching € 250 million. The Italian growth is in line with the performance of the other main Western countries, even if Italy has lower numbers, in terms of market value, compared to other European and US markets.

Despite the positive results, to date the presence of several barriers obstacles the real Smart Home opportunities.

Literature Review

As mandatory for each scientific research, this dissertation starts from a gap highlighted from the past work of academics. The final sample contains papers that are the result of several searches on Scopus, Web of Science and Google Scholar and of a systematic selection process.

The detailed analysis on 100 papers is categorized into three macro-groups: Smart Home (45), Internet of Things (40) and Data (15).

Among the various sub-groups, the most relevant for our scope are obviously the strategic and value-oriented ones. They show evident insufficiencies on the studies about ecosystem nature of Smart Home industry and roles in the value network, about required business modelling innovation of the involved actors, value creation processes, sustainable strategies and data relevance.

Objectives and Methodologies

This thesis objectives have been set out in the form of two research questions, which are presented below.

RQ1: How is configured the Smart Home offer in Italy and in the rest of the world?

To understand the Smart Home scenario is first and foremost essential study the state-of the art of the offer and the evolution undertaken by smart solutions in the last years. To do this, different solutions to date on sale or already announced by the manufacturers have been analysed, identifying the practices of the market and the solutions-types diffusion trend.

RQ2: How is it possible to create value in the Smart Home scenario considering the ecosystem of actors involved?

In answering the second research question are defined strategic models aimed at understanding the possible position of the actors in the competitive arena and taking the right strategic decisions. Given the relevance of data, their role has been carefully considered, exploiting a valorisation model. The actors who can obtain advantages from the proposed tools are multiple. However, three of the most relevant Smart Home actors have been deepened.

In order to achieve the objectives described, several methodologies have been exploited:

- analysis of the existing literature, which provided a strong support to outline the context of the research work;
- interviews, with executives of companies producing Smart Home solutions;
- three focus groups with different Smart Home actors have been realized thanks to Internet of Things Observatory;
- analysis of secondary sources, consisting in data, reports and analyses from reliable sources, which helped in finding a considerable amount of information in all those areas where literature was lacking;

- **creation and use of models**, some coming from the work of other authors, others created during the work.

Table 1 sums up objectives and methodology in a single graphical representation.

	RQ1	***RQ2***
Analysis of the existing literature		●
Interviews	●	●
Focus groups	●	●
Analysis of secondary sources	●	●
Creation and use of models		●

Table 1: objective and methodologies summary

Smart Home Solutions Analysis

To understanding the Smart Home sector, an analysis at a macroscopic level on the current state of the Smart Home offer has been performed. Thus, in collaboration with the Internet of Things Observatory, a database mapping different Smart Home solution was created.

The thesis work carried out analysed 408 products offered by 279 different companies, distributed all over the world, even though almost 90% of the mapped solutions originated in *North America* and *Europe*. About half of the companies present in the database are *Startups*; this proves the great innovativeness and the low maturity of the sector. However, the so-called *Big Players* have a big share, superior to 40% (the rest is covered by *SME*), and are taking the field as the Smart Home sector grows. They often adopt an acquisition strategy, buying established startups and incorporating new knowledge. The database solutions have been subdivided into sub-domain, based on the functionalities they are required to perform. The first sub-domain for quantity of registered solutions is *security*, including all the solutions aimed at protecting the home. The second place belong to solutions related to *scenario management*: the aspect of controlling everything through a single device/app is crucial to the products success, since no customer wants to handle many solutions in one way, with a different interface. Third is *home*

appliance management, a category that includes all the smart appliances offers, protagonists in the last years International Customer Electronic Shows in Las Vegas.

After this sample analysis, the work proceeded by studying the main components of the offer. Result shows that business model preferred by companies consists in a *physical product with* a *free* smartphone/tablet *app* or a dedicated web page for its remote management. Most companies use traditional models, in which the customer purchase the product with a *unique payment*, although in scientific publications there is much talk of the new phenomenon of *servitisation*, for which anyway was registered a growth. Among the most used sales channels, *e-commerce* stands out, often used by companies in combination with *traditional retailers*. This is especially true for Big Players, while startups, unable to access the traditional supply chain, basically focus on online sales.

The last interesting analysis was that of sector trends, studying the distribution of sub-domains over time. The most surprising fact is the explosion of the share related to *entertainment* solutions in 2017. This is due to the great success of smart speakers, which led to a considerable expansion of the products range; new players entered on the market and many companies started the production of high-end devices, oriented to the reproduction of music with quality sound and high performance, respect the "basic" ones more oriented to the interaction with the user. Adding that *scenario management* related solutions are fairly distributed over time, the importance to offer a unique interface for the Smart Home is confirmed. For customers it is important to have a single touch-point for the Smart Home, otherwise with a large number of apps to manage becomes annoying and occurs the risk of losing control of smart products.

Smart Home Ecosystem: Business Model Evolution and Value of Data

In order to understand the strategic path of the actors involved and their roles in the Smart Home ecosystem, has been necessary to start from an analysis of what is the value and how IoT changed the traditional value chain perspective. Indeed, the cooperative and digitized context which characterise the Smart Home scenario lead to the necessity of taking the new perspective of *Value Networks*. Consequently, the vision must shift from a sequence of operations with a key role for manufacturers, retailers, and channels to an ecosystem of non-linear interaction mechanisms in which the consumer assumes a centric value.

Smart Home Ecosystem

The *Smart Home Ecosystem* is still at the *birth stage*: the nature and the logic of the market are yet not well defined. *Early adopters* are approaching the offer, but the *early majority* is still far. An in-depth analysis of the state of the ecosystem and the creation of strategic models is therefore useful for companies to structure the offer correctly and cross the chasm to mass adoption.

One of the most evident trend is the attempt, shown from different actors, to create a *platform* able to give resonance to the real value that Smart Home devices and services can deliver. It should be able to orchestrate different IT technology, communication standard and so on but must mostly manage the different services and products increasing their value thanks the integration. The platform appears as a mediator between the different actors' roles and the customer, reducing complexity and cost and increasing the synergies.

The different roles in the Smart Home value network are clustered with the *Smart Home Ecosystem Layers Model* (Figure 1), articulated into four layers:

1. *Infrastructure,* means providing the necessary pre-requisites;
2. *Device*, the development of smart products and sensors;
3. *Service*, providing digital services;
4. *Integration,* managing smart solutions in a single touch point.

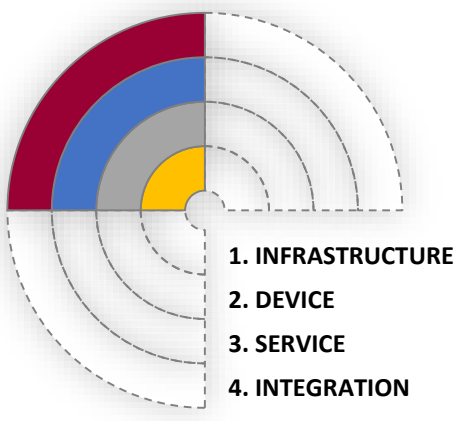

Figure 1: Ecosystem Layers Model

The order, from infrastructure to integration, follows the shift from elementary and basic scopes, that are fundamental for the mere existence of the industry itself, to more sophisticated and crucial roles that instead guarantee the creation of value and the sustainability of the market.

For the sake of clarity, all the actors who, to date, can be part of the Smart Home ecosystem are summarized in the chart below (Figure 2).

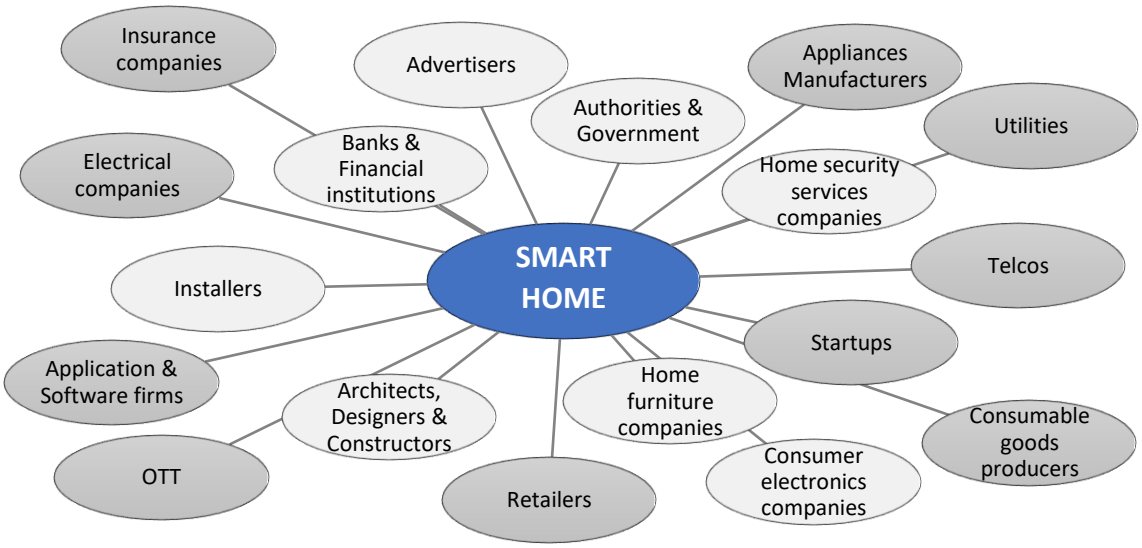

Figure 2: Smart Home Ecosystem

Business Model and Competence Innovation

Moving to the Smart Home strategic implications, actors have to face a choice: maintaining *traditional business models,* also if industry and contingencies which these models target change, or adopting *innovative business models*, completely unexplored by the company.

Moreover, it is not just business models that can change, but also the skills and competences needed by the actors. Indeed, sometimes the *conventional competences***,** the ones associated to the traditional way of doing business in the long-established domain, are enough; in other cases, new *transformational competences* are necessary to create value in an advanced and ground-breaking domain as the Smart Home one.

At this point, the necessity of crossing this analysis on competences and on business models is undertaken through a model able evaluate the intensity of the transformation that the company have to meet in order to pursue a specific competitive strategy. The model, called *Transformation Intensity Matrix* (Figure 3), arranges four possible strategic missions:

- *Consolidation*: gathering best-practices into the new industry, no disruption of the way of doing business is brought. The needed resources are minimal, but difficultly the strategy will lead to high streams of profit in the long-run;

- *Expansion*: business model building blocks remain unchanged, but they are pumped by new smart competences that endorse efficacy and efficiency;
- *Innovation*: the company relies just on its actual skills, competences and resources but is capable of reorganizing them in a more profitable way;
- *Evolution*: the practitioner embraces the IoT as much as he can, investing lot of efforts for disrupting the conventional practices. Aiming at radically evolve the creation and delivery of value, a stubborn crossing between novel business model and competences must be found.

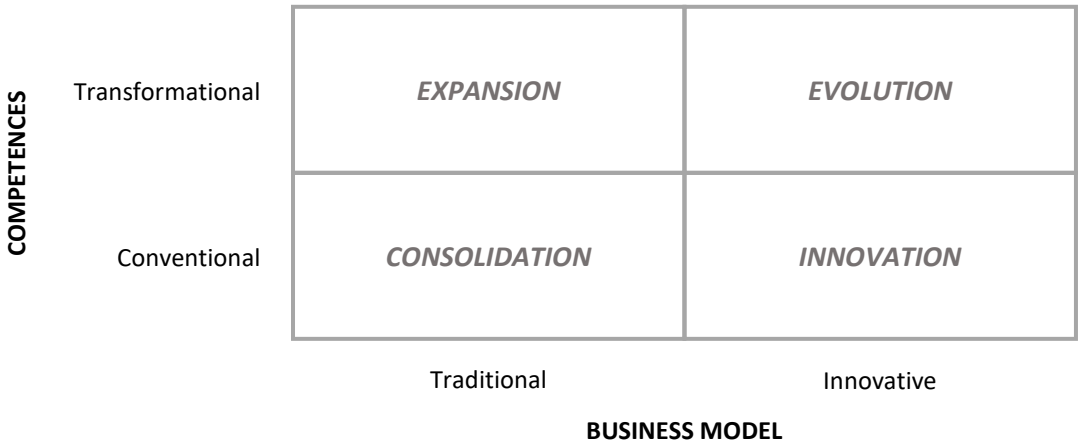

Figure 3: Transformation Intensity Matrix

Data Value

The intrinsic possibility of collecting, analysing and sharing data in the Smart Home value network is fundamental. The peculiarity of the home connected objects is exactly their capability of collecting various types of data from sensors, products usage, customer's preferences and so on. This opens the access to the development of strategies that have the information as one of the critical success factor: in the in the Smart Home, *data is king*.

In this case has not been necessary to arrange a new model, since the *Data Valorisation Model* of the Internet of Things Observatory (Figure 4) identify five different strategies prosecutable by the companies for extracting values from data. However, a new perspective has been given to this already existing model. The valorisation methodologies were in fact ordered according to a precise logic: moving from the first (*process optimization*) to the fifth (*monetisation*), there is an implicit a shift from an internal valorisation of data to an external one.

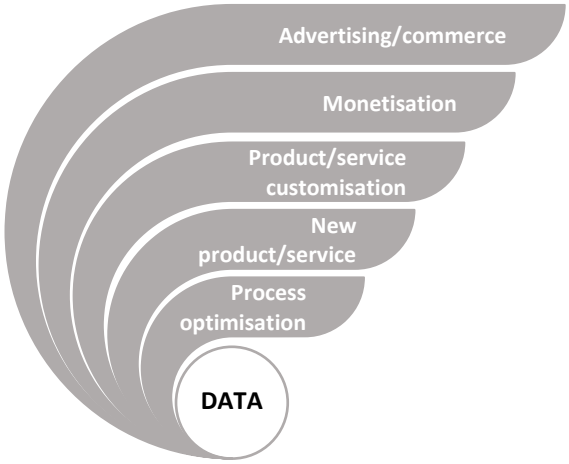

Figure 4: Data Valorisation Model

Actors Analysis and Models Application

Among all the ecosystem actors, have been selected for this activity *Telcos*, *Energy Utilities* and *Appliance Manufacturers*.

The analysis of the actors is functional to the application of the models previously presented, so a way to show effectively how value can be created in the real context, providing insights on how these three actors approach the Smart Home.

For each of the entities have been investigated characteristics and peculiarities summarized into a *SWOT analysis* framework. Then, have been explored the actual or future *competitive strategies*, successively projected into the *Smart Home Ecosystem Layers Model*. As follow, the *data usage purposes* were highlighted and subsequently transposed to the *Data Valorisation Model*. After, to provide an overview of the behaviour which actors could keep in the sector, has been created the *Business Strategies & Data Usage Matrix*. Finally, has been evaluated the transformation that the actor might have to face in order to compete in the smart home scenario, exploiting the *Transformation Intensity Matrix*.

Among the three actors, in this executive summary just the Energy Utilities case is deepened.

Their peculiarities are showed in the SWOT analysis in Table 2.

STRENGHTS	WEAKNESES
• Experience and expertise in energy management • Huge customer base • Experience in providing services • Great attention and investments on startups • Product installation service • Possibility to pay in instalments added to the energy invoice	• Delay compared to competitors • Basic and not very innovative solutions • Offer far from core competence • Poor data analytics capacity • Poor hardware and software skills
OPPORTUNITIES	**THREATS**
• Partnership with Appliance Manufacturers • Partnership with professional installers • Improved customers' behaviour knowledge • Energy network optimisation	• Contraction of energy demand • Other providers establish themselves as providers of energy services • Loss of the privileged relationship with the customer, who becomes prosumer

Table 2: Energy Utilities SWOT analysis

Three actual competitive strategies that the Energy Utility are undertaking have been identified:

- *Reseller*, acting as a sales channel for solutions produced by third parties, with the intention of retaining customers and therefore adopting loyalty-based business models;
- *Smart energy solutions*, providing own energy-related service to customers, exploiting the possibilities related to smart metering. This involves a *digitalization* of Utilities companies, creating a new type of interaction with the customer and new type of business models;
- *Adjacent solutions*, offering a range of new interactive and digital services complementary to energy. The reference model is the *cross-selling*.

Then, look beyond the actual situation, has been outlined a further competitive strategy that the Energy Utilities could undertake in the future:

- *Integration platform*, which consist in creating a platform for the management of the home-related services and the control of all the smart devices installed in the house.

To have a better understanding of the position Utilities can take in the Smart Home ecosystem, competitive strategies has been projected in the *Smart Home Ecosystem Layers model* (Figure 5).

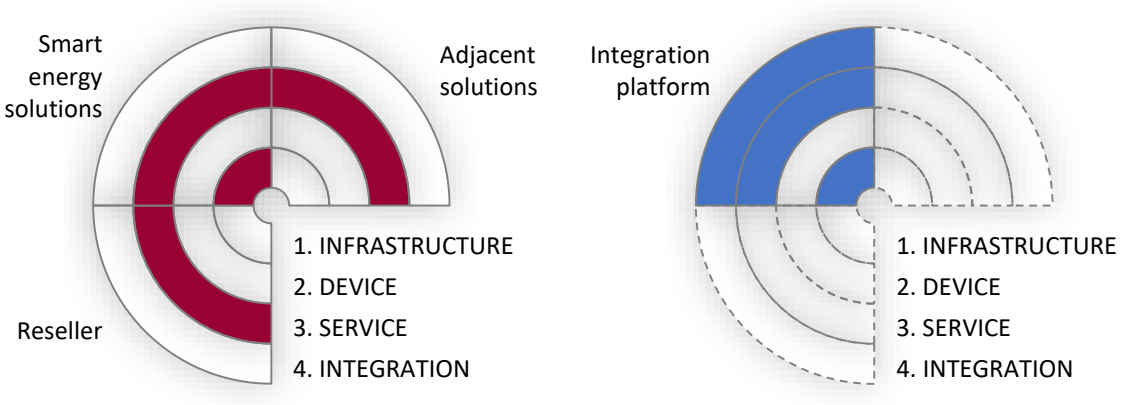

Figure 5: Energy Utilities Ecosystem Layers Model

In the present and in the following graphs the two different temporal perspectives are represented with different colours: the present in claret, the future in blue.

Subsequently have been investigated the purposes for which the data could be used by Energy Utilities. They are:

- *Grid operations*, meaning an efficient network management thanks to data collected from homes' smart meters;
- *Customer engagement*, since data, through analytics, can be transformed into user knowledge useful to strengthen the relationship with customer.

Despite being an unexplored path for Utilities, there is an additional data usage purpose which these companies could start to cover in the next future to sustain new possible strategic directions:

- *Data integration*, aggregating data coming from the different typologies of services offered to consumers, both energy and non-energy: from this large amount of data could be extrapolated precious insights.

Data utilization purposes have been generalized into the *Data Valorisation Model*, matching them with the possible data valorisation methods (Figure 6).

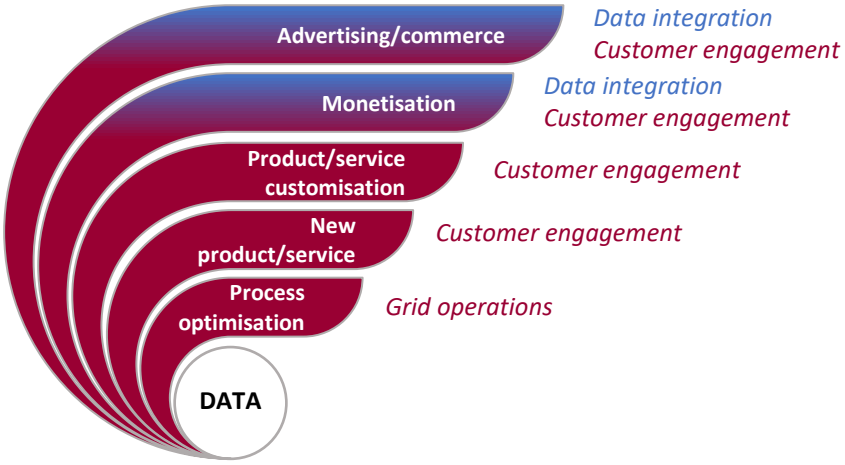

Figure 6: Energy Utilities Data Valorisation model

Once *competitive strategies* and *data usage purpose* has been identified, these two dimensions has been crossed in the *Business Strategies & Data Usage Matrix* (Figure 7); in this way, from intersection, real application cases and Smart Home solutions emerges.

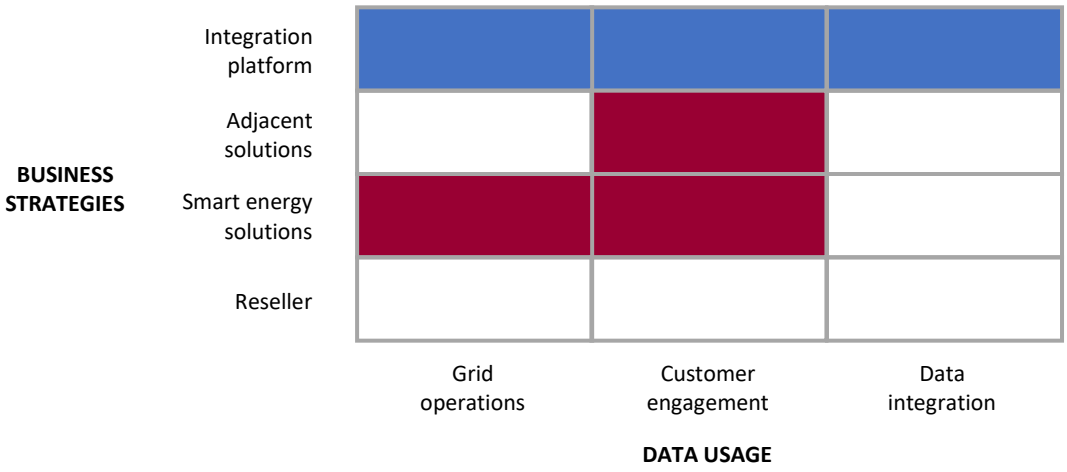

Figure 7: Energy Utilities Competitive Strategies and Data Usage Purpose Matrix

In conclusion, the *Transformation Intensity Matrix* has been applied to Energy Utilities' strategies (Figure 8), in order to evaluate how these companies should change to compete in the Smart Home scenario according to the selected strategy.

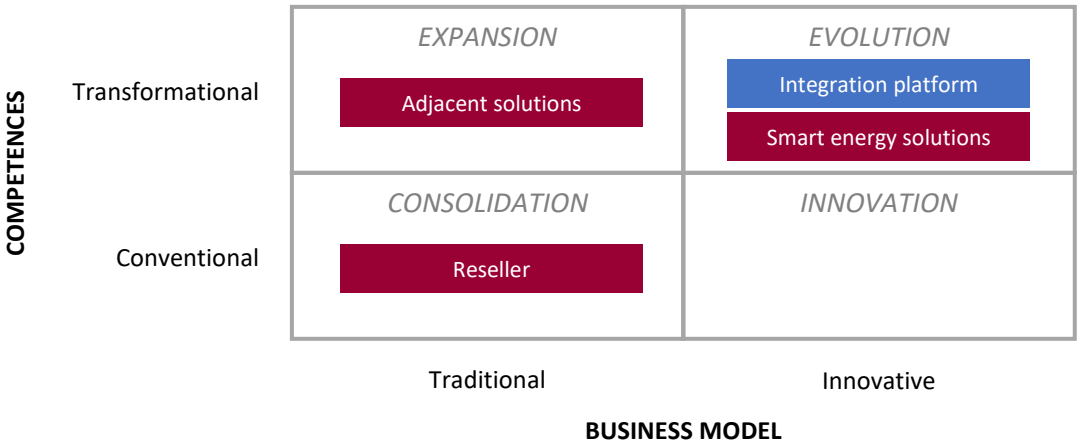

Figure 8: Energy Utilities Transformation Intensity Matrix

Up to this point the discussion about the three actors has proceeded in parallel, maintaining a common structure but highlighting the characteristics and the specific work of each of them individually.

In order to compare the behaviours of the selected actors in the Smart Home scenario it was decided to introduce a new common tool. Has been realised the *Ecosystem Layers* & *Data Valorisation Matrix* (Figure 9), in accordance with what already established in the discussion of individual actors. In this way actors' behaviour in Smart Home scenario could be compared. The following is the one of Energy Utilities.

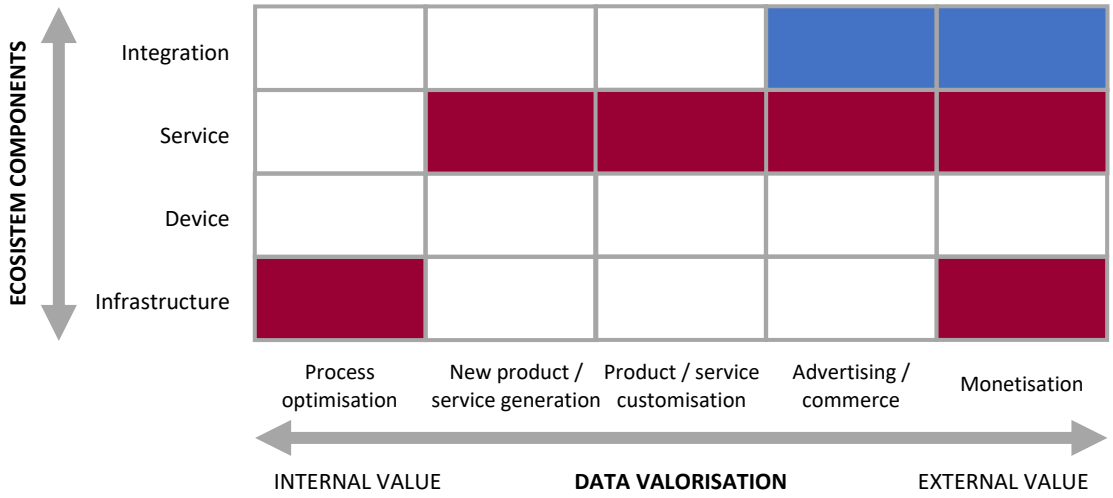

Figure 9: Energy Utilities Ecosystem Layers and Data Valorisation Methodologies Matrix

- *Infrastructure* and *process optimization* refers to all the activities of grid and energy efficiency, such as the production of energy based on houses consumptions or demand-

response programs, which can be activated thanks to the wide availability of data that can be collected with smart metering;

- *Infrastructure* and *monetisation* refers to the possibility for Utilities to sell data and information about grids to interested companies;
- *Service* and *new generation of product/service* represents the new non-energy services that the Utility could open in the Smart Home context (e.g. maintenance or video surveillance services);
- *Service and advertising/commerce* refers to data used for directing to the customer only Utilities' service offers that exactly match his needs or the possibility to trade third-party services;
- *Service* and *product/service customization* refers to the customer support for saving more energy, possible thanks to the advent of smart meters;
- *Service* and *monetization* refers simply to the sale of data coming from smart services;
- *Integration* and *monetisation* refers to the possibility of selling the wide quantity of data obtainable from the implementation of a platform, which allows the Utility to aggregate the information coming from different services.

Conclusions

For academics, this study is important because it is a call for a major shift in value creation research. The work adds to the current business model research in the emerging context of Internet of Things, both theoretically founded and field-tested strategic frameworks. In this way researchers can readily use the frameworks for analyse Smart Home business model patterns in an efficient and structured way.

For practitioners, each of the above-mentioned research outputs can be useful for reaching their destinations, configuring like a roadmap for decision making.

This work can be used by newco, startups and incumbents for understanding how the offering is developing and finding out the right space in the market; it gives the right pillars for understanding the deep features of the Smart Home ecosystem; it permits the evaluation of the strategic effects of IoT on the Home market in terms of business model sand competences; it lets a company to understand the right positioning in the ecosystem and how to exploit the data for increasing value. Moreover, this dissertation does not provide just theoretical tools but also shows how an actor may exploit them offering three detailed examples.

Finally, interesting *future directions* implies: enlarging the use cases to the other actors and representing the overall value network; realizing more quantitative studies on profits streams, cost structures and pricing policies; using the models for other IoT industries; analysing the implementation processes of the defined strategies and so on.

1. INTRODUCTION

In this introductory chapter will be provided some key information to understand the context of the Smart Home, which is the subject of this thesis. First of all, the concept of Smart Home will be clarified and compared with Domotics one, to underline similarities and differences. Subsequently, referring to the classifications proposed by some authors, characteristics and features of the Smart Home will be introduced. Then, some data will be presented on the value of the Smart Living market, collected for 2018 Internet of Things Observatory of Politecnico di Milano, which will allow to understand the weight of the Smart Home within the Internet of Things (IoT) scenario. The chapter will continue with a discussion on the barriers that limit the diffusion of Connected Home solutions and the challenges to a more pervasive diffusion. Finally, the chapter will close with a consideration on the importance of data within this industry.

1.1 The Concept of Smart Home

In the next chapters, are going to be discussed various issues related to a highly innovative and still evolving industry as the Smart Home one. It is therefore a good idea to precisely define the concept. There is no official definition of Smart Home, nor it can be identified the person or the company who coined the term, but in the last few years different actors have tried to represent the concept. Among the many definitions proposed in the literature, the two considered most effective are the following:

"Smart Home is the integration of technology and services
through home networking for a better quality of living."
Robles R. J., Kim T. (2010)

"A Smart Home can be defined as a residence equipped with computing and information technology which anticipates and responds to the needs of the occupants, working to promote their comfort, convenience, security and entertainment through the management of technology within the home and connections to the world beyond."
Aldrich F.K. (2003)

In these definitions there are only three common words: *Smart, Home* and *technology*. This immediately clarifies the innovativeness of this sector, which is in a continuous rise thanks to the availability of new technologies that enable possibilities inaccessible until yesterday. Then, even if expressed in different words, in both definitions there are two similar concepts. The first is the *well-being* of the customer: everything that is Smart Home is made to improve quality of people's lives. The second is the *connectivity* (or *networking*) which, as will be explained soon, is the keystone of the Smart Home respect what existed in past and the reason why the Smart Home is intrinsically related to the Internet of Things.

Trying to use different words, the Smart Home could be defined as the set of all products and services connected to the network, able to improve the quality of life of people.

The term Smart Home is often used as a synonym of *Domotics*, even if inappropriately, as the two terms refer to close but different concepts. Smart Home can be considered an evolution of Domotics. Before highlighting differences and similarities, it is appropriate to illustrate a couple of definitions also of Domotics.

"*Domotics is a collection of technologies and systems that allow to automate different tasks performed inside a house in order to reduce human intervention as much as possible*."
Monteiro P. et al. (2015)

"*Domotics is the application of computer and robot technologies to domestic appliances*"
Delgado A.R. et al. (2006)

It is evident how the two concepts are closely linked to the application of computer science, robotics and other various technologies to homes, with the aim of automating the operations and simplifying the task of the tenants. However, the Smart Home is a step further, as it aims to meet the needs of customers going beyond the automated products and introducing services. Furthermore, a great added value is the pervasive connectivity, which allows data and information to flow through wireless technologies, eliminating the need to install wired systems and opening up to the possibility of greater interoperability and co-operation of different products. Summing up, Smart Home is primarily focused on increasing the residents' comfort and on making life easier all-round, while the concept of Domotics is more focused on technological aspects, in the creation of systems for automating some functions of the house.

1.2 Features and Functionalities of the Smart Home

In defining what are the key features of the Smart Home, references are made to the model proposed by Lê et al. (2012) that defines five distinctive characteristics:

- *Automation*, defined as "*the ability to accommodate automatic devices or perform automatic functions*";
- *Multi-functionality*, defined as "*the ability to perform various duties or generate various outcomes*";
- *Adaptability*, defined as "*the ability to adjust (or be adjusted) to meet the needs of users*";
- *Interactivity*, defined as "*the ability to interact with or allow for interaction among users*";
- *Efficiency*, defined as "*the ability to perform functions in a time-saving, cost-saving and convenient manner*";

A more technological approach is the one of Balta-Ozkan N. et al. (2013), which identified four key components of Smart Home:

- a *communication network* enabling the communication among different devices;
- *intelligent forms of control* to manage the entire system;
- *sensors* able collect data and information;
- *smart features* able to act on the basis of data coming from sensors (e.g. smart thermostat setting the temperature autonomously) or instructions coming from the users (e.g. smart appliance managed remotely through a smartphone app).

As regards the functionalities that Smart Homes can fulfil, the same authors offer a very interesting classification. Balta-Ozkan N. et al. (2013), through a holistic approach, identified functionalities to which correspond a broader spectrum of possible Smart Home solutions and services (Figure 10). In particular, they are*: security, assisted living, health, entertainment, communication, convenience and comfort,* and *energy efficiency*. Subsequently, they grouped them into three clusters. The first one is *Energy Consumption and Management*, the second is named *Lifestyle Support* and regards people well-being while the third is *Safety*, related to people's health. What makes this model interesting is that some functionalities are not assigned to a single category but are the result of the overlapping of diverse needs, suggesting that a rigid classification is not feasible.

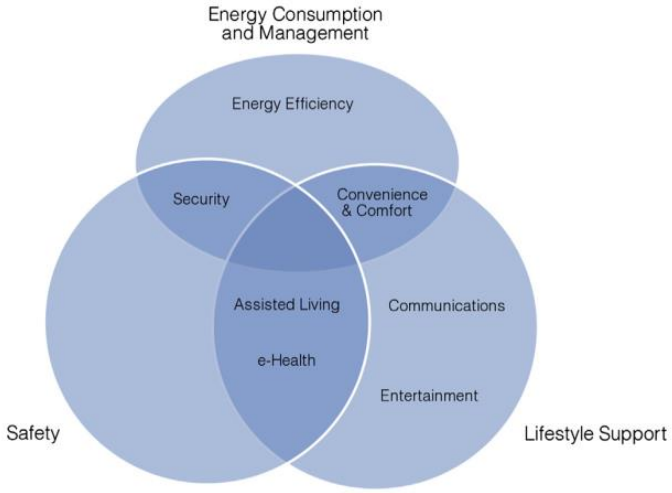

Figure 10: types of Smart Home functionalities, Balta-Ozkan N. et al. (2013)

As will be possible to see in chapter 4, for this thesis it was decided to adopt a different classification of the Smart Home functionalities, in agreement with the Internet of Things Observatory, to remain consistent with the research address they took.

1.3 Smart Home Market

Smart Home is taking a leading role in Internet of Things universe. The importance of the home in people's lives is a great advantage for the affirmation of this sector, as the customers can easily obtain visible benefits on the daily routine. In addition, IoT applications for the Smart Home are configured as an ideal interface to introduce the individual in the other IoT applications like Smart Metering, Smart Grid, Smart Car and Smart City, acting as a leading industry for enhancing the awareness on the advantages of the Internet of Things.

According to the esteem of Internet of Things Observatory of Politecnico di Milano, last year the Italian market showed a significant development of Smart Home, with an evolution both on the demand side and on the supply side. In 2017, the market for smart and connected solutions for homes recorded, in Italy, a high growth rate: + 35% compared to the previous year, reaching € 250 million. The Italian growth is in line with the performance of the other main Western countries, even if Italy has lower numbers, in terms of absolute market value, compared to other European and US markets.

The number of global players who have entered the market proposing Smart Home solutions proliferates. During this research work has been created a database, exploited for an analysis of the offer, which contains some of these solutions. It will be illustrated in chapter 4.

In the Italian market are still missing, or better are going to arrive in very brief time, the Over-The-Top (OTT) as Amazon, Apple and Google, which actually started the sales of Google Home at the end of March 2018. At international level they have now defined their battleground: Smart Speakers (or Intelligent Voice Assistants). On this product type is taking place a real fight for the global market conquest, with OTT gaining a leading role in the competitive arena. It is curious that, even offering the same product, they are creating synergy between Smart Home value proposition and their core businesses, which are obviously different and thus making impossible to predict who will be the winner.

Also touch-points between consumers and Smart Home multiply: retailers (traditional and online), manufacturers, insurance companies, Utilities and Telcos and so on. All move, even if with different speed and strategies, towards the Connected Home.

For what concern the demand of Smart Home solution, according to a research conducted by Internet of Things Observatory, Italian citizens on average have a good knowledge of what actually is a Smart Home and are demonstrating interest in this field. The 55% of respondents to the survey said they already heard about Smart Home and 38% of them owned at least one connected product: about 1 in 3 bought its device in 2017. In addition, 12% of the sample analysed in the survey intends to purchase a connected item in 2018.
Among the most widespread products in the homes of Italians there are sensors for doors and windows, cameras, video door-phones and home locks, all products related to home security. In fact, by investigating what are the reasons that have led consumers to equip themselves with connected devices, Internet of Things Observatory has found in 64% of cases a desire of increasing the level of security of own residence. Another interesting information is the 77% of the sample interested in activating additional services, demonstrating the great development of services in the Smart Home. The last clue obtained from the survey concerns privacy. Respondents were asked if they are worried about their privacy due to the management of personal data collected from connected devices: 51% of respondents said they were fearful about this aspect. The two main reasons for this feeling are the fear that personal data can be used for

purposes different from those declared or that these can be used by hackers to commit harmful actions against citizens.

1.4 Barriers to Smart Home Adoption

As explained in the previous paragraphs, the Smart Home (and even before Domotics), has been on the market by many years, but, despite the growth, to date it is clear that it still not reached a mass diffusion.

There are several barriers that make the complete affirmation of Smart Home difficult. On the topic different authors have furnished their contributions.

Ciesielska M. and Li F. (2011) have identified the following obstacles to the large-scale development of the Smart Home:

- *User perception,* since people are not informed about possibilities or advantages of the Connected Home. In addition, there are several topics that could really influence attitude of people which should be clearly addressed by companies like price stability, lack of information, compatibility and possibilities of upgrades, reliability, servicing costs, and complexity in use;
- *Poor understanding of user needs*, meaning that products functions are far from the real needs of people;
- *Lack of installation, maintenance services and skills*, since these new technologies have a complexity that cannot be easily managed by the average user. To date the plug-and-play solutions on the market are not so immediate: products requiring settings which need the support of an operator. The problem lies in the fact that even technicians still have difficulty with these devices and often avoid proposing them to customers to prevent problems;
- *Costs of devices and installations,* given that Smart Home solutions are still quite expensive;
- *The supply,* because Smart Home requires involvement of various specialists from different industries, such as retail, transport, services, installation, house-building and software industries and their collaboration has to be properly managed. They still have difficulties in interacting each other;

- *Interoperability,* or the lack of common standards. The presence of many communications technologies and protocols create barriers for the systems integration;
- *Old housing stocks and retro adaptation problems*, on account of the large Old House Stock, particularly in Europe, is considered a problem. It is estimated that networking old building requires large investments, significantly more expensive than doing it during the new construction works;
- *Data security and privacy issues,* due to the importance of creating a reliable system which cannot be attacked by hackers. It is also important to ensure that customers' data are used in the correct way;
- *Lack of effective marketing messages*, owing to marketing strategies aimed at informing potential customers are poor, making the acceptance of the products more difficult.

The paper date of publication is enough aged, so over time some of these barriers have been almost overcome such as the *poor understanding of user needs*, through solutions targeting specific use cases and thanks to the customer centric approach now adopted by companies. Other barriers can be considered mitigated, as the *high cost of products* that is progressively lowering with the democratization of technology, rather than the *supply*, thanks to the progresses on channels and greater cooperation between the industries.

Citing a more recent publication, the work of Baffalio Y. et al. (2013) propose a smaller number of barriers which nevertheless remain in line with those highlighted by the previous authors:

- *Lack of standardization* in the transmission, collection and storage of data;
- *Unstructured ecosystem of players* operating independently;
- *Strong inertia from consumers*, which often do not perceive the value of new Smart Home solutions;
- Consumer concerns about *privacy issues*.

1.5 Smart Home and Data

This paragraph briefly introduces one of the key elements of Smart Home, which allows the functioning of IoT applications: data.

As stated, the Smart Home is populated by a series of smart and connected devices. Smart means that products can, more or less independently, support people in certain contexts. Connected means that these products are connected to the network, according to the IoT paradigm, and they are able to interact with third parties. Indeed, objects are equipped with processors, sensors, software and connectivity, favouring an exchange of information between the product and its environment, manufacturer, user and other products and systems. Some product functionalities can exist even outside the physical device, in what is known as a product cloud. Data is the fundamental unit of all these digital processes.

With the technologies available on the market, a single (smart) home can generate hundreds of thousands of transactions every day: each smart object can collect an enormous amount of information. The point is that, in most of cases, this huge quantity of information remains mainly unused by companies. Despite the availability of data, obtaining useful information is not so easy: companies operating in the Smart Home have to make an important effort to achieve excellent data analytics capabilities. The more information can be extracted on the state of the environment or on the habits and preferences of the customers, the better the product or the services provided can be. Paying attention to privacy and security issues, innovative methods for data valorisation could be designed.

Data is a key element in the Smart Home and it is a competitive success factor. It is therefore necessary for companies to evaluate carefully how it is possible for them to gather information, making them knowledge and insights.

2. LITERATURE REVIEW

As mandatory for each scientific research, this dissertation addresses a gap highlighted from the past work of academics.

Thus, the chapter starts with the identification of this gap and with the description of how the process for identifying the right paper sample has been performed. Then, the different classifications are provided and the most important contributions of the past works are handled detail.

2.1 Introduction to the State-of-the-art Analysis

The revision of papers represents the first step in order to understand what has been studied and accepted from the academic world on the Smart Home. With the goal of increasing the knowledge, the literature analysis increases the propositions reliability and reduces the risks of proposing concept already considered unfounded. Despite this method does not assure accuracy and veracity, it is the best way to enhance the knowledge on a particular topic under a critical ideas analysis. Thus, for providing a real new contribute to the academic research, it is compulsory to show that the results are not in contradiction with previously validated studies.

Given the immaturity of industry, it can be deeply interesting to study how the Smart Home ecosystem is composed, in which way the value is created and which are the strategic paths of the actors. As will be stated in Chapter 3, this dissertation wants to fit out the practitioners with the right tools for identifying the best profits models and the most satisfactory ways to deliver value to actual and potential customers.

As follows, the literature is useful for understanding the actual state-of-the-art on the topic. Particularly, for finding out the research areas that need higher attention, must be identified both the most discussed topics and the abandoned ones. Successively, a second minor objective is pinpointing the future development of the industry (Chapter 7). Obviously, the thesis purposes will be supported also from other secondary sources, not definable as scientific but however valuable, that reinforce the literature analysis.

The literature review admits the presence of a strong gap on the strategic impact of Internet of Things on the Home Market. There are evident insufficiencies on the studies about ecosystem nature of Smart Home industry and roles in the value network, about required business modelling innovation of the involved actors, value creation processes, sustainable strategies and data relevance. This evidence is confirmed by the observation that the few Smart Home strategic papers do not enter in details of the above-mentioned issues also if, sometimes, recognize their importance. Enlarging to the IoT literature, this blank is more explicit:

- Westerlund M. et al. (2014)

  "However, research on the IoT and related business models from the ecosystem perspective have been virtually non-existent because the scarce studies on the IOT have focused on the technological platform and a single firm's business models".

- Vimarlund V. , Wass S. (2014)

  "Big data is expected to fundamentally transform smart homes and ambient assisted living delivery of services and consequently managerial and economic aspects of health services delivery, business models and governance processes.... To our best knowledge, there are no scientific publications that report empirical findings of the use of big data in smart homes and ambient assisted living"

  "There is a need to be able to develop a big data strategy and innovative policies and routines to handle a new phenomenon."

- Nancy V. Wuenderlich N. V. et al. (2015)

  "Despite the accelerating development of these smart services, academic research is still in its infancy… Moreover, it is important to understand how we can design and innovate services and business models to move from smart technologies to smart services that add value to customers".

  "To accelerate the development of smart service offerings, it is important that researchers and managers collaborate in identifying profitable business models and smart service strategies. Organizations need to adapt their business models, internal cost structures and their product/service offerings to accommodate the new smart service business

models. Still, there is no knowledge on how - or how dramatically - an organization has to adapt to the smart service paradigm".

- Uchihira N. et al. (2016)

  "Although R&D of IoT has been actively conducted in recent years, these activities mainly focus on the technology itself, and discussions from service marketing and management viewpoints are not enough to develop IoT service businesses. More concretely, research on IoT service-business modelling and design methodology is insufficient".

  "Although many scholars have mentioned the structure of business ecosystem, concrete business-ecosystem design methods are not yet established, especially for IoT services."

- Jua J. et al. (2016)

  "*Although developing IoT business models is important, IoT research has mainly focused on technology, leaving business models relatively unexplored."*

For solving these literature gaps, it is necessary to make order among all the possible concepts coming from the past scientific research.

Clearly, it is fundamental starting with a deep knowledge and solid base on the Internet of Things world and the Smart Living environment. For having a large awareness on the topic, just focusing on *Smart Home* papers is not enough, also because the studies about these topics are scarce and unsatisfactory. Thus, a second stream of literature analysis enlarges the focuses on the *Internet of Things*. In fact, these general publications can be easily translated to Smart Home domain, in particular the strategic ones. Moreover, usually they report case studies about Smart Living. Finally, these publications are enriched by supplemental researches about the *Data* strategic impact.

So, within the process of classification, the papers are grouped for matter. As follow, there are three *macro-categories* (Figure 11) of literature analysis: the first category permits to catch the intrinsic peculiarities of the industry that are fundamental for understanding the value creation modes; the second researches address a general outlook on the Internet of Things universe that can be source of inspiration; the data research addresses the necessity of the innovative business strategy to have the data exploitation always in mind.

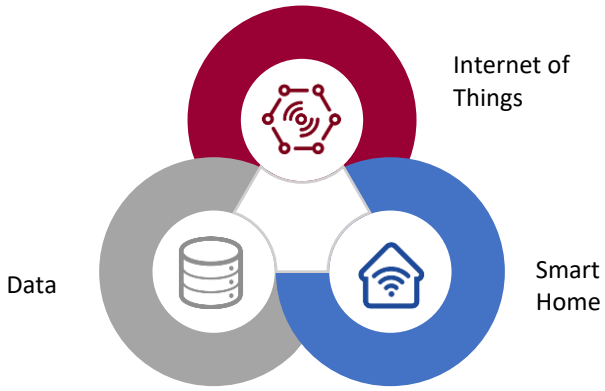

Figure 11: literature analysis macro-categories

Aware of the trade-off between simplification and risk of losing information, in order to identify the existing trends in the research and better describe the handled issues, sub-classifications will be furnished in the following sections.

It is important to clarify that not all the papers of the final sample will be analysed or cited in this chapter. Indeed, it will be preferable to introduce the main sections of Chapter 5 starting with a brief, but strongly targeted on the topic, literature analysis: some critical publications will be exploited there.

Finally, there are some classical strategic papers or old Smart Home publications, usually belonging to years largely previous to the 2010, that are not considered part of the state-of-the-art analysis but they are just used for providing definitions or general theoretical frameworks of reference.

2.2 Papers Search

The process that brought to the chosen papers, for describing the state-of-the-art of the Smart Home, is constituted by two steps: the search of the papers and their selection.

The criteria applied for the search of the scientific publications are:

1. Identification and selection of the sources;
2. Choice of the time lapse;
3. Usage of specific key words.

2.2.1 Sources

The sources of the selected papers are various but, for the online search of scientific publications, has been firstly used two scientific search engines:

- Scopus: http://www.scopus.com/home.uri
  It is the most complete database of academic works with summaries and citations;
- Web of Science: http://login.webofknowledge.com
  It is the ISI (Instituted for Scientific Information) database.

Successively, for increasing the results number, also the Google scientific search engine has been exploited:

- Google Scholar: http://www.scholar.google.it

2.1.2 Publication Years

Despite the concept of Smart Home was already existing before, initially the starting year fixed in the search engines was the 2007, the smartphones birth year that signed the beginning of the world digital revolution. But, after some initial searches, it was clear that the publications which belong to the years antecedent the 2010 are too far from the actual concept of Smart Home. In those years the technologies were not ready, the market was almost inexistent and the practitioners were not aware of the opportunities. The risk of taking into consideration those articles was to acquire a biased knowledge because referred to a too distant period for a dynamic and digital industry.

Consequently, the final chosen release years were between the 2010 and the 2017: the limitation permits to make the analysis, despite quantitatively less completed, qualitatively more updated. Moreover, it must be highlighted that the most interesting results for the thesis purposes are found out from the 2014 onwards: in that period, final consumers started to be attracted by the offerings, the technologies were mature enough, the companies and the academics started to be interest in the value creation and delivery processes within the Smart Living ecosystem.

Finally, as said in the literature analysis introduction, the papers antecedent the 2010, exploited for definitions or starting points, are not part of the sample of reference.

Figure 12 exhibits the distribution of the papers among the years.

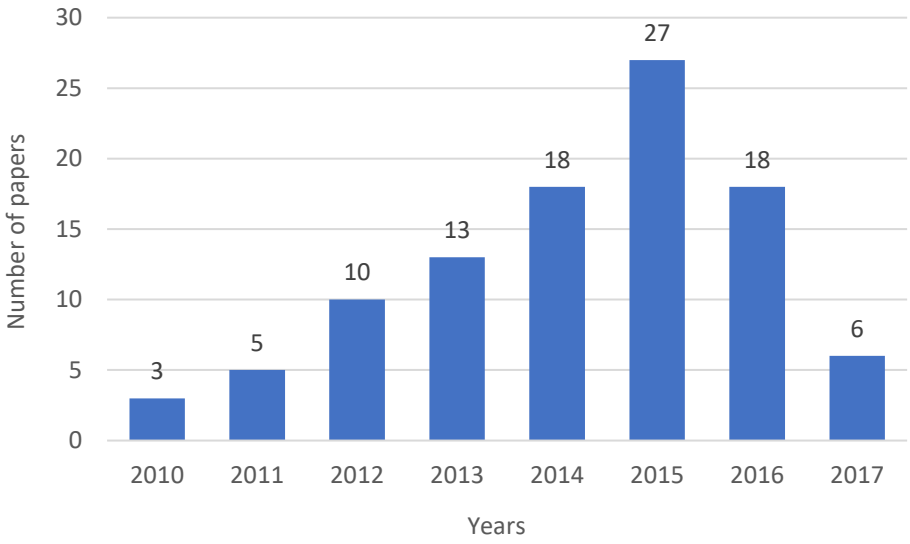

Figure 12: papers distribution among years

2.1.3 Search Keywords

The third step was the selection of the keywords that guided the search engines' work.

Initially, as regards the first category, just the generic English words for defining the concept of the intelligent house were used: *"Smart Home", "Smart House", "Smart Living", "Connected Home", "Intelligent Home"* and *"Automated Home"*. The results were around the 3.5 million, but they touched all the matters. The results dropped under the 1 hundred when filters, for having more business-oriented results, were applied or second keywords, interesting for the research purposes, were associated to the above-mentioned ones like *"Strategy", "Value", "Business Model", "Ecosystem", "Actors", "Competence", "Roles"* and so on.

The same reasoning was applied to the category linked to the keyword "*Internet of Things*": here, the results were around the 9 million if considered the sum of all the three search engines outputs. Juxtaposing managerial filters or keywords, the results dropped around the 3 hundred.

As regards the third minor category, the keywords "*Data*" and "*Big Data*" were putted from the beginning beside the two previous categories main keywords "*Smart Home*" and "*Internet of Things*" but the outcomes were enough unsatisfactory. Some interesting results appeared instead

keeping a general strategic overview of data opportunities just filtering with the source engines tools or placing beside "*Data*" the words "*Strategy*", "*Value*" and "*Business Model*".

2.3 Selection Criteria

For performing a necessary selection of the papers which are relevant for our research objectives, three criteria were applied:

1. *Analysis unit*;
2. *Paper focus*;
3. *Sampling number.*

2.3.1 Analysis Unit

The first step was the selection of the most relevant publications from the content point of view. Thus, just the papers that have as main object of analysis the "*Smart Home*", for the first cluster, the "*Internet of Things*", for the second one, and "*Data*" for the third one. This criterion permitted the exclusion of works that have these topics as ancillary.

For simplifying the selection, just the results with the above-mentioned terms in the *Title, Abstract* or *Keywords Lists* were considered.

2.3.2 Papers Focus

The second phase was about associating the keywords "*Smart Home*" and "*Internet of Things*" with terms more specific respect the research questions. Given that the focus of this thesis work is on the Smart Home value creation and strategies, the exigency was to target the papers research on these topics. As mentioned above, examples of combinations in the first bunch are "*Smart Home Business Model*" or "*Smart Home Business Value*" while, in the second group, "*Internet of Things Strategy*" or "*Internet of Things Management*" and so on.

Moreover, given the importance of the ecosystem of actors and roles in the value network, some searches targeted these issues: example of searches are "*Internet of Things Value Network*", "*Internet of Things Ecosystem*", "*Smart Home Roles*", "*Smart Home Actors*".

Both the searches on strategies/business models and on roles/actors/ecosystems provided few results in the case of the Smart Home and few more as regards Internet of Things. This increased the necessity to deepen these topics with a specific dissertation.

Finally, as regards the third supplemental cluster, the search about "*Data*" works was concentrated on the papers related to the Smart Home, Internet of Things or strategy in general. Example of pairings are "*Data Smart Home*", "*Data Internet of Things*", "*Data Strategy*", "*Data Business Models*" or "*Data Value*".

As regards the technological papers, they are the most abundant on the web for both the first and the second category: 54 papers about technological issues was found out in relation to the Smart Home while 111 in the Internet of Things domain. Of these, just the most generic were included in this literature review: in fact, they convey the mandatory basic knowledge about exploited technologies, communication protocols and architectures. Moreover, the ones that deal with interoperability were considered interesting for ecosystem development.

2.3.3 Sampling Number

The last step of the procedure was to fix the maximum number of papers to be included in the analysis. Indeed, analysing too many papers risked to increase the complexity: in this sense, a more accurate and intense study on a minor number of well-focused works was preferred.

The maximum numerosity of the sample was fixed on *100*. Thus, filtering after filtering, the publications inserted in the literature review were: *45* about *Smart Home*, *40* about *Internet of Things* and *15* on *Data.*

Figure 13 shows the incidence of the number of papers for macro-category on the overall sample.

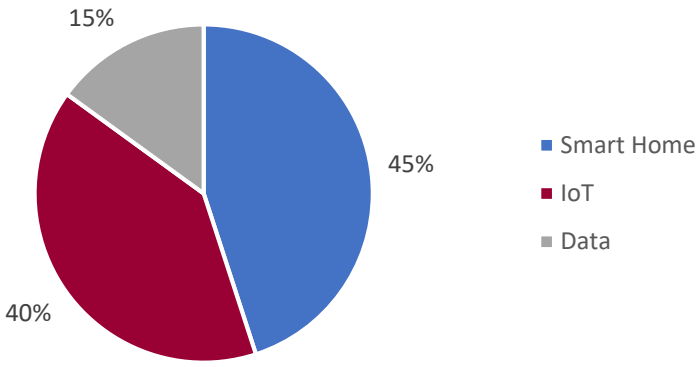

Figure 13: papers distribution for macro-category

Obviously, the bond was not fixed a priori but iteratively during the analysis. The reason is because the awareness of which could be the literature structure and of how many papers were necessary for a good understanding of the Smart Home and Internet of Things domain was not a fact but instead a goal.

2.4 Process Subjectivity Analysis

Lot of decisions taken in the setting of the literature review were clearly subjective: for instance, the choice of exploiting those three scientific search engines, addressing the three categories, or applying some filters and so on. This is obvious in each literature analysis given the necessity of personal hypothesis.

Probably, alternative choices would have brought to slightly different results but not mandatorily better, more satisfactory or too much far from the actual. The reasoning behind the decisions, indeed, supported the belief that the right choices for addressing optimally the state-of-the-art of the Smart Home were taken.

2.5 Reference Sample for the Analysis

The reference sample is constituted by the 100 papers that respected the research goals and selection criteria of the pervious paragraphs.

As regards the typology, the papers can be:

- Articles from scientific *journals* as Ghayvat H. et al. (2015);
- Publication from *conferences* as Monacchi A. et al. (2013);
- Essays extracted from scientific *books* as Shah M. (2015).

Among the journals, the most important are: *Information Technology, Cleaner Production, Indoor and Built Environment, Engineering Applications of Artificial Intelligence; Top Quality Management and Business Excellence; Technological Forecasting and Social Change; Small Businesses and Enterprise Development; Future Generation Computer Systems; Energy Policy; Information Management, Sustainability, Marketing Management, Manufacturing Technology, Systems Science and Systems Engineering; Smart Home; Business Horizons; Computer Communications; Research in Marketing; Network and Computer Applications; Operations and Production Management; Renewable and Sustainable Energy; Intelligent Buildings International; Personal and Ubiquitous Computing; Energy Efficiency; Information and Organizations; Innovation and Learning; Service Marketing*.

Among the conferences, the most important are: *EuroSymposium; International Conference on Logistics, Informatics and Service Sciences; International Conference on Industrial Engineering and Engineering Management; Conference on e-Business, e-Services and e-Society; International Joint Conference on Services Sciences; International Conference on Management Engineering and Technology; NEW2AN; International Conference on Internet of Things and Cyber, Physical, Social Computing; International Conference on Pervasive Computing; International Conference on Communications; International Conference on Concurrent Engineering; International Conference on Green Computing and Communications; International Conference on Intelligent Control Power ad Instrumentation; International Conference on Software Business; International Conference on Intelligent Environments; International Conference on Mobile Business; World Forum on Internet of Things; International Conference on Digital Ecosystems and Technologies.*

Figure 14 shows the incidence of papers number for typology on the overall sample:

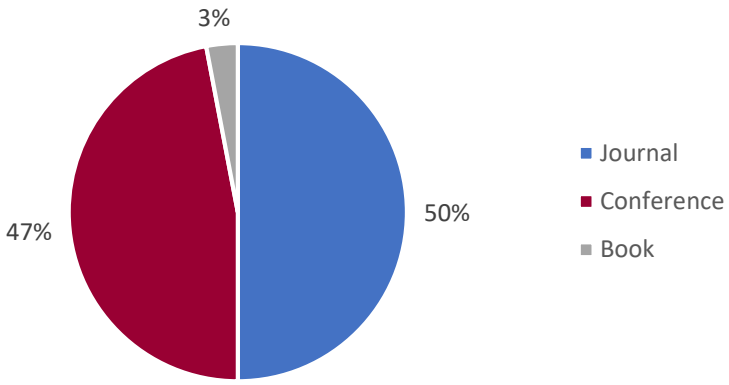

Figure 14: papers distribution for typology

2.6 Classification for Research Method

The first classification of the papers, characterized by a high level of objectivity, is based on the exploited method of research. In simplicity, the publications were differentiated due the method used by the authors for answering to their research questions.

The typologies are the following:

- *Literature Review*: analysis of the previous literature on a particular topic; e.g. De Silva L. at al. (2012);
- *Conceptual Framework*: modelling of a phenomenon through causal maps, matrixes or diagrams; e.g. Lee I. , Lee K. (2015);
- *Analytical Method*: exploitation of a process based on analytical and mathematical calculations which permits to reach the resolution of a problem; e.g. Woerner S. L., Wixom B. (2015);
- *Case Study*: empirical analysis for studying an actual phenomenon in its real environment; e.g. Kim L. J. et al. (2015);
- *Survey*: statistical analysis, targeted on a sample of people, aiming at gathering opinions, preferences, behaviours; e.g. Kim Y. et al. (2017).

Figure 15 exhibits the incidence of the papers numbers for research method on the overall sample:

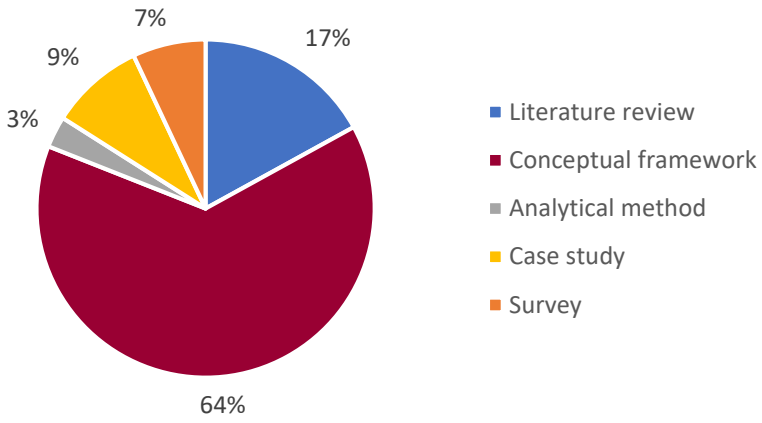

Figure 15: papers distribution for research method

It is also possible to differentiate the papers respect the *type of analysis*, among qualitative and quantitative. 93% of the publications are qualitative: this is in line with a strategic/business topic.

2.7 Classification for Topic

The papers were then classified for *topic*. Obviously, each of the three macro-categories (Smart Home, Internet of Things, Data) have their sub-topics.

Once defined the category, this literature review preferred a simpler one-level classification respect the subject matter, instead a more complex two- or three-levels one. In this way it is solved the necessity of having a classification able to manage the trade-off between complexity and information poverty.

This type of classification is totally subjective and developed ongoing the reading of the papers. As regards the first category, *Smart Home,* the identified scopes are:

- *Strategy* (8): all the strategic papers that stressed the vision or mission in the industry, applicable old and new business models, paths to profits, ecosystem and value network configuration, business processes or customer needs; e.g. Xu H. et al. (2012);

- *Technology* (15): all the technological studies on the Smart Living are grouped here. In particular belong to the sample the papers about interoperability, general architecture and connectivity; e.g. Reinisch C. (2010);
- *Market* (6): in this cluster there are the papers related to the general conditions and trends of the market and the ones about opportunities, threats, barriers, adoption factors, challenges; e.g. Bernheim Brush A. J. et al. (2011);
- *General* (16): all the other topics, usually more generic, are inserted in this group. There are papers about smart products, ambient-assisted living, social networks, user perspective, security, privacy and so on; e.g. Perera C. et al. (2016).

Figure 16 displays the number of Smart Home papers for each group and their incidence on the first category sample (45 papers).

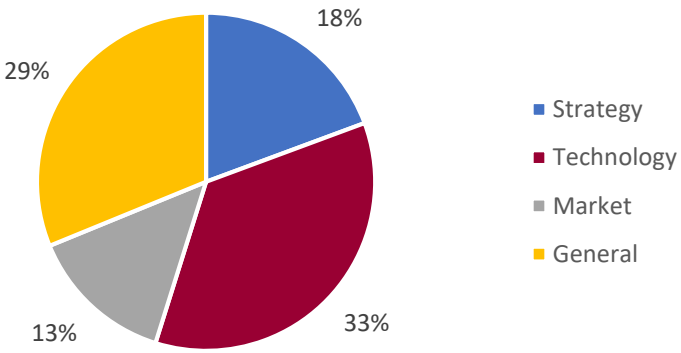

Figure 16: Smart Home papers distribution for topic

As regards the second category, *Internet of Things*, the defined groups of topics are:

- *Strategy* (24): all the strategic papers that stressed the vision or mission in the industry, applicable old and new business models, paths to profits, ecosystem and value network configuration, business processes or customer needs; e.g. Glovaa J. (2014);
- *General* (16): all the other topics, usually more generic, are inserted in this group. There are papers about smart products, overview of the market, technology and so on; e.g. Kyriazisa D. , Varvarigoua T. (2013).

Figure 17 reveals the number of Internet of Things papers for each group and their incidence on the second category sample (40 papers).

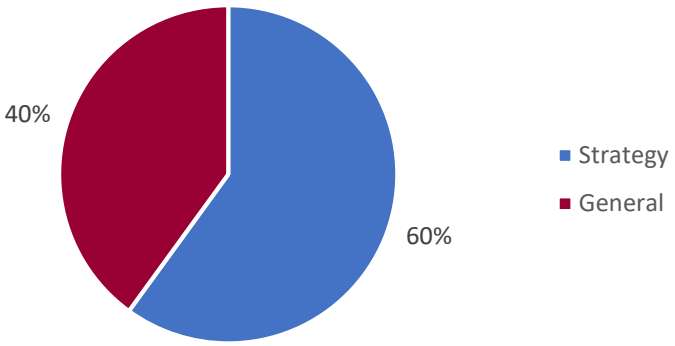

Figure 17: Internet of Things papers distribution for topic

As regards the third category, *Data*, the sub-clusters are:

- *Internet of Things* (3): all the essays about the exploitation of data, for creating value, within the IoT boundaries are grouped; e.g. Qin Y. et al. (2016) ;
- *Strategy* (6): the papers of this class are about general strategic perspective on the data opportunities and the strategic impact of the data on value creation processes; e.g. Bhimani A. (2015);
- *Business Models* (6): the publications about the new business models facilitated by exploitation of data and big data are clustered here; e.g. Hartmann P. M. et al. (2016).

Figure 18 reveals the number of Data papers for each group and their incidence on the second category sample (15 papers).

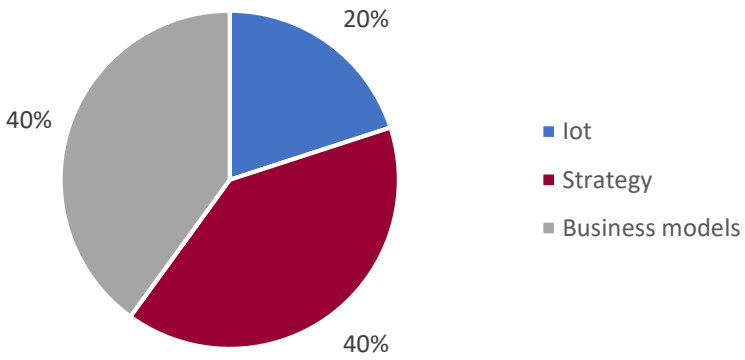

Figure 18: Data papers distribution for topic

2.8 Literature on Smart Home

In relation to our thesis scope, the literature on the Smart Home category is surely the most relevant also if it is not satisfactory enough respect the necessities of this research purposes.

2.8.1 Strategy

The strategic papers of the first category are the most critical for understanding the state-of-the-art about value network logics and paths to profits within the Smart Home ecosystem. As will be also explained in literature section of Chapter 5 and as it is emerged from the literature gaps, to date the work of academics to find out the right mission and scope for each actor and to identify the best business model is still incomplete.

All the publications of this cluster address the need of having a value network perspective when the Smart Home ecosystem is studied. As will be stated in Chapter 5, the necessity of establishing collaborations and partnerships within the industry is so strong that companies cannot be analysed individually but always taking into consideration the process of value delivery and extraction with the other involved actors.

The awareness about these issues is high and it is demonstrated by the work of Mäkinen S. J. (2014) about the Nest ecosystem.

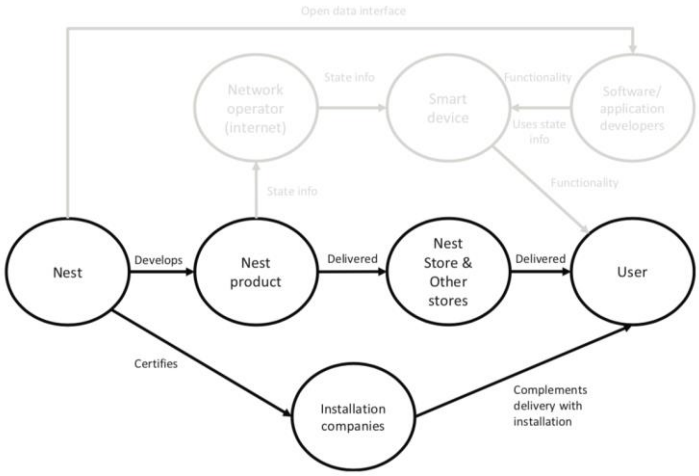

Figure 19: Nest value network, Mäkinen S. J. (2014)

Illustrating the value network relationships between Nest and the other nodes (Figure 19), the Finnish author performs a disruptiveness analysis on the smart thermostats: "*the Nest innovation has the potential to substantially change the heating system ecosystem and its functionality*".

In doing so, Mäkinen S. J. underline also the five mechanisms that have permitted to the general ecosystem of a thermostat to be reconfigured: *relocating, combing, subtracting, separating, adding* (Figure 20).

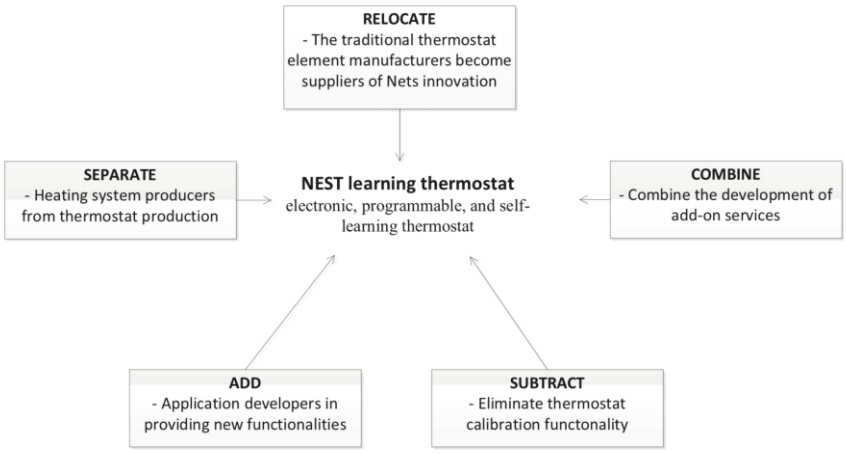

Figure 20: Nest learning thermostat innovations, Mäkinen S. J. (2014)

This essay just provides a specific case study but does not bring any generalization on the Smart Home and so appears incomplete. Differently, Ehrenhand M et al. (2014) starts mapping the value creating system on a healthcare case study and then generalizes illustrating the general Smart Home value network with a focus on roles and activities. This paper will be the starting point for the creation of the *Smart Home Ecosystem Layers Model* in Chapter 5: it is one of the most important contributions of the literature.

Within the ecosystem actors, a particular attention is always given to the final consumer: he is the real users of the Smart Home devices and services and the real addressee of the value creation. To this purpose, Brink M., Van Bronswijk J. (2013), inspired by the *Maslow's Hierarchy of Needs,* provide a table which shows the different *need deficiency levels* and the *specific need addressed*.

Nikayin F., De Reuver M. (2012) prefer to focus their studies on the motivations and strategies analysing the collective actions and the collaboration possibilities between the small businesses.

Then, two articles target the alignment between the firm strategy and the business process. Limitations in these works are clearly given by the fact that, if neither processes nor strategies are well defined in the industry, it is difficult to understand their alignment.
Solaimani S. at al. (2010) exploit a case survey technique identifying that the work is a *"comprehensive starting point that addresses the existing theoretical gap in business model and business process modelling literature"* and they "*Recommend both researchers and practitioners to put more emphasis on the provider's side, especially on the discussed alignment domains, in order to improve business model viability and feasibility*".
Solaimani S. et al. (2015) improve the previous studies identifying the steps that are necessary for moving from an abstract business model of collaborating enterprises towards an aligned business model that can be implemented.

2.8.2 Technology

As regards the technological publications, the most important are the ones that address the interoperability problems. As stated by Albuquerque H. J. O. et al. (2014), these troubles are strictly related to the collaboration between actors in the ecosystem and the inability of finding common standards.

Kamilaris A. , Pitsillides A. (2013) stress the necessity of having interoperable devices and sensors through the help of web application and common projects in order to make sustainable the Smart Home businesses.

Similar concepts are expressed by Kim J. E. et al. (2012) and Gambi E. et al. (2017): the first propose an extensible architecture for highly heterogeneous home systems to enable dynamic integration of devices and services, demonstrating how the interoperation of different home network protocols can be handled in a systematic way by corresponding device discovery approaches; the second consolidate previous technologies and protocols proposals that can be the base for new projects.

Miori V. , Russo D. (2014) address the shift from Domotics to Smart Home from the technology point of view, extending an interoperability framework.

Fernández M. R. et al. (2015) concentrate on the technological way of collecting and analysing data within a Smart Home in order to extract value for the energy efficiency. Figure 21 exhibits the Smart Home energy environment used by the authors.

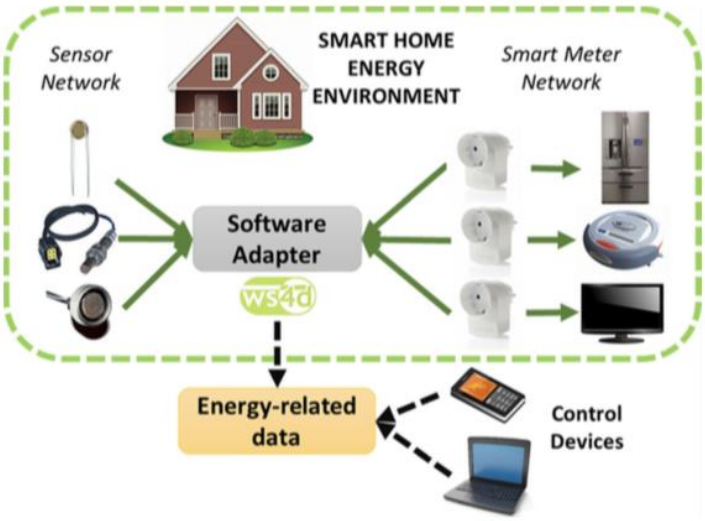

Figure 21: Smart Home energy environment, Fernández M. R. et al. (2015)

Moving to literature about software, Aiello M. et al. (2011) overview the current state of the art with respect to software control and user interfaces in the Smart Homes arena.

For technically managing the different devices, Mainetti L. et al. (2015) develop a "*software ecosystem that allows different-skilled users to develop location-aware services able to autonomously manage the Smart Home*".

Cook D. J. et al. (2013) focus on the architecture of a Smart Home, developing CASAS, a kit "*that facilitates the development and implementation of future Smart Home technologies by offering an easy-to-install lightweight design that provides smart home capabilities out of the box with no customization or training*".

Finally, the most important contribution for giving a general and simple overview of communication protocols and technological challenges is the work of Samuel S. S. I. (2016). He disclosed the five main connectivity standards in a table (Figure 22) with their principal features.

Wireless Protocol / Characteristics	ZigBee	WiFi	Thread	Z-Wave	Bluetooth LE
IEEE Standard	802.15.4	802.11	802.15.4	N/A	802.15.1
Frequency band	2.4 GHz	2.4 GHz, 5 GHz	2.4 GHz	900 MHz	2.4 GHz
Nominal range	100 m	150 m	30m	30m	10 m
Peak current consumption	30 mA	116 mA	12.3 mA	17 mA	12.5 mA
Power consumption per bit	185.9 µW/bit	0.00525 µW/bit	11.7 µW/bit	0.71 µW/bit	0.153 µW/bit
Data Rate	250 Kbps	1Gbps	250 kbps	100 Kbps	1 Mbps
Network topology	Star, Cluster, Mesh	Star, Mesh	Mesh	mesh	Star-Bus
Number of nodes per network	65000	250/access point	300	232	one-to-many

Figure 22: connectivity standards, Samuel S. S. I. (2016)

Then, Samuel S. detects the connectivity challenge of Smart Home:

- *Interoperability*: necessity of having easy-to-connect and easy-to-use devices that simply work together. For achieving real results and execute together tasks, devices and services from different vendors with different network interfaces must interoperate. The exchange of information and use the information exchanged is crucial;
- *Self-management*: in order to operate and collaborate with other devices, to adapt to failures, changes in the environment, it is a main requirement of the sensor nodes to be self-managed, which means to be completely independent of human intervention;
- *Maintainability*: Smart Living network must be designed with the objective of easy maintenance that repairs the various devices and communication components quickly and cost-effectively;
- *Signalling*: bidirectional signalling is vital for collecting and routing data between smart devices;
- *Bandwidth*: the necessity of moving high quantity of data within the home network reflect high bandwidth consumption;
- *Power Consumption*: need of minimal battery drain and low power consumption.

2.8.4 Market

This sub-category grouped all the Smart Home papers about challenges, opportunities, drivers and risks in the market.

An interesting analysis of the European market is presented by Balta-Ozkan N. et al. (2014) that, comparing drivers and barriers of three countries, aim at illustrating the economic and technical diversities linked to different policies and socio-economic contexts. The results are presented in the two tables of Figure 23.

Theme	Description	UK	Germany	Italy
Energy and cost savings	Increasing energy prices and a desire to reduce costs through household energy savings	✓	✓	✓
Tangible benefits improving quality of life	Services that are perceived as practical and with the potential to improve quality of life	✓	✓	✓
Environment	Saving energy for the environment	✓	✓	
	Preservation of environment to improve quality of life			✓
Transparency	Gaining additional information about saving money and energy		✓	✓

Table 3
Overview of barriers.

Theme	Description	UK	Germany	Italy
Retrofitting existing homes	Value of historic or aesthetic buildings hinders consumers' willingness to alter them	✓		✓
Reliability	Concerns on how to operate smart technology	✓		
	Reliability of smart technology	✓	✓	
	Concerns on increased connectivity in homes and their risks	✓	✓	
	Lack of technological competence and acquaintance			✓
Costs	Associating smart homes with luxury items and high costs	✓	✓	
	Concerns about the costs associated with acquisition, operation, management and maintenance of smart home technologies.	✓		✓
Privacy and data security	Compromise security	✓		
	Invasion of privacy	✓		✓
	Concerns about misuse of personal data	✓	✓	
Tenure	Renters may be less likely to invest in smart homes	✓	✓	

Figure 23: drivers and barriers, Balta-Ozkan N. et al. (2014)

Similar barriers are identified by Ciesielska M. , Li F. (2011): *users perceptions; poor understanding of user needs; data security and privacy issues; lack of effective marketing message; lack of installation, maintenance services and skills; the cost of devices and installations; the old housing stocks and retro-adaptation problems; the pessimistic perspective of distribution and supply; lack of common standards*.

Balta-Ozkan N. et al.(2013), instead, address only the social barriers: *fit to current and changing lifestyles; administration; interoperability; reliability; privacy and security; trust; costs*.

Finally, little different is the work of Jacobsson A. et al. (2014). They perform an analysis, involving leading industrial actors, for understanding the risks related to the use and potential misuse of information about homes, partners, and end-users, as well as, forming methods for integrating security-enhancing measures in the design of architecture.

2.8.5 General

The remaining general topics are clustered here.

The ambient-assisted living is a topic well diffused in the Smart Home literature. Also if is not so inherent to the aim of this thesis is however important having a basic knowledge about these opportunities, like the one provided by Labonnote N. , Høyland K. (2015).
Peruzzini M. , Giordani M. (2015) develop a service-oriented architecture that result in "*an interoperable and flexible platform that allows creating user-centred services for independent living*". Instead, Ziefle M. et al. (2011) study, using the questionnaire, the attitudes of users towards video-based monitoring systems for long-term care of elderly or disabled people.

The cluster includes general Smart Home management model as the one in Figure 24 of Stojkoska B. L. R. et al. (2016) or a model that integrates security and privacy into the design of Smart Home services and systems, envisioned as general support for developers, providers and users, like the one of Jacobsson A. , Davidsson P. (2015).

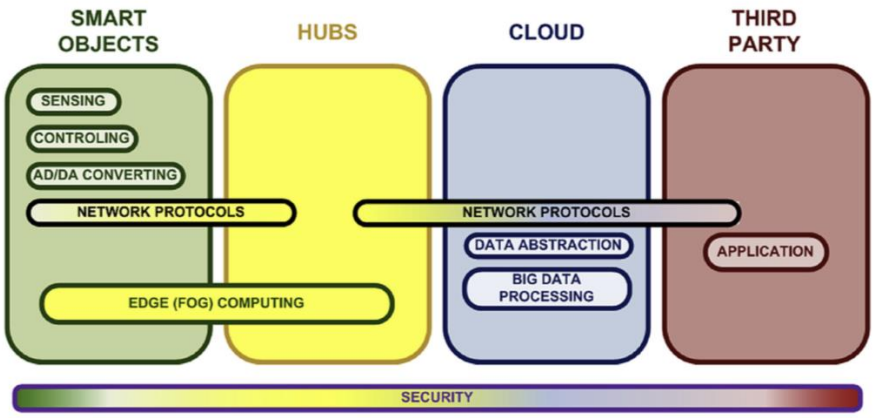

Figure 24: general Smart Home management model, Stojkoska B. L. R. et al. (2016)

Also the literature reviews, Solaimani S. et al. (2013) and Alam M. R. et al. (2012), are grouped here. A review about tools and technologies, that can be integrated or applied in a Smart Home system, is instead realized by Robles R. J., Kim T. (2015).

Yang H. et al. (2017) and Wilson C. et al. (2014) work on the user perspective and acceptance on the Smart Home.

The steps for creating a Smart Home are identified by Mennicken S. and May H. E. (2012) and represented in Figure 25.

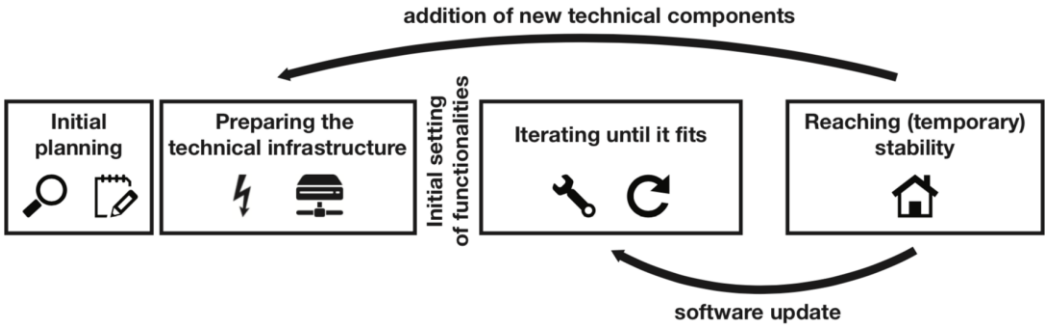

Figure 25: steps for creating a Smart Home, Mennicken S. and May H. E. (2012)

Shin H et al. (2016) base their publication on a survey for customers aiming at identifying the necessity of smart products and the right design method.

The need of connect Smart Home with Smart Grid and Smart City is addressed, respectively, by V.C. Gungor et al. (2012) and Hosein A. et al. (2013).

Finally, Wich M. , Kramer T. (2016) "*conduct a literature research that investigates the current state-of-the-art of smart homes and the related generation of social network services in a big data driven environment and reveal future research opportunities that emerge from the combination of mastering big data in smart homes and, hence, provide design recommendations for social network services*".

2.9 Literature on Internet of Things

As stated in the first paragraph of this chapter, the literature on Internet of Things is functional to understand the universe of reference of Smart Home and translating some relevant matters to this domain of interest.

2.9.1 Strategy

Several papers that belong to this sub-cluster will be take into account in Chapter 5 for introducing the contribution given by this thesis.

However, relevant issues on business modelling are reported by Kralewski D. (2016) who, starting from 400 case studies and 55 business models, identifies 33 innovative, but already existing in other industries, business models applicable to the Internet of Things.

Dijkman R. M. et al. (2015) highlight the importance of identifying business models able to create value with the Internet of Things applications. Using the *Business Model Canvas*, the first step was the identification of the blocks discussed by papers about IoT. The second step was constituted by interview with IoT specialists and companies, while the third one by a survey. Results are shown in Figure 26 and Figure 27.

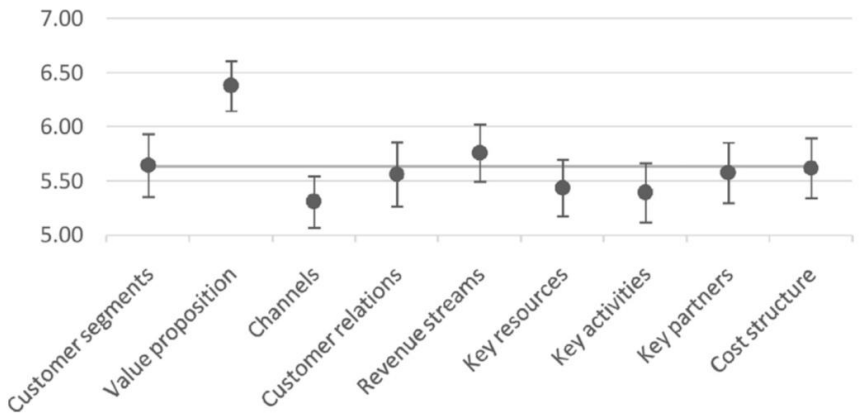

Figure 26: relative importance of building blocks, Dijkman R. M. et al. (2015)

Key Partners	Key Activities	Value Propositions	Customer Relationships	Customer Segments
Software developers **	Product development **	Convenience/usability **	Communities **	Multi-sided platforms
Launching customers **	Software development	„Getting the job done" **	Co-creation *	Mass market
Data interpretation **	Customer development	Performance **	Self-service	Diversified
Hardware producers *	Service; Implementation	Possibility for updates *	Automated service	Niche market
Service partners	Platform development	Comfort *	Personal assistance	Segmented
Distributors **	Sales; Marketing	Accessibility	Dedicated assistance **	
Other suppliers **	Partner management **	Cost reduction		
Logistics **	Logistics **	Risk reduction		
	Key Resources	Customization	**Channels**	
	Software **	Design	Web sales **	
	Employee capabilities *	Price **	Partner stores	
	Relations	Newness **	Sales force	
	Physical resources	Brand/status **	Wholesaler	
	Intellectual property		Own stores **	
	Financial resources *			

Cost Structure			Revenue Streams		
Product development cost **	IT cost	Logistics cost **	Subscription fees **	Lending/renting/leasing	Startup fees *
	Hardware/production cost		Usage fee **	Licensing	Installation fees *
	Personnel cost		Asset sale *	Advertising	Brokerage fees **
	Marketing & sales cost				

*<0.05 significance, *<0.02 significance, **<0.01 significance.

Figure 27: business model framework for IoT applications, Dijkman R. M. et al. (2015)

The conclusions emerged from this paper are the following:

- The value proposition is the most important block;
- Other relevant blocks are the customers relationship and key partners;
- The reduction of costs is not enough, also the increase of revenues is important;
- The co-creation fits well the customer relation;
- The partners are important for the outsourcing of critical activities not realizable internally and also complex strategic collaborations are relevant;
- There is correlation from value proposition, customer relationship and partner.

Turber S. et al. (2014) realize a business model framework for IoT context (Figure 28) consisting in three dimensions:

- *Who*: collaborating partners who build the value network;
- *Where*: sources of value co-creation rooted in the layer model of digitized objects;
- *Why*: benefits for partners from collaborating within the value network;

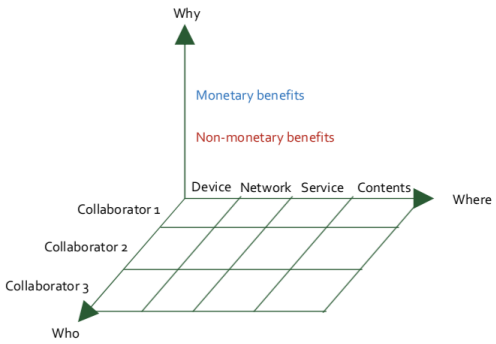

Figure 28: business model framework for IoT context, Turber S. et al. (2014)

Other less interesting contributions about business modelling in IoT are Chan H. C. Y. (2015), who check the existing frameworks for IoT, Huan L., Zheng-zhong X. (2013), that investigate on business model using the multiple open platform (MOP) and the four archetypes proposed by Yuan L. et al. (2012).

Japanese studies brought to the SCAI model introduced by Uchihira N. et al. (2015) that takes into consideration the identification of value, opportunities and difficulties. The model is than better explained using a trial Smart Home application in a conference paper of the same authors and of the same year. Successively, this business modelling technique is contaminated by a high

ecosystem perspective in the model proposed by Uchihira N. et al. (2016) that is an improvement of the business model canvas (Figure 29).

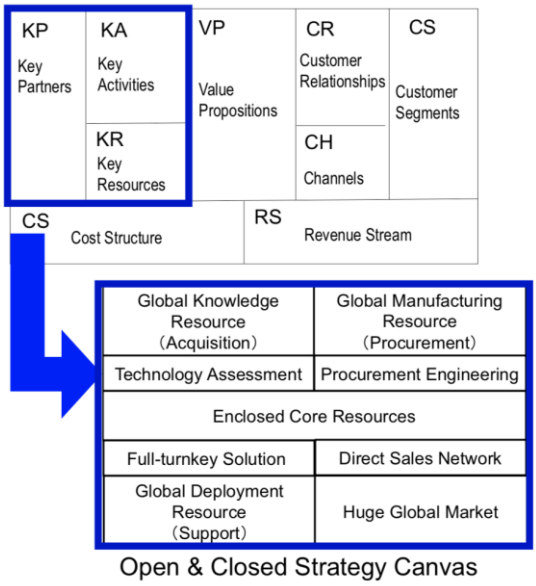

Figure 29: improved business model canvas, Uchihira N. et al. (2016)

The 6C framework of Rong K. et al. (2015) permits to understand the complex network that makes up IoT-based business ecosystems:

- *Context*, environmental features of the supply network;
- *Construct*, fundamental structure and supportive infrastructure of a business ecosystem;
- *Configuration*, external relationships among partners in the business ecosystem and its configuration patterns;
- *Cooperation*, mechanism by which partners interact in order to achieve the common strategic objectives;
- *Capability*, key success features of a supply network;
- *Change,* how a system configuration pattern shifts dramatically from one type to another.

The paper of Gonçalves V., Dobbelaere P. (2010) discusses several business scenarios wherein the stakeholders assume different levels of control over the customer relationships and the assets that make up the value proposition.

The value networks and its characteristics are the subject of analysis of the work of Prince K. et al. (2014) who illuminate "*how different types of legitimacy are established through various dialogical strategies in orchestrating strategic innovation networks*".

Westerlund M. et al. (2014) studied the value creation in a generic IoT ecosystem (Figure 30):

- *Value drivers*: individual and shared motivations of the participant;
- *Value nodes*: actors, processes and activities that are linked to other nodes for the creation of value;
- *Value exchange*: exchange of value by different means, resources, knowledge and in formation;
- *Value extract*: part of the ecosystem that extract value;
- *Value design*: how the value is deliberately created and captured in an ecosystem.

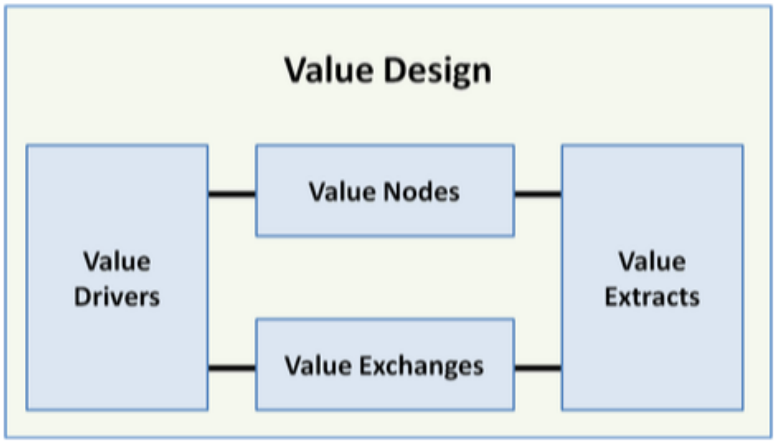

Figure 30: value creation in a generic IoT ecosystem, Westerlund M. et al. (2014)

The identification of IoT business as multi-sided markets, that will be taken into account in chapter 5, is a contribute of Keskin T. , Kennedy M. D. (2015). The authors represent (Figure 31) the offering in the IoT markets and then focus on a number of business service models that link the four sides of a market comparing the advantages and disadvantages of network externalities generated by Internet of Things in each model.

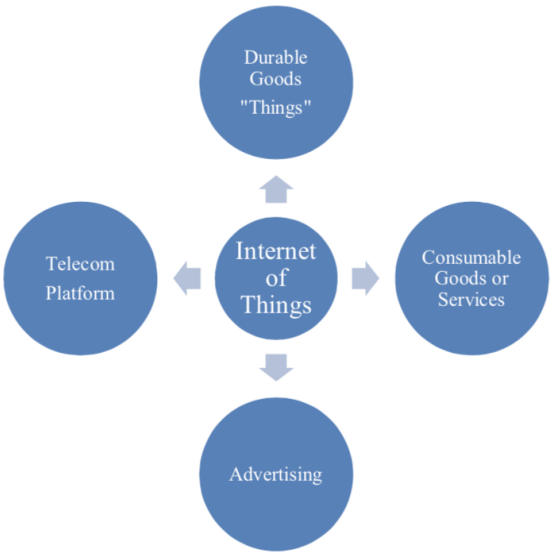

Figure 31: IoT multi-sided markets, Keskin T. and Kennedy M. D. (2015)

Moving to the importance of taking strategic decision oriented to the final customers, important are the contribution of Shih L. et al. (2016) that proposes a six-step design method by extending visual mapping design method for the PPSs that plan to apply IoT technologies and that is strongly addressed to the final users' needs. The necessity of co-creation logic is instead the focus of Mejtoft T. (2012).

2.9.2 General

Firstly, belong to this sub-category the generic studies that bring an overview on the Internet of Things. Kang Y. et al. (2015) summarize the most important IoT applications; Bhardwaj S. , Kole A. (2016) realize a model able to "*help technology enthusiasts navigate the dialogue surrounding the same, be well versed in IoT and understand its potential to change everything we know to be true today*"; Skarzauskiene A. (2015) studies the impact of Internet of Things to national development and related sectors; Kaliczyńska M. , Dąbek P. (2014) address the value of the IoT technology for the industry (Figure 32); Komarov M. M. , Nemova M. D. (2013) bring the concept of Social Web of Things as the synergy between Internet of Services and Internet of Things that aims at offering new services within the integration of new smart things into human life.

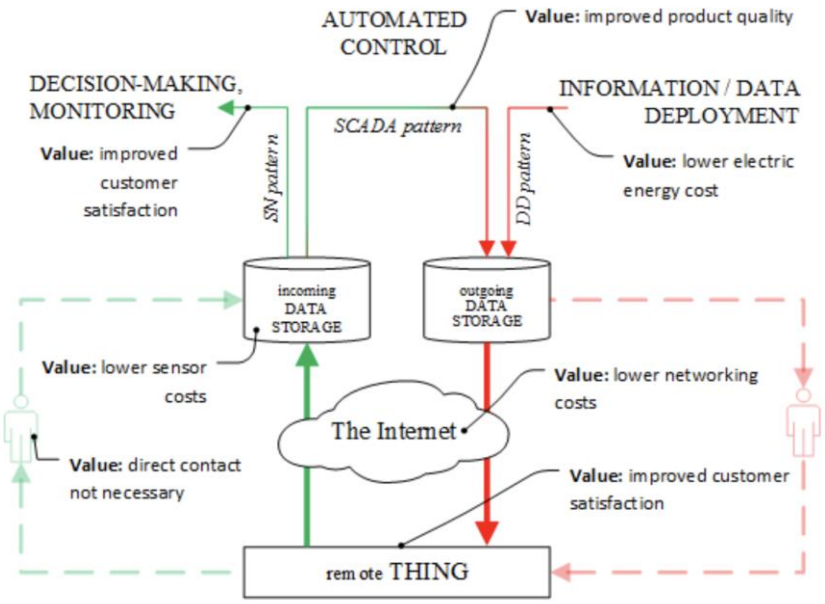

Figure 32: value of IoT technology for the industry, Kaliczyńska M. and Dąbek P. (2014)

Then technological papers of the sample are found out here: Mazhelis O. et al. (2012) aim at summarizing the technologies that could form a core of an IoT ecosystem, while Ma M. et al. (2013) present a layered reference model for IoT data management.

Three publications cover the smart products subgroups. Takenaka T. et al. (2016) examine log data format which might be used for the design of new products, maintenance, or services; Gerpott T. J. , May S. (2016) adapt previous works for addressing the roles of IoT components in offering portfolio (Figure 33); Tien J. M. (2015) address the servitization phenomenon qualified by the smart devices.

	Complement		*Replacement*
Role of IoT	Smoothing (enabler)	Adaptation (adjunct service/product)	Innovation (core service/product)
Role characteristics	IoT component: – is pivotal to *initiate transaction* – potentially *reduces transaction costs* – is *not* a part of the *core product/service*	IoT component: – significantly *increases value* but is not the main value driver – enables *additional functionality* to an otherwise standalone product/service	IoT component: – is the *main value driver* of the product/service – creates product/service features which were *not available in the past*
Examples	Amazon dash button Car2Go	Parcel tracking Augmented reality product information	Smart home Mobile health monitoring

Figure 33: roles of IoT components in offering portfolio, Gerpott T. J. and May S. (2016)

Irene C.L. , Wakenshaw S. Y. L. (2016) provide an IoT review and research directions.

A focus on the customer is instead visible in the works of Mani Z. , Chouk I. (2017), who study the drivers of customers' acceptance of smart products, and of Olsson H. H. et al. (2016), who present the UDIT model.

2.10 Literature on Data

As explained in the first paragraph, the data literature is less critical respect the two previous ones but is however important. Indeed, the implicit value of the connected services and products of the Smart Home is related to the high availability of data: thus, understanding how to manage these data with a strategic vision will be necessary for the Chapter 5.

2.10.1 Internet of Things

In the third category of papers are gathered publications about the strategic use of data within the IoT domain.

The one of Riggins F. J. , Wamba S. F. (2015) is a study which "*concludes with a set of proposals regarding a number of avenues for future research on the IoT through big data analytics, based on the four levels of analysis; namely the individual, organization, industry and society levels*.".

Shah M. (2015) discusses various avenues of the IoT where big data analytics either is already making a significant impact or is on the cusp of doing so. The author identifies the three most important objectives that an organization needs to achieve to realize a data-driven transformation:

1. *Data and analytics strategies that align with the business vision*;
2. *Culture change to accept insights from validated, verified and principled data-driven analytics into decision making at all levels*;
3. *Innovation to address open problems especially in the context of respective business applications*.

Then, *technological and adoption challenges* are presented. The first ones are: *privacy; security; interpretability; data quality*. The second ones are: *model reliability, validation and adaptation*; *Integration and reconciliation with our physical understanding of the world; human-analytics interaction; potential for systemic errors and failures; personalization versus limitation of choice*.

2.10.2 Strategy

Another stream of data literature is about generic strategical impact as Constantiou I. D. , Kallinikos J. (2014). For example, Di J. et al. (2014) furnish the opportunities and challenges of data on the competitive challenges and compare three different competitive intelligence collaborative analysis mode (Figure 34).

	Autonomous cooperative mode	**Central collaborative mode**	**Hierarchical collaborative mode**
Characteristics	Flexible collaboration and sharing.	Unified service entrance.	Allocating the magnitude and precision of data according to user types.
Data scope	No requirements for comprehensive domain data.	Requirements for comprehensive domain data.	Requirements for integration of data from various industries and fields.
Scenarios	Data sharing and analysis among organizations with non-compete and mutual trust relations.	Providing comprehensive data service for big data analysis systems in authoritative industries, districts and fields.	Large and medium-sized organizations taking advantage of big data recourses in whole society to do very large scale analysis and calculation.

Figure 34: competitive intelligence collaborative analysis model, Di J. et al. (2014)

Furtado L. et al. (2016), instead, compare the value creation under a traditional view versus a big data view (Figure 35).

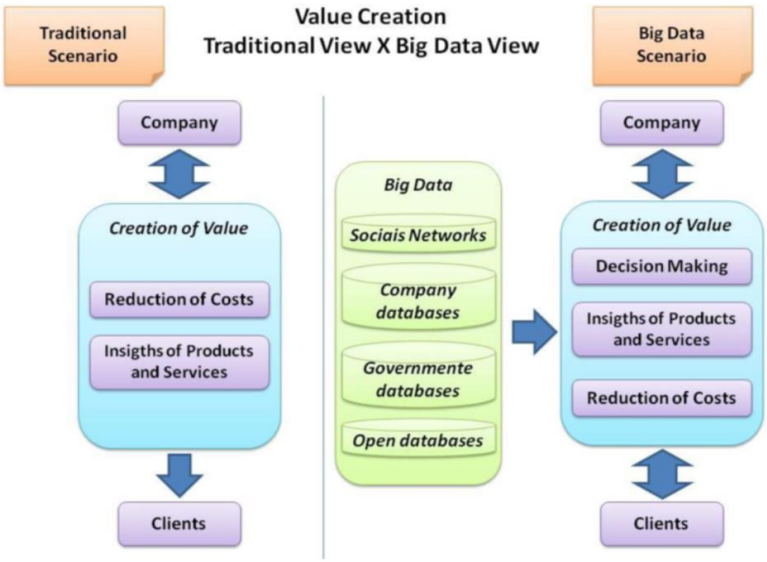

Figure 35: value creation traditional view versus big data view, Furtado L. et al. (2016)

2.10.3 Business Model

The last subgroup of data research is about business modelling.

Yongsheng Z. (2015) "*describes the Big Data and business model innovation concept and essence on the basis of feedback theory, summarizes the form of business mode innovation driven by the Big Data Era from product innovation, management innovation and value innovation aspects*".

Sadovskyi O. et al. (2014) perform an analysis of recently published literature to identify patterns and trends and to assess difficulties in research and implementation of big data-driven business models.

Chaudhary R. et al. (2015) depict how big data analytics techniques have enabled new business models which were either hard to shape or impossible to render.

Chunfang G. , Zhongliang G. (2015) analyse the impact of Big Data on enterprise:

- *Big Data will move traditional decision-making method to data-driven decisions*;
- *Big Data will shift the traditional marketing mode to precision marketing mode*;
- *Big Data will improve the satisfaction of customer*.

Finally, Saarijärvi H. et al. (2014) focus on the *reverse use of customer data* (Figure 36) which is the process of converting customer data into information that directly supports customers' value creation, provides service firms a unique tool to intensify their service orientation. From the managerial point of view, the author stated that reverse use of customer data reconfigures firms' roles in customers' value creation.

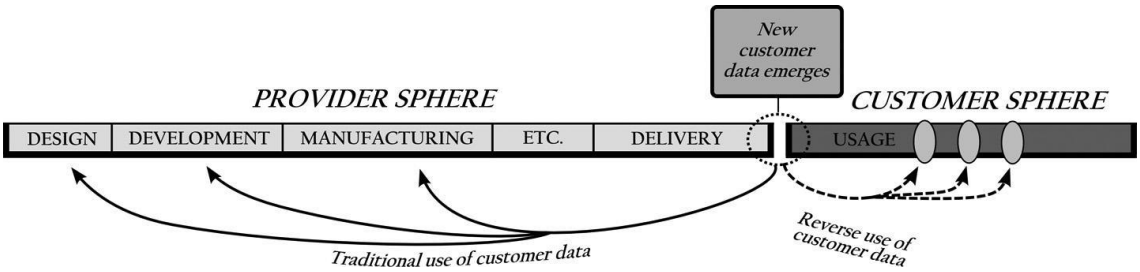

Figure 36: reverse use of customer data, Saarijärvi H. et al. (2014)

2.11 Final Structure of the Database

During the papers analysis a database has been realized for collecting all the necessary information to describe the identified and classified publications.

The database, whose some rows are exhibited in Figure 37, is composed by eleven columns:

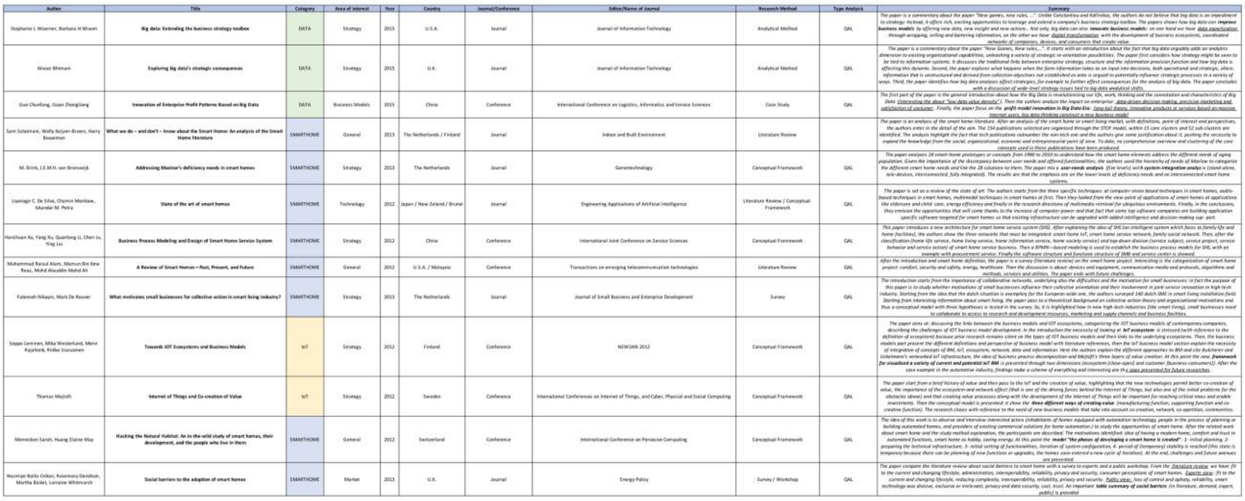

Figure 37: database for paper analysis

- Identification information:
  - Authors;
  - Title;
  - Publication year;
  - Country;
  - Type of paper (conference, journal, book);
  - Nome of the conference, journal, book.

- Classification information:
  - Macro-category;
  - Area of interest;
  - Research methodology;
  - Type of analysis;
  - Brief description.

3. OBJECTIVES & METHODOLOGIES

In this chapter are described the purposes of the research and the issues to which this study aims to give an answer. In addition, the methodologies applied are described and the boundaries of research are defined. This thesis is part of a wider research conducted by the Internet of Things Observatory of Politecnico di Milano, with whom a constant contact and ongoing support was maintained for all the research period.

3.1 Objectives

The bibliographic analysis and the web articles consulted showed a strong interest in some aspects of the Smart Home, highlighted in the gap in Chapter 2, which to date have been little detailed. For this reason, this thesis presents objectives aimed at filling the gap.

The objectives have been set out in the form of two research questions, which are presented below.

RQ1: How is configured the Smart Home offer in Italy and in the rest of the world?

To understand the Smart Home scenario is first and foremost essential study the state-of-the-art of the offer and the evolution undertaken by smart solutions in the last years. To do this, different solutions on sale or already announced by the manufacturer are taken into account. Starting from the characteristics of these solutions, a data elaboration is carried out in order to understand the peculiarities of the analysed sample. Then, the main components of value creation are identified, outlining the most widespread practices of the market. Finally, market trends are studied to understand how the offer, divided into the various sub-domains, has changed in recent years.

RQ2: How is it possible to create value in the Smart Home scenario considering the ecosystem of actors involved?

Companies belonging to different industries, to operate in the context of Smart Home, need to acquire new knowledge and, taking advantage of the peculiarities of IoT and new technologies, update their business models or create totally new ones. This implies a change in the context,

which generates a difficulty in decision making. It is therefore interesting and important to deepen this aspect: in answering the second resource question are defined strategic models aimed at helping companies in understanding their possible position in the competitive arena and taking strategic decisions for success. Given the fundamental importance of data in the creation of value, their role in the Smart Home has been carefully considered, identifying the possible methods for data valorisation.

The actors who can obtain advantages from the application of the tools provided are multiple. However, in this thesis, three of the most relevant Smart Home actors have been chosen and their cases are treated in depth.

3.2 Methodologies

In order to achieve the objectives described in the previous paragraph, several methodologies have been exploited:

- the ***analysis of the existing literature*** has been the starting point for approaching the subject, providing strong support to outline the context of the research work. Literature has been useful to understand the current Smart Home ecosystem and value network, the competitive scenario, the strategic directions and business models applied by companies and the data centrality in the industry;
- thanks to the mediation of the Internet of Things Observatory, was possible to arrange **interviews** with executives of companies producing Smart Home solutions. In this way has been possible to obtain "first hand" information, not filtered or interpreted yet. Thorough the interviews it was possible to understand specific issues related to the companies' businesses, obtaining detailed descriptions of their solutions and validating input data from secondary sources;
- three **focus groups** with different Smart Home actors have been realized by Internet of Things Observatory, with the support of TechnoConsumer. The first was organized with eight companies including electronic retailers, e-retailers and do-it-yourself retailers, the second with eight among architects and builders, while the third with eight installers and distributors. Each of them was intended to understand the Italian scenario and clearly identify the role of these actors in the supply chain;

- besides literature there was an **analysis of secondary sources**. Data, reports and analyses from reliable sources helped in finding a considerable amount of information in all those areas where literature was lacking. In particular, they were fundamental to analyse the different Smart Home solutions, the actors' business strategies and general features of the market. Within this wide category of sources, it is possible to identify two typologies of documents. The first are *conceptual secondary sources*, such as white papers, transcripts of interviews with experts of the sector and web articles. The second are *commercial secondary sources*, such as websites of companies creating Smart Home products and services;
- Finally, the **creation and use of models**: several different models have been utilised. Some of them came from the work of other authors, others were expressly created with the aim of understanding at which level of the ecosystem the actors act, the methodologies for data valorisation and the magnitude of the transformation required to the actors to compete in the Smart Home market.

3.3 Objective and Methodologies Summary Table

It is useful to sum up objectives and methodology in a single graphical representation, so Table 3 has been realized.

	RQ1	***RQ2***
Analysis of the existing literature		●
Interviews	•	●
Focus groups	•	•
Analysis of secondary sources	●	●
Creation and use of models		●

Table 3: objective and methodologies summary

4. SMART HOME SOLUTIONS ANALYSIS

In this chapter is presented a macro analysis of the Smart Home solutions available on the market, with the aim of understanding how the offer is structured. The analysis is based on a database containing solutions that are already available or coming soon in the market, realized with the support of Internet of Things Observatory. In the first part of the chapter is presented the structure of the database, while successively several relevant cases are proposed to underline the most relevant trends occurring in the market.

4.1 Database Structure

Database construction is an indispensable prerequisite to perform the solutions macro-analysis. It contains all information considered relevant for the research objective. The database has also been a fundamental tool for the realization of this thesis: the data collected in it has been used to obtain comprehensive information on what is the current state of the Smart Home offer, which player are acting in this sector and how they are behaving.
In this section is provided a detailed description of the header items, or all the information was decided to trace for each one of the solution mapped.

Database is divided into column clusters that store information about different aspects of the solution.

(1) The first cluster provides general information.

Company name

Product/Service name

In case of startups, often the product/service name coincide with the company name. In these cases, information is reported just one time in Company name cell, leaving Product/Service name cell empty.

Description

Brief description of the solution. Usually are presented the features, the functioning or type of service offered. If present, there are also indicated facts that have given a particular relevance to the case, for example the acquisition of a startup by a large player that took control of it.

Geographical area

Continent where the company is based. Macro-area considered are: Europe, North America, South America, Asia, Africa, Oceania

Country

Country where the company is based.

Company type

Three distinct types of business were considered: Startup, Big Player and SME (Small and Medium Enterprise). Startup is referred to a company born with the purpose of developing a single innovative product/ service and, since is still looking for a sustainable business model, receives funding from external actors to survive. With the definition Big Player is listed a leading multinational corporation, with a strong brand and reputation. It generally has a large portfolio of products, including the solution considered. PMI defines a small or mid-sized company that, unlike startups, do not receive any longer founds from external actors to implement their solutions.

Year

Reference year is the one in which the solution is launched in the market. In cases in which exact launch date could not be found, was took as a reference the first available solution review. In the case of products not yet available on the market, the expected launch date was selected.

Application sub-domain

All the solutions are obviously inherent to the Smart Home ecosystem but is possible to deepen the topic identifying a classification based on the final aim of the offer. Sub-domains considered in the database are:

- *Ambient Assisted Living* (o *Safety*), solutions aimed at assisting people to guarantee physical integrity and well-being. Are therefore considered all the offers that assist and protect vulnerable or needy people (e.g. children, elderly, disabled) and those related to health monitoring;

- *Cooling/Heating*, intelligent devices to control heating and cooling system (e.g. thermostat or air conditioning system able to learn customer habits and behave autonomously basing on that);
- *Energy consumption monitoring,* products aimed at identifying the main sources of energy consumption (e.g. household appliances) and wastes, to intervene where necessary and reduce energy costs (e.g. light bills);
- *Entertainment*, solutions for leisure, such as audio and video equipment (e.g. music reproduced by sensors integrated in the walls and managed by smartphones);
- *Environmental parameter monitoring*, sensors measuring air parameters such as temperature, humidity, concentration of polluting gasses, to ensure better living conditions;
- *Home appliance management*, solutions that permit to make smart, more accessible and automatize home-based tasks;
- *Lighting*: intelligent lighting system to reduce the waste or increase home comfort (e.g. light bulbs that you automatically switch off if there are no people in the room);
- *Scenario management*, solutions that allow the integration and management of multiple products in just one interface and at the same time;
- *Security,* solutions to protect the home from any intrusion and theft (e.g. cameras or sensors that detect the opening of doors or windows and alert the owner via the smartphone);
- *Smoke, flood, fire detection,* intelligent sensors able to detect problems inside the house and immediately inform the owner;
- *Other,* the category includes different sub-domains that are less widespread or less consistent with the goal of this thesis. Any details regarding this sub-field are included in the "Detail" column.

Secondary application sub-domain

Some solutions can satisfy two different need. For this reason, the column is used to take note of a secondary purpose of the mapped product/service. The categories considered are those presented above.

Detail

This column shows, if necessary, any clarifications with reference to a subfield. For example, in the case of “Other”, the exact functionality is indicated; or in the case of wide-ranging sub-areas

(eg Entertainment) where possible you specify the area of interest (audio, video, travel, etc.). Or even, where necessary, indicate some peculiarities, such as the type of consumptions analysed (electric, water, etc.) in the case of “Energy consumption monitoring”.

(2) After this initial section, there are a series of columns dedicated to the description of the *business model*, that is the strategy and methodologies that the company uses to create value for the consumer and to get its profits.

Hardware

The cells were used for indicating the sale of one or more physical devices (e.g. sensor). The successive column “HW Description” has been reserved for an optional description of the hardware compartment.

App

It indicates if there is an App in the solution, identifying, where possible, whether free or paid.

Service

It can be associated with the physical product or be independent. Possibly described in the successive column “Service Description”.

Subscription

Indication of the presence of a compulsory or optional subscription charge, with relative time horizon.

(3) The third section of the database contains information about the sale channel. The columns provide details about how the product reaches the end customer.

Main channel

Sale channels considered in the database are:

- *eCommerce*, online sales. This is the most manageable sales channel and allows to have direct contact with the customer. In addition is the easiest way to spread the offer internationally;
- *Retailers*, the product is available on the shelves of the world's largest retail stores;
- *Professional technician*, used for the distribution of complex and niche products. Their installation is often not possible directly by the end consumer due to their

invasive nature and it is therefore necessary the intervention of professionals. They generally are also in charge of the promotion of the solution to the end customers.

There is a possibility that companies adopted more than one of the previously identified channels, so they are both presented. For solutions which was not possible to identify the sale channel, if the solution was launched on market, the cell was left empty. Otherwise, if offer was not started, the label "Not yet on sale" has been used.

Presence on producer eCommerce

In this column cell can assume yes or no value. The name of the column is self-explanatory: the content of the cell allows to understand if the solution is on sale on the manufacturer's e-shop.

Presence on other eCommerce

In this column cell can assume yes or no value, the next one is reserved to specify which eCommerce websites (e.g. Amazon, BestBuy, …).

Presence in Italian retailers

In this column cell can assume yes or no value.

(4) In the fourth database section are presented information about solutions pricing.

Pricing model

Three methodologies:

- *Lump sum*, the product/service in paid in one solution at purchase moment;
- *As a Service*, the offer consists in a subscription, with a fee that must be paid periodically in order to access to the service on a pre-defined time interval (typical of services);
- *Lump sum + as a service*, combination of the two methodologies. Usually lump sum payment is referred to the acquisition of hardware, while the subscription fees are needed to obtain an additional service (e.g. acquisition of a camera + video cloud storage service).

(5) The last section of the database contains the ***sources***, so the like to the websites where the information about the smart home solutions have been found.

4.3 Reference Sample

In this paragraph is provided a detailed description of the sample that has been taken as a reference in the following Research.

For this thesis work, 408 products offered by 279 different companies have been examined.

The solutions included in the database cover a time span ranging from 2000 to the first quarter of 2018, with the most dated that have been updated over time to track the development of products and services.

A first aspect which could be analysed is the geographic one. Database cases has been broken down according the continent and by country where the companies are based. Figure 38 gives an intuitive representation of the geographic distribution.

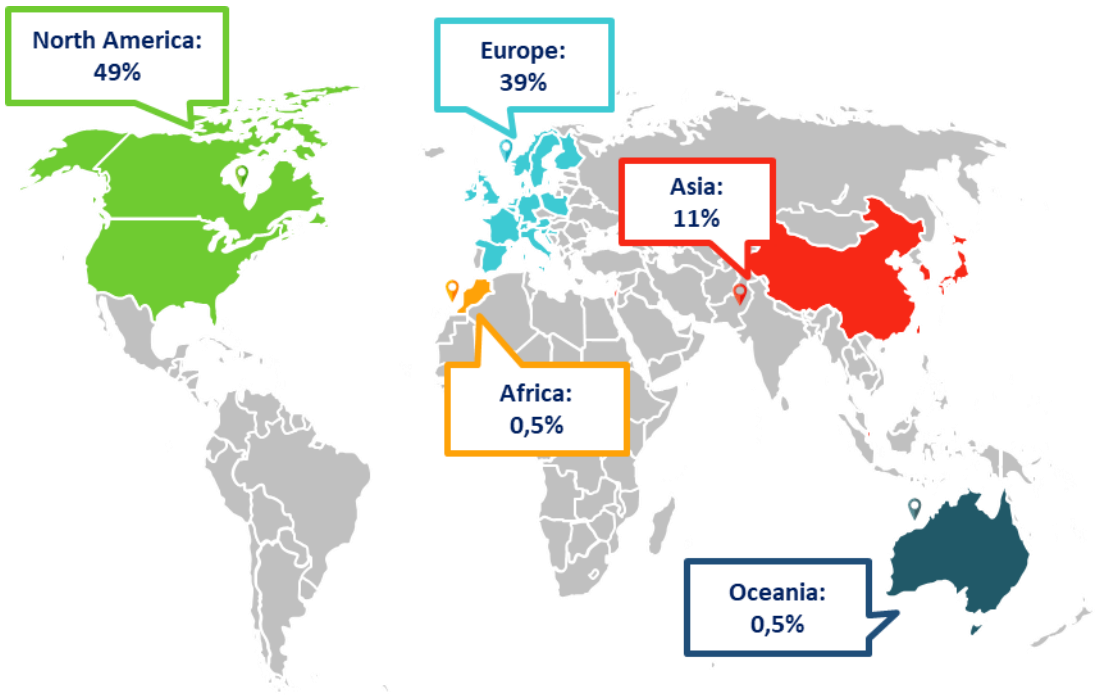

Figure 38: geographic distribution of Smart Home solutions

As can be seen from the Figure 38, about 90% of the monitored companies are distributed between the North America (49%) and the Europe (39%), with the former who alone gives home to about half of them.

Asia has a not negligible number of companies engaged in Smart Home market, being worth the 11% of the solutions mapped in the database. The remaining two continents have very few solutions offered, actually representing less than 1% per head. No one of the solutions contained in the database comes from *South America*.

Same results are expressed in a traditional histogram (Figure 39).

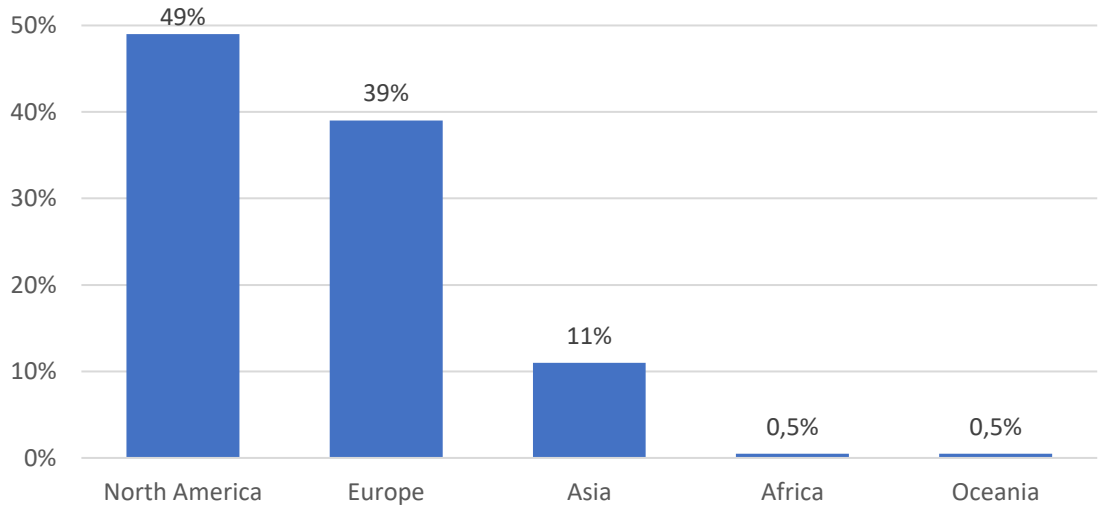

Figure 39: Smart Home solutions for continent

In Figure 40, the most relevant countries in the world scenario are highlight, or better those countries with a greater concentration of companies that realise Smart Home products and services.

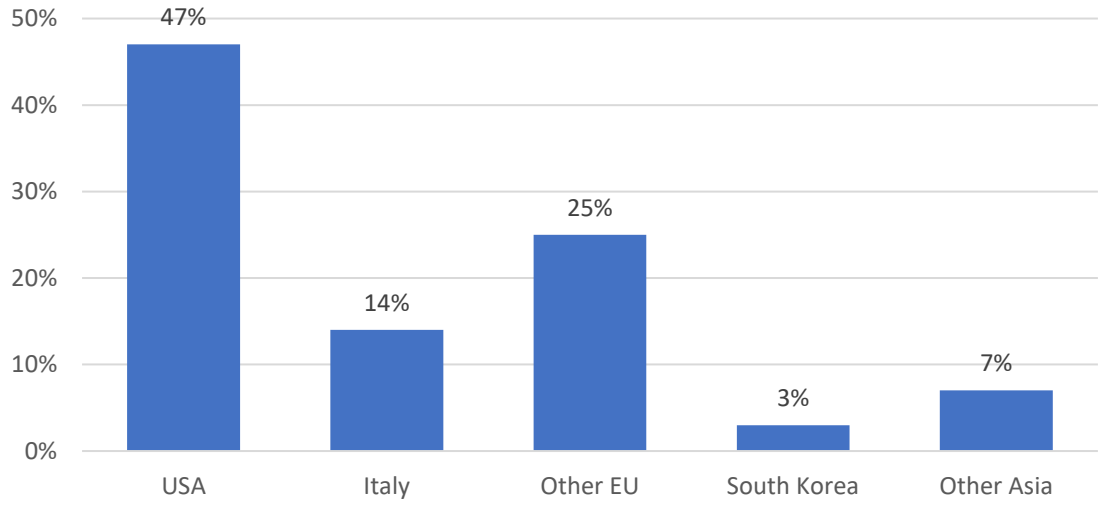

Figure 40: Smart Home solutions for relevant countries

Most of the cases mapped come from the *United States of America* (47%). One of the factors that surely explains this percentage, rely in the practice of startups which begins to gain some visibility: they often move their headquarters to *USA*, in particular in the Silicon Valley, where growth opportunities and possibilities are generally greater.

The presence of a significant amount of *Italian* solutions, 14% of the sample, must be weighed with the strong focus kept on our country during the analysis. Mapping for *Italy* can certainly be considered more exhaustive than other countries. The other two European countries giving home to the highest number of solutions are *Germany* (6%) and *United Kingdom* (5%).

Proceeding with the analysis, is presented the distribution of offers among the different types of companies: *Startups*, *Small and Medium Enterprises (SME*s) and *Big Players*. The results are presented in Figure 41.

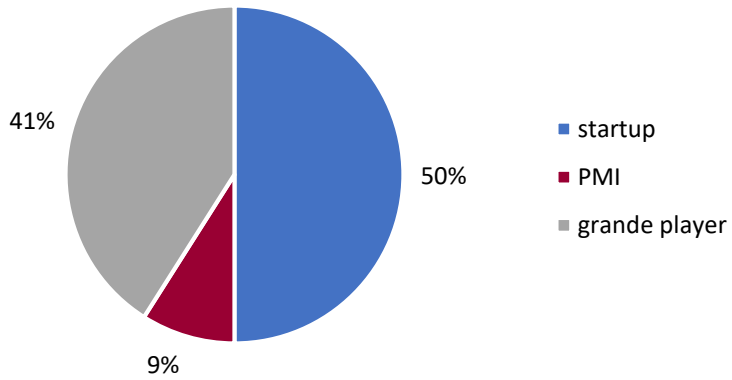

Figure 41: distribution of offers among different types of companies

Looking Figure 41, it is clear that *Startups* have shown greater interest in the Smart Home, creating interesting and innovative solution. However, with the raise of popularity and the size of this market, the attention of market big players has increased considerably. *Big Players* and OTT companies have been launching their products since a while, but using an approach aimed at creating knowledge, curiosity and preparing the consumer for a second phase of more intensive home transformation. The innovative potential of Smart Home products is clear, but, at the moment not fully understood by end users; therefore, *Big Players* stalled to push hard the solutions to the mass market, which is their typical approach. Anyway, as the market maturity curve has soared, a growing number of solutions from established companies have been launched on the market.

However, it is important to point out how the two parties (*Startups* and *Big Players*) are getting more and more in touch, thanks to the partnerships and the acquisitions these actors are signing. Some examples of famous acquisition are Google with Nest, in the "far" 2014 for the for $3.2 billion. Samsung few months later reacted acquiring Smart Things, while in the second half of 2017 Apple took the control of Beddit, producer of sleep tracking solutions. The last big acquisition chronologically (February 2018) was that of Ring, an American company producing automatic systems and home security, by Amazon for about $1 billion.

The underlying picture (Figure 42), show all the most relevant mergers and acquisitions happened from 2013 to mid-2017 regarding Smart Home-related companies.

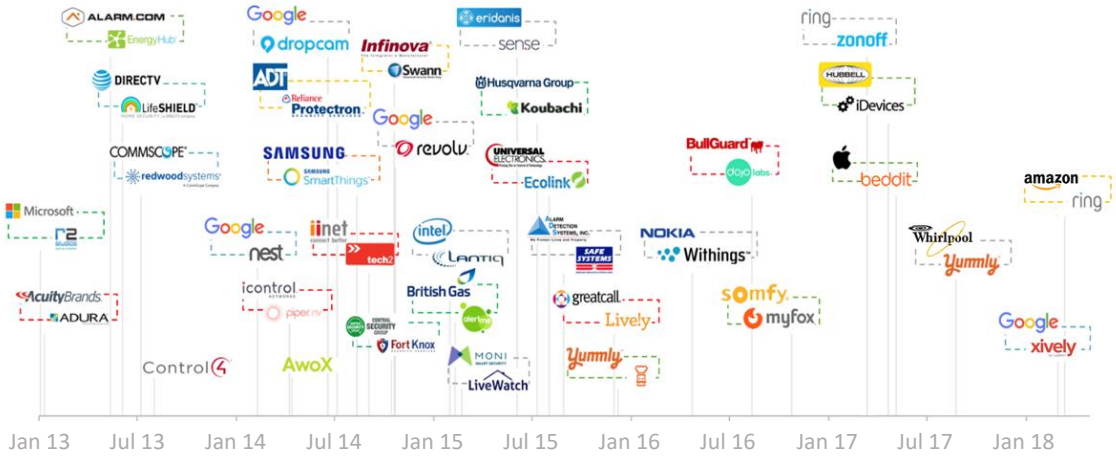

Figure 42: relevant mergers and acquisitions (2013-2017) for Smart Home-related companies

For what concern collaborations and partnerships, the numbers are even greater. An example is surely the hardware manufacturers' desire to integrate functionality for their products in the *Big Players'* smart personal assistant. Amazon has built the success of Alexa exactly on this: the company gives developers the possibility to create "Skills" for Alexa, or integration for third-party devices. In this way, speaking with the assistant, is possible to have access to the features of connected device. This opportunity is widely exploited by *Startups*, but even large and established companies have begun to move in this direction. Also, the insurance industry is moving to strike strategic alliances, such as State Farm with Canary. In this case the partnership consists, on one hand, on a discounted purchase price for the device (if you have subscribed an insurance) and a discount on the insurance policy premium (if you own the device) on the other hand.

The analysis of the sample continues focusing on application sub-domain. The distribution of them is showed in Figure 43.

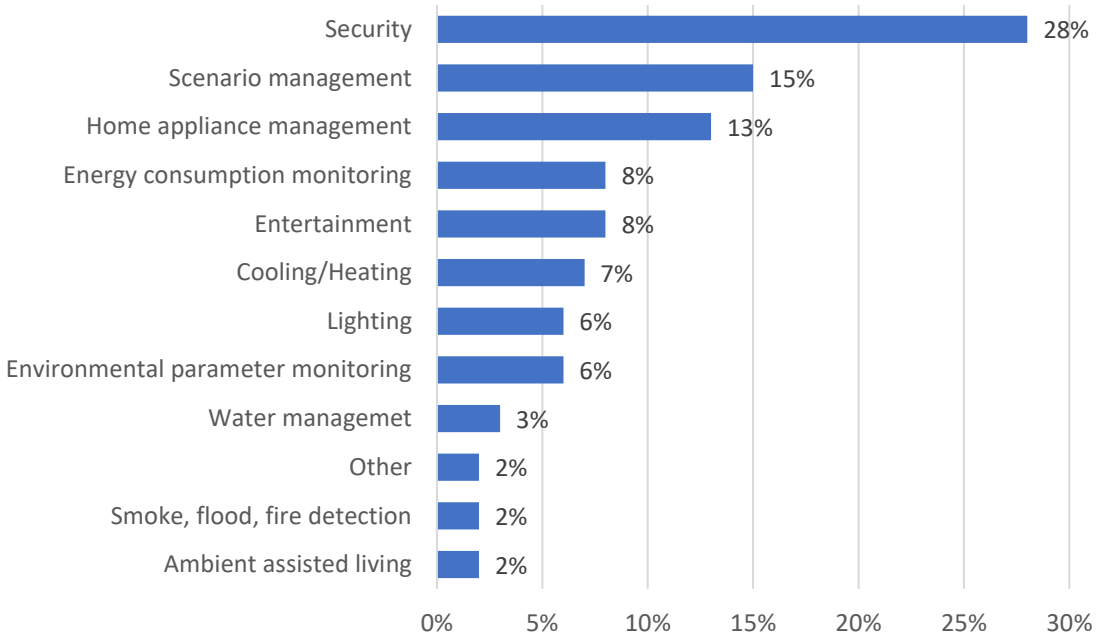

Figure 43: distribution of offers among sub-domains

In Figure 43 emerge a sub-domain which is more widespread than the others: Security (28%). Offers categorized in this sub-domain respond to a primary need of people, clearer and more explicit respect to other Smart Home propositions. So, probably, the high diffusion of this sub-domain relies on the fact that people are aware of this need and are looking for solutions to it.

The second most common sub-domain, with 15% of solutions, is *Scenarios management*. The aspect of controlling everything through a single device/app is crucial to the products success: no customer wants to handle many solutions each one in a separate way, with a different interface. This is one of the limit of the Smart Home diffusion so far. Growth in the number of these products could also be the result of greater dialogue and opening to partnerships between companies active in the market, which are trying to standardize the communication protocols.

The third sub-domain for number of solutions on the market is *Household appliance management* (13%). Household appliance manufacturers are year after year enriching their mix with smart and connected products, demonstrating their interest in the Smart Home market.

Energy consumption monitoring continues to be present on the market (8%), enabling more efficient energy management and generating valuable benefits for consumers. Until recently, the

energy bill payment was done without knowing the details of the consumption during the reference period were. The modern technologies make possible to monitor real-time consumption of homes, reducing the waste and the cost of bills. The same percentage is held by solutions related to *Entertainment*, which basically innovative products that generate curiosity from customers.

Other sub-domains, such as *Cooling/Heating*, *Lighting* and *Environmental Parameters Monitoring* follows, with a market share between 6% and 7%. Lower common are *Water management*, *Ambient assisted living* and *smoke, floods and fires detection* solutions.

4.4 The Actual Market

To analyse more in detail the mapped solutions have been considered different elements including the business model, the pricing model, and the channels used.

Starting from the business model, used by companies to define how to create value for the customer and generate profit for the company, several choices have been made by companies. They are represented in Figure 44, which offers also the diffusion percentage on the market.

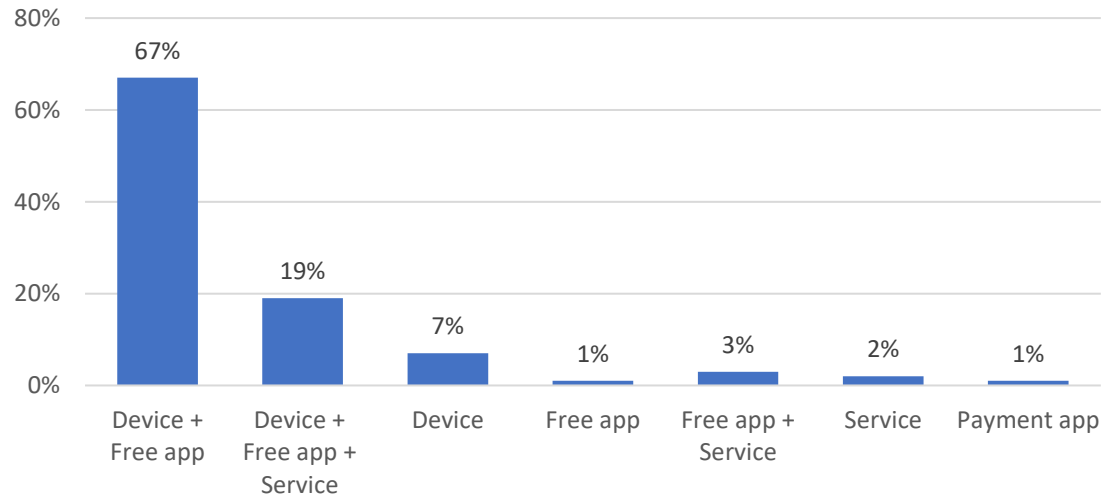

Figure 44: business model typologies

Figure 44 shows that in most of the solutions (67%) the business model is based on the sale of a physical *device* managed remotely thanks to a *free dedicated app*, accessible through

smartphones or tablets. An example is the BTicino Classe 300, a connected video intercom which integrates the smartphone into the traditional functionality: thanks to the integrated Wi-Fi connectivity, video door phone calls can be managed on the smartphone through the dedicated BTicino app, so that landlords can see who ring the door even when they are away from home.

Besides this dominant option, other business models are slowly progressing. The second for diffusion combines *devices with services* and made them accessible thanks to *free app* (19%). An interesting case base on this business model is the one represented by Curb, a US startup. Through sensors that connect directly to the electrical box, Curb monitors all energy consumption within the home. It knows which appliances are operating, how much they are consuming and the associated costs. The mobile application shows the consumption data and the cost of the electricity bill. Moreover, it gives useful tips to save money and it tells the user when something is going wrong sending security alerts. Not only startups are offering this kind of model, but also larger companies. Somfy, a French home automation company, offers an interesting solution called "Security Camera". It allows to increase the safety of the house, monitoring what is happening in the rooms remotely through live streaming on dedicate smartphone app and with the possibility of having an unlimited number of screenshots from videos. Besides, it includes Vision, a technology for infrared motion detection, integrated with an image analysis to detect false alarms; in case of suspicious movements the device send an alert on the app or via SMS. The privacy of residents remains anyway protected, in fact it is possible, if desired, to close the camera's shutter with an automated cap manageable through the app. The service offered consists in the option of saving records for a certain number of days in the cloud, in order to create a video history, and a security surveillance service. As the examples show, this type of business model tends to be more widespread in the fields of Energy consumption monitoring and Security. In these cases, to the consumer is given the opportunity to benefit from a service that can be free or requires the payment of a fee like the video history creation in the Somfy camera.

In 7% of cases, only a physical product is sold (*device*). This usually consists in products able to interface with user through different ways than the video, in particular through voice control. This means that all the products which can be managed only through the vocal assistants, such as smart speakers, are included in this category of the database. The examples are many, because the smart speakers are proliferating and in 2018, alongside the classic Amazon Echo and Google Home, are going to be available on the market others: the long-awaited Apple HomePod, but also devices of JBL, Sony and LG that will be natively equipped with Google Assistant.

Another business model that has been very rarely found (3%) is *service with free app*. It consists in platforms or mobile applications which do not require the presence of any physical device, or which can be sold individually and eventually, in a second moment, combined with other devices, even of different brands. An example is Smartfrog, an innovative solution for "cheap" home video surveillance. It consists in a software platform that allows to transform used smartphones and laptops into security cam, saving on the purchase cost of new connected cameras. In addition is possible to save in cloud up to 4 hours videos for free.

The remaining three business models are characterized by a low diffusion.

Next there is the analysis of adopted pricing model, or better how the consumer has to pay the product or service offered. Results are presented in Figure 45.

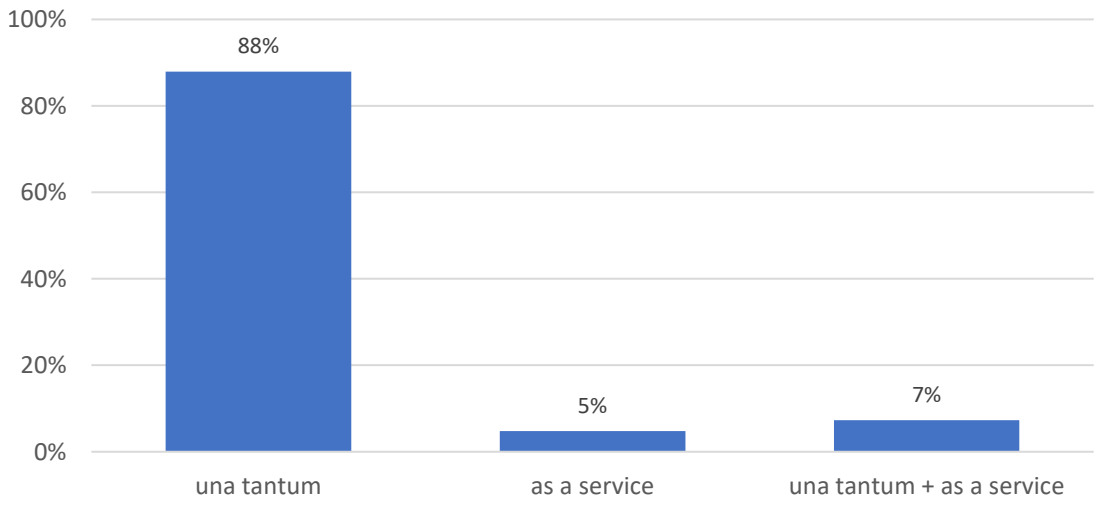

Figure 45: pricing model typologies

The majority of the solutions (88%) uses a traditional pricing model, in which the customer pays only the product purchase, the *lump sum* pricing model. The issue of this solution is that, after the transaction, the company loose contact with the client. Nevertheless, companies and innovative solutions continue to largely adopt this model, perhaps because it is considered clearer and more transparent by consumers. For example, the Italian startup 1Control offers a product named "Solo". This solution allows to eliminate all the remote controls for home gate and garage doors, opening them through the smartphone. Another interesting case is represented by Jibo, a US startup that has realized a small robot equipped with Wi-Fi and Bluetooth connectivity. It acts as personal assistant, able to recognize familiar faces and associate

them with different users. It even has the ability to turn its head to follow the movements of people within a room.

The other solutions are *lump sum + as a service* and *as a service* only. In the first case (7%), usually solution consist in a device plus a service. The product, a physical part, is paid during the purchase, while the services require a subscription with a periodical payment. This type of pricing model is for example frequently used in the security field, where companies give some hardware (e.g. camera, motion sensors, door/window sensor) to the user and then provide a collection of services (e.g. 24/7 assistance, cloud data storage) that require a monthly fee. Among these companies there is Sicuritalia: its Protection24 package consists of security service and smart alarm system with a dedicated app to manage it remotely and to connect with the surveillance operations centre. The offer includes a product bundle to be purchased with a single payment containing motion sensors, door/window sensors and night vision security camera connected to the operations centre, in order to determine any anomalies inside the home and provide with the intervention of security guard. While the dedicated App allows the customer to activate the security camera to receive images form home on smartphone or computer and even send the recorded videos directly to the Operations Centre in case of suspicious events. In this category has also been included the cases in which both the payment option can be chose: single payment or as a service. Tado°, a quite popular smart thermostat manufacturer, applies this policy: the customer can decide whether to buy the product or rent it for a minimum period of 2 years.

The second case, found in only in 5% of the solutions, consists in services subscriptions. For instance, Octo Homebox is a self-installing system providing protection against fire, flood, electrical hazards and theft; in case of any of these events the product immediately alert both a surveillance centre and the homeowner. The product is offered by insurance companies with the signing of the home security policy and paid together with it.

In order to analyse deeper the pricing models, can be interesting to observe how the different company clusters (startups, SMEs, Big Players) behave. The expression of Smart Home market is presented in Figure 46.

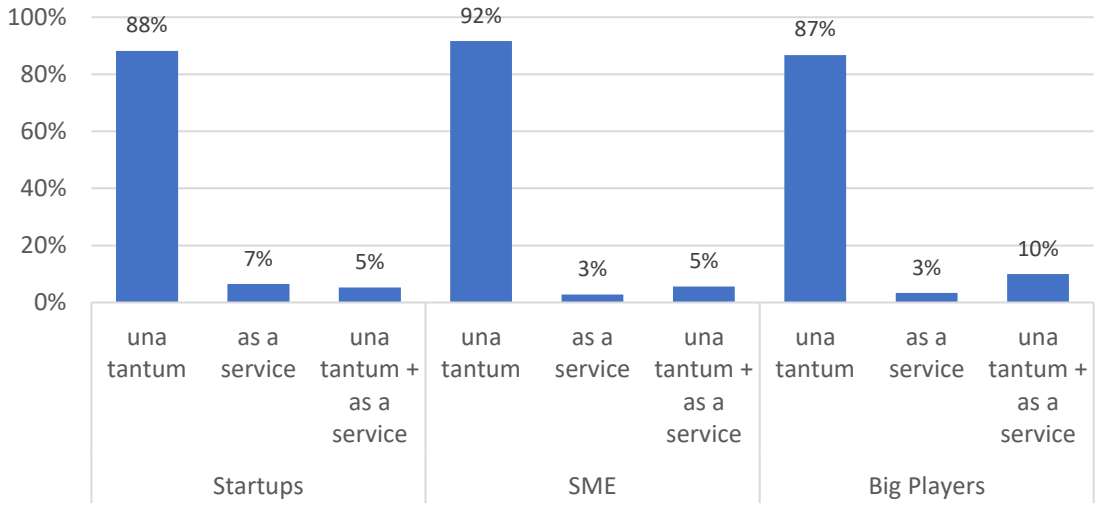

Figure 46: pricing model typologies among company typologies

For all three company's typologies, for the cases registered in the database, is possible to notice a clear prevalence of *lump sum* pricing model.

In scientific publications is a recurrently suggested that profit should not be simply generated by a surplus on the sale price but may be recurrent over time thanks to the administration of services, subscriptions and applications usable in the face of a periodical payment. The market seems, up to now, to have put this advice away. There may be several motivations that lead to a more frequent adoption of *lump sum* approach; for example, it can be said that startups need to maximize revenue in the short run to support their business, while other companies are likely to choose the traditional pricing model because of a good response of the market, so not perceiving the need to change business model.

Anyway, despite the numbers are still small, is important to underline that this type of approach is significantly growing in the last year: the trend of turning offer, even of a physical product, into a service is present in many areas and in many application field and consumers are beginning to appreciate and adhere to these types of solutions. In particular, while product manufacturers still present a limited adoption of this pricing model, an increasing number of retailers opts for servitisation in their sale strategy. Therefore, is quite probable that a growth of as a service or pay as you go model is going to happen in the next years.

Channels used by companies to reach the final customer are another remarkable aspect. A first issue can be related to the choice of companies about a *single-channel* or a *multichannel strategy*

in their business model. The answer is presented in Figure 47, where a clear prevalence of the *single-channel approach* emerges.

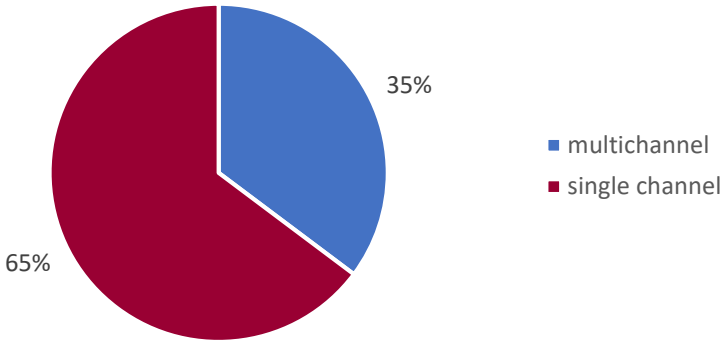

Figure 47: sale channel typologies (1)

In this case the sample is reduced to 349 products out of the 408 mapped, since for several reasons (e.g. product not yet on sale) it was not possible to identify the channels of all the solutions. The result indicates a clear majority but is strongly influenced by the large amount of e-commerce-only offers, as will be seen later. Recognizing as different touch points the company direct online channel and generalist ecommerce website, so considering them as different sales channels, a very different picture appears (Figure 48). With this expedient the situation overturns.

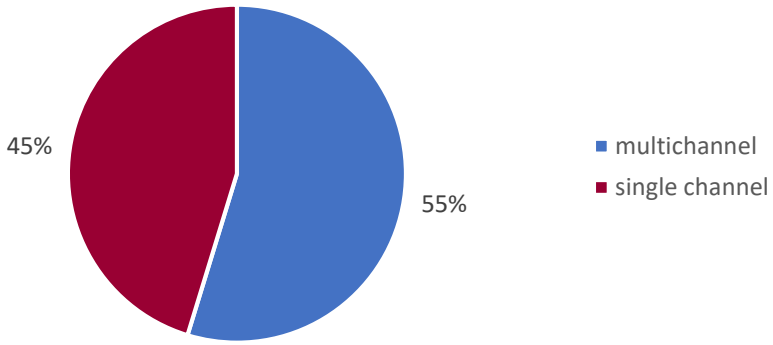

Figure 48: sale channel typologies (2)

The analysis continues identifying the different distribution channels and their diffusion (Figure 49).

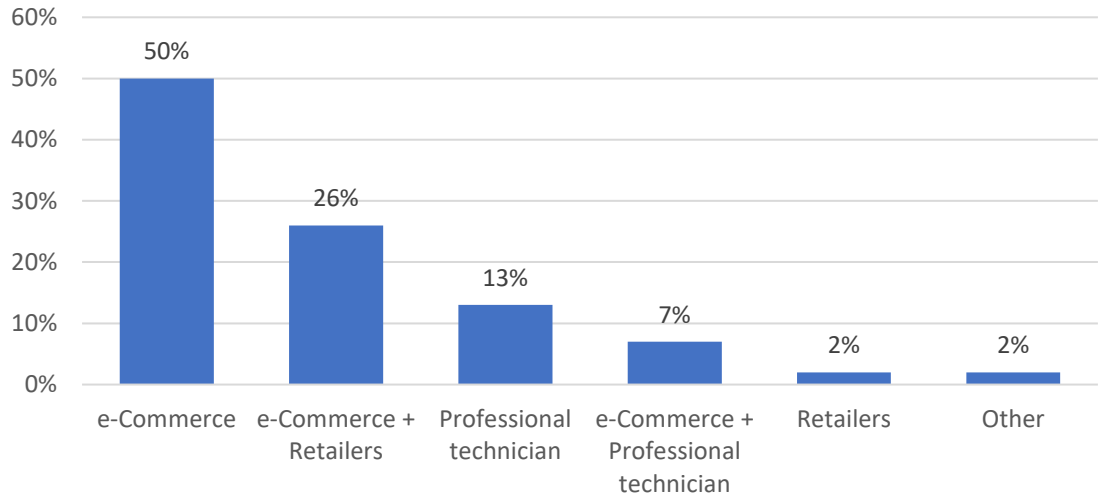

Figure 49: distribution channels and relative diffusion

E-commerce is clearly the most used sales channel, being adopted as unique channel in 50% of the cases mapped in the database and on the whole in 83% of solutions. The role of *professional technician*, which are often neglected by companies in favour of more direct sales methods, is still quite important in the market, covering about 13%. Curious what happened to *retailers*: only 7 solutions out of 349 are sold uniquely on this channel, while 26% of the deals exploit this channel at the same time as the *e-commerce*.

Having very different characteristics, it is easy to imagine startups, SMEs and Big Players can adopt a different approach to reach their customers. Figure 50 presents these differences.

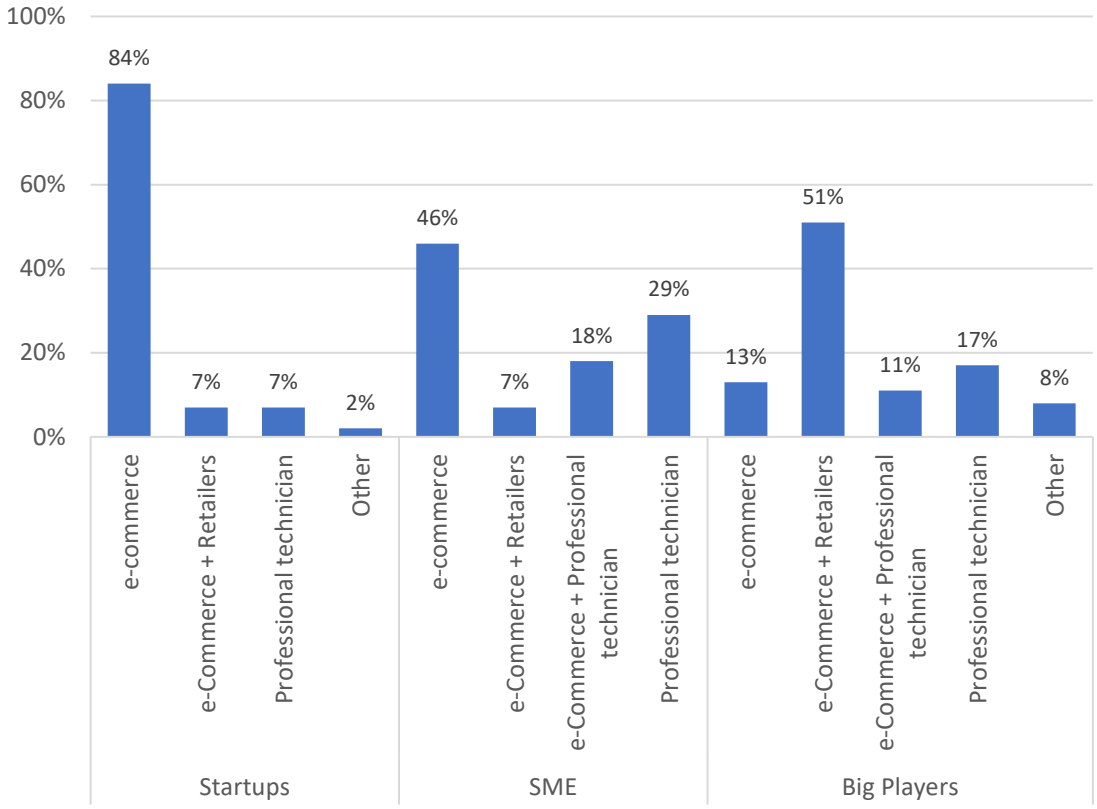

Figure 50: distribution channel diffusion among company typologies

For what concern startups, *e-commerce* represents almost the only channel, since is preferred in 84% of solutions. The inability to reach *retailers* and *professional technician* push startups to sell their solutions directly, but, leveraging the power of the internet, they can still reach potential customers around all-over the world. SMEs leverage in particular on *e-commerce* (46%) and *professional technician* (29%), while Big Players basically exploit all the distribution channels they have at their disposal. A channel that Big Player cannot abandon is the one of the *retailers*, which, in any case, is almost ever associated with online sales (51%). The importance of *retailers* is confirmed by the habits of companies of developing partnerships with them: several producers of connected home products use to set up small showrooms in big retailers' stores.

4.5 Industry Trends

After offering an overview of the features of the solutions in the database and analysing the current situation of the Smart Home market, is interesting to investigate the trends that have characterized the sector in recent years. This insight proves to be very useful in understanding the evolution of the context over time.

In this regard, the analysis performed (Figure 51) is focused on the diffusion over time of Smart Home solutions according to their sub-domains, or better are highlighted the percentage of offers on the market belonging to each sub-domain, per year. Solution before 2014 have been merged in a unique cluster, while year 2018 has not been considered since just a quarter of year is gone and the pool of solution inserted in the database in little and could be not representative.

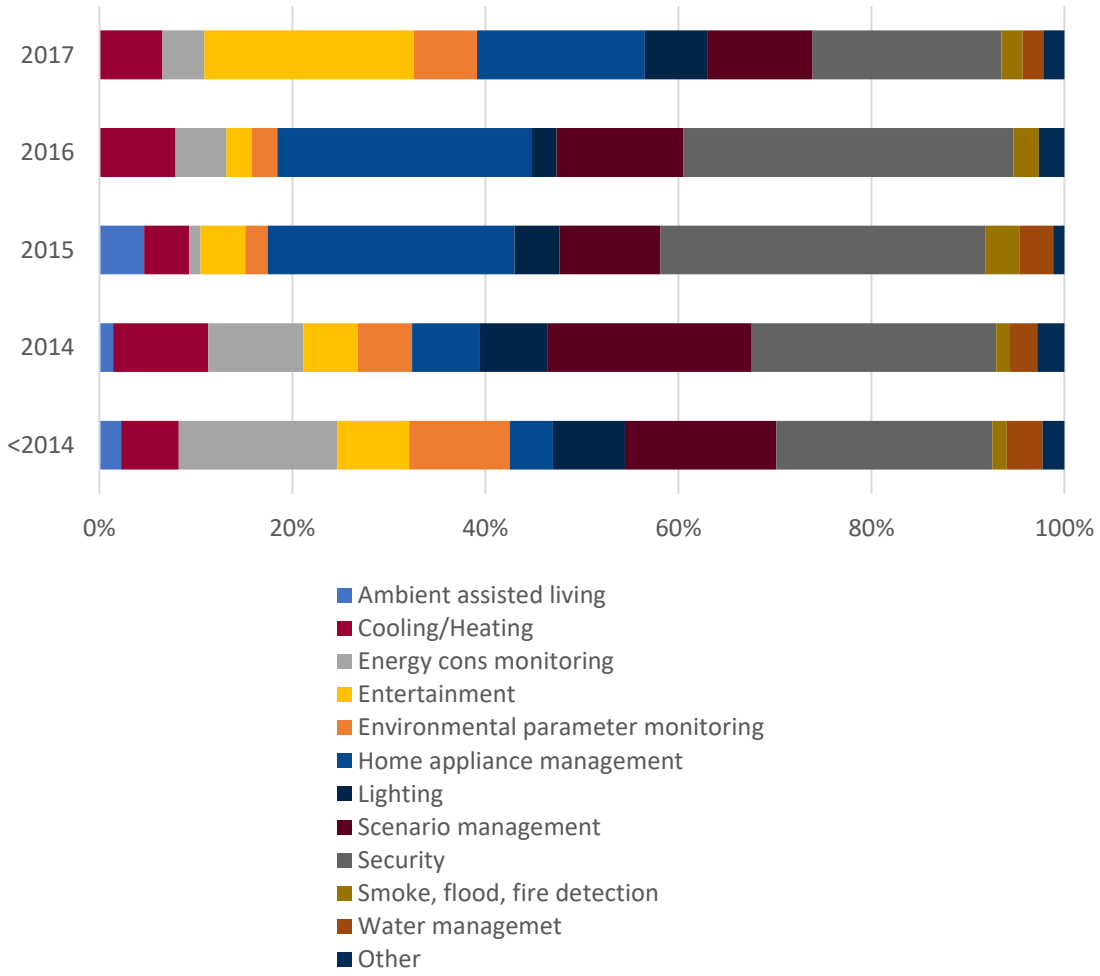

Figure 51: diffusion of Smart Home solutions over time according to their sub-domains

Some considerations can be added on the basis of results presented in Figure 51.

Scenario management related solution are fairly distributed over time, confirming the importance to offer customers a unique interface for the Smart Home. Same behaviour and considerations, even if with a smaller market share, for Cooling/Heating solutions. Smoke, flood and fire detection sub-domain, instead, has reached maturity only after 2014 and now has stable, albeit small, market share. Anyway, the most surprising figure regards Entertainment solutions: their boom in 2017 is evident. This is due to the great success of smart speakers, which led to a considerable expansion of the products range; new players entered on the market and many companies started the production of high-end devices, oriented to the reproduction of music with quality sound and high performance, respect the "basic" ones more oriented to the interaction with the user. Precisely for their recreational purpose these solutions have been classified within this category. Energy consumption monitoring, on the other hand, presents an opposite trend. Energy saving was one of the founding themes of the Smart Home and for this reason there was an initial wave of solutions. The fall in 2015 could be due to an over-saturated market, while in the last two years product share has stabilized. The almost same trend characterises solutions for Environmental parameters monitoring, which, after a good diffusion in the early years, have undergone a decrease and have finally apparently stabilized. Ambient assisted living domain seem to have disappeared, probably not able to obtain a significant result on the market in recent years. Water management and Lighting solutions declined in 2016, but in 2017 the number of solutions observed on the market returned to the percentages of previous years. They are therefore domains that will continue to count solutions even in the coming years. Security, after a peak in supply in 2015, still continues to record a significant share of solutions. This is also the most mature area: the first product registered in the database dates back to the year 2000. The Home appliance management category, which also includes all connected appliances, had a significant explosion in 2015 and 2016, when companies decided to proceed with the smartisation of their entire range of products. The decrease in the number of solutions should not suggest a negative trend on the market, since the products' lifecycle is quite long and consequently the frequency of new launch on market is not as high as in consumer electronics. It is pretty sure that this sub-domain will continue to be important in the Smart Home in the coming years.

Figure 51 and comments on its data give an idea about sub-domains which the attention of the companies and the market is focusing on. However, the study of market solutions and the

analyses made so far do not reveal the complexity of the Smart Home and do not highlight the actors who are investing and working to ensure that the connected offers spread in the homes of more and more people. These aspects will however be deepened in the course of the next chapters.

5. SMART HOME ECOSYSTEM: BUSINESS MODELS EVOLUTION AND VALUE OF DATA

Both academics and practitioners show a consistent gap in identifying, in the Smart Home ecosystem, how is managed the creation of value, who are the roles and actors involved and which are their strategic business modelling. In this chapter are provided information, approaches and models to fill this gap.

5.1 From Value to Value Network

The results of the Smart Home market, as presented in detail in the Chapter 1, are positive. McKinsey (2017) states that *"the market has seen substantial year-over-year growth in the number of connected homes, and this is expected to continue in the years to come",* given that in the US the number of connected home expanded from 17M in 2015 to 29M in 2017 and a doubling in 2018 is forecasted. In Italy, Internet of Things Observatory registers a market growth of 35% in the 2017 respect the 2016: the Italian market reaches a good 250M € while other European market shows much more interesting numbers: 1.5B € in Germany, 1.4B € in UK, 600M € in France.

Despite the numbers depict a good trend of the industry, it is clear that the value of the global market is far enough from its big potential dimension. This limitation can be addressed to the myopic perspective of scholars and companies. The first have shown in the last years high interest in technical debates and connectivity-orientation rather than a focus on the value creation and on strategical/managerial issue. The second ones have not been able to communicate in the right way the value proposition and to address the need of customers with clear value propositions.

As observed, the M2M Smart Home market is nowadays really fragmented: on one hand there are new small developers and startups but they don't have the resources and capabilities to fill the gap and overcome problems with deployment and economies of scale; on the other hand there is the need to understand the real value for the existing working services, with incumbents

fighting for their predominance. Thus, as will be shown in the following sections, the deploying of single vertical solutions must be abandoned because the benefits of common infrastructures and interdependency are clear: the value creation, from connectivity to service delivery, can be shared between renewed existing players and new-comers reducing investment costs and increasing economies of scale, capabilities, opportunities and potential profits. In this environment, has emerged a value network of multiple stakeholders that has impact on a large number of processes.

In order to understand the strategic path of the actors involved and their roles in the Smart Home ecosystem, is fundamental to start from an analysis of what is the value and how IoT changed the traditional value chain perspective.

Porter M., Heppelmann J. (2014) underlined this radical shift in an article on Harvard Business Review: "*These 'smart, connected products', made possible by vast improvements in processing power and device miniaturization and by the network benefits of ubiquitous wireless connectivity, have unleashed a new era of competition. Smart, connected products offer exponentially expanding opportunities for new functionality, far greater reliability, much higher product utilization, and capabilities that cut across and transcend traditional product boundaries. The changing nature of products is also disrupting value chains, forcing companies to rethink and retool nearly everything they do internally."*

5.1.1 Value and Value Chain

First of all, it is necessary to question about what the value is and when it is created. The topic of value and added value has been the subject of discussions for generations and centuries and an interesting consideration was given by Karl Marx in its book Capital (1867): *"nothing can have value unless it has utility. If it is useless, the labor embodied in it has been useless; such labor cannot be counted as labor, and therefore cannot produce value".*

For a long time, the concept of added value has been closely linked to manufacturing.

Drucker P. (1973), considered one of the management's fathers and pioneer in the theory of added value, stated that *"even 'value added' is not an adequate measurement. For it can be applied only to manufacturing companies. 'Value added' is a meaningless concept for a retail*

business, for a bank, for a life insurance company, and for any other business which is not primarily engaged in manufacturing".

In this context was born the most famous model concerning value, as well as the first one describing the structure that allows an organization to create value: Value Chain. This model was theorized by Porter M. (1985) in his best-seller "Competitive Advantage: Creating and Sustaining Superior Performance". According to this model, shown in Figure 52, an organization is constituted by nine fundamental processes, that includes five primary activities and four support activities.

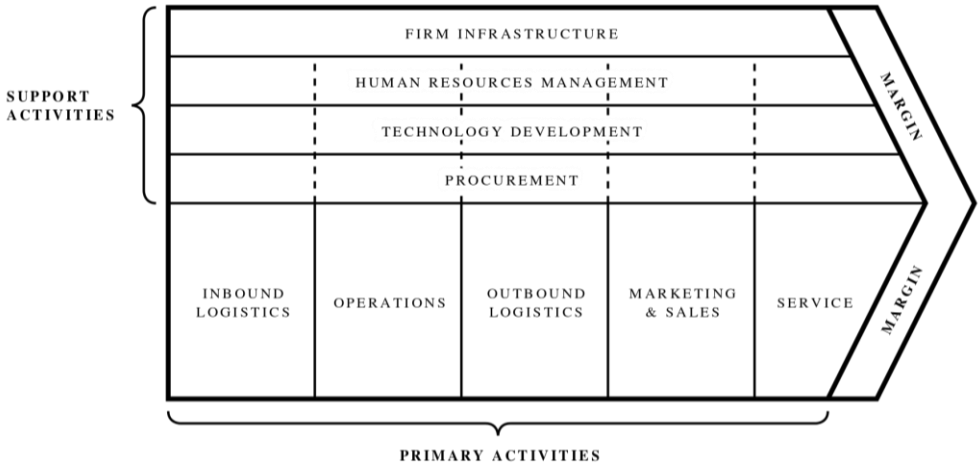

Figure 52: the Value Chain

The value chain has proved a very powerful tool for describing the linkage between the activities and between the actors that exist in the physical world within traditional industries, enabling also strategic analysis. Furthermore, it has also framed the common vision of value and value creation.

However, the value chainis linked to a more conservative vision of businesses which differs from the what happens today in many sectors, where the digitalization has revolutionized the value delivery. In these new business environments both the demand and supply are dematerialized, with the service component that has gained a great importance. As a result, in situation like these, some activities lose a physical dimension and the value chain concept becomes inappropriate to analyse processes and uncover sources of value. In addition, the linear model does not take in consideration alliances, partnerships, co-creation and other types of relationships that can be created in the modern business environments.

Hence, emerged the need to identify a new model that could represent how value is created in these new cooperative and digitized contexts. Frist, was necessary to focus not only on the single company or on a specific industry, but keep a broader perspective looking across different industries, where several economic actors work together to co-produce value. Secondly, in the Porter Value Chain, the emphasis is on essentially physical processes, which are a linear and unidirectional flow. The great importance that today the information has to achieve competitive success leads to the creation of digital flows constitutes by data, that moves in parallel with physical flows. This exchange of information works bilaterally: towards and from the final consumer, in accordance with what is the true essence of the Internet of Things. Third, in the static value chain system, the consumer is always positioned downstream, a condition that does not correspond to today's tendency to place the consumer at the centre of the process.
For these reasons the concept of chain was replaced by the Value Network.

5.1.2 Value Network

Value Networks can be defined as "*multiple organizations that collaborate and utilize their resources and capabilities to produce and deliver a product or service to an end customer and create value for the organizations within the value network*" (Helander N., Rissanen T., 2015).

Networks are organized around the consumer, by offering a variety of channels and interfaces across all the value-adding processes. The model shifts from a sequence of operations with a key role for manufacturers, retailers, and channels to a series of non-linear interaction mechanisms in which the consumer assumes a barycentric value, with important reliance on the entire supply chain. Here the importance of the concept of service emerges: the consumer benefits from a range of services offered by different channels, which differ according to the type of services offered. In this way, the value chain gain complexity and becomes value network.

Looking at these definition is clear why it's mandatory to look at the Smart Home as a value network of actors (OTT, Telcos, Utilities, Appliance Manufacturers, Retailers, Assurances, …) who relies one on the others and exchange tangible and intangible value. Moreover, these actors usually are in competition and this stress an interesting issue: in the value network the interactions for creating value may born from a competitive scenario. Finally. Within the ecosystem, it is the customer who defines the worth of the offering through is buying and consuming activities and this is why its role is even more crucial and central in the IoT.

In order to better understand the logics behind the Intelligent Home industry and go deeper in the knowledge about the value networks functioning, is necessary to explore some of the major models and the methodologies proposed in literature.

One of them is proposed by Allee V. (2002) in her book "The Future of Knowledge" which offers a definition of value network as *"any purposeful group of people or organizations creating social and economic good through complex dynamic exchanges of tangible and intangible value"*. The book also introduces the *HoloMapping*, a whole-system diagramming technique created by the author. It is a systematic and organized way to visualize the tangible transactions and other intangible value exchanges in the network, taking into great consideration the role of knowledge: as will be deepened, data and the multiple nature of value are the basis of the Connected Home business environment. However, drawing value network is the first step, analysing it under a business perspective is another important issue for this work but Allee's theory is less complete under this point of view.

A second approach that is of fundamental importance for carrying out this thesis work is the one proposed by Peppard J., Rylander A. (2006). The authors describe the value network as *"a network of interconnected companies that form a value-creating system where suppliers, partners and customers work together to co-produce value"*. The authors also introduce a the *NVA (Network Value Analysis)*, the five-step methodology shown in Figure 53 useful for understanding where value lies in the network and how it is created, how the firm's activities can affect the network and how the members are likely to respond.

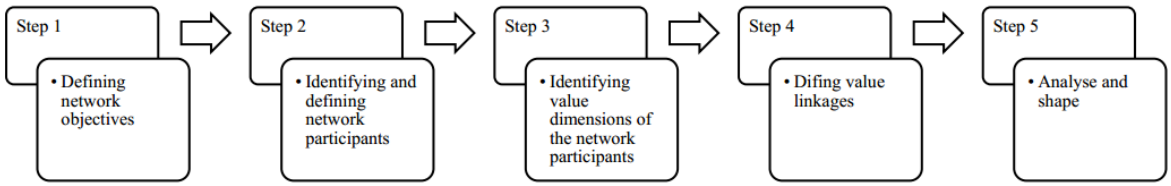

Figure 53: five-step methodology, Peppard J. and Rylander A. (2006)

NVA provides help in dealing with the definition of the strategy to be kept within a value network, because it allows us to find answers to these fundamental questions:

- *What roles (or groups of players) are benefiting most in the configuration?*
- *What are the key resources they need to have?*
- *Could an actor build the resources and capabilities required to compete in its role?*

- *Which roles are appropriate for each actor?*

The work of these academics gives useful advises for dealing with Smart Home and the business philosophy behind the NVA is embedded in the process that will bring to the definition of strategies and modelling the business model changes and opportunities of the actors in chapter 5.4 and 5.5.

Another interesting approach is the one proposed by Al-Debei M. et al. (2013), which describes the value network in the operating context of mobile operators, who need to collaborate to develop mobile data services: the focus on these specific actors is really interesting considering that Telcos perform fundamental roles in the Smart Home domain, as will be shown in Chapter 6. The authors propose a model to support the development process of the value network constituted of seven design elements:

- *Network-mode* refers to the way in which the value network is established and expanded. Substantially, it can be in an open or closed mode;
- *Relationship* refers to the connection which could be established between the actors in the value network;
- *Actors* refer to the involved parties that realize the value network;
- Each one of the actor play a *Role* in the value network, that can be functional or strategic differentiating the importance within the value network. Actor with functional roles give a contribution in terms of knowledge, experience and specialties, while strategic actors permit to reach a key objective or function of the value network;
- *Flow communication* refers to the objects communicated between the actors of a value network;
- *Channel* involves the used means to operate flow communications;
- *Governance* refers to the actor (or actors) who control, direct and manage the value network;

For answering the research questions presented in Chapter 3 will not be literally followed any of the models presented before, since the final aim of this thesis is not providing an accurate Smart Home value network but, instead, is going deeper into the strategy and business models. In doing this, a profound inspiration has been drawn from the authors abovementioned, because they provide the necessary starting pillars for proposing the models.

5.1.3 From Value Network to Ecosystem

The value creation logic explained in the previous paragraphs pointed out the general management of the business networks that builds the Smart Home Ecosystem. Taking the ecosystem perspective is fundamental because the value network is a specification/subset of a business ecosystem and they cannot be considered separately, and, on the other hand, it permits to define the characteristics, stage of progress, actors, roles of the industry.

The idea that the IoT panorama fixes the perfect conditions for the creation of a big ecosystem of actors is clearly shown by Porter M., Heppelmann J. (2014): "*The powerful capabilities of smart, connected products not only reshape competition within an industry, but they can expand the very definition of the industry itself. The competitive boundaries of an industry widen to encompass a set of related products that together meet a broader underlying need. The function of one product is optimized with other related products … Basis of competition thus shifts from the functionality of a discrete product to the performance of the broader product system, in which the firm is just one actor … Increasingly, however, industry boundaries are expanding even beyond product systems to systems of systems—that is, a set of disparate product systems as well as related external information that can be coordinated and optimized, such as a smart building, a smart home, or a smart city".*

The authors provide then a graphical example (Figure 54).

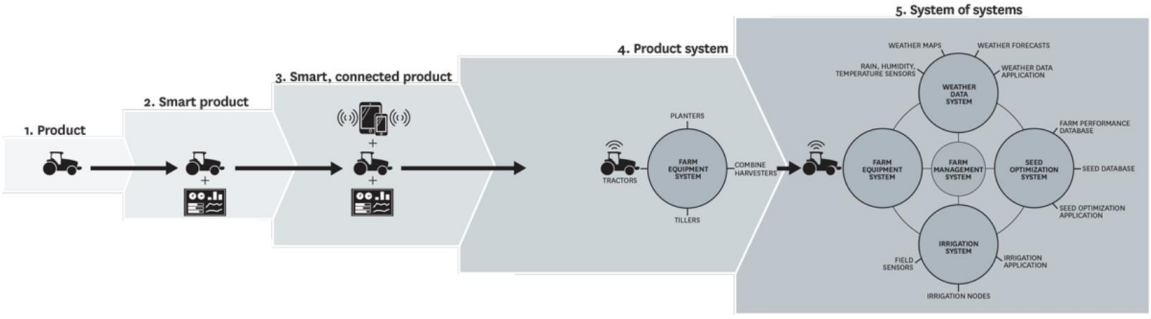

Figure 54: smart connected product systems, Porter M. (2014)

It is important to underline that it is possible to think to the general Smart Home Ecosystem or to a solution-specific Smart Home ecosystem. The first meaning defines the industry from the highest point of view, under the notion that there are multiple participants with different roles that create value networks among themselves. The second one instead refers to an ecosystem

born in the Connected Home context but developed around a particular solution provided by a specific company. Obviously, in the market can be identified lot of these ecosystems, also in competition among themselves (for example, the "Nest ecosystem" or the "Amazon Echo ecosystem"). These is the reason why it has been chosen the term "ecosystems" in the thesis title.
In the following sections it is always alluded to the most generic terms of the Smart Home Ecosystem.

5.2 Smart Home Ecosystem

Before focusing on the key stakeholders and their business models, it is necessary to study the characteristics of the Smart Home Ecosystem, highlighting how the value can be generated and captured.

During an interview with a relevant global Appliance Manufacturer, the manager stated: "*it is not just a problem of business models or not ready users but also of value communication: just the 20% of the customer that buy a smart appliance use their smart functions*". One of the main barrier emerges: it is unquestionable that customers don't recognize clearly the advantages of the connected products and services. For this standpoint, it is necessary to establish the right level of trust with actual and potential users. But, for obtaining support from users, the first step for the companies is obtaining industry stability: it is essential to recognize that the new home can be built just on a foundation of networks, platforms, ecosystems, co-creation and coopetition. How can a firm satisfy customers' needs if don't know how to act in the ecosystem?

Accomplished a literature review about Internet of Things and Smart Home (Chapter 2) and investigated the solutions in the market with the correlated strategies (Chapter 4), it has been manifest that the mission of this new industry actors is not well-defined: lot of firms reveal their interest in the IoT opportunities for homes providing different solutions but is not clear the approach to keep for extracting profits in a sustainable way.

"Home-technology market as a whole remains fragmented, and the potential for a truly smart home is still unrealized" stated Mc Kinsey (2017). Every day new players arise while others leave, every day actors create or destroy partnerships, every day firms provide new solutions or change

the existing ones: it is a market in complete evolution finding for leaderships and a more defined structure.

In order to really dunk the Home Market into the IoT universe, there is the demand of various competences and capabilities, both technical and managerial. Specially is not possible to consider just one or few actors that work alone but there is a call to a real symbiosis of collaborators within a broad business community.

In fact, in the last decades, the idea of the stand-alone company in his vacuum that has to push hard in order to acquire market share and battle with competitors in the industry can be considered a limit to innovation. High-technology businesses need companies coming from different industries with different perspectives and skills for extrapolating real value: there is the necessity to look across different industries. The peculiarities of these decades like globalization, digitalization and data pervasiveness concede lot of tools for establishing the best-practices of doing business and helping customers in this fast-changing environment.

At this point, the next step is defining what is an ecosystem and then entering in detail on which are the peculiarities of the Smart Home one: the goal is building the ground for analysing actors and their roles and strategies.

5.2.1 Business Ecosystem Definition

The term ecosystem was introduced for the first time in the 30's by Arthur Tansley, a British botanist, to describe a community of organisms interacting, competing and collaborating to co-evolve and jointly adapt to their environments, catch opportunities and exploit available resources.

Pfeffer J., Salancik G. (1978) theorized the resource-dependence perspective, according to which the external resources of organizations impact on the behaviour of the organization, but the concept of ecosystem was applied to business theory for the first time by J. Moore (1993): *"Successful businesses are those that evolve rapidly and effectively. Yet innovative businesses can't evolve in a vacuum. They must attract resources of all sorts, drawing in capital, partners, suppliers, and customers to create cooperative networks … I suggest that a company be viewed not as a member of a single industry but as part of a business ecosystem that crosses a variety of*

industries. In a business ecosystem, companies co-evolve capabilities around a new innovation: they work cooperatively and competitively to support new products, satisfy customer needs, and eventually incorporate the next round of innovations"

Moore was really a precursor, he wrote about ecosystem when internet was just arriving and smartphones didn't exist.

In "Death of competition" J. Moore (1996) drafted a model that show the evolution from a company-perspective with its core contributors to the concept of extended enterprise and finally to business ecosystem. This model, show in Figure 55, it is a source of inspiration for the Smart Home Ecosystem Layers Model that will be provided in the chapter 5.3.

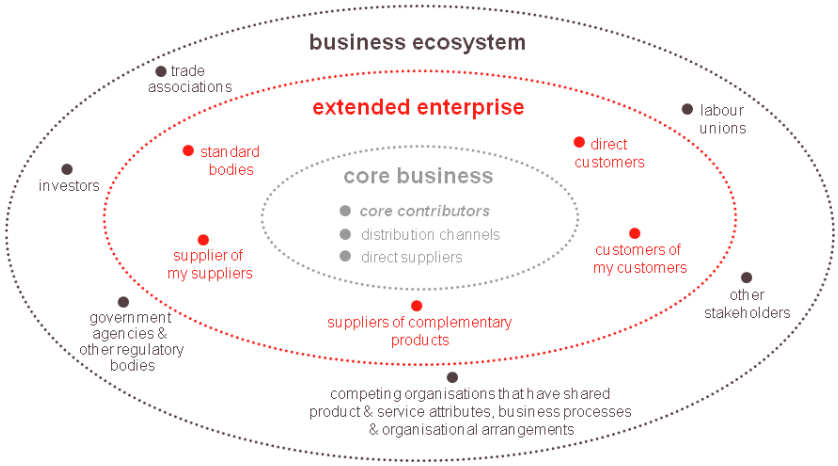

Figure 55: core business, extended enterprise and business ecosystem, Moore J.F. (1996)

The concept was then deepened after the real diffusion of internet, media, digital platforms and data. These global trends were able to enlighten the real potentialities: clear examples are the computer industry where companies like Apple and IBM developed their ecosystems or the social network industry where Facebook is a clearly grown under these logics.

Another interesting concept is present in the work of Peltoniemi M., Vuori E. (2008) who wrote "*the system is more than the sum of its parts*". This attribute is empathized also by some interviewed practitioners who argued that partnerships are functional just if the entities are able to extrapolate a final common value that is major than the sum of the value deliverable by the single actors. In the Smart Home this is a basic starting point for fostering co-evolution and adapting the business models to the environment.

About similar issues is the research of Urmetzer F. et al. (2016): they suggested that every actors create and capture value, showing the bi-univocal reason why the ecosystem can be a profitable strategy.

Talvitie J. (2011) focused instead on the benefits of companies and institutions to join a business ecosystem: market creation, market expansion, market access and the access to complementary competences and business models.

In a white paper, Accenture (2015) listed what a digital winning ecosystem embraces:

- *Co-creation,* the workforce is a mélange of talent from competitors, suppliers and customers;
- *Innovation,* co-innovation is the primary engine and process driver;
- *Interdependence and dynamic roles*, no more traditional industry silos and dynamic networked relationships across markets;
- *Adaptive environments*, entities must adapt and respond rapidly to the disruption;
- *Governance*, necessity of rules for communication and collaboration;
- *Easy adoption,* reduced risks permit to start from small situation and then scale fast;
- *Simplified experience,* movements in the system are easy and fluid.

For a final, actual definition of ecosystem, it can be cited E. Kelly, who, on Deloitte University Press (2015), wrote: *"Ecosystems are dynamic and co-evolving communities of diverse actors who create and capture new value through increasingly sophisticated models of both collaboration and competition … ecosystems come in a broad array of shapes, sizes, and varieties … First, ecosystems enable and encourage the participation of a diverse range of (large and small) organizations who together can create, scale, and serve markets beyond the capabilities of any single organization … Second, participating actors interact and co-create in increasingly sophisticated ways that would historically have been hard to formally coordinate in a 'top-down' manner, by deploying technologies and tools of connectivity and collaboration that are still proliferating and disseminating … Third, participants are bonded by some combination of shared interests, purpose, and values which incents them to collectively nurture, sustain, and protect the ecosystem as a shared "commons." Everyone contributes, everyone benefits. This enhances the longevity and durability of ecosystems."*

The definition of ecosystem on which will be built the following sections is largely consistent with the one of literature and secondary sources just provided.

5.2.2 Smart Home Ecosystem Evolution

Once specified what is a business ecosystem in general terms, now the focus moves on the specific Smart Home world. A useful operation for understanding better the Smart Home ecosystem is identifying its evolutionary stage: also if it is evident at which growth stadium the system is, it will be attainable to draw the right evolution road.

In reference to the framework (Figure 56) formulated by J. Moore (1999), the Smart Home ecosystem is still at the *birth stage*. As pointed out by the previous paragraphs analysis, the nature and the logic of the market are yet not clear: the companies have first to identify collaborators and start to work with them and their potential customers for reaching the large market in the expansion phase.

The Evolutionary Stages of a Business Ecosystem

	Cooperative Challenges	Competitive Challenges
Birth	Work with customers and suppliers to define the new value proposition around a seed innovation.	Protect your ideas from others who might be working toward defining similar offers. Tie up critical lead customers, key suppliers, and important channels.
Expansion	Bring the new offer to a large market by working with suppliers and partners to scale up supply and to achieve maximum market coverage.	Defeat alternative implementations of similar ideas. Ensure that your approach is the market standard in its class through dominating key market segments.
Leadership	Provide a compelling vision for the future that encourages suppliers and customers to work together to continue improving the complete offer.	Maintain strong bargaining power in relation to other players in the ecosystem, including key customers and valued suppliers.
Self-Renewal	Work with innovators to bring new ideas to the existing ecosystem.	Maintain high barriers to entry to prevent innovators from building alternative ecosystems. Maintain high customer switching costs in order to buy time to incorporate new ideas into your own products and services.

Figure 56: the evolutionary stage of a business ecosystem, Moore J. F. (1999)

The heart of the ecosystem is not well-defined and there aren't actors able to orchestrate the others: the actual picture of the industry exhibits *"random collection of elements"* searching for *"a more structured community"*. Some Smart Home companies push hard for entering in the

second phase and oblige their dominator role but, until the right business models are not pursued, and the partnerships are not enforced, this looks premature and can't lead to a sustainable ecosystem configuration. In fact, the current situation is characterized by a high price of solutions and lots of proprietary platform, interfaces and protocols making the compatibility between vendors poor. The actual offer is fragmented and targets specific vertical domains and types of applications while, instead, the mission would be shared infrastructures with horizontal services developed across different vertical businesses.

The identification of this premature stage is supported by the identification of an immature phase also in the diffusion of the smart products/service in the home market.
In reference to the Roger's bell curve (Figure 57), it can be qualitatively stated, crossing the results of secondary sources with focus groups or interviews with practitioners, that the Intelligent Home market is in the second phase: *early adopters* are approaching the offer, but the *early majority* is still far. In the focus group with physical and online retailers emerged that they all agree in identifying an actual demand composed majorly by technology addicted and not premium customers. This is confirmed also by the 2017 Consumers Survey by Internet of things Observatory.

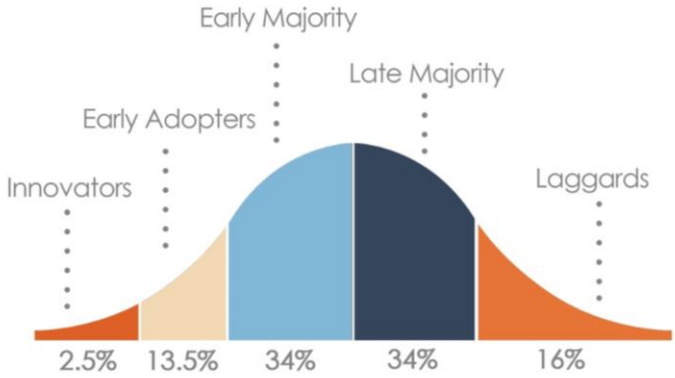

Figure 57: Roger's innovation bell curve

Making parallelism with other similar digital industry, it's known that the toughest jump is from the stage of early adopters to early majority. The phase in which the critical mass must be gathered is the most vulnerable and it's necessary a more stable system of actors and clearer business models, able to show the real advantages for the end users.
So, the answer of the final demand is linked, another time, to the configuration of the network value. Indeed, the early majority don't want to take risks and can't tolerate the immaturity of the innovation and the crudeness of value proposition: for reaching a mass market and really

changing the way people live in and with their home, the Smart Home Ecosystem must move from its infancy.

In one of the interviews, TIM argued that the first enthusiastic stage (i.e. innovators one) is been overtaken by a more realistic one where the aim of the industry players is to accost the consumers' habits curve to the exponential curve of technology innovation. With this goal clear in mind, the industry players must bring the offer near the users debating about its value instead communicating technical or technological issues.

5.2.3 Smart Home Ecosystem Peculiarities

As shown in Chapter 2, In the recent literature (2010-2017) is not easy to find satisfactory and complete researches on Smart Home ecosystems and also, more in general, on Internet of Things ones. Lot of papers and white papers argue the importance of having an ecosystem business perspective in this market, but no-one enters then in detail of the features, strategies and mechanisms.

First of all, it is required to identify the challenges of Smart Home world of practitioners:

- *Diversity of objects*, lot of different types of intelligent hardware, devices, objects that work on various standards instead a unique accepted one;
- *Immaturity of the innovation,* the technologies dominating the IoT are continuously evolving and are not mature;
- *Unstructured system,* the value-creation logics, the governance and the stakeholders' functions are not clear;
- *Numerosity and heterogeneity of actors*, the number and diversity of roles and actors interested in the home innovation is very elevated;
- *Actors' competition,* incumbents startups and experts newcomers battles impact on the stability;
- *Network laggards,* there are some actors that have to upgrade perspective and increase competences and skills;
- *Coopetition trouble,* complex interplay between competitive and collaborative strategies that usually overlap;
- *Business models gap,* lack of clear paths to profit*;*
- *Data orientation lack,* the potentially of data opportunities is not well addressed*;*

- *Users' needs diversity*, the potential customers don't share the same desires;
- *Customers' unconsciousness,* the customer could be ready, but sometimes the needs aren't so limpid and they are not well stimulated;
- *Value identification and communication toughness,* difficulties in the value delivery to the final user and lack of full trust;
- *Costs and prices limitations,* the costs and prices are not so convenient if compared to the value recognized by the final consumers;
- *Social barriers:* the solution sometimes required too high know-how and expertise, appearing complex for some user that don't want to lose control on their homes;
- *Institutions' laziness,* governments and authorities should grant more effort for regulation, incentives and policies;
- *Home market conjecture,* the contingent housing stock has a strong impact (e.g. new connected homes vs retrofitting existing one);
- *Security and privacy issues,* (cyber)security and privacy concerns are still barriers.

For overcoming these challenges, to date the Smart Home market evidences that the companies tried to pursue their individual goals: this is not the best strategy and they must re-focus on collaboration for not risking to remain excluded from the systems of collaborators. Doubtlessly, Internet of Things inspires new business processes, models and relationships, involving different partners and so the creation of a cross-industry ecosystem is inevitable.

In this landscape, Smart Home firms need to rethink their firm-centric perspective applying a *network-centric view*. The main critical consequence is the eager *decomposition of business processes*. There is a shift of mastery towards the network: there is no more a single company able to manage all the processes, but they are reorganized and managed from different entities. This means modularization of value creation and delivery that usually denotes decision-making decentralization and increase of efficacy, efficiency and scalability of the system. This phenomenon is also peculiar of other ecosystems, but in the Smart Home one it benefits from the nature of the technology and information availability, so the integration of data and knowledge exchange becomes crucial.

In addition, in this complex constellation of technology, stakeholders and needs, firms have to start from the value proposition: just a *value proposition orientation* led to understand the real opportunities of the market. McKinsey (2017) stated: "*keep in mind that the success of homebots*

and smart homes is not wholly about technology. Rather, smart homes and bots are about how technology makes us feel. The objective is to meet the needs of human consumers and to make a house feel like home".

In the Smart Home environments, the companies as "organizers of value creation" work one with the other and one against the other but must keep always in mind the relationships with users. Undeniably, the *role of the customer is crucial*: he is the co-producer of value, he is an essential part of the value creation process and the companies must keep in mind always is monetary and non-monetary benefits. Given that IoT is a technology-driven innovation, even more companies must think with the lens of the costumer, identifying the needs and understanding in what they can be really interested, creating desire and structuring the right way to deliver the value proposition. Indeed, the Smart Home market is full of technological innovation but, aside from the digital lovers and pioneers, the mass customer has not clear in mind the real value. Finally, is the digital context for its nature that give resonance to the user involvement providing tools for collaboration: data-sharing, applications, co-managed platforms and so-on. For all these reasons, customers will be represented, with a relevant positioning, like the other collaborators in the ecosystem.

It is interesting to underline that if that Smart Home whole market is configured as an *open system*. Indeed, there aren't strong entry barriers and everyday new actors offer their contributions and try to find the right space of action. The nature of Intelligent Home permits a special type of community with companies that interact with their socio-economic environment. The big advantage of Connected Home as open network is its potentiality to attract an extremely large number of problem solvers and, consequently, a vast number of ideas. Considering that, to date, there is no language, communication technology or other standards on the market, but many different languages and protocols that can be used by everyone, there is the possibility for anyone for trying to carve out a role in the industry. An evidence of what has just been written is the large amount of startups that offer existing home-related products (as a highlight in Chapter 4). Open models, however, have both advantages and disadvantages. The big advantage is the ability to share costs, risks, and technical challenges of innovating with others. For what concern disadvantages, must be considered that, as the number of participants increases, the likelihood that a participant's solution will be selected decreases.

As it will be explained in the next section, the probability for the Smart Home to remain an open ecosystem or change nature depends a lot from the core platform provider strategy. Obviously, once the industry will reach a more stable and mature stage, a series of competing ecosystems, within the large domain of the Smart Home, will arise and will be a decision of their leaders to which extend keep their systems open or close.

5.2.4 Smart Home Platform

In the end of previous paragraph, a critical peculiarity of the ecosystems came out: there is the necessity of guide able to manage the actors of the system. Independently from the creation of an open or close system around this entity, surely it is fundamental for the growth of the market the identification of a heart able to anchor all the individual business activities.

Iansiti M. (2004) and Talvitie J. (2011) asserted that *"the business ecosystems are formed around a specific core … The core can be in a form of platforms, technologies, processes, standards or other assets common to and used by the members of the ecosystem in their businesses. Making these assets available to the ecosystem members helps them in product and service creation by enabling higher levels of productivity, stability, and innovativeness, while also creating the positive network effect."*

As investigated for the concept of ecosystem, also for the platform definition there are two points of view to be considered. On one hand, there is the general platform definition as the generic entity able to foster the Smart Home growth. On the other hand, there is the specific proprietary platform of a company that is able to develop a system around itself and compete with the other platform ecosystems in the Smart Home market. In the actual immature stage, it is preferred keeping a more generic perspective.

For sure, one of the most evident trend is the attempt, shown from different actors, to create a service platform able to give resonance to the real value that Smart Home devices can deliver. It appears as a mediator between different actors involved in the ecosystem and the customer, reducing complexity and cost and increasing the synergies. It must be the tool for deleting the problems linked to technical interoperability and for reducing complexity and cost for the customers, enhancing the implementation fastness of the projects involving the Smart Home devices and services. Moreover, it must guarantee the trust among firms and users sharing

marketing efforts, creating trust and surveilling security and privacy. The underlying concept is that real value is extracted when the consumers don't use just one small smart solution but when transform their homes in full connected ones, with a system of different intelligent devices and services. In order to reach this goal, something able to aggregate in simply way is fundamental.

Nowadays, the digital revolution and technology evolution led to lot of novel strategic models based on the platform concept called *multi-sided business model* (Figure 58). In this framework, are classified all the businesses in which two or more entities exploit technologies, products or services in order to create a value enabled by the direct interaction between the actors. The real worth of Smart Home is reachable just providing value in a collaborative way and laying down the game setting as a multi-side value network: lot of different actors able to make profit just working in collaborative way. Thus, the presence of a core element as a platform able to orchestrate the different collaborators and able to impose its leadership for enhancing the market is necessary.

Figure 58: multi-sided business model

With focus on the Smart Home, lot of academics and practitioners' contributions show strong technology-orientation on the platform issues. Muegge S. (2011) defines it as a set of technological building blocks and complementary assets. The concept, in this perspective, is the following: the platform represents a hub or architecture just able to speak different IT languages, work with different protocols, run different applications, orchestrate different hardware and manage databases and analytics. Indeed, the home hub is in charge of collecting data and managing them in the cloud, performing local information processes, commanding the different devices and interoperating among the various communication protocols. This definition underlines the strong technical perspective and show the platform just as a mere integrator not able to provide adding value.

This outlook hasn't led to results in the market and so is been replaced in the last period from a more startegical business platform. Schreieck M., Wiesche M. (2017) stated: "*In contrary to the technical design, the functionalities for its users or the IT architecture of platforms, the goal of the platform governance is to orchestrate the communication between the different actors. The interplay of the actors is orchestrated by the platform owner by means of platform governance, the 'partitioning of decision-making authority between platform owners and … developers, control mechanisms, and pricing and pie-sharing structures'. Governance has been identified as what holds ecosystems together at its core, beside the technical features it offers. The right governance strategy brings together the actors on a platform and aligns their incentives making the ecosystem flourish".*

A so crucial role in the Smart Home ecosystem must be able for sure to orchestrate different IT technology, communication standard and so on but must mostly manage the different services and products increasing their value thanks the integration. Aiming at creating a common working environment, must be able to simplify the relationship between users and the rest of the ecosystem proving an integrated solution that is an aggregation of the value propositions of the collaborators. The home platform is an entity that provides strong added value: not the mere sum of solution but something more with an equilibrium between a customer-centric and a network-centric perspective (Figure 59).

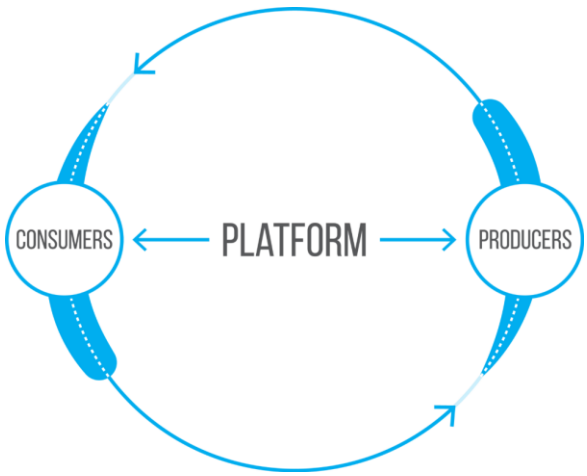

Figure 59: platform functioning

From the point of view of the users, the platform has the responsibility to be the first point of contact, acting as a help/support centre. From the point of view of the collaborators, the platform must act as guide and helper to connecting all the different services, devices, gateways.

Under a data-perspective, instead, the platform has the responsibility to manage the data flow and information sharing between the actors, exploiting the knowledge rising form the data mining for improving its and the platform performances and offers. In this fashion, the platform represents the heart of the Smart Home and is required to collect and analyse data for provide corresponding decisions.

Entering then in detail with the characteristics of a Smart Home platform, the table of Schreieck M., Wiesche M. (2017), showed in Figure 60, point out the most important trade-offs.

Trade-off	Description
Vertical vs. horizontal market approach	Focus on use cases across different industries with less specialized functionality or on industry-specific use cases with highly specialized functionality.
Degree of openness	Degree to which the platform is open to third-party contributions in terms of technological openness as well as mechanisms applied to control the third parties.
Complexity of partner networks	Balance between keeping power within a complex network of partners and expanding the network through building trust in reliable business partners.
Compatibility to IoT standards	Approach to either embraces as many standards as possible or to focus on single or even a self-developed standard for IoT data and processes.

Figure 60: platform trade-offs, Schreieck M. (2017)

Finally, for guaranteeing expansion to the Smart Home industry, it is really important for the several actors to realize who will be best positioned to govern the value network. Porter M., Heppelmann J. (2014) argued that *"Companies whose products and designs have the greatest impact on total system performance will be in the best position to drive this process and capture disproportionate value".* Hence, given that platform leadership is a well-known competitive strategy for imposing supremacy in a system and that the platform provider should be the actor able to extract the majority of the value of the entire Smart Home network value, there are lot of players fighting for this predominance, but this fast-growing landscape hasn't yet identified a champion.

Under the condition that to date a real Smart Home leader is not present yet, lot of actors aim at obtaining this aspired position or at creating their own ecosystem around which to build profitable strategies. In tangible terms, actually there are two trends. The aspirant platform governor can decide to develop the ecosystem around a physical device, build by himself or in partnership with suppliers. On the contrary, the candidate platform leader can prefer to push a lighter solution as a simple smart application able to conglomerate the different devices and

appliances in a smart way. Surely the suggestion is that hub entities may be particularly suited in arranging strategic purposes given the necessity to balance competing values and interests whilst unearthing new forms of meaning and possibilities.
As will be shown in chapter 5.3, in the current situation the best candidates are surely the OTT and their Smart Speakers but there are more traditional actors as Telcos and Utilities that won't leave their crucial positioning.

Citing McKinsey (2017): "*platforms will provide the foundation to integrate different devices while providing a consistent interface for the consumer. Frontrunners include Amazon, Apple, Google, and Samsung; startups at various points in the development cycle will be part of the mix, as well. The winners will deliver omnipresence through ubiquitous connectivity and go-anywhere hardware, as well as integration, with bots collaborating among each other and linking to third parties' products and services.*"

5.3 Smart Home Roles and Actors

As showed, with Smart Home there is a shift of focus towards value creation into the ecosystem level and thus it is mandatory a high-level perspective: this thesis wants to take in consideration the network logics and addresses the drastic IoT impact on the conventional Home market.

Investigating the value network, firstly the different roles have to be identified and classified, after the different strategies of the specific actors must be crossed with those roles for understanding their possible positioning in the ecosystem. Indeed, the immaturity of this market does not let the participating firms to have just one clear strategy but a range of these. As it will be clarified in Chapter 6, each possible strategy is positioned in a particular ecosystem layer and is associated to different way of creating, delivering and capturing value.

Obviously, the choice of a strategy or a role does not depend exclusively on the considered actor but, instead, on the general ecosystem configuration and on how the collaborators/competitors act. This brings high complexity and uncertainty in the setting of the company mission. If in conventional industry the success of strategy depends on both external and internal factors, in Smart Home the characteristics of the market emphasize that the exogenous determinants are even more crucial. The companies do not know precisely what the customer will want, how the

technology will evolve, which dimension the market will obtain but, above all, will not control the overall ecosystem.

As follows, the starting point is the investigation of the Smart Home network for understanding the roles that have to be taken into considerations. Then, the *Smart Home Ecosystem Layers* model for classifying the different roles/scopes into four layers is formulated: it will be fundamental for classifying the strategies of the actors in Chapter 6. Finally, an outline of who are the entities that actually are working in the Connected Home domain ecosystem is provided.

5.3.1 Network Perspective on Smart Home

From 2010 and 2018, just a couple of Smart Home papers deal with value network logics. Broadening the scope, also the more general Internet of Things literature gives very weak contributions: some works talk about the importance of value network and ecosystem perspective but any of them enters in detail of strategies, roles and actors.

The approach of "market as a network" that it will be followed in this chapter is well explained by Markendahl J., Laya A. (2013): "*instead of analysing the relationship between two companies in isolation, the whole context that is surrounding their relationship should also be considered; this type of analysis is based on the consideration that there in an interdependence among all the business relationships … This type of analysis typically provides information about the distribution of activities among actors, activities that provides a certain type of value and the interaction patterns between different actors*". Despite the good starting point, unfortunately they focus on value propositions and challenges in the generic M2M industry.

Taking inspiration from past researches, it is interesting to investigate which type of configuration can be created in the Smart Home Ecosystem. Different authors identified two conflicting structures: the *keystone model*, with a hub firm encircled by smaller collaborators, or the *flat model*, where there is no a leader company. In the Smart Home case is not so evident which will be the dominant architecture of the ecosystem: there are actors that are trying to push their leadership imposing strong platforms (as the OTT or the telecom operators) but, at the same time, there are lot of players that surely don't want to act as mere suppliers. As always, given the immaturity of the market, the final configuration cannot be identified.

As said in Chapter 5.2, probably will be a platform, pushing a keystone model, to become the heart of the Smart Home ecosystem, but, at the same time, the necessity of sharing the value creation and delivery will encourage a hybrid final configuration. The platform will orchestrate the market, but the other actors will not lose their importance.

The most important reason why actually there is no a predominant infrastructure or an ecosystem leader is that the actors are not willing to abandon this fight until they are not completely sure of be able to reach the right profitability. Despite they understand the possible benefits of the network configuration, they need to overcome the lack of well-defined solutions and to be sure to not lose control over consumers.

5.3.2 Roles in the Value Network

In literature, the major contribute in the study of the value network and ecosystem for Smart Home is the work of Ehrenhard M. et al. (2014). Starting from the case study of Trimenzo in the healthcare domain, they graphically depicted the general Smart Home value network (Figure 61) and realized a table of all the different roles and activities (Figure 62).

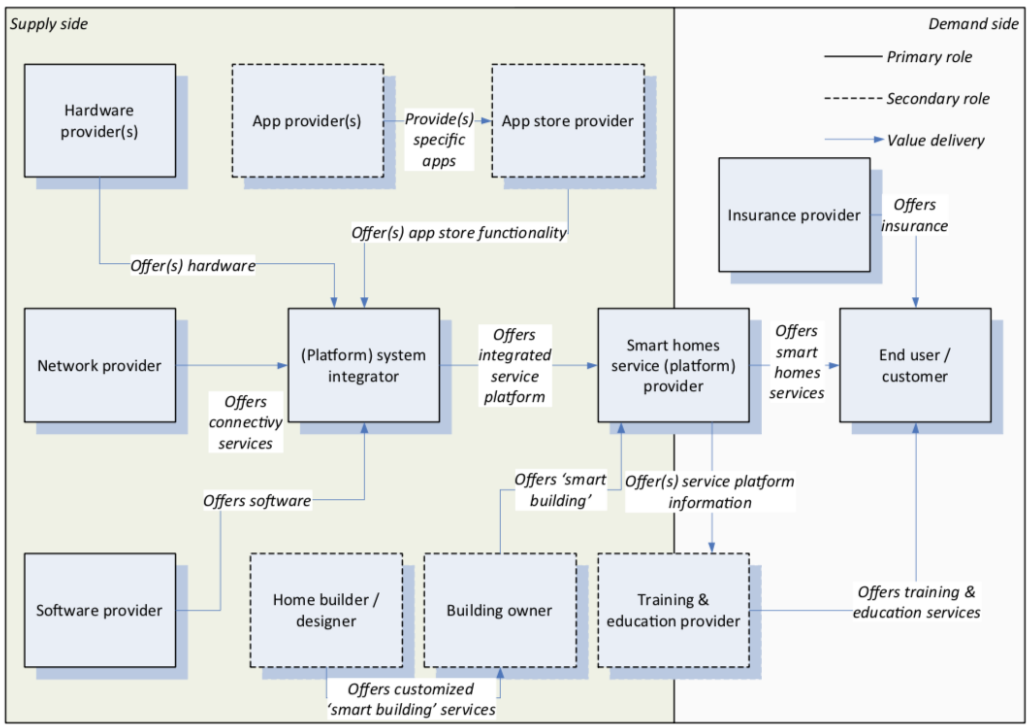

Figure 61: generic Smart Home value network (1), Ehrenhard M. et al (2014)

By mapping the ecosystem in this way (Figure 61), they provide a clear framework of the actors involved. Also if it is a 2013 paper, the analyse is complete, showing more or less all the actual roles of the Smart Home market. Then, despite the focus of the work is on the "market of aging population", the generalisation from the use case (healthcare) to the general Smart Home environment provides an overview functional to all the other application fields. In fact, the ambient-assisted-living was really a strong trend of those years but nowadays the focus is shifted to the general mass market.

Role	Activities	Category
(Platform) system integrator	Integrates (hardware and software) technology	**Primary**
Customer	Pays for the product or service offered	**Primary**
End user	Using the product or service offered	**Primary**
Hardware provider	Offers hardware	**Primary**
Network provider	Offers connectivity services	**Primary**
Smart homes service (platform) provider (nodal role)	Offers smart homes services	**Primary**
Software provider	Offers software (platform)	**Primary**
App provider	Provides specific apps	**Secondary**
App store provider	Offers app store functionality	**Secondary**
Bank	Offers financial services	**Secondary**
Building designer / architect	Offers customized 'smart building' services	**Secondary**
Certification provider	Offers certification services	**Secondary**
Consultant	Offers consultancy services	**Secondary**
Contractor	Offers construction work	**Secondary**
Government	Determines regulation, privacy aspects, …	**Secondary**
Helpdesk provider	Offers support	**Secondary**
Home / building owner	Offers 'smart building'	**Secondary**
Home builder	Constructing building	**Secondary**
Private investor	Invests in the service	**Secondary**
Public investor	Invests in the service	**Secondary**
R&D provider	Research & development	**Secondary**
Retailer	Sells hardware	**Secondary**
Software developer	Develops software	**Secondary**
Technology standard provider	Offers technology standards	**Secondary**
Training & education provider	Offers training and education	**Secondary**
Video connection provider	Offers video connectivity	**Secondary**
White goods provider	Offers white goods	**Secondary**

Figure 62: generic Smart Home value network (2), Ehrenhard M. et al (2014)

Unfortunately, in the paper the roles are described only by the description of related activities (Figure 62). In general, the role is crucial because encases all the peculiarities in terms of offer, business model, strategy, competence and relationship with the other entities of the ecosystem. For the authors, the choice of not deepening these peculiarities is in line with the aim of the research: finding out the Smart Home adoption barriers. Instead, for this thesis purposes, will be fundamental to analyse in detail the role peculiarities for providing an accurate modelling of the chosen actors' strategy. At this point, another weakness of the Ehrenhard's work must be highlighted: actors are not mentioned. Indeed, knowing the role but not giving any reference to the type of actor that can cover that roles leaves the study incomplete.
An actor could choose different roles, but, at the same time, a role could be interpreted from different actors. Thus, actors and roles cannot be considered separately.

Then, the perspective of authors' value network is explicitly platform-centric. First of all, the paper defines the platform as something too much technological and less value-oriented. Moreover, actually the role of the customer is crucial and so the ecosystem must surely be more customer-centric. So, for improving the value network in Figure 61, the platform and costumer centricity must occupy at least the same level of importance.

Going on with the criticism, the roles are classified by Ehrenhard in two different ways: *supply* or *demand side* and *primary* or *secondary role*. The side refers to the direct or indirect relationship with the customer; the grade of the role refers to its essentiality. The contraposition of demand side with the supply one highlights a distinction from back-end and front-end activities: today, in the ecosystem perspective, this distinction should be integrated due to the bi-directional contribution of suppliers and demanders. Despite the differentiation is well reasoned, the choice of just two role grades makes the classification too much simplified and some middle situation are taken to the extremes. Then, another weakness point is that the essentiality grade is strongly associated to the platform-centric perspective of the research. Thus, some activities identified as primary (like software/hardware provision) by the authors would lose importance if roles that explicitly deliver value to final customer (like retailers or white goods manufacturer) will be instead evaluated as main ones.

Finally, the choice of representing the contribute of an actor respect another one through narrows is appealing. The problem here is that these arrows are, in each case, mono-directional. This is completely in disagreement with was it has been found in Chapter 5.2: the relations

between actors are bi-directional and the strength of the value network is inherent to the possibility of delivering and extracting value in the same time. A representation like the Figure 61 fits a supply-demand traditional configuration of a value chain that is far from the logic of the Smart Home ecosystem. The most relevant example here is the user one, that shows a total farness from the co-creation concept: he receives the offer by the service platform, the educator and the assurance but does not give nothing back.

Despite the identification of all these possible improvements, the goal of this thesis is not the upgrading of Smart Home value network. Indeed, given the early stage of evolution of the market and knowing that internet service ecosystems change rapidly, there aren't the right conditions for providing an exhaustive value network representation. This thesis research, instead, prefers to propose models that can help a deep study of the actors from the strategic perspective of the ecosystem, involving surely value network considerations but not as final objective. In doing so, three actors will be selected and deeply analysed in Chapter 6. As it will be advised in the future direction (Chapter 7), after enlarging this type of analysis to the other actors and with more stable external conditions, the goal of providing an updated value network with all the roles, actors and exchanges of value will be useful.

5.3.3 Smart Home Ecosystem Layers Model

At is point, it is useful to provide a framework able to cluster the possible roles in the Smart Home value network: the *Smart Home Ecosystem Layers Model.*

It improves the comprehension of the ecosystem macro-levels and it makes easier to understand how to position the actors' strategies in Chapter 6. Thus, the model substitutes the roles classification (i.e. primary and secondary) and the layers can be interpreted like high-level scopes of the actors.

The model (Figure 63) is articulated into four layers: *infrastructure, device, service, integration*.

The order, from infrastructure to integration, follows the shift from elementary and basic scopes, that are fundamental for the mere existence of the industry itself, to more sophisticated and crucial roles that instead guarantee the creation of value and the sustainability of the market.

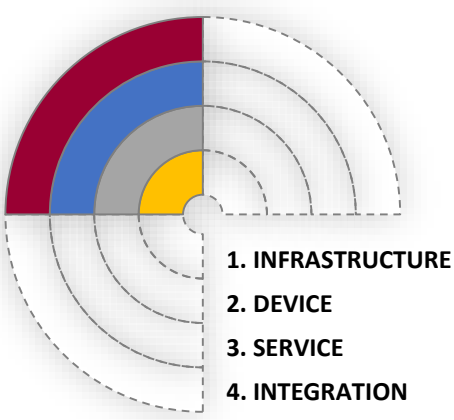

Figure 63: Ecosystem Layers Model

1. Infrastructure

The first-level scope is building the infrastructure, defined as a broad concept and necessary for the endurance of the industry. Firstly, there are that roles which aim at offering the communication network and endorsing the transmission of data and information: a Smart Home, without internet and connection, is not smart. The types of communication are manifold: the short-range exchange of information between sensors and hubs, the communication between users and home technologies, the conversation with the cloud or between actors of the ecosystem. Moreover, the electric infrastructure management and the energy provision are activities that fit this layer. Also governments, authorities and certification providers are characterized by roles that help the establishment of the infrastructure. Activities concerning standardization, security and privacy make more stable to the overall market.

2. Device

Belong to this layer all the strategies strongly associated to physical devices and their design and manufacturing. Obviously, the smart environment obliges to consider the connected functions but, in this layer, the service streams linked to the devices are not taken into consideration. The servitisation of products shifts the ownership of devices and appliances and changes the business models, but the physical component remains however indispensable in the Smart Home: there is no smart metering without a meter, there is no smart lighting without spotlights, there is no home security without cameras and sensors, there is no smart kitchen without white goods.

3. Service provisioning

Internet of Things opens lot of service opportunities in the Home industry. Indeed, many roles are based on the service provisioning. At first, there is the service component of the connected products. In fact, the data provided by the smart products and the always-on connection permit improved and customized services. On one hand there are strategies that merge product and added services, on the other hand business models that are exclusively based on services for the Smart Home. All the scopes based on the general services monetization belong to this layer. So, not only services like the energy management for a smart meter or the 24-hours assistance associated to security video-cameras, but also services of diverse nature like banks financing or the tailored home assurances. In this cluster there are also the activities of training and education and the roles linked to consultancy scopes. Finally, into the services stream also retailers and installers find the right space: they are the channel between manufacturers of devices and final users and so the service that they offer is critical for the growth of the market.

4. System integration

In the integration layer, all the roles have the scope of integrating two or more propositions and orchestrating the actors to guarantee growth. The goal is providing system integration, allowing the management of devices and/or access to different services in a single touch point. Obviously, the highest level of integration scope is the platform one. The system aggregator role is situated at the top of the model because actors who perform this function have an irreplaceable long-term strategic level in the market. It is important to stress how the model presented here is not a value chain, as it does not consist of a series of linked activities that lead to the creation of value. The elements identified here are logical components that must be present within the ecosystem in order to create a valuable offer for the end customer. These components have no time constraints, they simply need to be provided by ecosystem actors.

As will be better explained after, probabily the smart speakers will be the drivers for this integration.

5.3.4 Smart Home Actors

Entering in detail with the different actors that can cover, with their strategies, the layers of the ecosystem is possible to deepen the best path to profits and the future configuration of the Smart Home value network.

The difference between roles and actors is the following: a business role is a discrete set of actions, activities and responsibilities that together have a value-adding logic. A business actor is a market entity that encapsulate a coherent set of roles. But, despite the distinction, sometimes an actor and its role coincide.

The ecosystem of actors is presented in Figure 64.

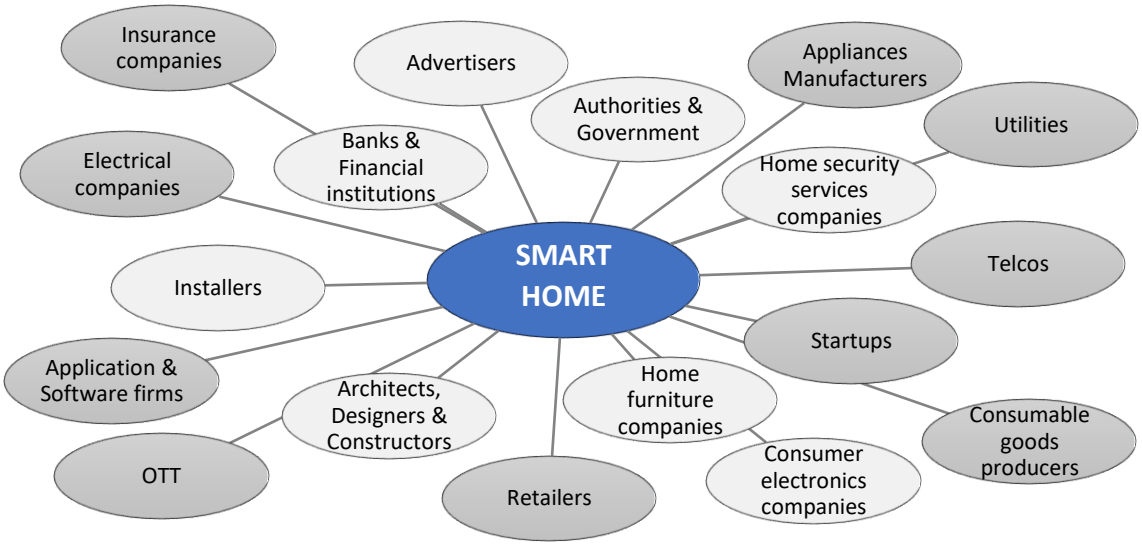

Figure 64: Smart Home Ecosystem

Firstly, the **final consumer** is an actor that must considered separately from the others. In the Internet of Things domain, the term "consumer" can confuse: one side of the market can be a consumer of another. To avoid disorientation, this thesis uses "consumer" in reference to the end users. The consumer is not only a member of the ecosystem but also the most important one: the growth of the market depend from its acceptance. So, all the other actors must have always the final user in their mind. *"The success of the innovation is dependent on the value consumers see in smart services and in how much they value their own active participation"*, Wuenderlich N. et al. (2015). So, as explained in Chapter 5.2, the idea of co-creation is

fundamental: if internet opened the doors to the presence of the user in the process of value creation, with the IoT this aspect is exalted. Companies must design user-centred value creation, including the consumer in any phase of this process. Thanks to the technology, real-time and no-stop communication and data is it possible to offer to the customers something that born from their collaboration. This is fundamental for addressing the right need, communicating the right proposition and so explaining the real value of Smart Home solutions making the customer aware of the advantage and willing to spend money for these products and services.

Aside from the final costumer, the complexity of the Smart Home market is associated also to the actual presence of different actors. Moreover, the openness of the industry, in this early evolution stage, would let other new actors to enter.

OTT

The Over-The-Top companies like Amazon, Google or Apple came heavily in the market just some months ago but they are already pushing for having a central role. Thanks to their affordability, these actors are able to create strong partnerships while the cash availability opens to strong acquisition policies. They are obtaining the access to broad competences and high streams of value, acquiring startups in different Smart Home sub-industry or collaborating with strong actors. Moreover, their ability in collecting and managing data in an optimal way improve their value proposition and increase customers retention. They are entering in the homes through the smart speakers and are creating a seamless experience that touch all the possible sub-industries, developing close or open systems. Amazon Echo wants to find synergy with e-commerce, Google Home aims at increasing the life-simplifier services offer and its data-wallet for users profiling, while Apple HomePod invests on quality of the hardware, coolness and high control into a close system. Given their economic power and wide knowledge in internet ecosystem, they can create synergic propositions with their core businesses: OTT are surely the first candidate for establishing platform-oriented leaderships. Their entry in the market is an advantage for increasing the interest of the mass market: these entities are able to bring trust to the overall Smart Home thanks to their brands and effective communication.

Startups

Usually Internet of Things deletes barriers invalidating strengths and assets of incumbents, opening the doors to numberless offers from startups in all the possible sub-industries. They have

less risks: as companies unencumbered by legacy product definitions and entrenched ways of competing, with no historical profit pools to protect, seize opportunities to leverage the full potential of connected products to create value. Their problem is the lack of customer base and trust in the market: the mass market is doubtfully with the startups products and services. Thus, their strategy should be finding the right partnerships or waiting for the acquisition by some incumbents. The fresh perspective and the low necessary investments usually bring them to cover roles linked to the diffusion of small devices and sensors, the development of application and software for home management or the provision of simple super-targeted services.

Telcos

Telecom providers (like Orange, Vodafone, AT&T, Tim, etc) offer telecommunication networks through different technologies. These operators are critical as they provide the connectivity and have a head start over others with M2M. For network operators, there is an increased interest in the Smart Home market since there is a current saturation of the human market in developed countries. Thus, they are actively entering the market with the creation of ad-hoc business units and working with partners. They have different possible strategies: considering themselves as frontrunner, their aim is positioning themselves also in higher layers of the ecosystem in order to extract more value. Clearly, these actors are also well-positioned for establishing strong platforms thanks to integration of IT applications and infrastructures with the mobile network.

Energy Utilities

Given the struggle of these actors, in the conventional market, for falling demand and low prices, they see lot of opportunities in the Smart Home. They have experience in the home market and big costumer base: these are optimal starting points for enlarging the value proposition both in vertical and horizontal perspective. Their competences in grids and homes create the right ground for synergies between Smart Home and Smart Grid: they are the best actors for developing innovative energy management solutions and smart metering. Moreover, Utilities can use the bill advantage for purposing tailored price-policies and partnerships with established companies or startup for broadening their scope to higher ecosystem layers.

Appliance Manufacturers

The white goods producers offer durable goods. They have the advantage of their indispensability in the homes but the disadvantage of long product-lifetime. So, making appliances connected

increases the functionalities of the products but, above all, increases the possibilities of new correlated services. These actors can embrace the IoT revolution for purposing just new updated products or try to push hard for opening new profit streams. They can pursue strategies for developing tailored services with external partners but they can also create proprietary platforms trying to lock the costumers in their range of appliances. Also, the payment method can move from the traditional one-time payment to more servitisation-type models than create the space for covering new roles.

Insurance companies

Despite the financial services technologies are still in evolution, the opportunities for insurance companies to change their business models and find a scope in the Smart Home environment are a lot. In a Smart Home, action buttons, cameras and sensors create a better protected home that can be covered by highly tailored insurance policies. Strategies go from product-service offers to pure services: creating always-on, direct communication link between customers' homes and operators, providing remote monitoring system that actively and passively collects data for future analysis, sending someone to customers home to take action on any detected anomalies. It is not hard think how a home protected by these features will lead to lower premiums on home insurance than an unprotected home.

Retailers

Retailers can establish new channels between potential customers and Smart Home. The offerings may range from simple products (like DIY) to complex products plus installation services. Retailers have strong responsibilities for the Smart Home value identification by final consumers: they have to communicate in the right way. But, given the risk of propositions pollution by these actors, support from the well-known manufacturer brands and a strong grid of partners is necessary. Great part of products are sold by means of distribution. This central role is visible also through specific corners in the physical shops and dedicated section in the e-commerce.

Consumer Electronics Companies

These actors are responsible for the proliferation of products that, combined in an agglomeration of smart objects in the home, increase the overall value of the market. Looking at international expositions (like CES), the number of offerings and strategies increase every day. All the traditional C.E. firms (like Belkin, Logitech, D-Link and so on) want a space into the ecosystem.

The opportunities for connecting smartphone and tablets to intelligent objects and devices are many: from basic security monitoring to small appliances, lighting, window coverings, irrigation, entertainment systems and so on.

Application and Software Firms

The doors of Smart Home are totally open to the firms that have as core activities the development, integration and provision of software. All the devices need software tailored for this specific market to be integrated with easy-to-use applications able to manage products and services. Obviously, these actors have to find the right partnerships given the useless of a software/application without a hardware/device that support it and given their lack of competences in producing physical objects.

Electrical Companies

This cluster belong to all that firms that have as core business the manufacturing and selling of hardware, electric components, sensors and electronical equipment. Actors like BTicino or Gewiss are interested in the home domain from the born of the traditional home automation. Understanding the limits of that applications in terms of interoperability, complexity and costs, they see lot of chances in the Smart Home thanks to their skills and abilities in working in electrical environment. The opportunities range from the creation of electrical infrastructure for supporting Smart Home to the supply of electrical components to partners up to the delivery of complete Smart Home solutions. Moreover, these firms usually produce also security systems and alarms, that are one of the most diffused devices among the Smart Home offer.

Other Actors

Finally, there are other interesting actors in the ecosystem that have to be mentioned.

The installers have to increase their competence and to start supporting the diffusion of home innovation. They are close to the final customers and their services are fundamental to make Smart Home landing in the mass market.

The home security service companies, like Sicuritalia, may improve their 24h assistance thanks to the integration of intelligent devices and sensors to their security services.

The **consumable goods producers** can find new business opportunities working with smart appliance producers that want to enlarge their strength through the combination of services and white goods.

The **advertisers** can improve their ability in analysing consumers. The advertising service has to work on the data coming from all the data sources and communicate the appropriate advertisement back to the device or through other channels.

There are interesting actions also by **home furniture companies** (like Ikea or Grohe) thanks to the skills developed in the home environment and their closeness to the final users.

Actors like **architects, designers** and **constructors** have the take into consideration the Smart Home necessities in the realization or restauration of houses.

Banks and **financial institutions** must understand the opportunities in providing financial support to companies that want to invest in this industry or consumers that want to finance their home digitalization.

Finally, **authorities** and **governments** have to provide the right policies and legal infrastructure to support the industry growth.

5.3.5 Strategic Positioning

The actual situation shows that there are lot of different actors that have to identify their scopes: some positions are empty and others full, leading to competition or scares results. Moreover, as products continue to expand both in number and diversity, many companies will have to re-examine their core mission and value propositions.

The idea of competitive advantage remains fundamental in the strategic perspective. On one hand, the operational effectiveness linked to the best practice is changing and are being decoupled in the value network. On the other hand, what really lead to competitive advantage is the *strategic positioning*: right now, is fundamental understanding where companies should position themselves in the Smart Home ecosystem and identifying how doing the things differently in order to attract more value and overcome possible competitors.

Thus, making these make-or-buy choices, companies should identify those layers that offer the greatest opportunities for product insight, future innovation, and competitive advantage, and outsource those that will become commoditized or advance too quickly. The position in the value network would define relevance, strategy and opportunities: for answering the research questions is important to enter in detail of the deep peculiarities and of the possible strategies identifying a model to show the right path to long-term profits.

5.4 Business Model and Competence Innovation

In the previous chapter (5.3), it has been disclosed, through the Smart Home Ecosystem Layer Model, that the operators of the ecosystem may position themselves and their value propositions at one (or more) of the four scope layers. Obviously, this choice has strong strategic consequences in terms of business models and required competences.

This chapter starts with a brief and functional analysis of the state-of-the-art on strategic Smart Home topics. Then, concentrating on business modelling and competences, a model for understanding how much the IoT impacts on the strategy definition of the involved actors will be drawn up.

5.4.1 Strategy Definition in Smart Home

In the literature review (Chapter 2) is been highlighted that, to date, few papers about Smart Home business modelling and strategy adoption is provided by scholars.

Enlarging the focus to the Internet of Things in general, some more results are found but they difficultly integrate interesting use cases about Smart Home. They stress the exigency of having a managerial perspective but just contribute through generic business modelling frameworks, based usually on the re-elaboration of the traditional ones and without mastering instead the explicit vision and mission that the involved actors have to take in the IoT environments.

Jua J. et al (2016) reveal that the findings of the most relevant papers in the Internet of Things business model panorama do not present reference to Smart Home and they are manifestly very

generic. Their aim is providing models to make easier the analysis and visualization of the business models but do not take care of deep strategic features, choices and processes.

Their conclusive "state-of-the-art" criticism goes across several authors' work (from 2010 to 2015) providing a clear picture of the status quo: "*The interconnected nature of IoT leads to openness and collaboration across industries, which makes building business models complex … Companies need to rethink their current business model strategically to dominate the emerging IoT market. However, many companies have difficulty developing IoT business models because IoT-driven market dynamics are not explicit in the model … Changes in technology require changes in business models … Fast change in technology implies that companies must quickly adapt to market challenge … The characteristics of IoT, pervasiveness and ubiquity, drive the development of new business models. Moreover, companies need to collaborate with competitors and other companies across industries because of the nature of the IoT ecosystem … Thus, traditional business models are not adequate for IoT service".*

The intelligible overview of the literature findings, displayed by Figure 65, highlight all these issues.

Author(s), Year	Business Model	Business category	Findings
Li & Xu (2013) [23]	MOP Model	None	The multidimensional structure composed of technology dimension, industry dimension, policy dimension, and strategy dimension
Sun et al. (2012) [19]	DNA Model	Smart Logistic	The basic visual structure and relationships between the DNA blocks – design, needs, and aspirations are the same at any level of the business model.
Qin & Yu (2015) [24]	Value Net Model	Tele-communication	The strategy of customer centered, information sharing, and resource integration
Leminen et al. (2012) [6]	2x2 matric dimension	Automobile	B2C solutions through IOT technology in the automotive industry
Bucherer & Uckelmann (2011) [25]	Business model canvas	Information Systems	The importance of information as a major source for value creation and the value proposition
Chan (2015) [26]	None	None	Three-dimensional model (collaborators, networks, tactic, inputs, service/processing/packaging, benefits, strategy, content/information product)
Dijkman et al. (2015) [27]	Business model canvas	None	Building blocks that are relevant in the IoT and identifying the relative importance of these building blocks

Figure 65: relevant paper about Internet of Things business model, Jua J. et al (2016)

As explained in Chapter 2 and Chapter 3, this thesis work wants to solve the literature gap with the ambition of going along with how the role of some actors can be addressed exploiting a strategic perspective able to deepen the most-appropriate business model. Consequently, this research concentrates on the different scope layers in the overall ecosystem, the required competences, the business models change and processes.

5.4.2 Business Models and Smart Home

First of all, it is inevitable to briefly define the concept of business model. A synthetic definition is proposed by Ovans A. (2015): "*a company's plan for how it will generate revenues and make a profit. It explains what products or services the business plans to manufacture and market, and how it plans to do so, including what expenses it will incur".* Obviously, it is mandatory to attach that a correct business model must start from a clear value proposition and must always take into account the target market of reference.

Since the beginning of 2000s, the term "business model" is been largely employed with lot of different meanings in the management vocabulary. In terms of form, it is interpreted like a description, a statement, a conceptual tool, a method, a pattern or architecture.

Timmers P. (1998) defined a business model as an "*architecture of the product, service and information flows, including a description of the various business actors and their roles; a description of the potential benefits for the various business actors; and a description of the sources of revenues".*

Business modelling technics obtained crucial importance with complexity brought by the dot.com era.

Osterwalder A. et al. (2005) described it as a "*blue-print of how a company does business"*, while Melin L., Naldi L. (2013) observed the definition was shifting from "*what business models are*" to "*what business models are for*".

The most famous visionary designing method was illustrated by Osterwalder A., Pigneur Y. (2010). Through a nine-pillars framework (Figure 66), the *business model canvas* takes into account the most important building blocks.

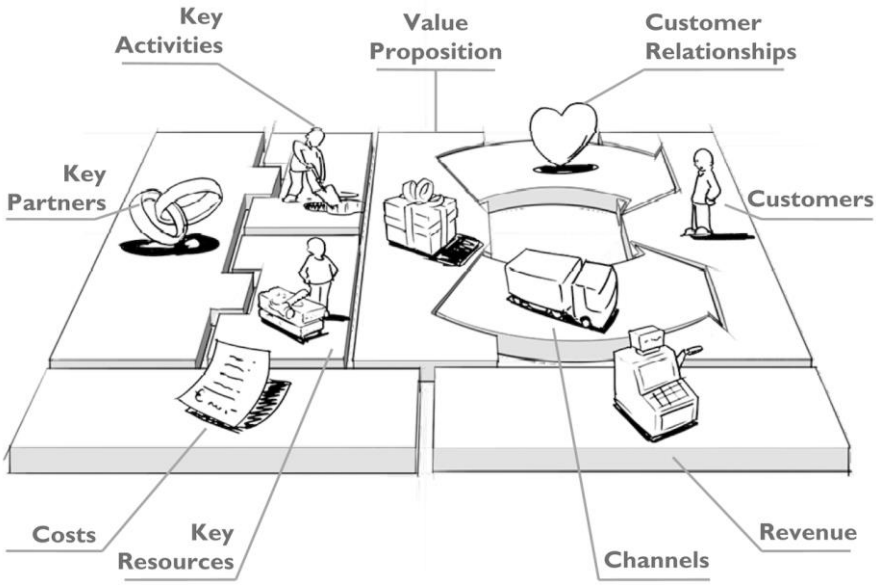

Figure 66: business model canvas

The necessity of making explicit the link between the company activities and the surrounding network was pinpointed by Westerlund M. (2011), who , via a study on the media industry, identified the possibility of having different new or renewed strategies by linking the business models to the relationships with the other firms in the ecosystem.

Hence, business modelling becomes fundamental when targeting emerging domains as the Internet of Things one. In these highly-technologic, value-intensive and multi-actor industries, the business models have to look at all the ecosystem collaborators and thus several authors agree that existing techniques present some limits. Indeed, it would be profoundly wrong to just consider a single actor and not the strong impact of the "*key partners*" building block on the overall strategy, to forget the crucial positioning of the ecosystem platform, to deny the central role of customer as co-creator of value, to omit the challenges of the market or to leave out the stage of evolution of the industry.

Aspiring to identify scopes and strategies with a high-level perspective, the traditional business model templates and frameworks will be a prominent reference but will not be applied meticulously.

First of all, the relationship between technological and business perspective must be elucidated. In fact, new and reinvented business models and strategies must be in the centre for the technological development. Under a strategic perspective, it is fundamental to go behind sensors and artificial intelligence technologies for focusing in the identification of the companies' competitive advantages and how these advantages could be aligned to the opportunities there are emerging from homebots and home connected services. It is the best developed and executed business model what will win the battle for the smart home thanks to related companies and alliances, not the technology or communication protocol.

The exponential growth of the Smart Home market permits to embrace a vast range of opportunities that suit almost any business configuration. However, there is a clear debate among traditional business models taken for granted and more innovative strategies that address the dynamics of the markets. Therefore, a distinction between two business models cluster is provided (Figure 67).

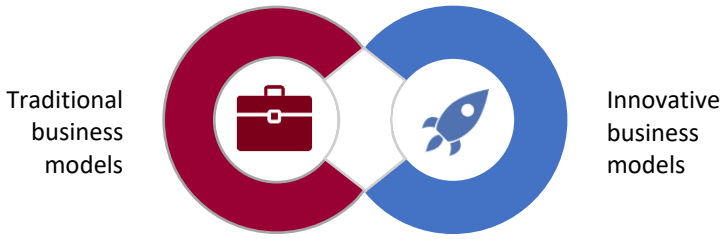

Figure 67: business model categories

On one hand, companies can pursue strategies that involve *traditional business models*. They refer to the conventional way in which the actors do business and manage value: what change is just the industry and contingencies which these models target.
An example may be the simple connectivity strategy by a Telco. What mutates is only the provision of connection to smart home objects instead of smartphones or routers, but the business model remains substantially unvaried.

Alternatively, new strategic configurations can arise: *novel business models* which, despite sometimes are yet exploited in other digital contexts by diverse actors, are completely unexplored by the firms under analysis. In this case, the necessity of catching the best positioning

in the Smart Home ecosystem obliges the actors to rethink their firm-centred view and upset the profits generation processes.
For instance, the servitisation of some white goods may lead the appliances manufacturer to move from traditional ownership models to product-as-a-service models.

5.4.3 Competences and Smart Home

The competences, in the strategy definitions, have a central importance. Lot of business strategy authors underlined the competences identification as one of the first ingredient for business modelling. The most important contribution in the literature about competency is the work of Prahalad C., Hamel G (1990): they defined a competence as "*a harmonized combination of multiple resources and skills*".

In particular, core competences, as a combination of technical abilities, managerial capacities and pooled knowledge, are the main strength points and strategic advantages of a business. Giving that they are toughly replicable by competitors, they allow the companies to deliver value to the customer and to expand in new markets. Indeed, Martin D., Allen A. (2013) argued that a core competence is a specialized technique, knowledge or skills that highlights the competitiveness of a company in the market. Thus, given also the innovativeness of the market, it is impossible to research on the strategy of Smart Home actors without taking into consideration the strong importance of competences.

Aiming at analysing the actual competences existing in the market and identifying the necessary new ones, this thesis provides a simple distinction among three clusters of competences that characterize the Smart Living operators. The choice of a particular layer in the ecosystem and the needed competences have a strong tie and appear like a sort of virtual cycle. On one hand, the lack of some critical competences may estrange an actor in choosing a particular strategy; on the other hand, the choice of an ecosystem layer usually needs the building of some peculiar competences. It is important to underline that the following competences categorization (Figure 68) is well suited for the traditional companies (like Telcos, Appliances manufactures and Utilities) which are trying to find the right space in the new Smart Home ecosystem. These firms are characterized by a well-defined strategy in other traditional industry and so they may need organizational changes. The other less traditional actors who are born in this environment (like

Smart Home startups) or are used to work in similar markets (like OTT companies) have less necessity to be analysed under a competences-perspective that is given for granted.

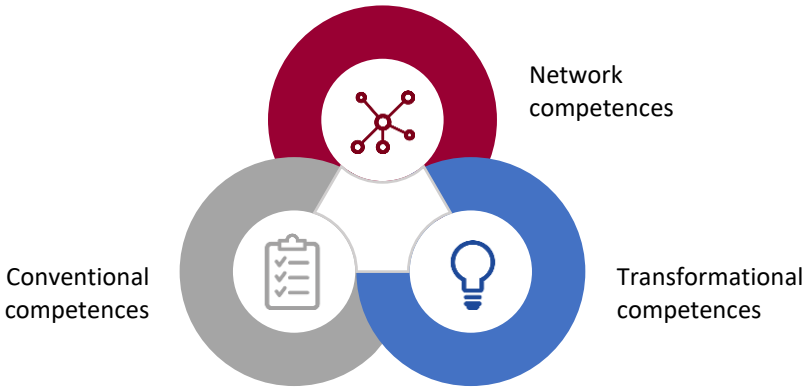

Figure 68: competence categories

First of all, there are *conventional competences* that are independent from the ecosystem: these are the competences linked to the traditional way of doing business of the different actors in their long-established domain. For example, the ones linked to the connectivity provision for a Telco, the ability to plan the right product in the right place at the right price for a Retailer or the capacity of producing the white goods for an Appliance Manufacturer.

Secondly, there are some new specific competences that are completely linked to the roles that the actors will perform and so to the related innovative strategy. The *transformational competences* characterize the intersection between the scope layer in the ecosystem of the agent and its usual nature and permit to create value in an advanced and ground-breaking domain as the Smart Living one. For example, the ability of an Energy Utility of exploiting smart metering for proposing energy management programs, the competence required by Installers for incorporating the smart objects in their Home offer or the capacity of a Telco in bundling smart products and services or realizing a home platform.

Not just the smart competences belong to this cluster, but also those competences which are conventional for some actors but not for the entity under examination who decides to broad the offer with a horizontal approach.
For instance, a famous hood cocker company, Elica, during a panel discussion of the annual closing convention of Smart Home research by Internet of Things Observatory, stated that to embrace the Smart Home opportunities there is the necessity of transforming itself from a

manufacturing to a service firm and this implies new skills and knowledge. Moreover, starting to enlarge the range of proposals to other home products/service far from the kitchen generates the need to embrace competences that are taken for granted for someone but not conventional for it.

Finally, there are some transversal competences that all the actors of the ecosystem must exercise to work in this new workspace: the *network competences*. These general competences are associated to the concept of digitalized value network and, stressing the necessity of being able to act in an Intelligent Home ecosystem, they leave aside from the novelty of the strategy implemented. For this reason, they are given for granted if an actor wants to work in the Smart Home Ecosystem and they will not be made explicit in the following model.
For example, the competency to set and manage partnerships and understanding the data opportunities and the capability to exploit digital tools or involving deeply the customers.

5.4.4 Transformation Intensity Matrix

At this point, the necessity of crossing the analysis on competences and on business models is undertaken through the *Transformation Intensity Matrix*, able to define the key features of a precise strategy in the Smart Home environment and the impact of intelligent objects on the strategic decisions.

Given the firms' intention of setting themselves at a particular layer of the ecosystem, the exigency of specific competences and of best-suiting business models consents to point up how a company wants to make capital out of the Smart Home opportunities.

The *Transformation Intensity Matrix* (Figure 69) arranges four possible strategic missions:

- *Consolidation*: the actor relies just on his core competences and business models. Gathering his best-practices into the new industry, no disruption of the way of doing business is brought. The needed resources are minimal, but difficultly the strategy will lead to high streams of profit in the long-run;
- *Expansion*: the building blocks of the business model remain more or less unchanged. However, the strengths of traditional revenue-streams, value propositions, cost-structures are pumped by new smart competences that endorse efficacy and efficiency.

- *Innovation*: the company relies just on its actual skills, competences and resources but is capable of reorganizing them in a more profitable way;
- *Evolution*: the practitioner embraces the IoT as much as he can, investing lot of efforts for disrupting the conventional practices. Aiming at radically evolve the creation and delivery of value, a stubborn crossing between novel business model and competences must be found.

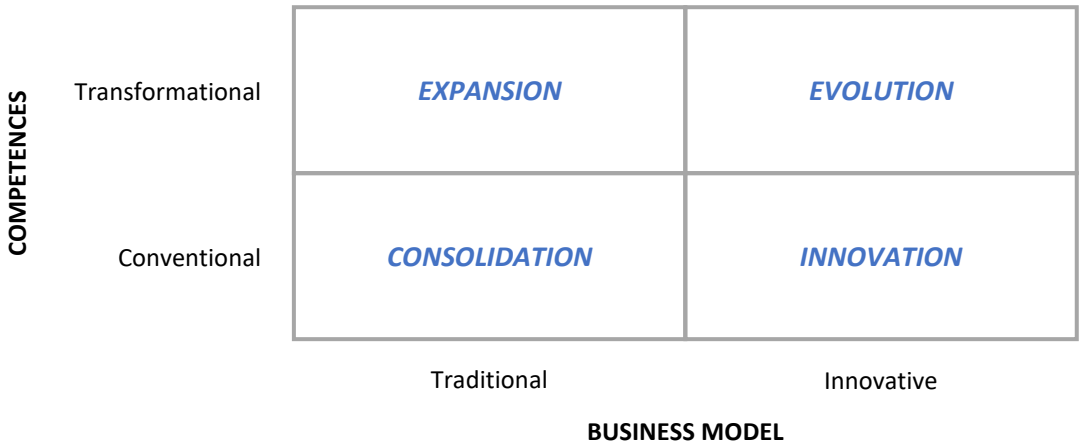

Figure 69: Transformation Intensity Matrix

A basic business trade-off is explicit here: if a company craves to boost the profits stream under a long-run perspective, it will incur in more complexity and risks today. Instead, if a firm prefers a more conservative strategy, it will imply less costs and bewilderment but more probability of losing the competitive advantages in the long-term.

It is obvious that, for being a first-mover and do not risk to lose a relevant positioning in the market in future, the most sustainable strategy is the evolution one. Unfortunately, it implies high investments, strong organization changes and a higher level of uncertainty. For this reason, sometimes the actors prefer intermediary steps like the expansion and innovation one: they let the actors testing the ground before incurring in irreversible strategic choices. Finally, the consolidation may hide a myopic outlook that will expose to danger.

Going in depth behind the model, the selection of the right collaborators in the ecosystem has an incidence on the necessary competences or on the choice of the right business model. Moreover, the companies have to keep in mind that a good action of the partner increases deeply the overall value but a wrong move risks to ruin the reputation of everyone.

Finally, the fact that the Smart Home ecosystem is still in an immature stage makes difficult to date steadily declaring which will be the perfect role, strategy and the best practices for each actor. Nevertheless, lot of new different business models proliferate every day. These use cases, mixed with the knowledge of the Smart Home industry nature and peculiarities, will lead to exploit the models for providing a truthful and accurate strategic direction for the selected actors and, in future, for the overall industry in general.

This model will be exploited in Chapter 6 for sketching the several actors strategies in a framework able to encase a high-level perspective and understanding the impact of the smart technologies on the managerial silos.

5.5 Value of Data

In some of the previous chapters, it has been anticipated the importance of data as discriminating factor of Internet of Things. What distinguishes a traditional home from a smart one is primarily the faculty of the intelligent objects of pulling out benefits from data. But so far, this thesis has just mentioned the incredible potentiality of data without explicit focus on them.

The prior chapters concentrate on ecosystem, roles, business models, competences and so on: all these matters are validated just by the intrinsic possibility of collecting, analysing and sharing data in the Smart Home value network.

McKinsey (2017) pinpoints these concepts stressing the importance of dealing with data and how much they must be well integrated in strategy of Smart Home actors: "*The greatest source of value may come from the data. Bots will acquire and generate reams of information, and these data points will be critical for increasingly data-driven projects and services. Data will be sources of insight and even products in their own right. And understanding the implications, opportunities, and information about the smart home won't be someone's part-time job. It will require a dedicated team to parse the data, develop strategies, manage partnerships, and drive experiments that will become integral to creating value.*"

As follow, it is necessary to modelling the strategies of the Connected Home through a framework which takes into account the different employments of data within a value creation perspective. In doing so, this chapter will go down into the data peculiarities and their importance in the Smart

Home. Once provided enough knowledge about data, a tool for classifying the different data exploitation blueprints will be presented.

5.5.1 Smart Home and Data Gap

As carried out in the other chapters, the starting point is always a check of the contributes provided by the literature about the subject of interest.

As stated in the Chapter 2, the investigation on scientific papers which bridges Smart Home and, more generally, Internet of Things with data brought insufficient results.

The call for novel studies in this context is been stressed also by Vimarlund V., Wass S. (2014): "*In the near future it will be important to develop a research agenda for smart homes and ambient assisted living that combines business and organizational initiatives to gain critical insight from the data collected*". Their research was about challenges and displayed high focus on ambient-assisted-living without deepening the key paths to extract value from data.

Unfortunately, in general, any works dig out how diverse strategies implies different way of generating profits from data and there aren't authors who have entered into detail of how precisely managing this source of value. The few articles found just mention the importance of data as source of competitive advantage but do not purvey any indication or model for precisely guiding with their exploitation. Similar poor results also enlarging the paper scope from Smart Home and Internet of Things to general corporate strategy: the numeric result slightly increases, but not the approach quality and study depth. Some essays address the business model shift fostered from the data and big data revolution, but strong gaps, in the study of how these phenomena affect precisely corporate processes, decision-making and leadership, are highlighted.

George G. (2014) argued, in his literature review, "*In careful examination of the limited discussion of big data in the management academic literature, it is striking that most dialogue revolves around how big data will affect management research rather than exploring how big data is revolutionizing the thought processes of corporate strategists and managers".*

The same lacunas are found in the practitioners' world. A Forbes article (When big data projects go wrong - 2015) reported that 85% of companies fail to integrate their data fully and 65% consider their data management practices to be weak. This pinpoints how the cases of success in data exploitation are very few: lot of companies don't understand the data opportunities or, when they are aware of them, fail in declining them in their strategies.

However, the companies need of improving data skills and competences under a long-term strategic outlook is underlined by all the academics. With this aim Mazzei M., Noble D. (2017) stressed that the importance of reciprocal communication between strategy and data is a responsibility of the top management: "*executives should align their big data aspirations with an authentic view of their own capabilities to get on the right track and stay ahead of the curve on innovation, competition, and productivity*".

5.5.2 Data Relevance in Smart Home

One of most diffused trends within the managerial journals is the *Big Data* one.

Indeed, the current century is defined as "Petabyte Era" due to the enormous quantity of structured and unstructured data exchanged worldwide every day. These data are characterized by the adjective "big" when they respect the 5Vs characterization: volume, velocity, variety, variability, veracity. Moreover, they are generated through multiple sources of interactions: machine-to-machine, human-to-human and human-to-machine or vice versa.

The diffusion of Big Data in each industry leads to the increasing importance of business intelligence activities able to bring value out. Thus descriptive, predictive, automated, prescriptive analytics is becoming crucial in every-day life and in each business.

Despite, in the Smart Home, the attribute "big" does not fit perfectly, due to its focus on the "small" house domain, the quantity of data exchanged is however high and the obtainable positive results and tools are similar.

The new capabilities of smart objects are altering each possible activity in the value chain, transforming it in a value network: the heart of value reshaping is data.

Thus, the main asset of connectivity is data availability: it permits upgrades, localization, diagnosis, information about usage and status of products. The impact goes from improved and customized services to reduction of expenditures: data enhance both efficiency and efficacy.

Moreover, data permit a more proactive interaction with consumer. In these terms, the co-creation is abled by giving the opportunity to the companies to have users' aftermarket data, usage information and feedback. In the home, data collection and analysis help in identifying and satisfying customer needs, creating new products and services: in this way, the value of the value propositions is enhanced.

In the Smart Home domain, two complementary approaches for the use of date are identified:

- *Simple data exploitation for the basic functioning of products and services*.
  The data used are the ones necessary for the simple functioning of a device or for the provision of the services; in the way, data act like a necessary input. For example, the localization data for a product that advises the customer when its pet is too far from home or the status data of a smart appliance;
- *Data intelligence for novel streams of value.*
  The data are collected and re-elaborated in order to nurture new streams of value that go beyond the standard usage of a smart product or service. Indeed, sensors, products, services, bots gather lot of data about customers, products usage, services, environment conditions that, if managed in the right way and combined in the right mix, can provide new insights that before were invisible.

If the first group of data are associated to the nature of Smart Home products and services and actors have not problems in dealing with them, as regards the second one some troubles emerge. Each actor knows the potentiality of this data approach but the immaturity of the market and the lack of well-established competence in the managing these source of value, led to a postponement of its exploitation. This has been confirmed also in a call with Vodafone in which the interviewed manager argues that the big Telco recognizes the importance of picking up all the functional data but, at the moment, has not idea of how really exploiting them.

Moreover, data is a critical ingredient for the Artificial Intelligence. As published in the Smart Home research of the Internet of Things Observatory, AI is something that can decrease the barriers to adoption and increase IoT diffusion in the home domain. All the activities that the intelligent products can perform are characterized by some level of AI. So, understanding which

data collecting and how managing and processing them means improving AI systems and consequently enhancing integrated user experience.

Finally, data lead complexity in terms of privacy and cyber security. These are relevant topics for the final customer, given also a not so well-defined and accurate regulation by the authorities. If companies want that users share their personal information, they must work hard for making the consumers aware of the value conveyed thanks to the Smart Home propositions. Indeed, actually, the 51% of the customers are alarmed in sharing sensible data (2017 Consumers Survey by Internet of Things observatory). As regards cyber security, for assuring the access to delicate access points and many objects within the home wall, the firms investments in making devices, software, databases and cloud secure must be ponderous. The 72% of the users declare that they are scared by the access risks and by the control of their home devices from malicious people (2017 Consumers Survey by Internet of Things observatory).

5.5.3 Strategic Application and Implication Of Data

The peculiarity of the home connected objects is the capability of gaining various types of data from sensors, products usage, customer's preferences and so on. This opens the access to the development of strategies that have the information as one of the critical success factor: in the in the Smart Home, data is king.

Porter M., Heppelmann J. (2014) stated that "*Smart, connected products are raising a new set of strategic choices related to … how the prodigious amount of new and sensitive data they generate is utilized and managed*". This sentence stresses the necessity of having also a data-perspective in the research of strategic impact of the Smart Home.

For satisfy this need, the managers' mission is integrating the data strategy within *business models*. About this, Leminen S. (2012) sustains that "*designing feasible business models requires sufficient data, because the variety of data collected automatically from devices' information exchange helps to solve problems and enables the development of embedded services and revenue models".*

The novel business models (introduced in the previous Chapter 5.4), that lead to new path to profit within the boundaries of the Smart Home, necessary must include the capability of arranging the vast amount of data that otherwise make invisible many opportunities.

Moreover, the *value network* configuration of the Smart Home industry emphasizes these chances. Bucherer E., Uckelmann D. (2011) empathized the importance "*information exchange between the nodes in IoT network and the involvement of all stakeholders in win-win information exchange.*" Indeed, the possibilities of using data coming from proprietary solution is surely profitable but, above all, the possibility of making this data becomes even more valuable sharing them among the network actors. Data are important at each level of ecosystem layers, for each business model but become fundamental if they are agglomerated or made accessible to the network actors. Mixing data coming from different actors and levels of the ecosystem, new stream of knowledge and value can be generated.

Finally, also the *organizational* perspective must be considered. The multitudes of sensors led to a collect of enormous data from multiple sources in an autonomous and accurate way never seen before. But, as stated by Jua J. (2016), a possible downside can be that "*without excellent analysis, sensors will not give a competitive edge … Organizations often lack analytical capabilities due to absence of skill sets possessed by data scientists".*

So, there is also the need of a strong organizational change: organizations are under a strong evolution. Data require by itself new skills, cultural laws and working styles: the ecosystem firms have to look also to interior reorganization and not just to novel external strategy definition. There is a call for coherence among how a company act inside and outside its boundaries: internal consistency respect the data strategy is needed. Thus, skill requirements shift towards software engineering, services provision and fails anticipation rather than mechanical experience, products selling and damages resolution. On one hand, new professional roles between business and IT competences are needed, on the other hand, organizational structures, policies, staffs, norms are key points to be revised by human resources.

5.5.4 Data Valorisation Model

At this point, the framework for adopting this data-centric perspective into a strategic analysis of the Smart Home actors must be provided.

This thesis does not arrange a new model but instead exploits the data valorisation classification presented by Internet of Things Observatory. Their work, indeed, is sufficient for this dissertation intent and will fit well with our models.

The mentioned *Data Valorisation Model* identifies which are the different strategies prosecutable by the companies for extracting values from data in the Internet of Things environment. As shown in the graphical representation (Figure 70), there are five strategies: *process optimization, new product/service, product/service customization, advertising and commerce, monetization*.

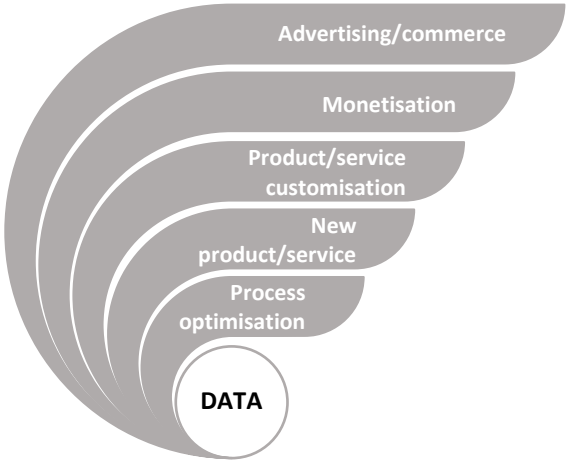

Figure 70: Data Valorisation Model

1. Processes optimization

   The data collected from sensors and devices are employed for the optimization of the company back-end processes with possible impacts on both efficiency and efficacy. The focus is on the improvement of internal procedures, performances, operations and practices that are characteristic and operative of the firm. This strategy can have an impact on the costs reduction or revenues boost.

2. New products and services

   Smart objects and services provide information that can help the organizations for developing and provisioning enhanced products and services. The aim is obtaining second or third generation value proposition more tailored on the specific needs of the users.

   These data increase the attention on the defects of the product and on their usability understanding which functions are really appreciated in order to orient the future product

development. Moreover, companies become aware of how a service is used by particular cluster and which are the satisfied and unsatisfied need obtaining sincere feedbacks from the devices.

3. Product/service customization

   Exploiting data for differentiate products and service respect the characteristics shown by the user through their usage. The information gathered from different clusters permit a more customized offer and consequently the possibility of increases profits conveying the right value to the right customer. This opportunity represents a powerful tool for showing a more customer-centric strategy with a precise profiling.

4. Data Monetization

   The idea is that data, rough or aggregated, collected from a company products and services can be sold to other actors. In fact, these data can create interest from other firms in the ecosystem that, combing them with other information, are able to extract insights from customers in the industry.

5. Advertising and commerce

   Intelligent products and services furnish a deep knowledge that can be exploited for new advertising ways and enabling novel purchases of products and services that can be also largely different from the object/service that is providing data. In this way, Smart Home has lot of advantage for more tailored advertising and cross-selling based on the customer habits. The collateral businesses that are activated in this manner can belong both to the specific firm that collect data or from other actors of the ecosystem: the goal is the creation of a virtuous cycle of information for exploiting communication and selling opportunities.

Moreover, it is functional to the next chapter already introducing here an ordering between the five levels as shown in Figure 71.

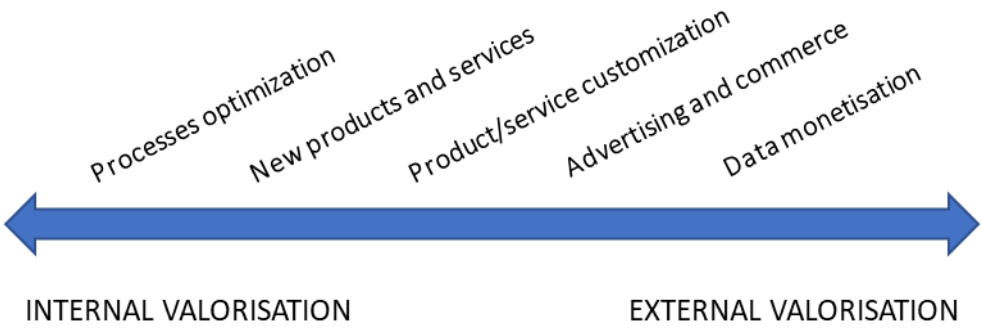

Figure 71: internal and external value in Data Valorisation methodologies

In fact, moving from the first to the fifth modes, it is implicit a shift from an *internal valorisation* of data to an *external valorisation*.

The most internal perspective is the one that looks to the back-end processes of the company (*process optimization*). Then the focus moves to the product/service that is the source of the data that is exploited (new *product/service optimization*). With the third strategy, the focal point is broadened to the user needs that are more exterior respect the organization and so the exploitation become user-centric (*product/service customization*). Thus, the perspective becomes really external when data are used of commerce and advertising of product/services (of the company itself or of other actors) that are different from the ones that were source of information (*commerce and advertising*). Finally, when a company sells data to external entities the valorisation happens totally outside the firm boundaries (*data marketplace*).

The ordering difference respect to the model presented by the Internet of Things Observatory consist in the inversion of the monetization and advertising/commerce methods.

A clarification about "data monetization" valorisation modes must be provided. Potentially, more or less each strategy within the Smart Home can exploit, as complementary valorisation model, this opportunity. In these terms, real data marketplace can be created in future but actually there are some problems related to the immaturity of the industry high and high restrictive privacy regulation. Moreover, as will be showed in Chapter 6, this valorisation stream will be taken into account for some strategies but obviously for an effective exploitation there is the maturity need of the surrounding industry.

In the end, these five data valorisation modes will be fundamental in Chapter 6. As will be shown, sometimes they are exclusive among themselves while, in other cases, are complementary.

This model will be exploited to generalize the punctual data strategies that characterize the various scopes of the different actors. Entering in detail with precise use case will be easier to understand the application of these data-paths and their strength point.

6. ACTORS ANALYSIS AND MODELS APPLICATION

The following chapter contains a detailed analysis of three actors, considered key figures and particularly interesting case studies in the Smart Home ecosystem. They are:

- Telcos
- Utilities
- Appliance Manufacturers

The analysis of the actors is functional to the application of the models previously presented, so a way to test them in the real context and consequently provide insights on how these three actors approach the Smart Home.

6.1 Actors Selection

The decision to investigate the behaviour and the perspectives of these particular three actors is not the result of a linear decision-making process. On the contrary their selection has been made by process of elimination.

First of all, it is necessary to make premises. This thesis is realized with the support of Internet of Things Observatory, which has made available its resources and contacts that were decisive to complete the research. Moreover, as already underlined, while taking into consideration the global scenario, this research has a strong focus on the Italian market and this has obviously influenced the decision process.

Starting from the graph representing the actors involved in the Smart Home ecosystem, (Figure 64), has been proceeded with an analysis of company-types to determine the most interesting profiles, on which to investigate further.

The first factor that led to the exclusion from the list of eligible candidates is the opportunity to exploit the potential offered by the data. Actors like retailers, architects and builders, are still far from a condition that allows them to collect and analyse data and consequently be able to derive value from it. Direct evidence of this condition emerged from focus groups, where the participants unearthed this issue. For this reason, the aforementioned actors were not selected.

Two other types of actors that were discarded are OTT and startups. For the firsts problem relies in their substantial absence on the Smart Home Italian market until now, with Google which announced the arrival of Home in Italy at the end of March 2018 ; while for the latter the nature of the companies constitutes a critical factor: startups are defined as innovative companies looking for a scalable and repeatable business model; without a clear and well-defined business model, becomes difficult to draw a picture of them. There is also the problem of considering as a homogeneous group companies that deal with products and services that are very different one from the other.

It was then decided to exclude all the actors that included in Chapter 5.3.4 within the category "other actors", because their presence and their impact on the Italian (but also international) market is still rather limited.

At this point actors still in contention were valid candidates for an in-depth analysis. Among them there were Consumer electronic companies, Appliance Manufacturers and Electric companies, types of companies with several common elements; it was therefore decided to select one of them, *Appliances Manufacturers*, as these actors has well-defined scope and come from an industry defined by clear boundaries, with a strong connection to the Smart Home market.

After selecting a physical goods manufacturer, it seemed logical to consider a service company as well. To this end were selected *Telcos*, as a category consisting of large companies with considerable innovation capacity, respect to actor such as insurance companies which are certainly more conservative.

Finally, *Utilities* were selected in spite of Applications & Software companies. The former, offer solutions that are functional to the habitability of the house and the operation of the Smart Home. The latter have important opportunities in B2B, as suppliers of software components to actors who market solutions, offering less frequently solutions directly to the final consumer.

6.2 Telcos

6.2.1 Introduction

Telcos are communications service providers (CSPs) or more precisely Telecommunication service providers (TSPs), providing to consumers and business markets telecommunications services such as telephony and data communications access.

Traditionally a Telco was a telephone company: they offered communications services through twisted pair wiring going into customers home. Nowadays this definition is extremely restrictive and does not take into consideration which are the two most relevant businesses for these companies: internet and mobile services.

Since the rise of the net, most Telcos have also become Internet service providers (ISPs). Initially they offered access to the web and e-mail services, through the same wires used for the telephone. In time services have improved, evolving through innovative technologies, and new services have been added. An example is Internet TV, that is TV channels or audio-video content that is available through digital streaming. A large part of the Telcos include them or make them available with their own landline internet subscriptions.

The concept of a landline network permit to introduce the second large business of Telco nowadays: mobile services. In parallel with internet penetration among consumers, the birth and explosion of mobile telephony has occurred. Today it is easier to find a person who has a mobile phone line and not a landline, respect than the opposite. Starting from the second-generation systems in cellular systems (2G), in addition to the classic telephony service, the data transport has also been added and subsequent connection to the Internet for the user. With the advent of smartphones internet connectivity has become a prerequisite for the use of mobile devices.

To date, the majority of Telcos offer telephone and internet services for both fixed and mobile network. Looking at the big players on the Italian market (TIM, Vodafone, Wind-Tre and Fastweb), all of them have a complete offer.

The impact that these companies have on people's lives is significant. To assess their importance, just think about how the connection among people and the information exchange in everyday life is enabled by Telco services: calls, emails, SMS, Whatsapp, Skype, social networks, etc. Telcos

offer the vehicle for digital communication, which has become a fundamental component of today's society.

6.2.2 Characteristics

There are several characteristics that give Telcos advantages in the race for ruling the Smart Home ecosystem but, at the same times, there are lot of difficulties and traps to be taken into consideration.

The first, quite obvious, consideration is that they are the sole actor having the necessary experience to *deliver scale connectivity solutions* at the centre of the IoT. They have the *ownership of the network infrastructure*, and this makes them an irreplaceable element of the value network. In addition, Telcos are the main *developers of some of the IoT-enabling communications technologies*. The offer of wireless communication technologies available at date is extremely varied, just like the type of services and the relative requirements for which these technologies are adopted. Each type of IoT application carries a series of communication requirements (latency, consumption, distance, bandwidth, costs) which makes it practically impossible to identify a single technology capable of satisfying the requirements of each application.

Figure 72 shows a possible classification of mobile radio technologies based on the coverage they can offer and the transmission speeds that can be achieved.

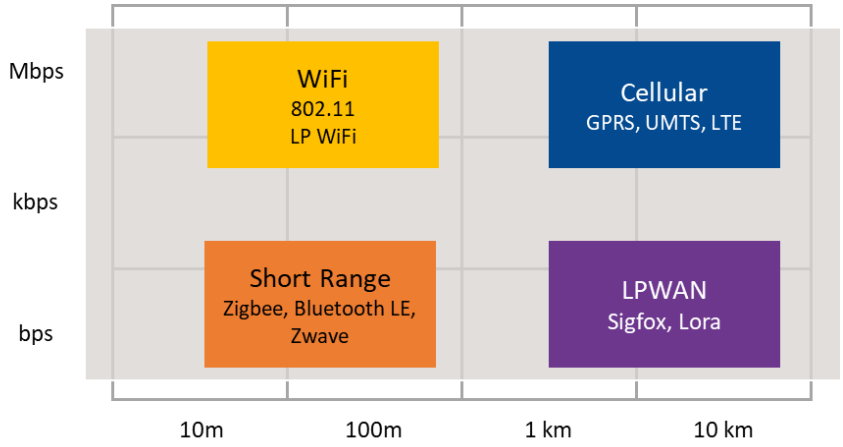

Figure 72: mobile radio technologies classification

In the world of short-range devices (widely used in the smart home), which normally operate on non-licensed bands, technologies such as ZigBee, Bluetooth LE, or Z-Wave are widely used.

To meet the growing needs of applications requiring a broader coverage without high bit-rates, the market has seen the startups of some proprietary solutions of LPWAN (Low Power Wide Area Networks), who have anticipated the solutions of traditional telecommunications companies. The LPWAN protocols guarantee low power consumption of devices, operate at low capacity and allow low cost solutions, great coverage and ready availability. Sigfox and Lora are in this sense the best-known examples.

In response, but with slight delay, the 3GPP standardization body has made available new mobile radio mobile standards for the IoT market. 3GPP (3rd Generation Partnership Project) is a worldwide project established at the end of the 1990s in which main players in the telecommunications industry work together for the definition of technological solutions for communication. As part of Release 13 of 3GPP (LTE-Advanced Pro, June 2016), three enabling technologies for IoT in the cellular environment have been specified, depending on the requirements to be met and the markets to which they address:

- NB-IoT (Narrowband Internet of Things), a solution based on a new radio interface deployed "in-band" in spectrum allocated to LTE and is also suitable for the re-farming of GSM spectrum. In Italy, the service is available from the last months of 2017, offered by 2 of the national operators (TIM and Vodafone);
- LTE-M (Long Term Evolution - Machine-Type Communications), represents an evolution of what has begun to be defined in the 3GPP Release 12 in terms of MTC (Machine-Type Communications) in an LTE network;
- EC-GSM-IoT (Extended Coverage GSM IoT), represents the solution compatible with a GSM / EDGE network, which reuses a portion of the band and requires the availability of EGPRS on the network.

The great advantage of these technologies is the use of already fired radio bands, that allow the operator to guarantee the safety, reliability and quality of the service, which is not subject to interference from other systems not under its control. In addition, they allow a low power consumption of the devices, extending significantly the batteries life in devices (at least 10 years). These are the communication technologies for the Internet of Things currently available, but work

continues on the 5G, whose development is also in this case in the hands of CSPs. Some experimentations are already started and 5G arrival in the market is scheduled for 2020.

If one of the most evident problems in the Smart Home is creating consumer awareness about the value of services and related products, even more difficult is asking, in addition to the cost of the product, a subscription for mobile connectivity services. The perceived price is still very high because the CSPs have not yet managed to find the effective formula to communicate the advantages and explain what are the needs that can be satisfied.

However, is important to consider that Smart Home market for Telcos is a significant growth opportunity. The traditional markets in which these companies work are nowadays mature and saturated, with very limited possibilities of growth. Giving an example related to mobile connectivity, according to data from the Osservatorio sulla Comunicazioni Agcom released in January 2018, in Italy in 2017 IoT SIM grew by 3.9 million units, while those providing "voice services only" and "voice + data" reduced by 2.4 million.

Competitiveness in telecommunication market is incredibly high, with margins that are eroding and with an increasing pressure on costs. For this reason, in recent years there has been an consolidation in the market: the smaller operators have been incorporated by larger players and companies operating in different segments (landline, mobile) have merged for becoming a single firm with a complete offer and able to work on economies of scale. Services related to Smart Home would serve to further expand this offer, with the possibility for Telcos to aggregate all the digital services costs in a single bill: a 2017 Accenture's research shows that around 80% of consumers prefer a single provider for all their digital needs.

TSPs could offer convenient support across all the digital needs and guarantee that users access only to devices and services that are safe and easy to use. On the other hand, linking the services dedicated to Smart Home to Telco's traditional businesses could have negative implications: an ultra-competitive business like the communication services is characterized by a high churn rate and thus combining the Smart Home offers with internet/telephony ones could afflict the new business.

Moreover, the Smart Home has great familiarity with the classic Telco activities since is characterized by a large service component. In fact, Telcos are actors specialized in the provision of services. While this gives them an advantage in terms of service delivery experience, it also

highlights the need to collaborate with other value network companies. Without knowledge and skills to create new connected products, become essential establish relationships with device/appliance manufacturers, in order to deliver connectivity services through physical products. The effectiveness of the product-service offer is a rather well-known topic and Telcos can boast a great experience on that: mobile business has led these companies to collaborate closely with smartphone manufacturers, developing specific strategies and business models.

Several researchers have proposed that, to understand the evolution of the Smart Home, it is possible to study how the mobile phone business has evolved over the years. Actually, there are significant differences between the Smart Home and the smartphone world. First of all, while the smartphone is a single plug-in product, Smart Home involves construction of a very complex and scalable system, including several physical components, which could be made by several manufacturers. Furthermore, the demand for smartphone is profoundly different from the home electronic goods one: if in the consumer electronics turnover is very high because customers always seek for innovation, new features and technologies and have great attention to design, the demand of home products has different divers; more attention is paid to the reliability and robustness of the product as a much longer life cycle is expected. As a consequence, renewal of home electronic products is less frequent. In light of these differences, applying business models designed for smartphones to Smart Home products becomes difficult.

Another peculiarity of Telcos, is to be players with experience in managing lifecycles of millions of devices. These companies have the ability to manage the complex cycle of enablement, authentication, maintenance and replacement concerning a universe of products that is much larger than what other suppliers typically manage. Most Telco executives are aware of their expertise in managing devices like mobile phones and tablets, which have a SIM card and direct link to an individual account. However, an even larger opportunity comes from managing the billions of devices without SIM cards, lying behind gateways, such smart thermostats or other connected devices that are starting to populate homes.

Other positive point is the householders' need of owning a telephone line and internet connection: Telcos acquired a huge customer base, which means a huge pool of potential customers for Smart Home services. To manage its huge base, companies have developed a dense network of POS, distributed throughout the territory in order to be close to their customer. Smart Home devices may be comfortable, but at the beginning they can be challenging for

consumers to be set up and use. Telcos are long-standing providers who have introduced other innovations in customers' homes creating a strong relationship, thus they are natural partners to support them in discovering this new technology. To be clearer, the example of smart thermostats can be taken into consideration. There are several channels through which a consumer can buy them: one of the most used, as showed in Chapter 4, is the e-commerce. Taking the most famous among them, Amazon, it has an enormous choice of smart thermostats, in the order of the dozens of products offered. As a consequence, scrolling the pages, consumer clashes with the complexity of the product: often he finds difficulty in understanding the technical specifications or in the comparison between two similar products. This complexity can be found also at the moment of installation; user reviews show this discomfort: it is quite common to read critiques as "too complicated to use", "cannot connect to the Internet", "the setup does not work" or "does not work as advertised". Other issues include privacy concerns and lack of customer support. Thus, despite potential financial and environmental benefits, e-commerce has some weaknesses that open a window for different sales channels. The presence of proprietary stores in the area, with trained staff able to provide assistance to the consumer, is a possible solution. The store is the simplest and clearest touch point that any consumer type can have with a company. With owned POS the purchase of the product and/or service is surrounded by an in-store experience that allows to know the product, touch it, try it and have an aid to clarify any doubt: an assisted sales approach slightly different from that offered by the big retailers of electronics. In a market where the knowledge of the offer by the consumer is still low, the possibility of offering an experience, educating and indoctrinating the client could prove to be a key factor for competitive success. The customer is guided towards the solution that best suits his needs.

Besides the local presence with stores, telecommunication companies have also the advantage to be already present in customers' homes, through the tool that diffuses internet access throughout the home: the router. They are usually provided to customer when the contract is signed and are long-lived products, because users are rarely interested in replacing them. So, Telcos own an already well-integrated device in the domestic context, with a fundamental role and "preserved" by consumers. This element could be exploited integrating new functionalities and bringing new value into customers' homes. Considering that in Smart Home the architecture with central hub, for various reasons, is still the predominant one, a router would have all the characteristics to assume the role of Smart Home gateway. By upgrading a traditional WiFi router, equipping it with short range communication technologies, it could become the unique hub able

to manage communication with home devices and then act as a bridge link them to the cloud. Several established companies have already implemented a solution like the one described. Among the many, examples are the Google OnHub and the Samsung Connect Home Router (which integrates SmartThings functionality). These products have not been very successful in the market, but an explanation could be that customers are not likely to spend money to buy a new device to replace the functions provided most of time for free by internet service providers. Anyway, the fact that two such important players have developed this type of solution can proves its validity. Offering a smart router to consumers would be easier for Telco to impose their Smart Home solutions, while customers would have an advantage in terms of simplification of the system architecture, with a single object that at the same time allows to control all connected devices and offers internet access.

The strengths listed until now, are combined with the companies trusted status. Evidence of consumers' confidence in Telco is proved by several researches, among which the one conducted by Arris, a telecommunications equipment manufacturing company which provides cable operators with high-speed data, video and telephony systems for homes and businesses. Having surveyed 19.000 people around the world for its annual *Consumer Entertainment Index (2016)*, ARRIS found that the three categories of company that would be most trusted to manage an automated smart home were, in order, Internet service provider, home security company and TV service provider. In particular 47% of people would prefer the ISP or TV Company to deliver smart home services. According to Accenture, in a more recent survey *(2017)* involving 26.000 consumers in 26 countries about the connected home services, 71% of respondents would choose a telecom operator.

Paradoxically, facing with so many opportunities, having all these possibilities, these companies run the risk of moving in too many directions at once and thus being overwhelmed by more focused competitors with more distinctive IoT related capabilities. For, example, the biggest danger for Telco is the role that OTT want to interpret in the Smart Home ecosystem. Players such as Apple, Google and Amazon are already chasing this market. Google and Amazon have voice assistants that can be used to control the smart home. The ones embedded in smartphones and PCs have reached a huge amount of consumers, allowing them to familiarize with the new technology. As a consequence, sales of standalone embedded digital assistants in smart speakers are continuing to increase, while these brands are expanding their product range. Apple, has introduced the HomeKit in the "far" 2014 and has more than 50 smart home brands in its

ecosystem. In addition to the HomePod, released in early 2018, the Apple TV can also serve as the home hub. If Apple has in mind a proprietary ecosystem through which control all the connected objects of the house since long time, even the other two American giants are thinking about integrating the functionality of hubs in their products. Amazon actually did it with Echo Plus. If these actors will be able to take control of the user interface through the use of voice assistant, transforming smart speakers into hubs, then could potentially try to act as connectivity provider (controlling embedded eSIM). In this case CSPs may struggle to retain their direct customer relationships.

Table 4 provides a summary of what has been told up to now. The SWOT model offers a structured and easily understandable framework to understand the potential that Telco have in the Smart Home market

STRENGHTS	WEAKNESSES
• Ownership of the network infrastructure • Huge customer base • Experience in providing services • Experience in managing device life cycles • Presence of POS on the territory • Presence in customers' home • Trust of customers	• Difficulty in exploiting mobile radio technology in the Smart Home • Companies characterized by high churn rate • Little familiarity with the home appliance market
OPPORTUNITIES	**THREATS**
• New growing market to complement traditional mature businesses • Router as the central hub in Smart Home • Not only Smart Home services, but a more complete offer following customer everywhere thanks to mobile	• Customers do not understand the value of Smart Home services and the perceived price is too high • Role of OTT • Moving in too many directions at once and thus being overwhelmed by more focused competitors

Table 4: Telcos SWOT analysis

6.2.3 Competitive Strategies and Related Business Models

At this point, defined Telcos' strengths and weaknesses, the opportunities, but also the threats concerning the Smart Home sector, it is possible to go deeper on the competitive strategies that these actors can adopt.

Connectivity providers

Telcos are the only actors able to provide services that enable communication. This strategy is consistent with telecommunication companies' *traditional business model*. TSP are already present in customers' homes with landlines and it is logical that the home Internet connection is used to enable the Smart Home. Alongside this, providers are developing new long-range radiocommunications technologies for the Internet of Things, illustrated in the previous chapter. These, despite having interesting security prerogatives, in a "static" context such as houses could have some difficulties to impose themselves respect to the short-range technologies combined with the internet landlines, which will probably remain the most used solution. Anyway, long-range communication technologies could actually succeed if integrated into particular categories of connected products, where for example the cost of direct connectivity could be diluted in the high cost of the product; an example of this type are large appliances such as boilers. The other big advantage of mobile communications is related to the portability of objects, being perfect for objects that follow people in daily movements or objects that are used partially in the house and partially outside, like pet accessories.

In an interview with Vodafone this concept emerged, but they also explained how NB IoT (and in the future the 5G) permits them to create an offer with broader scope. They are not focusing only on the house, but thinking to a 360° IoT offer for customers, being able to follow them even outside the home with services for all aspects of people's lives. This could be very important: not limiting the point of view to the home, but creating wider and more complete offers, make possible to deliver a value even higher for the consumer, combining different technologies (which are all however in the portfolio of this type of companies).

Smart home solution providers

The second strategic address for Telcos observed in the market is the transformation of these actors from a "simple" service provider to a sales channel of physical products and related services. This mode recalls the *bundling* model already used with smartphones, where the Telco

provide the customer with the device and offer a service connected to the use of it. Possibly, the cost of the product is accrued on the duration of a contract that binds the customer to use the services of the seller. For example, this strategy was adopted by TIM, which offers a good range of connected products on its ecommerce and in its owned physical stores, most of which can be used through the cellular network and paid in instalments. In order to take advantage of this feature, Telco provides an IoT SIM to charge with a tariff plan offering data, SMS and minutes. The service must be purchased separately from product and can be used in any connected device whose management requires the use of a SIM. Vodafone also launched a similar solution, V by Vodafone, at the end of last year. The offer includes a series of connected devices (linked not only at home, but to different aspects of the consumers' life) purchasable with a lump-sum payment, whose features are enabled through a monthly fee; in this case a *digital add-on* model is applied, thus not making profit on the product sold as intermediaries, but on the service necessary for the use of the product. An interesting novelty respect to the smartphones offers consists in the possibility to switch the service on or off at will and at any time, creating (or better, returning to) a *pay-per-use* model, almost disappeared for some years for telephony and internet services. This model can be effective on some connected objects, such as thermostats, or security cameras, but seems difficult to adapt it to other types of product, like home appliances. Probably act like a sale channel can be a first step to enter in the Smart Home market: what providers are doing is creating product-service offers related to specific use cases, making easy for the customer to understand the purpose of the offer, recognizing its usefulness and value. This step can allow to create awareness and open a window for the subsequent introduction of more structured and complex proposal.

Digital life facilitators

Actually, Telco seems to be more orientated, in the long term, in trying to assume the role of supplier of a Smart Home platform. But there are two paths to implement this strategy.

The first path consists in the creation of a *closed proprietary system*, where the company offers a series of directly managed services, usable through or with the aid of smart devices. The devices must be compatible with the system; this means that customers cannot expand the ecosystem at will, indeed are bound in the choice of products contained in provider's catalogue. These smart objects are obviously not realized by the telecom company but manufactured by expert and selected partners. The goal is therefore to create a *vendor lock-in* business model, binding the

customer to interface only with the Telco provider for the realization of. This strategy follows the model already implemented by Apple with its HomeKit. Apple has built a Smart Home ecosystem accessible via app for iPhone and iPad, where is possible to manage some compatible products. The compatible devices are thoroughly tested and integrated in the ecosystem by the company from Cupertino, and after the approval labelled as "Works with Apple HomeKit". This type of offer has been already proposed by different player like Orange, O2, Comcast and AT&T, which created an offer strongly focused on home security. After signing a binding subscription for a certain period of time (usually 2 years), customers have access to a series of services and the provision of device starter-kit at a considerably discounted price compared to the market one. Then the system can be enlarged with compatible products purchasable from the telecommunication service provider.

It is immediately clear that this business brings important advantages, such as the total control on system and services or a greater profitability for the owning company. On the other hand, choosing this type of strategy it is very risky because it means facing a complex and evolving market relying almost exclusively on its own strength. It is becoming even more risky since the wide diffusion of the voice assistants are having. The assistants, in addition of being plug-in and having compatibility with an ever-increasing number of objects, are able to put the user in communication with the connected objects of the house bypassing the intermediation of any system or platform, also not requiring any subscription or compensation. It will be increasingly difficult for a single actor, such as a Telco (no matter how big it may be), facing alone OTT. In this way, Telco will risk entering in competition with all the other actors of the ecosystem.

Studying the history of this type of Smart Home offers already launched on the market, it visible that the success of this proposition has been partial. The solutions for the European market, encountered difficulties in taking off: O2 shut its Smart Home service after low take-up in February 2018, after a short period from their launch date which happened in September 2016; same fate for Orange's offer, withdrawn in France and Poland, while it continues to be present in Romania and Spain (although in a different form). In the United States they actually had a good response, perhaps thanks to a more developed market, and AT&T continues with success to offer its proposition. However, it was able to collect less customers than rival Comcast: in 5 years since launching Xfinity Home, Comcast has attained over 1 million subscribers, acquiring an average of 200.000 Xfinity Home customers per year and an average run-rate of 22.000 new installs per month. Comcast leveraged on the completeness of its digital solution for the home: telephone,

internet, mobile, cable TV, voice assistant and smart home. Everything integrated, with a single provider for all the services of the house: simple, familiar, trustworthy, and with a unique billing, consolidating the relationship with customers. Anyway, the company, after having for a long time offered a subscription service, decided at the beginning of 2018 to switch strategy, moving to a different business in line with the digital life facilitator second path define in this research.

According to the second competitive strategy, Telco could act as *Smart Home integrators*, or better as facilitators of supply and demand matching. From the technical point of view the solution moves from a proprietary and closed system to an integration between devices, services and any other smart offer available on the final market and so purchasable by the consumer, independently from the telecommunication provider. All these components would be managed through a unique open platform. The potential success of this model lies in establishment of a favourable physical architecture of the system, hierarchical, with a single hub as the nerve centre of the Smart Home: the router. It is already installed by CSPs in customers' home to provide internet service but should be enriched of short range communication technologies to act as a gateway, communicate with each one of the smart devices to then bridge them to the cloud. In the same way, looking to the user interface perspective, a digital platform will act as a connection point for the management of devices and for the access to services, thus becoming the only touchpoint for the customer to control the entire Smart Home.

This model, before Comcast, has already been explored by Deutsche Telekom. The German telecommunications service provider has smooth the way for its customers into Smart Homes, integrating its Magenta Smart Home platform features into a smart router. DT has enabled its routers to not just manage phone calls, Internet and TV, but they can also control Smart Home devices. To this end, in addition to Wi-Fi, they also support DECT ULE cordless standard, enabling the integration of smoke detectors, thermostats, and many other smart devices. Other protocols can be retrofitted via USB port. A USB stick for the ZigBee protocol is already available and a stick for the Homematic IP protocol has been announced. New smart routers were in part shipped to customers, while routers already installed in customers' homes received a firmware update to receive the additional features. The company affirms to have equipped 170,000 households in Germany in 2017 with control centre for Magenta Smart Home through the update and expects to ship around 1.2 million additional smart routers every year. In addition, DT decided to opt for a model that allows consumers who want to approach to Smart Home to experiment it; smart routers include a free version of the company's service, with some basic functions. The Magenta

Smart Home “basic offering” consist in a free starter package (door/window single sensor), on-router Magenta feature and the Magenta Smart Home app. They are sufficient to set up a simple alarm system for door or window manageable via smartphone app. The upgrade from the free starter version to the full range of features is possible at any time, through the smartphone app. Magenta is based on the Qivicon platform founded by DT Telekom together with eQ-3, EnBW, Samsung and Miele and designed to work with devices from other manufacturers. The purpose of DT is in fact to involve as many actors as possible, in order to offer a wide range of products and services. Among the partners that have already integrated are Volkswagen, with a service related to the smart car, but also Ergo, a German insurance company.

Coming back to Comcast, the American company signalled at CES 2018 that its customers currently leasing the last two versions of the Xfinity gateway routers would soon receive a firmware update to turn it into a smart hub. This means that customers who subscribe to internet services with the provider will also have access to a part of Smart Home services, such as home device control, free of charge. That's more than 15 million customers, or more than half of its 26 million internet subscribers; in comparison, Comcast says it only has about 1.3 million subscribers to its home-security service, so the company is opening up these feature to a vastly larger group.

Freemium model seems an excellent idea for this type of solution, also because it is rather difficult to think that a customer is willing to pay a subscription to have the ability to manage their connected devices at home and it can be done easily and for free through the artificial intelligences of Amazon, Google, etc. However, focusing on premium service, Telco will have to formulate offers and services with real added value, so that the consumer is willing to pay. Must be considered that the third-party services offered on the platform will probably have an own revenue model or, if free, will be probably accessible through the voice assistants. As a result, could be difficult for providers constraints their use to a subscription, partly because it could favour the rise of the OTT’s artificial intelligence. Consequently, it will be rather difficult for Telco to find a solution that encourages consumers to join premium services. Given the difficulties of this solution, may be better look for a different business approach. This last section of the paragraph presents a competitive strategy that has not yet been explored by Telcos, a future development that companies could decide to undertake in order to overcome the obstacles highlighted up to now.

Multi-sided integrator

The fundamental idea of this new competitive strategy is that Telcos, instead of asking the customer to pay for access to services, create value by facilitating a relationship between its huge customer base and other smart home ecosystem players. Telcos can take a lesson from the Facebook or Airbnb. An overused phrase is "Facebook is the largest content curator without owning any content" or "Airbnb is the largest accommodation provider without owning any hotels". Is possible to continue: "Uber is the largest transportation company without owning any vehicle", and so on. Telco can do the same in Smart Home: they have a massive audience, so why not just charge companies to access it. This strategy would consist of an even greater openness towards the ecosystem, because these actors would offer a space on which other players of the ecosystem can offer their solutions, because would bring an increase in the number of partners offering the services in the platform, both for the concept of this solution and because looking to the future many more companies could be ready with a SH offer and willing to integrate them into a platform.

Basically, *multi-sided integrator* strategy is configured as an evolution of digital life facilitator strategy. The *multi-sided market* business model probably may not guarantee high profitability as freemium could do, but overcomes the problems previously highlighted, resulting in a more competitive proposition on the market.

STRATEGY	BUSINESS MODEL	ADOPTION	RELEVANT PARTNERSHIPS
Connectivity provider	Service subscription	Stable	/
Smart solution provider	Bundling Digital add-on Pay-per-use	Growing	Smart device producers and possibly white goods manufacturers
Digital life facilitator	Lock-in	Declining	Smart device producers and white goods manufacturers
	Freemium	Growing	Any actor in Smart Home ecosystem
Multi-sided integrator	Multi-sided	Future development	Any actor in Smart Home ecosystem

Table 5: Telcos competitive strategy summary

Table 5 summarizes the competitive strategies identified for the Telcos, showing, for each of them, the related business model or the different business models applicable by the companies, the level of diffusion of this type of offers on the market and the most probable partnerships the companies would find themselves in a position to achieve to develop the aforementioned strategy correctly. The competitive strategy for the future is presented in the table separated from the others to underline the difference.

6.2.4 Business Strategies in the Ecosystem Layers Model

The identification of the different competitive strategies is functional to identify what scope these actors can pursue in the Smart Home ecosystem. To understand this, it is possible to take advantage of the Ecosystem Layer Model presented in Chapter 5.3.3. Figure 73, for each one of the three Telco's "actual" competitive strategies the relative layers are indicated.

The motivations of this characterization of the solutions can be found in the enunciation of the strategies themselves. As *connectivity provider* Telco offer the basic infrastructure, the connectivity, indispensable for the operation of smart devices. As a *solution provider*, beyond the connectivity component, telecom operators provide a service, intended as servitisation of the product or the offer not of an object but of a solution to an explicit customer's need. Finally, as a *digital life facilitator*, Telco offers a platform able to combine different products and services, in addition of course of connectivity, that remains the prerogative of these actors.

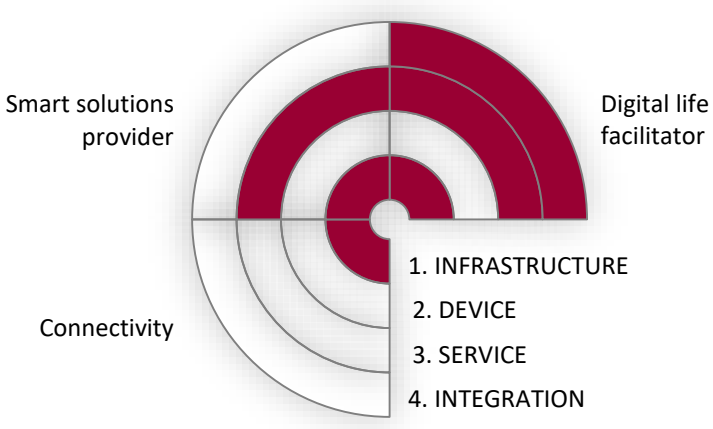

Figure 73: Telcos Ecosystem Layers Model

A separate chart has been dedicated to the future strategy, Figure 74, which is presented below.

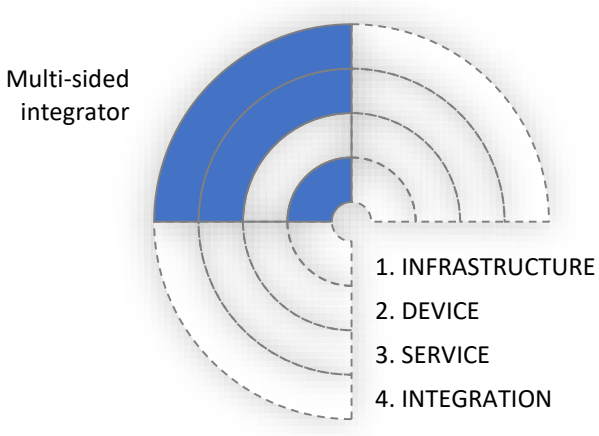

Figure 74: Telcos future Ecosystem Layers Model

In the previous and in the following figures the two different temporal perspectives are represented with different colours: the present in claret, the future in blue.

As previously mentioned, the *multi-sided integrator* is configured as an evolution of digital life facilitator, so it occupies the same ecosystem layers. The difference between the two is the business model, more open and with a different revenue stream.

What emerges from the two charts is a progressive growth of the role of Telcos in the different competitive strategies: from *connectivity provider* to *digital life facilitator* and then *multi-sided integrator* the role played by companies becomes increasingly transversal in the ecosystem, as the telecommunication provider can act on 3 of the 4 levels that characterize the components fundamentals of the Smart Home ecosystem. This representation clearly shows how the Telco want to play a leading role in the Smart Home, acting on several sides of the offer and interacting directly with the customer.

6.2.5 Data Usage Purposes

Data is one of the key topics of the Internet of Things. It is clear that this technology will provide companies with large amounts of information; what is still undisclosed is how companies can use the collected data to create value. What has been tried to do in this research is to identify which

advantages Telcos can obtain thanks to information retrievable from data. After an extensively research, two possibilities have been identified.

Network optimisation and analysis

In order to keep pace with the explosive growth of mobile data, Telco need to continue to invest in their networks and new communication technologies. Network capacity is a great resource and Telco can take advantage of data and data analysis effectively to monitor and manage network capacity, build capacity predictive models for then use them to define priorities and plan the decisions about the expansion of network.

Customer Experience Management

For today's Telco, improving and optimizing the customer experience is the key to maintaining market differentiation by reducing the churn rate. Leveraging the analysis of Big Data telecom companies can create vast data lakes of information to achieve a true 360 ° view of customers. Based on the detailed customer profiles, they can therefore aim to micro-segment consumer base, offer a valuable customer experience and develop customized offers for Smart Home and for all the other aspects in which the Telco are involved. Some use cases include tagged marketing and customization, customer path analysis, proactive assistance and predictive analysis of the abandonment rate.

Looking forward, there is another possibility of using data, functional to the previously identified competitive strategy.

Demand-Offer matching

It has already been clarified how Telco can, through data, succeed in obtaining a good knowledge about habits and preferences of its customers. Other possible exploitation of this information, only possible thanks to good analytical skills, is to identify what are the needs of consumers related to the Smart Home offers. In this way it is possible to understand what services are likely to fall within the interests of the consumer and therefore may be willing to activate. With the availability of this information Telco can take on the role of intermediaries, to bring together services offered by third-party companies and consumers or advertising on the customer based on their profile of interests.

6.2.6 Data Usage Purposes in Data Valorisation Model

Once the specific purposes for which telecommunications companies can use data have been listed, becomes interesting to understand how these can be exploited using a reference framework. For this reason, they have been catalogued into the Data Valorisation Model. This means that each data usage has been matched with one (or more) data valorisation method among the 5 present in the model, indicating how the value is effectively created. An intuitive representation is provided in Figure 75.

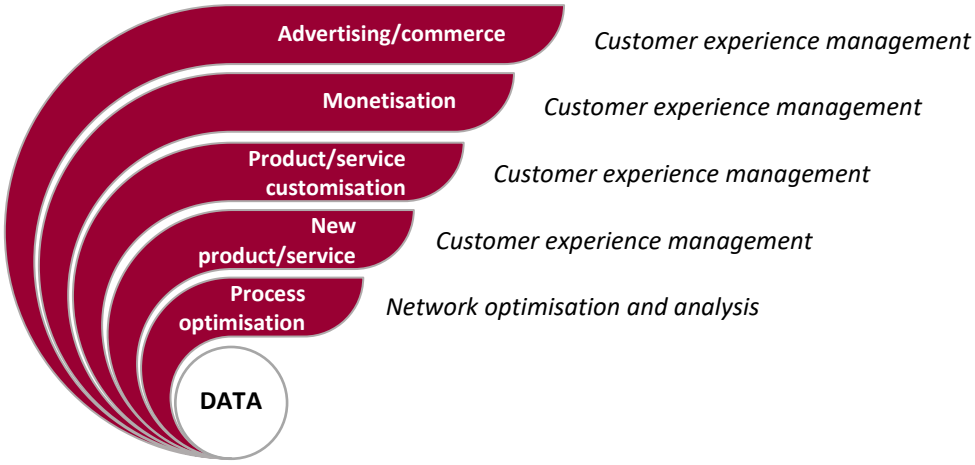

Figure 75: Telcos Data Valorisation Model

Telco have possibility to exploit all 5 methods of data valorisation. In particular, *network optimization analysis* does not consist in nothing more than an optimization of the company's processes, ensuring maximum efficiency in the delivery of telecommunication services. The *customer experience management* provides a personalization of services or the introduction of new ones that meet the needs of the customer, in order to constantly offer a high level of service and to reach a full consumer satisfaction. In addition, data can be used to advertise the client on solutions that might be interesting for him, or the valuable information which permit to do so can be sold to interested third parties.

A separate chart (Figure 76) has been built for the future data usage purpose.

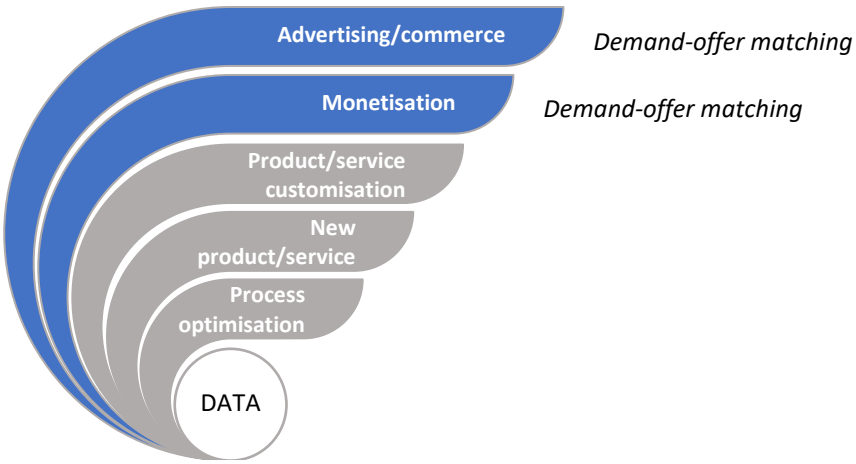

Figure 76: Telcos future Data Valorisation Model

The *demand-offer matching*, as the name itself explain, is a data usage pretty oriented to the integration of two components. So, the valorisation of these data is likely to be used for purposes considered "external" to the company itself. Practically, data would be used to understand which services are in the customer's interests, in order to advertise and sell them on the platform. In this type of activity usually the intermediary takes advantage of hidden revenues, then is remunerated by third parties for the fact of approaching or finding the customer for their services.

6.2.7 Business Strategies and Data Usage Matrix

Now that the strategies and methods of data use have been presented, it interesting to understand how these two dimensions are linked, or better which data usage can be pursued in the different business strategies. In this way a sufficiently complete overview on how a Telco could behave in the Smart Home ecosystem is provided. The *Business Strategies & Data Usage Matrix* presented in Figure 77 allows to cross the two dimensions, returning the possible intersections.

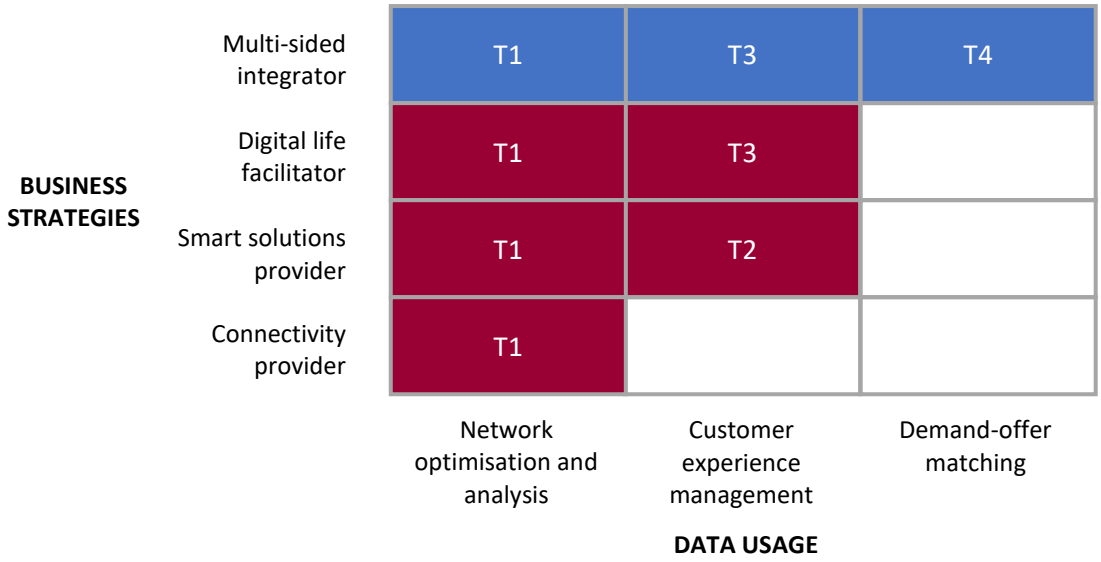

Figure 77: Telcos Competitive Strategies and Data Usage Purpose Matrix

In order to facilitate the explanation of these intersections, which is provided in the next lines with the aid of examples and solutions already presented in the previous paragraphs, codes have been inserted in grey boxes.

- With the code T1 are indicated all the case related to *network optimization*, which refers to the maintenance and upgrading of networks, in order to guarantee always top level of service for customers;
- T2, obtained between *Smart Home solution provider* and *customer experience management*, represents the creation of new "stand alone" solution for solving customers need. Companies through data can understand customers' requirements and then respond with the creation of specific use-cases, or with the personalisation of services. An example can be the case of V by Vodafone, a collection of smart objects with particular and specific features (real use-cases) sold by the Anglo-Saxon player with the related connectivity service, which can be activated and deactivated at will, allowing the company to understand how these services are used;
- T3, *digital life facilitator* and *multi-sided integrator* with *customer experience management*, is translatable as the offer of services on a Smart Home platform. Services can be proprietary, as the 24/7 security service with professional monitoring offered by Comcast to its Xfinity Home customers, or can be offered by third parties, as in the case of DT Magenta Smart Home platform, which have already integrated smart car services by Volkswagen and insurance services from Ergo, a German insurance company;

- Finally, case **T4**, regarding *multi-sided integrator* linked with *demand-offer matching,* make reference to the fact of exploiting data in order to understand what services fall within the interests of the consumer. As a consequence, Telco can match customer desires with the relative third-party's offers, with a consequent possibility of monetization for the Telco.

6.2.8 Conclusion

Finally, the Transformation Intensity Matrix is here utilised on Telcos to evaluate the intensity of the change required to them to compete in the Smart Home ecosystem (Figure 78).

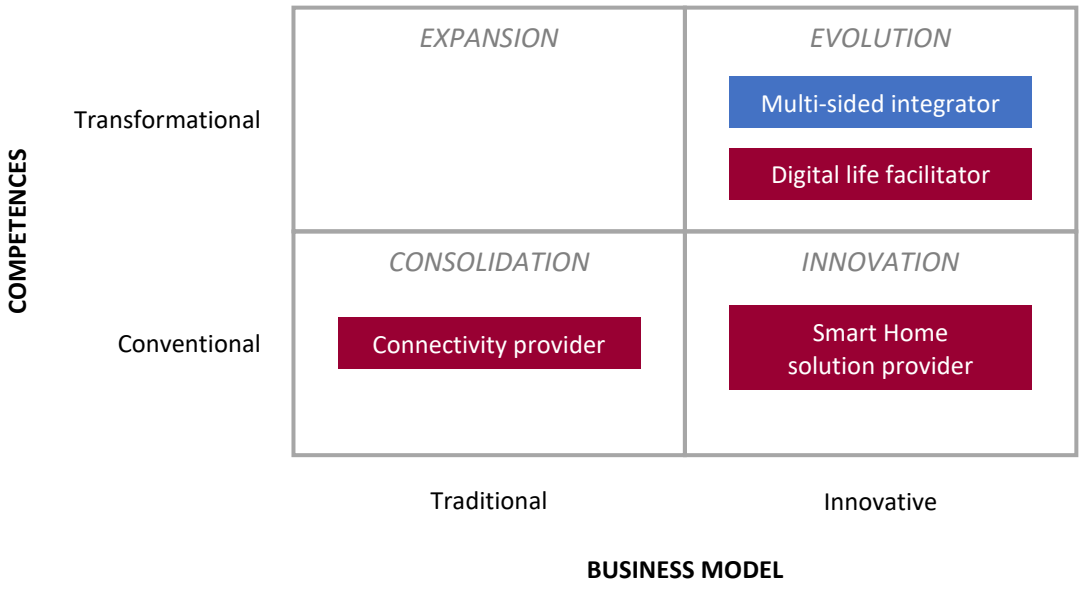

Figure 78: Telcos Transformation Intensity Matrix

If *connectivity* represents the core and traditional business of these actors, offering smart *solutions* is an innovative approach already implemented by Telcos. Anyway, they need some changes in terms of business model, since as explained above the characteristics of the demand are significantly different. For what concern the *digital life facilitator* strategy, Telco are trying to put themselves in a completely new ecosystem position, which will require new competences and skills, as well as experimenting with new business models for the company. Contained in the same quadrant, but perhaps even more radical, is the situation of *multi-sided integrator* strategy, as it presents a very innovative business model.

In conclusion, while their core mature businesses remain crucial to generate cash, Smart Home represent a whole new business opportunity to grow up. In order to gain a relevant position in the ecosystem Telcos cannot just offer connectivity. They need to exploit the potential of personalization and connectivity to deliver new services and open revenue streams, or better they require to develop new skills and pivot to new platform business models.

Proceeding in this direction, the Telco will inevitably clash with the OTT, who are trying to turn their smart speakers into real Smart Home platforms. It will therefore be necessary for Telco to be able to find the right positioning in the integration layer, to avoid direct competition with Google, Amazon and Apple, which probability would see them defeated. A possible solution would be to collaborate with OTT to ensure that artificial intelligences are integrated into the multi-sided platforms proposed by Telco.

A major challenge lies ahead: accelerate moves to become platform and data driven companies to prevent the disruptors from relegate them to minor role in the Smart Home.

6.3 Energy Utilities

6.3.1 Introduction

The term Utilities refers to those companies that offer public utility services such as electricity, natural gas or water. Also, telecommunications companies are often included in the category, as well as public transport companies, but in this study the term Utilities will refer only to companies selling to the final consumer offers and services related to energy, so Energy Utilities.

Energy Utilities have been contemplated among the fundamental actor of the ecosystem since they provide the vital fuel of home functioning and human comfort. If the connectivity provided by Telco is an enabling factor for the Smart Home, energy is even more indispensable as it is necessary in the home regardless of its smartness.

6.3.2 Characteristics

The energy market looks quite complex, for several reasons. First of all, unlike telecommunication which count few players for country, energy market is very fragmented: taking as a reference the Italian market, there are many energy providers with quite different sizing: Italian huge multinationals (e.g. Enel, ENI) and foreign ones (e.g. E.On, Engie), but also smaller and more established realities in the territory (e.g. Hera, Iren). Moreover, Utilities work in a highly regulated industry, sometimes regulated at multiple levels, subject to the control of governments and local authorities, which often also have participations in companies. Furthermore, energy vendors do not always own the infrastructure used to reach the customer; in the case of Italy, for example, the electricity grid is owned by a company that does not provide services, mostly unknown to consumers, while the customer interfaces with companies that acts only as energy sellers.

For these reasons Energy Utilities has been unlikely candidate for disruption and the sector has undergone a poor transformation over the years.

The situation is undergoing a radical change, because several coincident and significant transformations are causing a revolution in the way energy is produced, distributed, stored, and marketed. The traditional top-down and centralized system is evolving into a more distributed

and interactive configuration. In addition, governments and consumers, concerned over emissions and climate change, are bringing political and social pressure about how energy is produced. The result is a big push towards renewable energy. Until recently, for most users, electricity was a commodity over which they had little choice, but now consumers can choose from a wide array of potential power sources and providers. Technology gives them greater autonomy and more choices in the way they source, use and store electricity, with even the opportunity to monetize it at the same time.

The shape of demand is changing, too. A new home could require form the grid about 90% less energy, whether gas or electricity, than it does today. Alongside the innovations that make houses more efficient, the prosumers phenomenon has become reality: the transformation of consumers from simple energy consumers to renewable energy producers and users at the same is already happening. This scenario would have a significant impact on energy business, with the demand for energy that in future may decrease more and more. According to a McKinsey research published in January 2017, battery costs fell from ~1,000 per kWh in 2010 to ~$227 per kWh in 2016. The development of advanced battery storage is attracting investment capital, such as the $5 billion that Tesla Motors plans invested in its Gigafactory in Nevada. With this investment Elon Musk's company of wants to push battery prices below $190/kWh by the end of the decade. The trend of the average battery pack price over time is shown in Figure 79.

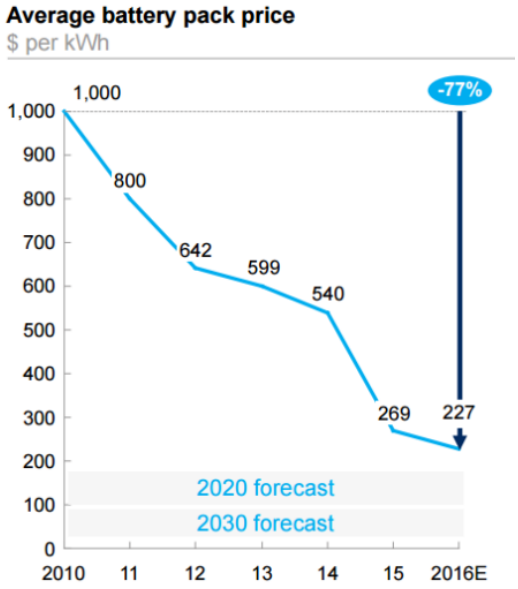

Figure 79: Average battery pack price, Electrek

Economical storage of electricity may significantly change customers' use of the grid. Utilities might transform from the primary supplier of electricity to an occasional one, and customers would monetize selling electricity to the grid themselves. Consequently, electric companies will to rethink not just their roles and business models, but also their service and product offerings and approaches to customer engagement.

In this context the Smart Home takes on an interesting role: it can create new opportunities and allow the Utility to evolve and keep up with the needs of consumers. In particular, these companies could create the conditions to forge a stronger connection with consumers, a relationship of trust that can continue in the coming years, as well as of course find new business models for the future.

The strong interest (or rather the need) to approach the Smart Home is evident in the Italian market. As of today, twelve Energy Utilities offer a Smart Home proposition to consumers. These twelve companies represent almost the entire market, underling the interest and openness that the Utilities have towards the Smart Home.

As they work to adapt themselves to a new competitive scenario, Utilities have the important advantages of long operating histories, substantial assets, big customer base and relevant capabilities. The greatest strength of the Utility is their undisputed experience and expertise in the field of energy management, also recognized by consumers. It is an important skill that allows to respond to a need already perceived by customers. According to the survey carried out for the 2017/2018 campaign of the Internet of Things Observatory, the analysis of energy consumption trends and personalized advice on how to save is the most requested additional service by consumers interested in approaching the Smart Home. Energy companies are well aware of this: Edison, during the interview, pointed out that the energy management is certainly the topic on which they feel stronger, and they know they are appreciated by consumers; consequently, regardless of how they will develop their Smart Home offers, energy management is going to be core.

In truth energy sellers, despite having key skills for the services required by customers, needs to catch up. Utilities have entered the Smart Home segment with a delay compared to both the actors taken into consideration in this thesis (Telcos and Appliance Manufacturers) and other ones active in the ecosystem. The first smartisation wave in homes has been closely linked to the energy management and to the saving on energy consumption: the most popular products and

the most famous brands related to Smart Home currently deal with these requirements. The various Nest, Netatmo and Tado hit the market first and probably have stolen some space of action to Utilities, anticipating them in the creation of products and services aimed at saving energy.

Under these circumstances, Utilities often trade these products on behalf of smart thermostats manufacturers, thus remaining at the margins of the ecosystem and playing a minor role.

Together with the connected thermostats, energy providers have begun to sell other devices connected to the house and appliances, in particular boilers, water heaters, air-conditioner. If Telcos were able to create a strong relationship with consumer electronics producers and OTT and this allowed them to access an interesting range of possibilities, the Utilities could approach Appliance Manufacturers to enable new services, leaving the role of a simple retailer to become an actor who strongly participates in the creation of value for the customer. An effective example is the installation of devices and appliances, which at the time the Utility are the only actors to offer with the sale of smart products. This service, despite its simplicity, is strongly appreciated by the customer and means great value, because there is still a lot of difficulty for consumers to deal with installation and set-up of electronic equipment. But far more complex and digital-based solutions, involving data sharing could be studied. In any case, here are introduced two possible partnerships for Utilities, to create services related to the home: on one hand the manufacturers of home appliances, not only to serve as sales channel, but to create an information exchange enabling new propositions; on the other hand installers, addressed to the customer to carry out their task of first installation, but also maintenance on behalf of the Utility itself.

This is not the only parallel that can be done between Utilities and Telcos, indeed both are service companies and have a large customer base. However, unlike Telco, the presence of Utilities in customers' homes is not so strong. The tool used for energy control is the meter, which is present in every house, but is usually hidden from view and in peripheral points of the dwelling. It is rather difficult to think that the consumer could interact daily with a meter and that this object could gain a key role within the ecosystem.

A big difference existing between the two actors is that, up to now, Utilities have struggled to collect data and information from users and consequently have developed poor analytical skills, which are also evident from offers not customizable and less clustered than those of Telco. The opportunity with the Smart Home arises from the ability to capture more information about

customers and their habits; knowing their behaviours would help companies in improving offers to the customer and could also have interesting internal implications for a better management of the energy distribution network.

Anyway, studying the solutions which Utilities are currently providing to customer, it is evident that they are still quite basic and have a rather low innovative content. Energy smart solutions are usually created by other actors and proposed to Utilities' costumers with rebranding or, as already said, are well-known products (smart thermostats) simply offered to Utilities' customers, acting as a sale channel. This approach is quite logical, given the lack of familiarity that this type of companies has with the creation of electronic devices or in the creation of digital products. The lack of this kind of skills and abilities is a limiting factor for Utilities in a technology-based market such as the Smart Home. For this reason, could be more convenient for Utility to work closer to their core business, the energy management for which they are recognized by customers as leaders, and to study new types of service related to energy.

In contrast with the statement just made is the fact that a large part of the smart offers of these players to date on the market are not about energy management, but security. It may seem quite illogical but, considering that these companies are in a phase of approach to the Smart Home, this choice could be finalized to a precise strategy. Has been said that the Utilities are at the beginning of their journey in the Smart Home market, starting with delay compared to other players and having rather limited hardware and software skills. Finding out products externally or developing them in partnership with other actors, focusing on simple and widespread solutions, was probably the easiest way to start working on smart offers. If the Utilities push too much on third-party solutions related to energy management, there would then be no more space for creating their own offers. In accordance with what has been seen in Chapter 4 and as emerges from IoT Observatory research, home security is one of the issues that arouses greater interest in consumers. According to the research, 64% of people who purchased a connected object in 2017 did so to increase the security of their home. As for the objects already present in the Italian houses, in 54% of cases they are doors/windows sensors, while in 41% cameras; respectively, first and second device types purchased.

Although the solutions proposed by the energy sellers consist in the majority of cases in the resale of products, the manner in which these products are offered has nevertheless represented a novelty in the Italian market. The Utilities were able to effectively combine Smart Home

propositions with the traditional business, uniting them into a single bill. This is a good advantage for the consumer in terms of convenience and allows to circumvent one of the most limiting barriers for the mass diffusion of Smart Home: the high price of devices that scares the customer.

Another peculiarity of Utilities is their great attention to the startups world. It is quite common for energy providers to create startups competitions, act as angels or creating innovation hubs. The cases are several only looking at Italy. Edison Pulse is a competition directed to the most innovative startups in the energy, Smart Home, consumer and earthquake reconstruction categories; the four winners receive funding, a monthly program of support and incubation in a business accelerator, a communication campaign and, after the incubation period, if sufficiently mature, they will have the possibility of forging a partnership with Edison for the joint development of the proposed product or service. Enel instead created innovation hubs in various cities around the globe, such as Tel Aviv, San Francisco and Moscow. Also, ENI has close collaboration with Talent Garden Calabiana, in Milan; the partnership not means only occupying a physical space in the well-known coworking structure focused on digital, but also support the master in Business Data Analysis of TAG Innovation School, in order to favour growth of professionals and solutions which permit to understand how the news and events of the company are perceived on a global level for orienting communication strategies. Actually, Utilities do not simply collaborate with startups to grow them, but also propose their innovative solutions directly to their customers. An interesting example is the Edison case: the energy provider chose the product realized by the Italian startup Alyt as smart hub for its Smart Living offer.

The characteristics of these important ecosystem actors are summarized in the SWOT analysis represented in Table 6.

STRENGHTS	WEAKNESSES
• Experience and expertise in energy management • Huge customer base • Experience in providing services • Great attention and investments on startups • Product installation service • Possibility to pay in instalments added to the energy invoice	• Delay compared to competitors • Basic and not very innovative solutions • Offer far from core competence • Poor data analytics capacity • Poor HW and SW skills
OPPORTUNITIES	**THREATS**
• Partnership with Appliance Manufacturers • Partnership with professional installers • Improved customers' behaviour knowledge • Energy network optimisation	• Contraction of energy demand • Other providers establish themselves as providers of energy services • Loss of the privileged relationship with the customer, who becomes prosumer

Table 6: Energy Utilities SWOT analysis

6.3.3 Competitive Strategies and Related Business Models

As previously done with Telcos, the identification of the competitive strategies implemented by the Utilities has been done.

Reseller

To date, the strategy used by almost all the Utilities is to act as resellers of third-party products and services. These are usually proposed to the customer in concurrence with the activation electric/gas supply: customers have the opportunity to receive the smart product by adding their monthly cost in the energy bill. The primary objective of this strategy is not creating a new revenue stream, because in most cases the products are offered at a discounted price compared to the market price; for example, Hera, during an interview, stated that they do not add any mark-up in the product sale. The real goal of this type of strategy is to bind the customer in a durable relationship, using instalments as a mean to create the conditions. In this way Utilities are able to reduce the churn rate and increase customer retention, in *loyalty-based models*. In the Italian market the examples are different: Engie offers Nest products (learning thermostat and indoor

cam) at half price in combination with the light offer Energia Casa; the aforementioned Hera offers Netatmo thermostat with the subscription, or even for already-customer, of some between its gas offers.

In other cases, the offer develops in parallel with the contracting for light and gas; it is disconnected from a specific service offer and accessible at any time by any consumer already a customer of the utility and, in some cases, even to non-customers. Among the companies that have implemented this type of policy there is E.On, which offers smart thermostat and thermostatic valves of the German bran Tado. Or Iren which, with the name CasaSicura, offers a modular and wireless video surveillance kit produced by Honeywell.

In all of these cases the companies offer both the possibility to pay the product in instalments and to pay it in a single solution. Anyway, according to the information gathered during the interviews with different energy companies, the monthly payment is chosen in the vast majority of cases.

The reselling strategy could be short-sighted. Energy Utilities are putting in their customers' homes products that offer functionality inherent to their core business, offering to manufacturers the opportunity to create a relationship with those people. In future, may be difficult for Utility to propose own offers for energy consumption monitoring services or remote control of heating systems, since customers already have them or will prefer to stay with Nest or Netatmo or Tado.

In feedback collected by the energy operators in the interviews carried out has also emerged that all offers active today have met a limited success on the market, with sales that in the best cases are about thousands of pieces per company. On the one hand it may be true that the market is not yet ready, as the Utilities themselves claim, but it is certain that the results obtained so far cannot be considered good.

Smart energy solutions

These are solutions in which the role of the Utility is not limited to that of the sales channel, but they act as a real energy-related service and possibly products provider. Possibly because, as already pointed out, the Utility companies are service companies, they have poor hardware and software skills and therefore, if they intend to create products connected or otherwise linked to the Smart Home world, they need to collaborate with other actors.

Smart service means a *digitalization* of these companies, creating a new type of interaction with the customer, where the technological means, allow customers to have a more interactive relationship with the energy seller and at the same time allow company to get to know its customers better.

In this context exists a great opportunity for Energy Utilities: the national rollout of second generation smart meters that regulators have mandated. Already 1.8 million of smart meters have been installed in 2017, while in 2018 the installation of 5.5 million ones is planned.

Smart meters, unlike traditional devices, allow the remote reading and remote management of electricity, gas and water meters. Smart metering systems will have numerous advantages, both on the company side and on the customer side; for example, the reduction of costs for consumption readings and contract management operations (eg. supplier change, deactivation, etc.), which can be carried out automatically at a distance without the operator's on-site intervention.

Roll-out is a legal obligation, which represents a cost, but, if correctly exploited, can generate great value. The smart meters collect data every 15 minutes, information that can enable new services for the Smart Home. To mention some possibilities, the immediate availability of the data for the supplier allows to apply an accurate pricing, based on real data rather than on consumption estimates, and offer the final customer a better awareness of their consumption communicating real-time data (energy monitoring). Particular attention is given to reducing the energy bill, promoting energy efficiency and the rational use of resources (energy efficiency consulting); helping customers decrease their energy bill with tips and advice is likely to naturally increase customer satisfaction and engagement: it moves the customer dialogue away from a negative binary (bills) to a more positive conversation around usage. For this purpose, Utilities seem oriented to apply gamification and/or rewarding systems for those customers who consume correctly. Speaking of rewarding, energy vendors in the UK are working on demand-response services that reward customers if they reduce their power use during peak periods. Or again, based on the demand response programs, Utilities could develop new types of pricing.

Energy solutions strictly related to the smart metering are beginning to arrive on the Italian market. The new smart meters, as already said, are able to collect information; but to transmit them to energy suppliers, or better to the cloud, appropriate devices are required. These devices need to be tested, so this is the objective of the experimentation phase required by the Arera

(the authority which regulate energy, networks and environment in Italy) and supported by E-distribuzione (company that owns the Italian electricity distribution network and provides smart meters). The first Energy Utility to obtain a result of the experimentation was Estra, which used devices produced by Sinapsi and Urmet. These devices are Wi-Fi connected and simply need inserted into a power outlet. After a simple set-up they receive a series of information on the energy consumed directly from the smart meters. Among the functionalities already active on the devices installed there is the acoustic warning to exceed the contractual power, which encourages the consumer to pay more attention and helps to avoid the repetition of these episodes that, as a rule, involve an automatic adjustment of power and therefore higher costs in the bill. In the future plans of the company the devices will give access to additional information and applications, for example via mobile app, and will allow the use of additional services, such as billing on more bands than those provided to date. The monitoring, launched throughout Italy, will end on 30 April 2018.

Another device under tests is Casa Manager, created thanks to a partnership between Acotel and the E.On group. It arrived in the first weeks of 2018 and is facing a first phase of testing and validation on a selected target of residential and business customers. "Casa manager" is able to acquire the consumption data of a power line, supplied at regular intervals by the new meters, and send them to the Acotel cloud platform with the same frequency. E.On stated that the collaboration aims to analyse the customer experience and involve them directly in the development and improvement of new solutions, to encourage virtuous behaviours in energy consumption.

This is what Energy Utilities are working on and which can be realized thanks to smart meters. Looking at future, interfacing with home appliances could permit to have a more precise energy imprint and more control consumption, enhancing Energy Utilities services. A little more further in future, as a consequence of consumers' self-production of energy and greater efficiency of housing, Utilities could use their skills to introduce new services aimed at managing energy production, purchase and selling on behalf of customers.

Adjacent solutions

Beyond reselling products and offering energy services, Utilities could try to expand their scope addressing other customer needs by offering a range of new interactive and digital services on issues adjacent to energy. The reference model is the *cross-selling*: propose to the customer who

already has contract for the supply of energy the purchase of additional complementary or particular Smart Home services. The aim is to consolidate the relationship with the customer, who often tends to procure more services from the same supplier for simplicity and convenience reasons, and thus increase its profitability. In a sector where energy demand has a downward trend due to structural reasons, this may mean for Utility companies the possibility of growth in the years to come.

For instance, Utilities could provide maintenance services for many types of equipment. Several companies in Italy such as Enel, Edison, E.On, Engie, Bluenergy and others already offer a service on boilers and air conditioning systems. British Gas has the HomeCare program, providing customers with options for maintenance and repair of boilers and central-heating units, regardless of where the equipment was purchased. This model can be especially attractive to Utilities that have a well-developed presence on territory and large concentrations of customers, typically located in urban areas. The fact of offering connected product sale and installation would allow an automation of maintenance and therefore a proactive assistance service.

Another example of this strategy can be given by proposition not yet on the market, but which Edison is studying. It consists in a video surveillance service in combination with the purchase of connected cameras realized by a partner. And this is not the only non-energy project that the Italian Utility is developing: in an interview with the firm's management, but also during the 2018 Smart Home conference held by Internet of Things Observatory of Politecnico di Milano, the company confirmed its interest in offering value-added services that came out of the pure energy context, indicating it as a strategy to be pursued to play an important role in the Smart Home.

As was done previously with Telco, has been tried to look beyond the present situation and the immediate future, trying to identify the direction that the Energy Utilities could take in the future. As a consequence of this a further competitive strategy has been outlined.

Integration platform

The Utilities could follow the path already chosen by Telcos, which for some time have started to put the basis for the creation of Smart Home platforms in which is possible to offer home-related services and control all the smart devices installed in the house, all in a unique solution. This type of strategy would allow to combine *smart energy solution* and *adjacent solutions* strategies.

A single platform to access all the services offered by the Utility is a real simplification also for the customer; thanks to the creation of a single channel of communication with the energy supply company the management of various bills would be greatly simplified. As a consequence, this would allow the Utility to significantly improve the relationship with the customer, tightening a relationship made of frequent interactions.

For the Utility there would be the possibility to offer all the proprietary services, but also to open up to the ecosystem, creating an open platform similar to the ones Telcos are approaching.

To conclude this part, below is presented Table 7 which summarizes the all competitive strategies identified for Utilities and also presenting related business models, level of diffusion on the market and the most convenient partnerships to establish.

STRATEGY	BUSINESS MODEL	ADOPTION	RELEVANT PARTNERSHIPS
Reseller	Loyalty	Stable	Smart device and white goods manufacturers
Smart energy solutions	Digitalisation Pay as you go	Growing	Connectivity providers, smart device and white goods manufacturers
Adjacent solutions	Cross Selling	Growing	Any actor in Smart Home ecosystem
Integration platform	Digitalisation Cross Selling	Future development	Any actor in Smart Home ecosystem

Table 7: Energy Utilities competitive strategy summary

6.3.4 Business Strategies in the Ecosystem Layers Model

The identified competitive strategies have been projected in the Ecosystem Layers Model. Results are presented in the Figure 80.

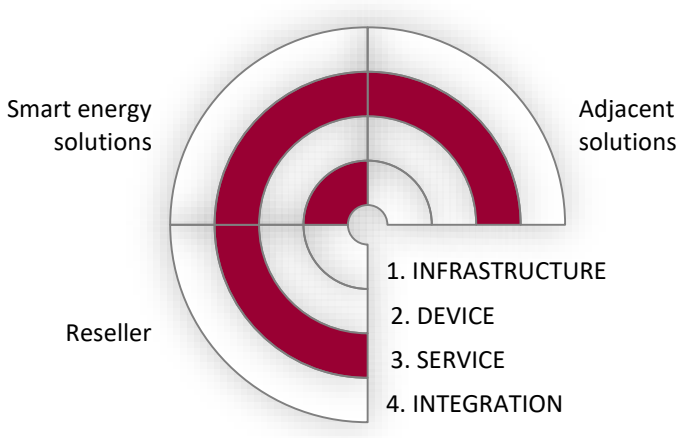

Figure 80: Energy Utilities Ecosystem Layers Model

Retailer is positioned at the service provider level: in this case the Utilities are the intermediaries for the arrival of smart solutions to the final customer, favouring the dissemination of knowledge and often assisting the customer in installation and utilisation. In *smart energy solutions*, the importance of smart metering for network efficiency has already been widely discussed, as well as the numerous value-added services that can be created. The *adjacent solutions* consist in services connected to energy or smart home, but not related to the supply of energy; for this reason, the scope is only that of service and not of infrastructure.

The fourth competitive strategy, which is important to remember that constitute a future development, has been included in a separate chart (Figure 81).

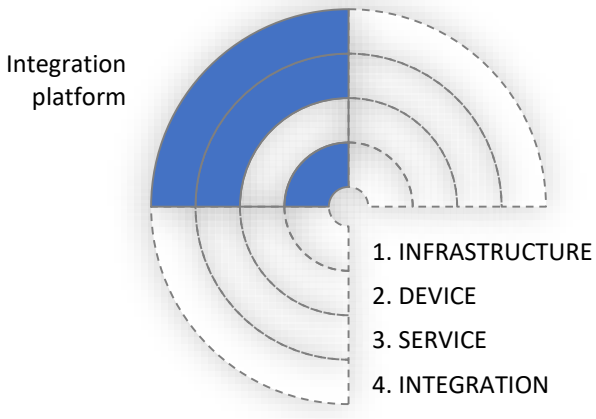

Figure 81: Energy Utilities future Ecosystem Layers Model

The similarity between Utility's *integration platform* and Telco's *digital life facilitators* strategy has already been declared, therefore the representation in the Ecosystem Layers model is identical. It should be noted that this representation is result of the sum of *smart energy solutions* and *adjacent solutions*, addition which is actually what happen at the strategic level.

Comparing Energy Utilities' Figure 80 with Telcos' Figure 73, immediately jumps out the different approach to Smart Home for the two actors. Unlike Telcos, which have a vertical presence in the layers of the model, Utilities have a flat distribution in the model, representing they are not interested in "dominating" the ecosystem but propose themselves as a valuable partner to offer services related to energy or to develop new ones. They are focused in transforming they relationship with customers respect to creating value looking internally to the ecosystem, like Telco does. Exactly looking at what the Telco are trying to create, the Utilities could in the future adopt a similar competitive strategy, aimed at acting as integrators of different solutions. Starting with a considerable delay compared to the other Smart Home actors will certainly not help these companies to succeed in the highest layer of the ecosystem.

6.3.5 Data Usage Purposes

The Energy Utilities interviewed were able to suggest a sufficiently precise idea of what could be the purposes for which the data could be used by them.

Grid operations

Available data bring great benefits to Utilities in efficient network management.

Surely, they will be useful to save in operations and maintenance expenditures, to optimize and the production or purchase of energy, according to the demand and to manage the grid on the basis of customers consumptions. Data will certainly be functional to ensure greater reliability. Advanced analytics can also help boost ability in preventing outages, improving response through situational awareness (for example, automated dispatch through real-time identification of an issue) and better management of performance. Another viable way is demand response programs, which seeks to adjust the demand for power instead of adjusting the supply. In demand response, customers' voluntary rationing is accomplished by price incentives, offering lower net unit pricing in exchange for reduced power consumption in peak periods. This use of data brings

an indirect advantage to the customer, while the Utility itself obtains the greatest benefits thanks to the efficiency of the processes

Customer engagement

In the previous section has been explained how data collection can help Utilities in understanding customers habits and their energy usage significantly better. But this is only half the process that can be achieved. In fact, thanks to data analytics the information collected can be transformed into knowledge useful to understand how to create new value for the customer.

It means being able to devise new offers, solutions, services that respond to that customers' needs which have still not been satisfied. One side on which the Utility definitely have to work is that of communication with the customer. Analytics also allow them to provide a more direct, simpler and better communication with digital touch points, with more accurate information to customers about energy consumption, power outages, grid updates, all of which can raise customer satisfaction. An eventuality to be taken into consideration is also the introduction of new types of tariffs that are better suited to the consumption habits of the specific consumer. So, in this address, the perspective is reversed compared to grid operations: here the goal is customer satisfaction. Obviously, all this also has a commercial implication, with the possibility of directing to the customer only offers that exactly match his needs, increasing the effectiveness of sales.

Despite being an unexplored path for Utilities, there is an additional data usage purpose which these companies could start to cover in the next future to sustain new possible strategic directions.

Data integration

Developing good data management and analysis capabilities, Utility could aggregate data coming from the different typologies of services offered to consumers, both energy and non-energy. From this large amount of data could be extrapolated precious insights, discovered new knowledge to be used later in different contexts.

First of all, information regarding the profile and habits of consumers could be used to make targeted commercial offers; moreover, such a large amount of data could be of interest to some external actors, willing to pay to get hold of them.

6.3.6 Data Usage Purposes in Data Valorisation Model

At this point data utilization purposes have been catalogued into the Data Valorisation Model, matching them with data valorisation method. Results are presented in Figure 82.

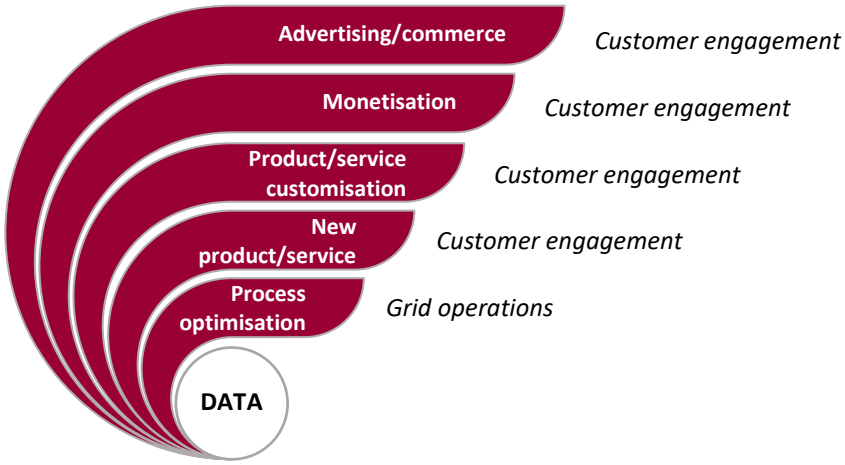

Figure 82: Energy Utilities Data Valorisation Model

The matchings showed in the model are in line with what has been treated up to now: in grid operations data enhancement involves an improvement in the company's processes, while the effective management of customers is linked to the creation of new services and the personalization of offers based on the characteristics of the client, with a consequent possibility of targeted advertising which in turn help increasing revenues or in the sale of the acquired information.

The matching between future data usage purpose, *data integration*, and the methodologies for data valorisation has been managed in a separate chart (Figure 83).

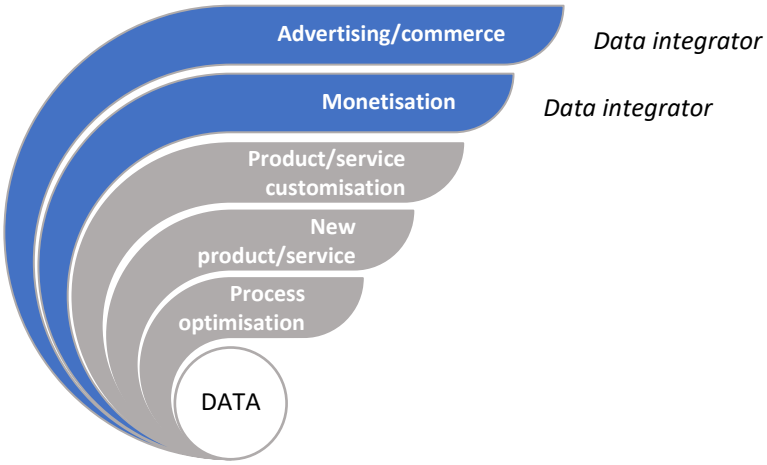

Figure 83: Energy Utilities future Data Valorisation Model

The *data integration*, as explained in the previous paragraph, is essentially aimed at creating new knowledge. Then this knowledge can be valorised with the two methods highlighted in the chart: the advertising of products and services of interest for the customer or the sale of information to third parties.

6.3.7 Business Strategies and Data Usage Matrix

Once are presented strategies and methods of data use, is possible to analyse how the two dimensions are linked through the Business Strategies & Data Usage Matrix. Figure 84 allows returns intersections representing which data usage can be pursued in the different business strategies.

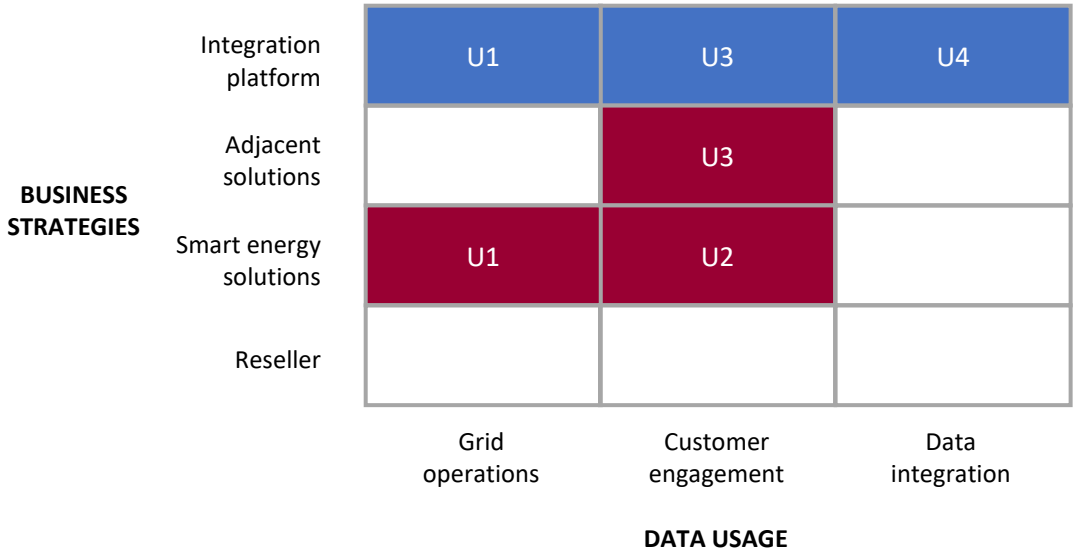

Figure 84: Energy Utilities Competitive Strategies and Data Usage Purpose Matrix

Similarly, to what was done for the Telco, the abbreviations that help in the description of the intersections have been included in the matrix:

- It might seem like a mistake that spaces corresponding to the *reseller* strategy are empty, but it is not. If acting as a sales channel, Utilities does not have access to any type of data coming from consumers' homes. They participate at the distribution of Smart Home solution, but their task end in the moment of product purchase, so they do not enter in customers' homes. Consequently, in that case Utilities have no advantages in terms of acquired knowledge or value by the use of data;

- Case U1 cover *smart energy solutions* and *integration platform* plus *grid operations* intersections. It refers to grid and energy optimization activities, such as the production of energy based on houses consumptions or demand-response programs, already extensively explained in the previous chapters.;
- Case U2, placed at *smart energy solutions* with *customer engagement* intercept, refers to the services aimed at supporting the customer to save more energy, possible thanks to the advent of smart meters. A couple of devices able to send data on electricity consumption are in the test phase in Italy, enabling new features such as consumption control with the relative expense, but also advise to have a more responsible energy use;
- Case U3, *adjacent solutions* and *customer engagement*, represents the new non-energy services that the Utility could open in the Smart Home context, created and offered to the right customer on the basis of data collected by companies. Some of the previously illustrated examples include maintenance services for many types of equipment rather than video surveillance services. The relationship with the customer further improves when *customer engagement* crosses *integration platform*, relying on a single platform
- Case U4, *integration platform* and *data integration*, refers to the availability of customer data obtainable from the implementation of a platform, allowing the Utility to aggregate the information coming from different services.

6.3.8 Conclusion

In conclusion, Transformation Intensity matrix has been applied to Energy Utilities' strategies, to evaluate how these companies could transform in the Smart Home scenario (Figure 85).

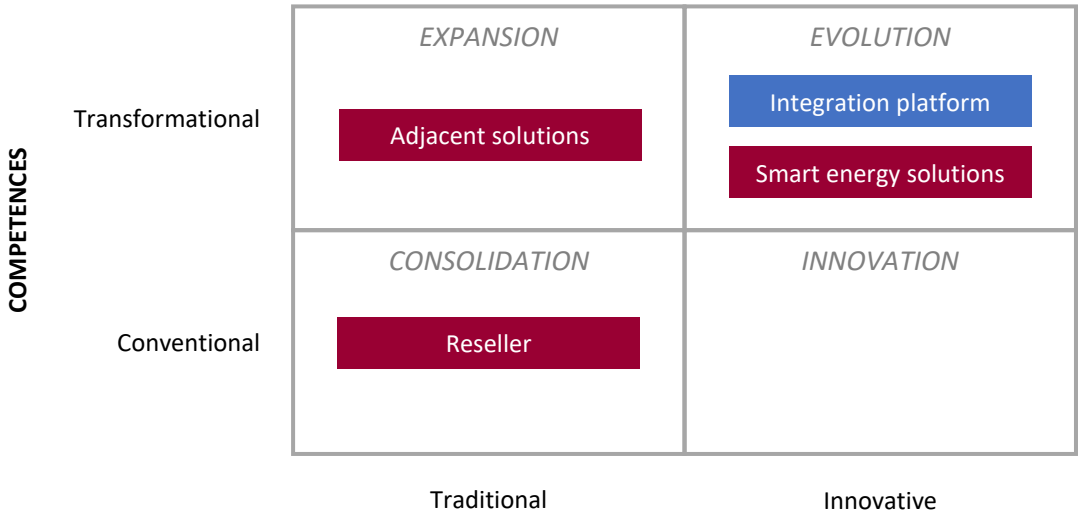

Figure 85: Energy Utilities Transformation Intensity Matrix

Energy Utilities should exploit Smart Home possibilities, focusing on customers and improving the relationship with them. This will lead to the creation of new business models, characterized by a faster and more frequent interaction with the consumer

In addition, as they move away from traditional models, these companies need to measure their core capabilities against the type and level of capabilities necessary to compete and prosper effectively in a Smart Home service marketplace. They have to determine which of their existing capabilities are adequate to the task, and which new ones may need to be developed. For example, improve customers' insights through advanced data analytics it is a necessity for these companies, as it is required in *adjacent solutions*, *smart energy solutions* and *integration platform* strategies. To do this, Utility will need to become competent in gathering, consolidating, analysing, and transforming data from smart products, adjacent service and grids into insight. Then, they'll have to combine the data with additional layers of information about demographics, behaviour, customer characteristics or from other sources to exploit the data opportunity. The path is still at the beginning, but besides preparing the market for the Smart Home mass adoption the Utilities will need to develop new skills e competences to have success in it.

The impact that smart speakers and AI diffusion on the market can have is this case difficult to predict. To date, Utility solutions are distant from OTT's products, but in the future, with an interest of the Utility to the realization of digital platforms, a contrast could occur. In this case a possible solution would coincide with the one already proposed for the Telco. Returning to the current situation, smart speaker could represent an additional touch-point for interacting with users: Energy Utilities could exploit skills communicate the information collected through smart metering or activate functionalities in non-energy services.

6.4 Appliance Manufactures

6.4.1 Introduction

In the Smart Home ecosystem there are different types of actors that manufacture connected products, from consumer electronics giants to startups that offer innovative solutions. Considering as a whole the world of electronics would have been impossible, as the technological and connected devices that make up the smart home actually have very different features and are characterized by different types of demand. Therefore, it was decided to narrow down the focus and study in depth a precise and well-defined category of actors focused on a specific family of products. Appliance Manufacturers were chosen.

Actually, Appliance Manufacturers remain itself a rather wide category. In fact, it includes actors who are dedicated to the production of the so-called “small appliances” and instead those who make "*white goods*", which basically coincide with what could be called large appliances. With a more precise definition they are all the heavy consumer durables which cannot be easily moved and are generally placed on the floor, such as refrigerators, ovens, stoves, dishwashers, washing machines, tumble dryer, air conditioners, etc which used to be painted only in white enamel finish. They are opposed to “brown goods”, that consist in electrical goods such as televisions, radios, phones, and computers, essentially consumer electronics finalised to leisure and entertainment rather than to accomplish a practical task. They are not to be confused with the aforementioned "small electrical appliances", portable or semi-portable machines, including microwave ovens, toasters, humidifiers, and coffeemakers.

The choice is not simply derived from the need to limit the scope of study, but rather it is due to the importance that white goods play in homes: they are the true technological heart of the home, the maximum expression of the technology present in homes.

So, even if a research has been done on all the manufacturers of household appliances, whose solutions are included among the other in the database analysed in, in this discussion the focus will be on companies that have a range of products consistent with the definition of white goods.

6.4.2 Characteristics

As mentioned above, home appliances are core element in the creation of home comfort: they are present in almost every house and nowadays they are considered essential and irreplaceable. Despite this great success, the innovation process cannot stop and household appliances cannot be considered at their highest level of expression. The Internet of Things has opened a new world of possibilities for white goods too: GFK, the German largest market research institute, has defined the smartisation of home appliances with the word “inevitable”. So, like or not, Appliance Manufacturers will have to adapt to this trend.

Actually, some manufacturers have started working on connected appliances before the concept of Smart Home was forged. Whirlpool, for example, was already working on it in the 2000s. They even created a tablet to control the appliance, but consumers were not ready for that kind of technology; iPad had not yet been launched on the market and the company was feared a proposition like that it would not have been understood by customers and would have inevitably flopped. So, the project was shelved.

Now consumers have developed a good ability to interact with digital products, especially thanks to the experience gained with smartphones. Moreover, the technology has made big steps forward, allowing to offer a more complete set of functions: if before was possible to only turn the appliance on and off, now these products, as well as being able to control all the features of the appliance remotely, are able to offer continuous monitoring and an uninterrupted exchange of information, enabling a control of the functioning of the appliance. From connected appliances technology has led to smart appliances.

So, rather than a demand for innovation from customers, the approach adopted by the industry is technology push: companies, on the basis of the available technologies, push smart and connected products onto the market. As a result, Appliance Manufacturers themselves, or their partners on their behalf, have to stimulate customer demand.

The approach adopted by these companies is to rely on retailers to persuade consumers in purchasing such products. This strategy, as gathered by the focus groups and the questionnaires realized by the Internet of Things Observatory, has met a little success. In fact, smart appliance sales through retailers, if compared with other channels or with expectations, proved to be quite unsuccessful. Large retailers have proved to be ineffective in involving the customer, despite

various initiatives were put in place by some big chains stores, such as the creation of exhibition spaces inside the sales points that simulated the experience of the Smart Home. Perhaps they did not their best to promote the diffusion of smart appliance, but probably even the producers have not made the necessary efforts to ensure that retailers correctly communicate the value of new solutions. One of the complaints collected from retailers during the focus group was the lack of a proper training on the sales force, which has essentially had to sell products they did not know, thus failing to communicate the proposition in the right way. Another big problem is related to appliance installation. Beyond the physical installation, a service that the totality of retailers offers, there is also the need to take care of the training on product usage; these are high-tech solutions, not really plug and play, so the customer must be guided in the set-up phase and instructed on the use of the product. This component is certainly lacking up to now in the sale of household appliances, both in resellers and in e-commerce, where however consumers are usually more tech-friendly and therefore have greater autonomous learning capacity. Consequently, this must be an aspect on which the producers of household appliances should think.

This shortcoming turns in the inability of the customer to fully exploit the potential of products. An evidence is collected by Candy, Italian white goods manufacturer European market share leader for sales of connected appliances: the company states that conversion rate of its washing machines, that is the rate of customers purchasing a connected appliance which then register it in order to use the IoT functionalities, is still rather low. What probably happens is that, when buying a new appliance, the customer opts for a smart product due to the fascination that technology exerts, but then is unprepared in the practical act of exploiting technology.

In any case, beyond the conversion rate, sales of the connected home appliances are growing year on year, probably driven also by a growth of the whole household appliances sector. Smart household appliances took some time to take off in the market, due to an innovative technology with which the customer is not familiar, but also a price that is accessible to the few. The average consumer, who has yet to become familiar with the Smart Home, is quite logical that has a low inclination to invest large amount of money in products that should give security and reliability but are today perceived as a sort of "magic boxes". Samsung, through the words of its Innovation Senior Vice President, admitted the Smart Home revolution is taking longer than what they have hoped. But now, on the basis of what has been learned in recent years and on the technologies that today companies hone, thanks to decreasing costs, companies are starting to push strongly

on this type of product. All the most famous brands have an entire white goods range of products: Whirlpool, Candy-Hoover, Samsung, but also LG, GE-Haier, Bosch-Siemens and Miele.

Actually, household Appliance Manufacturers are not much more than those mentioned above and, in any case, are all characterized by a strongly international presence: the brands have a global market, selling substantially around the whole world. This is a peculiar trait compared to the two actors taken into consideration previously: worldwide presence doesn't characterise for example Telcos which, even giants such as AT&T or Vodafone, do not have global coverage and certainly not Utility that are definitely more rooted in the territory. Furthermore, their market is characterized by the lack of new entrants, as the barriers to entry to the market are quite high. The existing companies are in fact large companies, very structured, with expertise and resources to carry out an expensive research and development. Without the presence of large capital and without previous knowledge and skills it becomes virtually impossible to enter this industry, the effort required is too high in light of a mature market.

Another feature that significantly differentiates the producers of home appliances from Telco and Utility is that they are manufacturing companies, not service providers. The advantages that this entails are good hardware skills, but in some cases also relevant software competences. For example, the two Korean producers, Samsung and LG, are also active in brown goods: this allowed them to develop software competences, which in the Smart Home field will prove to be fundamental. The other big players are obviously not sitting at the sidelines and have already taken steps to recover the gap with competitors by signing agreements with major players in the sector or buying interesting startups. For example, Candy has been working with both Google and Amazon since some time, as well as Whirlpool, which also bought in 2017 for an undisclosed amount Yummly, an American startup that will be introduced later. Also GE Appliances and Bosch have also worked with startups such as Drop and Innit to automate some processes in the kitchen.

Software competences will become increasingly important for this type of products because, in order to fully exploit the potential of IoT, consumers must be offered the opportunity to interact with objects. To date, the producers were not able to offer an intuitive and easy-to-use interface despite different ideas being proposed. A common solution adopted and that will probably not disappear soon is the use of a single app for all companies' products; it also allows to manage all the appliances in one place, controlling them even when far from home. Some companies are

also experimenting with the use of TVs as a sort of digital home hub, but it has also been considered the installation of large displays in household appliances considered key points of domestic life: refrigerators (LG, Samsung) or above the stove (GE), with the possibility of offering new functionalities related to the product in which the display is integrated.

Another viable path which, observing the 2018 Las Vegas Consumer Electronics Show trends seems to have become a must, is the integration of home appliances with the smart assistants proposed by OTT. Amazon and Google allow the control of connected products through the creation of customised "skills", vocal instructions corresponding to an action which artificial intelligence can understand and transmit to products. In this way, customers can interact more intuitively with home appliances through voice control. According to a 2017 study by consultants at Deloitte conducted on behalf of Bitkom, more than 70% of Germans who expressed an interest in voice-control technology said they would want to use it as part of a Smart Home system to manage household appliance, against 37% who signalled interest in receiving traffic news, 34% for reading emails and messages, 30% for the use of search engines. Consumers' vision of artificial intelligence is now clear, and producers can not overlook this. What clearly emerges from CES 2018 is the behaviour of the players in the appliance industry of not choosing a unique partner (Google or Amazon or Apple), but rather to try to integrate their products with all the assistants, not precluding any opportunity. The risk of a single-partner strategy would be that, in a market still to be defined, a wrong alliance can cause the loss in the race for the leadership of the Smart Home.

Artificial intelligences could actually be the first step of a more substantial integration of OTT in household appliance: Android Things, the Google's operating system dedicated to connected objects, has started its diffusion on third-parts manufactured devices. During the CES 2018, a number of OEM companies are announced their first set of products powered by Android Things, in particular the new generation of screen-assisted voice assistants. It is possible that the operating system will be soon used in "bigger" products.

The only player to partially depart from this approach is Samsung, which, thanks to the sales of smartphones and its dominant role in the consumer electronics market, has decided to develop its own operating system for connected objects (Tizen OS) and its own artificial intelligence (Bixby), already launched on the top-of-the-range smartphone. Despite this, the Korean firm has

not renounced the integration with Google Assistant and Alexa, capable of generating at this time a gross hype in the consumers.

The integration of voice assistants and, in future, a probable use of third-party software ecosystems is leading to a greater integration of products realized by different producers. Unfortunately for Appliance Manufacturers it goes in the exactly opposed direction respect to what was their objective: binding the customer within a proprietary ecosystem of products managed by the company's app. In truth this lock-in strategy is still valid is spite of the diffusion of voice assistants, since skills do not cover all the features of the appliances; so, for a complete control of them, there is still the need to access the app. The question could change with the rise of real software operating systems, which could bring great advantages in terms of integration and could break down existing barriers. However, to date it is still difficult to imagine the developments and implications of this type of solution.

Returning to talking about the software component in household appliance and taking for granted that it will become essential for the new products generation, a new big opportunity opens. Companies will have the possibility to exploit the mechanism of updates, already common on smartphones, to improve the device over time. The release of the next firmware version would allow companies to enhance the products during their life cycle, which by the way is quite long.

This could also be a mitigating factor for what is perhaps the biggest risk associated with smart home appliances: obsolescence. Nowadays technology is developing with an impressive rapidity, the rate of innovation is so dizzying that products can become dated within a few years, if not months. This is a significant problem for products with a long lifecycle, like household appliances. The matter is not just about price, considering that a top-of-the-range smartphone can cost more than a washing machine or a refrigerator, but also of convenience, because replacing a large appliance installed in the kitchen is not as simple as changing an iPad. In addition, beyond the product itself there is another important factor to be evaluated: compatibility. When a couple of smartphone or smart speaker generation (which means no more than 3 or 4 years) will pass, the new ones will still be able to communicate with the "old" home appliances? As mentioned, the ability to update the firmware of white goods could provide a mitigation of this risk, but the real implications are all to be verified.

The greatest opportunity that the manufacturers of connected home appliances have thanks to the IoT, however, is to establish a relationship with the customer. Being manufacturing

companies, until now the objective of these actors was solely to sell as many products as possible. In that business model the relationship with the customer was created at the time of purchase and lost exactly at the same moment. No type of communication or interaction existed between companies and consumers. With the advent of IoT and the consequent connectivity of products, Appliance Manufacturers can finally engage the consumer, have the opportunity to establish a relationship and collect useful information from customers. Know how customers use appliances and their habits could be a boost for companies to develop solutions that are increasingly practical and functional to needs.

However, it is questionable whether customers will be this willingness to share and exchange information. Consumers do not have a relationship of trust with white goods manufacturers as they have with Telco and Utility, which have always owned and kept personal information. Privacy is one of the biggest challenges for the Smart Home and become very relevant when consumers are asked to give personal information or about their lifestyle habits to new businesses they are not used to relating to. On the other hand, another important issue consists in the fact that Appliance Manufacturers are not structured nor accustomed in receiving large amounts of data from devices produced by them. It will be necessary to integrate new skills and abilities to remedy these tasks that will be fundamental then extract value from the collected data, in accordance with the purposes that will be presented in the next paragraphs.

For the moment, in Table 8 below, the characteristics presented up to now are summarized and organized in the SWOT framework.

STRENGHTS	WEAKNESSES
• HW and SW competences • Appliances are the technological heart of homes • Absence of substitute products • Big companies with great economic power • Experience in research and development of innovative solutions	• Low conversion rate • Unsuitable or inefficient preferred sales channel • Not effective customer interfaces • Lack of a true relationship with the customer • Lack of data analytics capacity
OPPORTUNITIES	**THREATS**
• Improve the product over time with new firmware releases • Creation of lasting relationships with customers • Customers' behaviour knowledge • Integrate artificial intelligences and third-party service/products into appliances	• Loss of the lock-in effect • Technological obsolescence • Difficulty in creating a relationship of trust with the consumer

Table 8: Appliance Manufacturers SWOT analysis

6.4.3 Competitive Strategies and Related Business Models

Following the canvas so far adopted, in this section are listed the competitive strategies that household appliance producers are using or will put in place in the Smart Home industry.

Smart products

The first strategic address, widely adopted by the market players, is to make features already incorporated in the home appliance accessible and controllable remotely. With products currently on the market almost everything can be managed remotely: turn the device on and off, monitor the operation and access complex features, such as the choice of the wash cycle, weekly scheduling or other. Samsung, for example, has a washer and dryer equipped with Smart Care, which allows to see how long the cycle still take from a smartphone app and sends a signal when the load is complete. These remote apps are especially convenient if home laundry system is in the garage or in a larger home where is unlikely to hear the alert or even better if people are away from home. The hesitancy on starting the washing machine or dishwasher when far from

home is quite common, it is a feeling that springs from the fear that something might happen. Thanks to the connectivity these simple and legitimate problems can be overcome, bringing great efficiency and comfort in people's lives. Basically, with IoT, use cases of the device are extended to meet the increasingly complex needs of the consumer and to support the increasingly hectic pace of life. A study by Whirlpool showed that the average percentage of cycles started remotely on a connected appliance is 20% but is reduced to 5% at weekends. This makes understand how smartisation is not end in itself, it is not an innovation to be imposed to customers but has real advantages that can improve people's lives.

Beyond the remote monitoring, which remains by far the most appreciated advantage by the consumer, there are other interesting aspects in the smart appliances. For example, the app interface allows consumers to learn how to use the product better. The machine's suggestions encourage consumers to use all the features of the appliance, many of which are often overlooked in favour of the classics. Otherwise, companies like GE, LG and Whirlpool are making their wares more energy efficient by monitoring energy consumption. Whirlpool's 6th Sense appliance show up consumptions on mobile devices, as well as the occurrence of any event considered waste, such as the refrigerator door left open. GE created a solution called Nucleus, a home manager which interfaces household appliance with a smart meter for wireless home-energy monitoring, to alert the customer at peak hours either to not run the product or run it in an energy-saving mode. So, here are still outlined great opportunities for collaboration between Appliances Manufacturers and Utilities.

In this type of approach companies do not actually innovate their products radically, nor do they invent something new. Everything that already exists is simply made more accessible to the consumer. As a consequence, the business model remains in line with the traditional one.

Digital-enhanced product

The second competitive strategy instead consists in an expansion of the scope of the product, adding new services and features.

First of all, there is a concept to be clarified. In this case products are not connected only to the customer and the company, but they are able to connect each other and therefore capable of interacting. The possibility of making different devices communicate one with the other implies the creation of new services and scenarios that are activated automatically when certain

conditions occur. For instance, LG showed off a smart fridge that can display recipes on a screen on its door-screen, and, when it is time to start cooking, can automatically turn the oven on and preheat it to the right temperature.

But this concept is not only created for home appliances of a single manufacturer, but also by making them work together with small devices or connected systems of other producers. Miele intends to include in its system a device that shuts off water if a leak is detected. Other examples could be the activation of the kitchen hood in response to the signalling of a smoke sensor, or the anti-intrusion sensors communicating the presence of an open window in order to stop air-conditioning / heating system to avoid energy wasting.

Home appliances become access points for digital services, provided by the manufacturer itself but also by third parties. The example of Yummly has been already mentioned; it has recently been purchased by Whirlpool and, from spring 2018, will be integrated with the Scan-to-Cook technology, which allows to program ovens for cooking food simply scanning the bar codes of packaged foods, giving an even simpler experience in food preparation. Yummly allow to integrate recipes and cooking modes into a single platform: user can select the desired recipe from the Yummly database and then all the necessary information is automatically sent to the appliance, including each cooking phase, from preheating to temperature and timing adjustment. Yummly, accessible through a smartphone app, will then guide the consumer through images and videos, to make each step of the recipe preparation as clear as possible.

Still remaining inside the kitchen, Samsung created a series of smart fridge, the Family Hub series, which have a 21.5-inch Full HD touch screen and stand as a real digital control centre for a connected home. In addition to remotely controlling the content in the refrigerator thanks to three integrated cameras, customers can use the display to share with family the shopping list, order directly it through online shopping applications such as Supermercato24 and consult recipes and video recipes directly from the display. It is also possible listen to music through Spotify, surf the internet and even watch favourite TV shows through the TV Mirroring function (compatible with Samsung Smart TV). Over the course of 2018 Family Hub refrigerators will be introduced additional features, such as meal planner and a software that new recipes based on the habits of family members, food intolerances and expiration date of products.

So, in addition to carrying out the traditional tasks of a refrigerator, these appliances offer many more, giving the possibility to access a wide range of complementary or collateral services. This

sets the stage for the creation of new interesting business models, such as a *physical freemium*, where appliances offer its traditional function, but then there are payment premium services, or the configuration of *products as a point of sales*, with the possibility to make purchases through the connected device.

Example of another "external" service is the Amazon Virtual Dash Button Service (VDBS). The physical Dash buttons from the famous e-commerce company have been adapted into online versions, allowing Amazon Prime members to quickly reorder favourite products with one click on appliances' screens. VDBS is currently being used by three appliance brands: Whirlpool, Samsung and LG.

Finally, through the interviews, it has come to light that several companies are working to understand how to take advantage of home appliances in assisted living system, especially for the elderly. The use of household appliances is a daily constant in people's lives, so by monitoring the interaction with them, for example the opening of a refrigerator or starting a laundry, is possible to understand if the pace of life is continuing on a regular basis or if these appointments are missed and there could be a problem. With a *sensor as a service* model, household appliances can then be used to monitor the elderly, without the need to install other systems or objects (cameras, motion sensors, etc.)

Actually, there is a further possibility, a strategic address that until now has still not been approached directly by any producers of household appliances, but that some startups outside the Smart Home sector have already tried to implement. It is therefore plausible to believe that, in the near future, some of the Appliance Manufacturers decide to take this approach.

Smart PaaS (Product-as-a-Service)

A business model based on the *servitisation* of household appliances is anything but far or impossible. The technologies to implement the solution already exist and even the customers are now used to buy (or rather not buy) products in this way. This is a familiar model of business across many industries from technology to automotive to consumer electronics.

Appling the same methodology, instead of buying the product, companies may decide to rent their appliances, transforming their business model like what printer manufacturers have done. While it sounds radical, the model is not entirely new. In the UK, there is a company called Radio

Rentals that rents washing machines and charge the user on a monthly basis; the same do another startup, Bundles, which is experimenting the same model in the Netherlands.

In this new potential model, the consumer who is given for example a washing machine, pays a monthly standard fee, supplemented by a pay-as-you-use tariff (in washing machine case a pay-per-wash plan). Every time the machine detects a new wash load, the consumer is charged a small amount. The advantages for the customer would be the saving on the cost of installation, maintenance and any necessary repairs, all included in the monthly standard fee, plus obtaining a tailored service. In case of need to replace the appliance, for example for an extension of the family, the customer may request an upgrade of the service, not having to immobilize any capital for the purchase of larger size one since the manufacturer substitute the product and to update the tariff plan.

If the consumer benefits are evident, there is also convenience for manufacturers. First of all, stipulating contracts with predefined durations, guarantees a safe horizon for the replacement of household appliances. In addition, "obsolete" products could be recovered, returning to the possession of recyclable or reusable materials and components.

Table 9 summarizes the possible competitive strategies indicating the main characteristics.

STRATEGY	BUSINESS MODEL	ADOPTION	RELEVANT PARTNERSHIPS
Smart products	Manufacturing	Stable	Utilities
Digital-enhanced product	Physical freemium Product as a point of sale Sensors as a service	Growing	Any actor in Smart Home ecosystem
Smart PaaS	Product servitization	Future development	/

Table 9: Appliance Manufacturers competitive strategy summary

6.4.4 Business Strategies in the Ecosystem Layers Model

At this point, as usual, the classification of the strategies in the Ecosystem Layers Model is proposed (Figure 86).

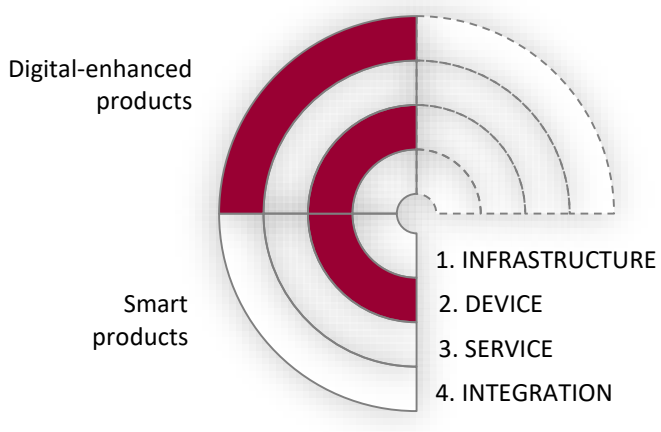

Figure 86: Appliance Manufacturers Ecosystem Layers Model

With the *smart product* strategy, the Appliance Manufacturers will remain consistent with the current mission, that is producing and sell devices. The decision to create *digital-enhanced products* instead implies a widening of the range of action of these actors, which consists in integrating services and digital contents, both proprietary or external, with the aim of creating new revenue streams and improving the customer experience.

The ecosystem layers of the "future" competitive strategy, namely *smart PaaS*, is presented in a separate chart (Figure 87)

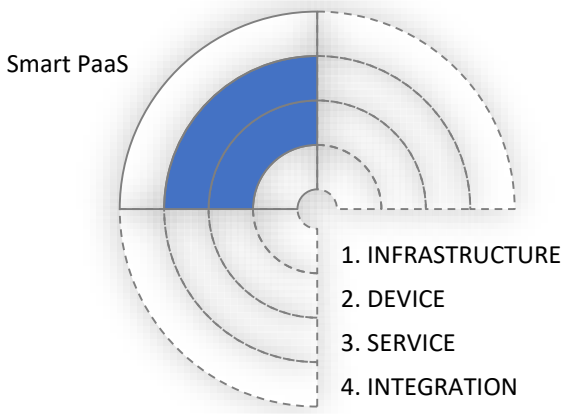

Figure 87: Appliance Manufacturers future Ecosystem Layers Model

Considering that it consists in the sale of a product as if it is a service, the considered ecosystem layers cannot be other than those of product and service.

6.4.5 Data Usage Purposes

Product diagnostics

A fairly obvious use of data is to check the functioning of the sold products. Diagnostics is closely linked to product maintenance. By identifying the nature of the problem, companies could intervene more efficiently. Today if an appliance breaks, typically a consumer does one of two things: if it is not in the warranty period, the broken machine might be discarded and replaced with a new model; if it is in warranty, a consumer might call out the assistance service to come and investigate the problem. While on site, the technician makes a diagnosis and identifying the fault, but is possible that he does not have in its van the required components. So, becomes necessary to arrange another appointment when parts are available.

In a scenario like this, the owner could have appliance out of service for several days, causing an inconvenient situation. For what concern repair service, technician had to schedule two trips to complete the job, with a relevant increase in costs. In the case of a connected appliance these wastes could be avoided: a connected machine is capable to collect several data about its process; these data can be compared to a computer model: if the appliance data follow the model it is working well, otherwise trends or anomalies which deviate from the model are detected and can be made predictions about what might happen in the future. Forecasting in advance a problematic situation, is possible to take actions to mitigate effects. Taking the example given before, is possible to ensure the right component is in stock and the owner to arrange a maintenance intervention before the machine breaks down, providing a better level of service and improving customer satisfaction.

Some solutions going in this direction have already been considered or implemented, so to explain the possible developments of the diagnostics is possible to refer to examples. LG's latest SmartThinQ appliances feature Smart Diagnosis, which tells in advance to the technicians responsible for a maintenance intervention what the problem is before they even arrive at customer’s home. Miele also uses connectivity to link enabled appliances to the company's monitoring centre; if a fault occurs, Miele's customer service is notified and take of contact client

to arrange and intervention to fix the issue. Samsung in turn revealed details of HomeCare Wizard, a unique AI-based service solution available on Samsung's 2018 Smart Home appliances, which essentially enables devices to diagnose themselves. The new feature provides meaningful insights about energy, usage patterns and cleaning reminders to users. Samsung claims that its HomeCare Wizard service makes use of an advanced algorithm to find and alert users about problems affecting their smart appliances' efficiency and performance. The service can also decide if the problem requires the intervention of a technician or not and in case provides the user with simple instructions for solving the issue.

Customers habits

Diagnostics are not the only information extractable from appliances, there is another interesting class of data that can be collected: the usage data, how customer is using the product. To be clearer, a common washing machine gives the possibility to use different types of wash cycles, but probably just few of them are used commonly. Data can be used to understand how many of the programs are actually used and which are not useful. In this way, when the company is creating the next generation of the washing machine, have the possibility to eliminate redundant programs, reducing design, engineering and test costs. In addition, from consumer perspective, the washing machine will be easier to use with a simpler access to the preferred settings.

The same data can be incredibly valuable in the process of improving ways in which individuals and organizations interact. Apart from customer and Appliance Manufacturer there are many other actors that could be interested in interacting with appliance and have visibility on the data collected from them. An already mentioned party might be the Energy Suppliers: they would like to be able to interact with household appliance to communicate peak periods, when energy is at premium cost, enabling the demand response plans.

Then there are insurance companies, which calculate policy pricing according to the class of risk. Connected appliances could help in lowering the risk: the more reliable white goods and connected security systems are, the more insurance companies can lower their fees.

These are just some examples, because knowing the habits and interests of the consumer new offers and tailored services can be developed, greatly increasing the value of the proposition of a home appliance.

Complementary products management

The appliances, in the accomplishment of their operation, have some interaction with several consumer products: refrigerator with the food it contains, dishwasher with the rinse aid, washing machine with detergent and softener, and so on. Knowing the information related to these complementary products allows household appliances to more efficiently perform their task and at the same time help the householder. In addition, retailers are already trying to sell products through appliances, as seen in digital enhanced product competitive strategy. Knowing how complementary products are used is possible for appliance to calculate when a consumption product will run out and arrange a new supply; for example, if a dishwasher knows how much washing tablets are on average used, can request them to be replenished before the current stock ends, in a sort of object self-service.

Unlike what happened previously, with appliances it has not been possible to identify further data usage purpose: the new competitive strategy in fact requires the joint use of the already listed ones.

6.4.6 Data Usage Purposes in Data Valorisation Model

Finally, data utilization purposes have been catalogued into the Data Valorisation Model. Results are presented in Figure 88.

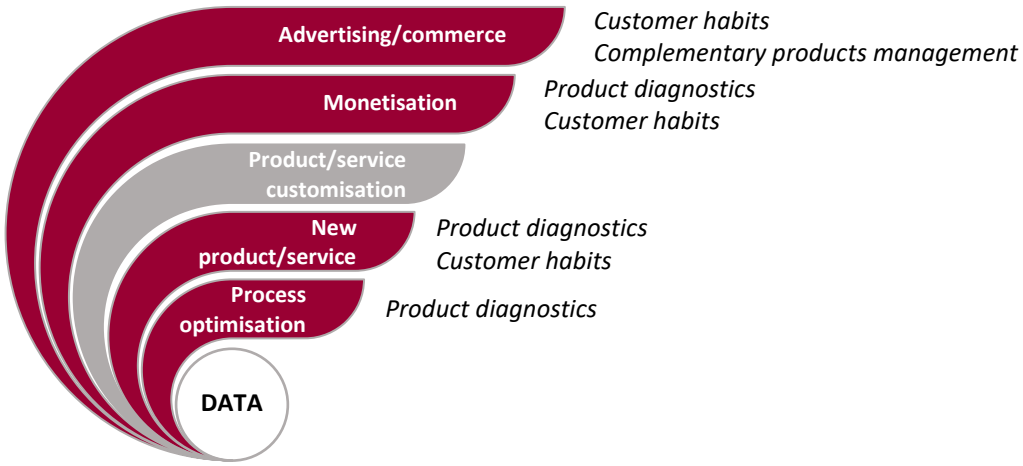

Figure 88: Appliance Manufacturer Data Valorisation Model

Complementary products management has only one way of data valorisation, since it is closely linked to the autonomous purchase of consumer products used with household appliances. *Product diagnostics* allow an optimization of the assistance and repair processes as well as are basis for improving future generations of products. Knowing *customers habits* instead permits companies to understand how to innovate and create products that reflect the market needs, as well as allowing the creation of new and innovative services accessible through the appliances themselves. Then, from both *diagnostics* and *habits* data, is possible extract information that could interest to different players on the Smart Home ecosystem.

6.4.7 Business Strategies and Data Usage Matrix

Crossing the two dimensions, possible competitive strategies and data usage purposes, emerges the Business Strategies & Data Usage Matrix shown below (Figure 89).

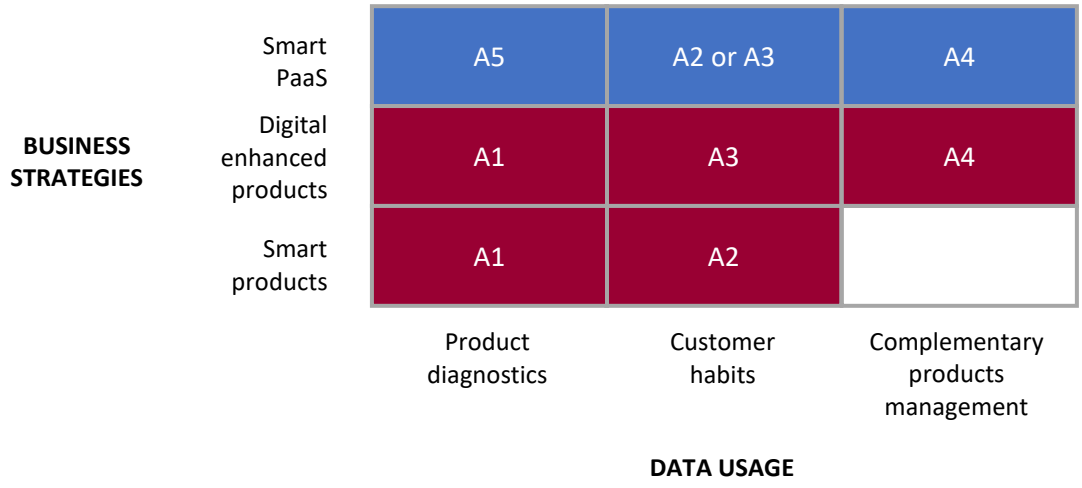

Figure 89: Appliance Manufacturers Competitive Strategies and Data Usage Purpose Matrix

- Case A1, *smart products* and *digital enhanced products* with *product diagnostics*, refers to the efficiency of product assistance and maintenance process, pursued through data collected from home appliances and, depending on the manufacturer, implemented differently, as seen in the cases of LG Smart Diagnosis, Samsung HomeCare Wizard or Miele assistance service;
- Case A2, intersection between *smart products* and *customer habits*, is linked to the possibility of improving the next generation of product thanks to the information

collected; for example, eliminating appliance functionalities which are barely used or improving or making consumers' favourites more accessible;

- Case A3, *digital enhanced products* with *customer habits*, refers to digital services that can be integrated into devices, creating new revenue streams for manufacturing companies. Here is the reference to the refrigerators with screen, from which householders can control many services, provided from both the home Appliances Manufacturer and external players, such as grocery shopping, music service providers, etc; but also services where home appliances act as sensors, such as monitoring of the elderly through the routine use of products;
- The cross between *smart PaaS* and *customer habits* contains both the codes A2 and A3, since from case to case the household appliance in question could have both the functions;
- The intersection between *digital enhanced products* and *complementary products management*, namely case A4, corresponds to the product-self-service model, or better the capacity of household appliances to autonomously reorder a consumer product based on preferences and use rate of the householder;
- Finally case A5, *smart PaaS* with *product diagnostics*, represent the servitisation of home appliance, a sale method in which instead of purchasing the product customer pay on the basis of the usage he makes of it. Diagnostics allow the manufacturer to understand how many cycles or ignitions are made, the time and the way of use; based on this data the producer periodically requests the payment of an adequate sum of money. In this way the lump sum payment is overtaken, in favour of a more continuous cash flow for the company and a dilution of the cost for the customer over the entire product life cycle.

6.4.8 Conclusion

Finally, to conclude the paragraph on household Appliance Manufacturers, Transformation Impact matrix has been applied these actors, in order to evaluate the impact that new business strategies and the new required competences could have (Figure 90).

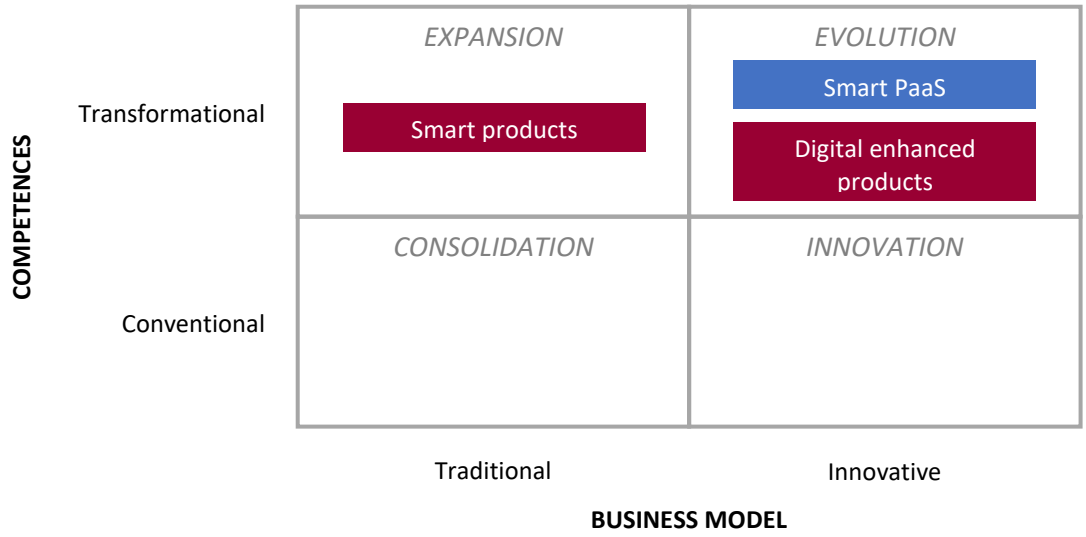

Figure 90: Appliance Manufacturers Transformation Impact Matrix

The transformation of household appliances into connected and *smart products* requires producers the ability to insert more and more lines of code into the machines, creating a software component that has considerable importance, as well as the ability to manage and analyse the amount of data coming from products. Furthermore, with the opening up to services in *digital enhanced products* and *smart PaaS*, are set the conditions for the definition of new business models, focused on the product's digital nature.

As already mentioned, integration of home appliances with voice assistants has been already happened: almost all international manufacturers are realising skills and creating the possibility to control appliances through smart speakers. Another interesting trend is in the decision to not choosing a single partner, Google or Amazon or Apple, but to collaborate with every one of them, giving customers the opportunity to combine products with the most appreciated artificial intelligence. The next step seems to be the inclusion of AI inside appliances, without the need for the mediation of a speaker or smartphone; this revolution is already close in the refrigerators, while the convenience of this configuration with other household products is to be verified.

6.5 Ecosystem Layers Model and Data Valorisation Matrix

Up to now the discussion about the three actors has proceeded in parallel, maintaining a common structure but highlighting the characteristics and the specific work of each of them individually.

The purpose of this chapter is to analyse Telcos, Utilities and Appliance Manufacturers with common tools, in order to compare the behaviours of these actors in the Smart Home scenario. Following this comparison, there will be the attempt of extracting a general insight, a knowledge which then it could be extended and used also towards other actors of the ecosystem.

For this reason, has been tried to standardize the two dimensions of analysis already taken into consideration in actors' dissertation: *business strategies* and *data usage* purposes. To obtain a higher degree of formalization has been made a re-elaboration of matrixes crossing these two dimensions. The axes have been replaced with two standard classifications that have already been contextualised for the actors: *ecosystem layers*, used in place of the business strategies, and *data valorisation methodologies*, substituted to the data usage purposes.

The intermediate step, the link between the characteristic traits (*business strategies* and *data usage*) and the standard models (*ecosystem layers* and *data valorisation methodologies*) has already been explained and inserted, for each actor, in the relative paragraphs. What has been done is a simple substitution in the matrix by following the matching already expressed in the actors' paragraphs.

6.5.1 Actors' Matrixes

What is presented below are matrixes able to explain the existing relationships between the *ecosystem layers* and data *valorisation methods*. A matrix for each of the actors has been created.

Telcos

The first one presented, following the order previously adopted, is the Telcos' one (Figure 91).

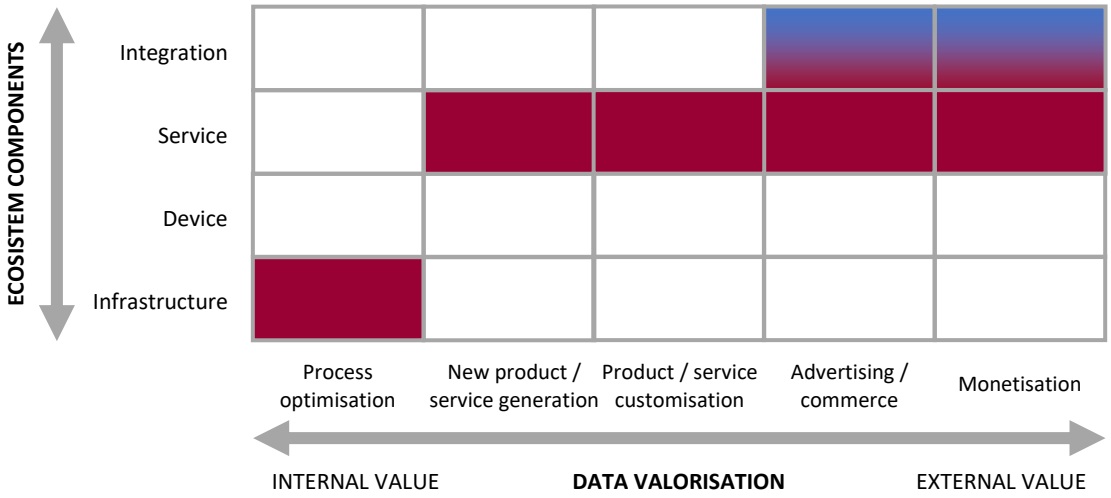

Figure 91: Telcos Ecosystem Layers and Data Valorisation Methodologies Matrix

To be clearer, intersections presented in Figure 91 are obtained simply by reporting the matching between business strategies and data usage with the new axes, along the same line of what was previously explained respectively in Figure 73, Figure 74, Figure 75 and Figure 76.

To give a more specific idea of what the coloured boxes mean, the same example already used to explain Figure 77 are re-proposed.

The intersection between *infrastructure* and *process optimisation,* refers to all the optimisation activity related to networks, from maintenance to expansion and upgrading of them, with the objective of ensuring a high of service for customers.

The intersection between *service* with *new product/service generation* and *product/service customisation* refers both to the creation or personalisation of "stand alone" Smart Home proposal, in order to satisfy customer requirements collected through the data analysis. Companies create product responding to specific use-cases or customise existing services on the basis of what client needs. An example can be V by Vodafone, a collection of smart objects connected design to solve explicit needs in the everyday life (use-cases). The offer consists in the sale of physical product and the subscription of a related connectivity service that enable product function; subscription can be activated and deactivated at customer will, allowing the company

to understand how these services are used by people. This leaves the door wide open to a greater customization of the subscription for the future, based on the habits and uses of the customer. Other cases related to the crossing between *service* and *new product/service generation* are the offer of proprietary services on a Smart Home platform created by Telco itself, as for example the 24/7 security service with professional monitoring offered by Comcast to its Xfinity Home customers.

For what concern the intersection between *service* with *advertising/commerce* and *monetisation*, refers to the possibility for Telco to take advantage of the data collected from the services offered. This ca be done re-elaborating data to obtain information useful to target marketing actions (*advertising/commerce*) or information processed can be sold to external actors (*monetisation*).

Integration plus *advertising/commerce* refers to services offered on a Telco's Smart Home platform but provided by third parties. For example, DT Magenta Smart Home platform have already integrated smart car services by Volkswagen and insurance services from Ergo, a German insurance company.

Finally, in the intersection between i*ntegration* and the *monetization* of the data, data are used to favour the meeting between supply and demand on the proprietary SH platform. In this case Telcos are remunerated for this intermediation role, with hidden revenues based on the number of successful contacts created.

Energy Utilities

The successive chart, Figure 92, represents the scenario for Utilities. It is built following the matching already presented in Figure 80, Figure 81, Figure 82 and Figure 83.

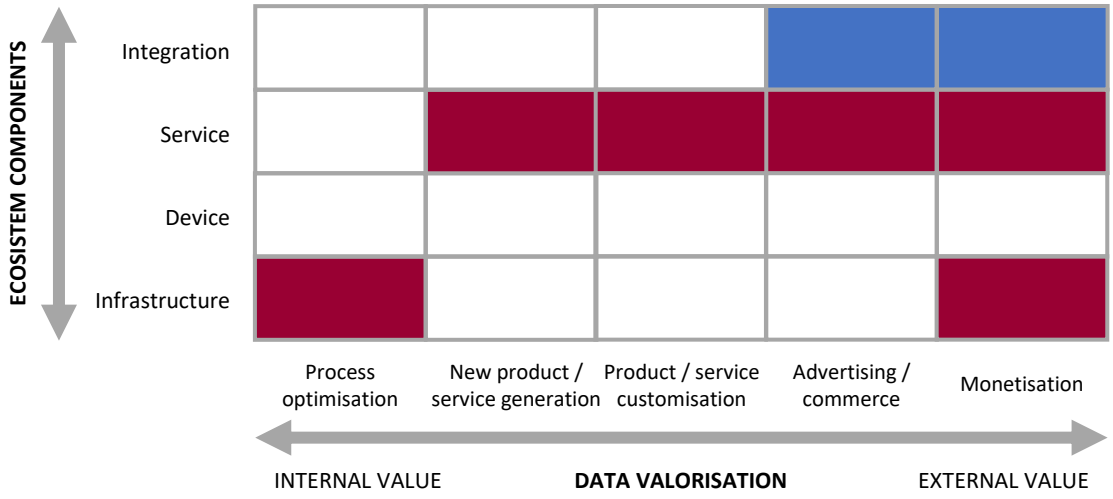

Figure 92: Energy Utilities Ecosystem Layers and Data Valorisation Methods Matrix

As before, the same example already used to explain Figure 84 are re-proposed, to facilitate the understanding of relationships.

Figure 92 is quite similar the Telco one (Figure 91), with only one small difference: the presence of an intersection between *infrastructure* and *monetisation*. This case refers to the possibility for Utilities to sell data and information about grids to interested companies. Beyond government and supervision bodies, energy producers (which often do not coincide with energy sellers) could be an example of firms strongly interested in this type of data.

The other match of *infrastructure*, the one with *process optimisation*, refers to all the activities of grid and energy efficiency, such as the production of energy based on houses consumptions or demand-response programs, which can be activated thanks to the wide availability of data that can be collected with smart metering.

Service and *new generation of product/service* intersection represents the new non-energy services that the Utility could open in the Smart Home context. Some of the examples described before include maintenance services for many types of equipment rather than video surveillance services.

Instead, *Service* and *product/service customisation* intercept, refers in Utility to only services. They are aimed at supporting the customer to save more energy, scenario made possible by the advent of smart meters. A couple of devices able to send data on electricity consumption are in

the test phase in Italy, enabling new features such as consumption control with the relative expense, but also advising customers for a more responsible energy use.

Integration and *monetisation*, refers to the possibility of selling the wide quantity of data obtainable from the implementation of a platform, which allows the Utility to aggregate the information coming from different services. Similar remarks for *service* and *monetisation*, even if the quality of the insights could be lower.

The cases of *service* and *integration* regarding *advertising / commerce*, on the other hand, differ significantly. If in the first case the data are used for directing to the customer Utilities' service offers that exactly match his needs, increasing the effectiveness of sales. In the second case, in addition to a targeted marketing, there is the possibility to trade third-party services.

Appliance Manufacturers

The last chart, Figure 93, obviously represent household Appliance Manufacturers matchings, realized on the basis of what was expressed in Figure 86, Figure 87 and Figure 88.

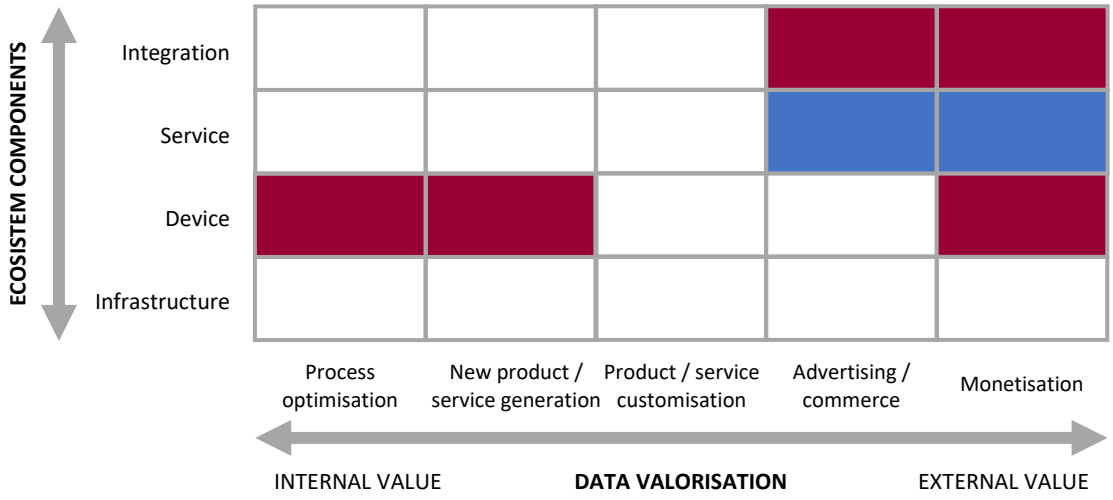

Figure 93: Appliance Manufacturers Ecosystem Layers and Data Valorisation Methods Matrix

Figure 93 seems to be quite different compared to Telcos' and Utilities' ones.

Moving to examples, the intersection between *device* and *process optimisation* represent the improvement possibilities of product assistance and maintenance process, reached through the data collected from home appliances. Depending on the manufacturer, the process is

implemented differently, as seen in precedence in the cases of LG Smart Diagnosis, Samsung HomeCare Wizard or Miele assistance service.

Device and *new product/service generation* matching is linked to the possibility of improving the next generation of product thanks to the diagnostics data collected. For example, having information about the product features utilisation, for manufacturer is possible eliminating functionalities which are barely used by customers, saving production costs; while they can improve customers' favourite functions or make them more accessible.

The appliance servitisation can be identified in the meeting between *service* and *advertising/commerce.* Diagnostics allow the manufacturer to understand how many cycles or ignitions are made, the time and the way of use; on the basis of this data the producer periodically requests the payment of an adequate sum of money. In this way the lump sum payment is overtaken, in favour of a more continuous cash flow for the company and a dilution of the cost for the customer over the entire product life cycle.

The intersection of *advertising/commerce* with *integration* refers to the offering of third-parties digital services through devices, generating new revenue streams for manufacturing companies. Here is the reference to the refrigerators with screen, from which householders can control many services. This service can be provided from the home appliances manufacture, but also from and external players, who would remunerate the Appliance Manufacturer for the visibility offered to him.

Are still to be contextualised cases concerning *monetization*. In the matching with *device* reference is made to the sale of data concerning the diagnostics of household appliances and consumer use habits. The first could be interesting for companies operating in the field of assistance and maintenance of appliances; the latter, on the other hand, have great importance for the Utility, which, as was highlighted in interviews with both types of actor, want to know this information as they strongly impact their business.

Similar remarks for *monetization* plus *services* in which, since it refers home appliance "rental" service, the data extracted by Appliance Manufacturer are those attributable to the use of the product by the consumer. This situation therefore coincides with the previous case.

Finally, the intersection between *monetization* and *integrator*. Here the information available to the manufacturer of home appliances is extensive, as they also include data obtained from the services. As a result these could be sold to interested companies in a sort of data marketplace.

6.5.2 Generalised Model

By comparing the three matrices, a common pattern can be easily identified: the Telco matrix (Figure 91) is almost equal to the one of the Utilities (Figure 92).

While, for what concern Appliance Manufacturers, they are present in a level (device) which is completely blank for the other actors.

Considering correspondences and differences, it was decided to produce a further chart containing all the relationships highlighted in the 3 actors' charts, thus representing both the overlapping and the "unique" pairings. Result is presented in Figure 95.

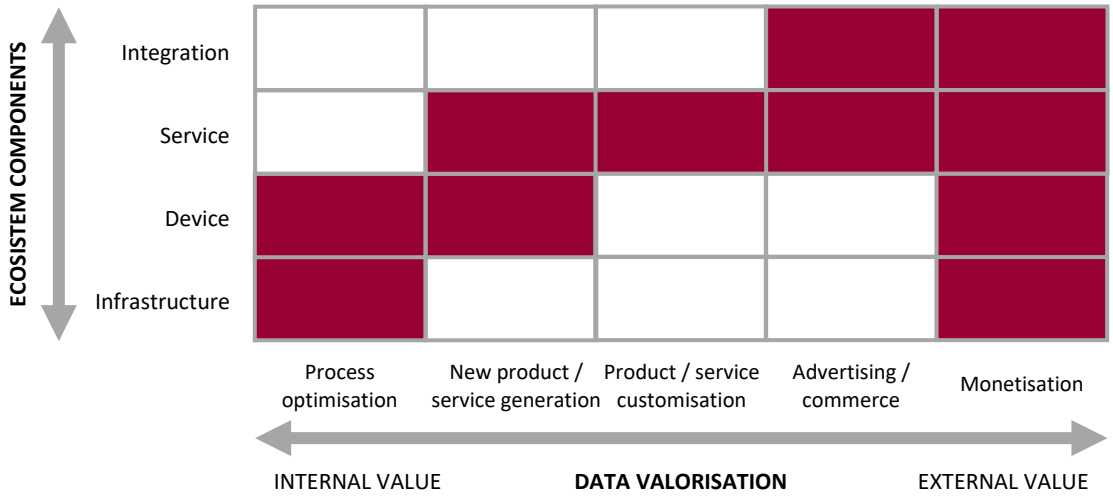

Figure 94: general Ecosystem Layers and Data Valorisation Methods pattern

A particular trend emerges in these graph: when the scope in the ecosystem changes going to "a superior level", also the methods for data valorisation change, moving towards approaches more focused on an external value generation. In other words, value created is delivered to other actors involved in the ecosystem or to the customer. The "lower" scopes, on the other hand, are more oriented towards an internal valorisation of the data, that is exploiting the extracted knowledge

to improve certain aspects related to the company itself. The only exception to this trend is the data monetization, which can be seen at all layers.

As a consequence, an actor strongly integrated in the ecosystem, capable of occupying multiple levels and thus supplying more components of the ecosystem, will have a higher possibility of exploiting the data, as it can use all 5 methodologies proposed in the model. An example in this sense are Telcos, which, as seen previously, although acting on only 3 of the 4 levels (infrastructure, service, integration), could use all the 5 methods described.

Figure 94 therefore offers a clear indication of which data valorisation methods should be exploited by an actor to reach the desired purpose it wants to pursue within the Smart Home. Consequently, a company can structure itself and foresee the skills necessary to achieve that purpose.

7. CONCLUSIONS

The last chapter closes the thesis retrieving the main steps that have permitted to solve the two research questions. The key findings are highlighted as well as the implications for both practitioners and scholars. Finally, a guideline for possible future studies is provided.

7.1 Conclusions and Implications

The purposes of this dissertation initially were born from an exigency of the Internet of Things Observatory of mapping the value creation and strategies in the Internet of Things universe. As suggested by the word "universe", it was clear that finding out significant results from a so vast analysis was not simple and effective. Thus, the study was focused just on the consumer stream of the IoT, leaving out the business-to-business sub-industries. Successively, the scope was further tightened because the various B2C applications have too many inconsistencies among each other. In the end, it was decided to focus on the Smart Home, one of the most attractive and profitable streams of the Consumer Internet of Things.

Papers and white papers, as well as other secondary sources, recognized strong gaps in the state-of-the-art analysis of Smart Home offering and value creation strategies. These gaps have been confirmed from the interviewed managers who pinpointed lacks in the business model definitions and in the identification of sustainable path to profits in this new industry characterized by different actors and roles in the value network, importance of data streams and necessity of upgrading competences and processes.

As follows, the requirements of this thesis were to satisfy both academics and practitioners needs: Chapter 5 started from previous scholars' findings for realizing models able to solve the gaps; Chapter 6 exploited use cases, examples and real applications to work the theoretical models over three actors, providing to the practitioners the right tools for applying these frameworks in their strategy definition.

Likewise, the research addressed the need of moving from technology-based analysis of the Smart Home towards managerial outlooks, recognizing the radical impact of the digitalization on the Home market and identifying tools for acting at value network level.

For theory, the work adds to the current business model research in the emerging context of Internet of Things both theoretically founded and field-tested strategic frameworks. In this way researchers can readily use the frameworks for analysing Smart Home business model patterns in an efficient and structured way.

For practitioners, the artefacts serve as tool for depicting, analysing and envisioning their value-orientation in the Smart Home. By making recent IoT-driven market dynamics and specifics of digitized goods and services explicit, the artefacts are able to decidedly support business model development. Without a clear view on market dynamics and collaborative value creation logic, it is hard to create sustainable Smart Home ecosystems and be a competitive part of it, which is the today situation for many companies.

Listing and deepening the specific research results:

- A *detailed study of the Smart Home offers* is provided, starting from a database of 408 solutions able to point out the value propositions on the market and the most diffused business models;
- The value creation at network level is identified and opens the doors to a *comprehensive analysis on the Smart Home ecosystem peculiarities*, with a particular focus on the evolution stage, challenges and platform issues;
- A framework for *assessing the strategic impact of the intelligent objects on the Home market* is provisioned: the Transformation Intensity matrix permits the companies to assess which type of transformation is necessary, ranging from a static consolidation of the business, to expansive or innovative strategies, up to real evolution of the strategy;
- The Smart Home Ecosystem Layers model is designed *to identify the different scopes in the Smart Home ecosystem* and to orchestrate the various roles of the actors;
- The Data Valorisation model of the Internet of Things Observatory is contextualized in the Smart Home market, supported by a *meticulous investigation on data opportunities* in the industry;
- A focus on three actors is exploited for showing *how to implement the frameworks and how to assess a value-driven analysis of Smart Home companies*. For each actor, after a

SWOT used to outline their features, the declining/stable/growing strategies are contraposed to the future ones and the different actual and next data usages are presented. They are successively generalized using the Ecosystem Layers & Data Valorisation matrix, which shows the *possible correspondences between scope levels in the value network and data valorisation modes*.

Concluding, for academics, this study is important because it is a call for a major shift in value creation research. It argues that business models should not be broken down into a number of unconnected components in the way of the majority of previous business model research. Instead, studies should focus on investigating ecosystem business models and the way these models generate and capture value through different value flows.

For managers, this study is like a roadmap for reaching their destinations. It can be used by newco, startups and incumbents for understanding how the offering is developing and finding out the right space in the market; it gives the right pillars for understanding the deep features of the Smart Home ecosystem; it permits the evaluation of the strategic effects of IoT on the Home market in terms of business model sand competences; it lets a company to understand the right positioning in the ecosystem and how to exploit the data for increasing value. Moreover, this dissertation does not provide just theoretical tools but also shows how an actor may exploit them offering three detailed examples on Telcos, Energy Utilities and Appliance Manufacturers.

7.2 Future Developments

Obviously, despite this dissertation brings important improvements in the Smart Home research, for having an exhaustive strategic study on the overall Smart Living industry, future improvements are necessary.

As regards the analysis of the offering, it is an up-to-date photography which needs to be continuously upgraded for underlining how the services and devices offers will evolve year after year and detaching the newest trends.

Then, the provided models focus just on three of the main Smart Home actors: it will be appealing to apply the same path for describing the other entities. Once a complete analysis of all the involved companies will be performed, the necessary conditions for outlining the overall Smart

Home value network will be realized. It will be useful showing which are the roles that each actor can cover, which strategies may be applied and how the different actors will work together and how they will exchange value.

Moreover, this study chooses a high strategical level of analysis. Future research must aim also at providing clear paths for the implementation of the identified strategies and at studying which are the internal and external processes that permit to create value within a defined mission.
Also deepening the business models building blocks or examining in detail the competences stream can furnish improvements for the realization of sustainable strategies.

As regards data topic, this thesis prefers to take advantage of the already existing Data Valorisation model, realized by Internet of Things Observatory. A future development can be instead converged on which are the specific value modes in the Smart Home market. Indeed, it has been stressed how the knowledge and application of data exploitation strategy are still immature: the future market growth also from this point of view can lead to more relevant data valorisation schemes suited just for the precise value network layers or, even more, on the explicit actors. Additionally, the exogenous conditions for data monetization can permit to better exploit these opportunities and the relative modelling in future.

Furthermore, the nature of this work is explicitly qualitative. Successively, more quantitative studies can assess, though variables and parameters, the numerically differences among strategies investigating related cost structures, revenues and profits. Other quantitative researches can address the pricing policies associated to the various business models, evaluate the different partnerships choices within the value network or numerically highlight the advantages for the final consumer.

Finally, enlarging the scope to the big domain of the Internet of Things, some of the models presented in this research can be directly applied to other IoT industries, like the Transformation Intensity matrix, while other can be used as a good starting point for adapted frameworks, like the Smart Home Ecosystem Layer model.

BIBLIOGRAPHY

Accenture, 2017, *Race to the Smart Home* (white paper).

Accenture, 2015, *The new battleground for communication and technology* (white paper).

Aiello M. et al., 2011, *Smart Homes to Improve the Quality of Life for All*, International Conference on Advanced Information Networking and Applications Workshops.

Al-Debei M. et al., 2013, *The Role of Value Networks in the Design of Mobile Platforms:The Case of Apple iPhone*, Approaches and Processes for Managing the Economics of Information Systems.

Albuquerque H., Soares de Aquino G., 2014, *Solution to Interoperability Protocols Smarthomes*, Iberian Conference on Information Systems and Technologies (CISTI).

Aldrich F.K., 2003, *Smart Homes: Past, Present and Future*, Inside the Smart Home.

Allee V., 2002, *The Future of Knowledge*.

Arris, 2015, *What is the role of connected home gateways and set-tops in the IoT?* (white paper).

Baffalio Y. et al., 2013, *Smart Home: hope or hype*?, Thoughts, Greenwich consulting .

Balta-Ozkan N. et al., 2013, *Social barriers to the adoption of smart homes*, Energy Policy.

Balta-Ozkan N. et al., 2014, *European smart home market development: Public views on technical and economic aspects across the United Kingdom, Germany and Italy*, Energy Research & Social Science.

Bhardwaj S., 2016, *Review and Study of Internet of Things: It's the Future*, International Conference on Intelligent Control Power and Instrumentation (ICICPI).

Bhimani A., 2015, *Exploring big data's strategic consequences*, Journal of Information Technology.

Borgia E., 2014, *The Internet of Things vision: Key features, applications and open issues*, Computer Communications.

Brink M., van Bronswijk J., 2013, *Addressing Maslow's deficiency needs in smart homes*, Gerontechnology.

Brush B. et al., 2011, *Home Automation in the Wild: Challenges and Opportunities*, ACM Conference on Computer.

Bucherer E., Uckelmann D. 2011, *Business Models for the Internet of Things*, Architecting the Internet of Things.

Chaudhary R. et al., 2015, *Business model innovation through Big Data*, International Conference on Green Computing and Internet of Things.

Chunfang G., Zhongliang G., 2015, *Innovation of Enterprise Profit Patterns Based on Big Data*, International Conference on Logistics, Informatics and Service Sciences.

Ciesielska M., Li F., 2011, *The Connected Home: From Market Barriers to Business Model Solutions*, Conference on e-Business, e-Services and e-Society.

Constantiou D., Kallinikos J., 2014, *New games, new rules: big data and the changing context of strategy*, Journal of Information Technology.

Cook D. et al., 2013, *CASAS: A smart home in a box*.

De Silva C.,2012, *State of the art of smart homes*, Engineering Applications of Artificial Intelligence.

Delgado A.R. et al., 2006, *Remote-Controlled Home Automation Systems with Different Network Technologies*, International Conference on Advances in Engineering & Technology Research.

Deloitte, 2015, *Business Ecosystem Come of Age,* (white paper).

Dijkman R. et al., 2015, *Business models for the Internet of Things*, International Journal of Information Management.

Drucker P., 1973, *Management: tasks, responsibilities, practices*.

Ehrenhard M. et al., 2014, *Market adoption barriers of multi-stakeholder technology: Smart Homes for the aging population*, Technological Forecasting & Social Change.

Fernández R. et al., 2015, *Using the Big Data generated by the Smart Home to improve energy efficiency management*, Energy Efficiency.

Furtado L. et al., 2016, *Characterizing the Value Creation in Organizations That Implement Big Data Environments*, International Conference on Transdisciplinary Engineering.

Gambi E. et al., 2017, *Interoperability in IoT Infrastructures for Enhanced Living Environments*, International Black Sea Conference on Communications and Networking.

George G., 2014, *Big Data and Management: From the Editors*, Academy of Management Journal.

Gerpott T., May S., 2016, *Integration of Internet of Things components into a firm's offering portfolio – a business development framework*, Digital Policy, Regulation and Governance.

Ghayvat H. et al., 2015, *Internet of Things for smart homes and buildings: Opportunities and Challenges*, Australian Journal of Telecommunications and the Digital Economy.

Glovaa J., 2014, *Business models for the Internet of Things environment*, Procedia Economics and Finance.

Gonçalves V., Dobbelaere P., 2010, *Business Scenarios for Machine-to-Machine Mobile Applications*, International Conference on Mobile Business.

Gungor V. et al., 2012, *Smart Grid and Smart Homes: Key Players and Pilot Projects*, Industrial Electronics Magazine.

Hanchuan X. et al., 2012, *Business Process Modeling and Design of Smart Home Service System*, International Joint Conference on Service Sciences.

Hartmann P. et al., 2016, *Capturing value from big data – a taxonomy of data-driven business models used by start-up firms*, International Journal of Operations & Production Management.

Heetae Y. et al., 2017, *User acceptance of smart home services: an extension of the theory of planned behavior*, Industrial Management & Data Systems.

Helander N., Rissanen T., 2015, *Value-creating networks approach to open source software business models*, Frontiers of E-Business Research.

Hosein A. et al., 2013, *The essence of future smart houses: From embedding ICT to adapting to sustainability principles*, Renewable and Sustainable Energy Reviews.

Huan L., Zheng-zhong X., 2013, *Research on Business Model of Internet of Things Based on MOP*, International Asia Conference on Industrial Engineering and Management Innovation.

Hubert C. Y. Chan, 2015, *Internet of Things Business Models*, Journal of Service Science and Management.

Iansiti M., 2004, *The Keystone Advantage: What the New Dynamics of Business Ecosystems Mean for Strategy, Innovation, and Sustainability.*

Irene C., Wakenshaw S., 2016, *The Internet-of-Things: Review and research directions*, International Journal of Research in Marketing.

Jacobsson A., 2014, *A risk analysis of a smart home automation system*, Future Generation Computer Systems.

Jacobsson A., Davidsson P., 2015, *Towards a Model of Privacy and Security for Smart Homes*, World Forum on Internet of Things.

Jeu Young K. et al., 2015, *Smart Home Web of Objects-based IoT Management Model and Methods for Home data mining*, Asia-Pacific Network Operations and Management Symposium (APNOMS).

Jing D. et al., 2014, *Research on Enterprise Competitive Intelligence Development and Strategies in the Big Data Era*, International Conference on Computer and Information Technology.

Jua J. et al., 2016, *Prototyping Business Models for IoT Service*, Procedia Computer Science.

Kaliczyńska M., Dąbek P., 2014, *Value of the Internet of Things for the Industry – An Overview*, Mechatronics - Ideas for Industrial Application.

Kamilaris A., 2013, *Towards interoperable and sustainable smart homes*.

Keskin T., Kennedy D., 2015, *Strategies in Smart Service Systems Enabled Multi-sided Markets: Business Models for the Internet of Things*, Hawaii International Conference on System Sciences.

Kim J. et al., 2012, *Seamless Integration of Heterogeneous Devices and Access Control in Smart Homes*, International Conference on Intelligent Environments.

Komarov M., Nemova M., 2013, *Emerging of new service-oriented approach based on the Internet of Services and Internet of Things*, International Conference on e-Business Engineering.

Kralewski D., 2016, *Business Models and The Internet Of Things*, EuroSymposium.

Kyriazisa D., Varvarigoua T., 2016, *Smart, autonomous and reliable Internet of Things*, International Workshop on Communications and Sensor Networks.

Labonnote N., Høyland K., 2015, *Smart home technologies that support independent living: challenges and opportunities for the building industry – a systematic mapping study, Intelligent* Buildings International.

Laya A., Markendahl J., 2013, *The M2M Promise, What Could Make it Happen?*, International Symposium on "A World of Wireless, Mobile and Multimedia Networks" (WoWMoM).

Lê et al., 2012, *Smart Homes for Older People: Positive Aging in a Digital World*, Future Internet.

Lee I., Lee K., 2015, *The Internet of Things (IoT): Applications, investments, and challenges for enterprises*, Business Horizons.

Leminen S., 2012, *Towards IOT Ecosystems and Business Models*, NEW2AN 2012.

Li Y., et al., 2012, *Towards a theoretical framework of strategic decision, supporting capability and information sharing under the context of Internet of Things*, Information Technology and Management.

Li-Hsing S. et al., 2016, *Creating Customer Value for Product Service Systems by Incorporating Internet of Things Technology*, Conference on Sustainability.

Ma M. et al., 2013, *Data Management for Internet of Things: Challenges, Approaches and Opportunities*, International Conference on Green Computing and Communications.

Mainetti L. et al., 2015, *An IoT-based User-centric Ecosystem for Heterogeneous Smart Home Environments*, International Conference on Communications.

Mäkinen S., 201, *Internet-of-things disrupting business ecosystems: a case in Home Automation*, International Conference on Industrial Engineering and Engineering Management.

Mani Z., Chouk I., 2017, *Drivers of consumers' resistance to smart products*, Journal of Marketing Management.

Markendahl J., Laya A., 2013, *Business challenges for Internet of Things: findings from e-home care, smart access control, smart cities and homes*, IMP Conference.

Martin D., Allen A., 2013, *Intermediaries for open innovation: A competence-based comparison of knowledge transfer offices practices*, Technological Forecasting and Social Change.

Marx K., 1867, *Capital*.

Mazhelis O. et al., 2012, *Defining an Internet-of-Things Ecosystem*, NEW2AN 2012.

Mazzei M., Noble D., 2017, *Big data dreams: A framework for corporate strategy*.

McKinsey, 2017, *A Smart Home is where a bot is*, (white paper).

Mejtoft T., 2012, *Internet of Things and Co-creation of Value*, International Conferences on Internet of Things, and Cyber, Physical and Social Computing.

Mennicken S., May H., 2012, *Hacking the Natural Habitat: An in-the-wild study of smart homes, their development, and the people who live in them*, International Conference on Pervasive Computing.

Melin L., Naldi L., 2013, *Dynamics of Business Models: Strategizing, Critical Capabilities and Activities for Sustained Value Creation*, Achtenhagen.

Miori V., Russo D., 2014, *Domotic evolution towards the IoT*, International Conference on Advanced Information Networking and Applications Workshops.

Monacchi A. et al., 2013, *Integrating Households into the Smart Grid*, Workshop on Modeling and Simulation of Cyber-Physical Energy Systems.

Monteiro P. et al, 2015, *Domotics Control System Architecture*, Iberian Conference on Information Systems and Technologies.

Moore J., 1993, *Predators and Prey: A New Ecology of Competition*, Harvard Business Review.

Moore J., 1996*, Death of Competition*, Harvard Business Review.

Muegge S., 2011, *Business Ecosystems as Institutions of Participation: A Systems Perspective on Community-Developed Platforms*, Technology Innovation Management Review.

Nassour S., Assoum R., 2016, *MNO's Approaches for Building loT Strategies*.

Nikayin F. et De Reuver M., 2013, *What motivates small businesses for collective action in smart living industry?*, Journal of Small Business and Enterprise Development.

Olsson H. et al., 2016, *User Dimensions in the 'Internet of Things' Systems: the UDIT Model*, International Conference of Software Business.

Osterwalder A., Pigneur Y., 2010, *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers*.

Osterwalder A. et al., 2005, *Clarifying Business Models: Origins, Present, and Future of the Concept*, Communications of the Association for Information Systems.

Ovans A., 2015, *What is a business model?,* Harvard Business Review.

Peltoniemi M., Vuori E., 2008, *Business Ecosystem as the New Approach to Complex Adaptive Business Environments*, Business & Economics.

Peppard J., Rylander A., 2006, *From value chain to value network: Insights for mobile operators*, European Management Journal.

Perera C. et al., 2016, *Valorising the IoT Databox: creating value for everyone*, Transactions on emerging telecommunication technologies.

Peruzzini M., Giordani M., 2015, *A Service-oriented Architecture for Ambient-assisted Living*, International Conference on Concurrent Engineering.

Pfeffer J., Salancik G., 1978, *The External Control of Organizations: A Resource Dependence Perspective*.

Porter M., 1985, *Competitive Advantage: Creating and Sustaining Superior Performance*.

Porter M., Heppelmann J., 2014, *How Smart, Connected Products Are Transforming Competition*, Harvard Business Review.

Porter M., Heppelmann J., 2015, *How Smart, Connected Products Are Transforming Companies*, Harvard Business Review.

Prahalad C., Hamel G., 1990, *The Core Competence of the Corporation, Harvard Business Review*.

Prince K. et al., 2014, *Dialogical strategies for orchestrating strategic innovation networks: The case of the Internet of Things*, Information and Organization.

Qin Y. et al., 2016, *When things matter: A survey on data-centric IoT*, Journal of Network and Computer Applications.

Raisul Alam M. et al., 2012, *A Review of Smart Homes - Past, Present, and Future*, Transactions on emerging telecommunication technologies.

Reinisch C., 2010, *ThinkHome: A Smart Home as Digital Ecosystem*, International Conference on Digital Ecosystems and Technologies.

Riggins F., Wamba S., 2015, *Research Directions on the Adoption, Usage and Impact of the Internet of Things through the Use of Big Data Analytics*, Hawaii International Conference on System Sciences.

Robles R.J., Kim T., 2015, *Applications, Systems and Methods in Smart Home Technology: A Review*, International Journal of Advanced Science and Technology.

Rong K. et al., 2015, *Understanding business ecosystem using a 6C framework in Internet-of-Things-based sectors*.

Saarijärvi H. et al., 2014, *Reverse use of customer data: implications for service-based business models*, Journal of Services Marketing.

Sadovskyi O. et al., 2014, *Analysis of Big Data enabled Business Models using a Value Chain Perspective.*

Samuel S., 2016, *A Review of Connectivity Challenges in IoT-Smart Home*, International Conference on Big Data and Smart City.

Schreieck M., Wiesche M., 2017, *Governing Platforms in the Internet of Things*, International Conference on Software Business.

Shah M., 2015, *Big Data and the Internet of Things, Discovering Networks of Interdependent Features in High-Dimensional Problems*.

Shin H. et al., 2016, *Method to design and analyze an interactive product based on design elements for creating an IoT-based service*, International Journal of Smart Home.

Skarzauskiene A., 2015, *The internet of things: When reality meets expectations International,* Journal of Innovation and Learning.

Solaimani S. et al., 2010 , "*Smart Home: Aligning Business Models and Providers Processes: A case survey*", Australasian Conference on Information Systems (ACIS).

Solaimani S. et al., 2013, *What we do – and don't – know about the Smart Home: An analysis of the Smart Home literature*, Indoor and Built Environment.

Solaimani S., 2015, *Networked enterprise business model alignment: A case study on smart living*, Information Systems Frontiers.

Stojkoska R., Trivodaliev V., 2016, *A review of Internet of Things for smart home: challenges and solutions*, Journal of Cleaner Production.

Takenaka T. et al., 2016, *Enhancing products and services using smart appliance networks*, Manufacturing Technology.

Talvitie J., 2011, *Business Ecosystem creation*, Tivit Business Forum.

Tien J., 2015, *Internet of Connected ServGoods: considerations, consequences and concerns*, Journal of Systems Science and Systems Engineering.

Timmers P., 1998, *Business Models for Electronic Markets*, Electronic Markets.

Turber S. et al., 2014, *Designing Business Models in the Era of Internet of Things*, International Conference on Design Science Research in Information Systems.

Uchihira N. et al., 2015, *Service innovation structure analysis for recognizing opportunities and difficulties of M2M businesses*, Technology in Society.

Uchihira N. et al., 2016, I*oT service business ecosystem design in a global, competitive, and collaborative environment*, International Conference on Management of Engineering and Technology.

Uchihira N., Ishimatsu H., 2015, *Service Modeling Method for Machine-to-Machine Businesses to Overcome Difficulties*, International Conference on Management of Engineering and Technology.

Urmetzer F. et al., 2016, *Business Ecosystems: Towards a Classification Model*, World Congress on Production and Operations Management (P&OM 2016).

Vimarlund V., Wass S., 2014, Big Data, *Smart Homes and Ambient Assisted Living*.

Westerlund M. et al., 2014, *Designing Business Models for the Internet of Things*, Technology Innovation Management Review.

Westerlund M., 2011, *Insights into the dynamics of business models in the media industry*.

Wich M., Kramer T., 2016, *Enrichment of Smart Home Services by Integrating Social Network Services and Big Data Analytics,* Hawaii International Conference on System Sciences.

Wilson C. et al., 2014, *Smart homes and their users: a systematic analysis and key challenges*, Personal and Ubiquitous Computing.

Woerner S., Wixom B., 2015, *Big data: Extending the business strategy toolbox*, Journal of Information Technology.

Wuenderlich N. et al., 2015, *"Futurizing" smart service: implications for service researchers and managers*, Journal of Services Marketing.

Yonghee K. et al., 2017, *A study on the adoption of IoT smart home service: using Value-based Adoption Model*, Total Quality Management & Business Excellence.

Yongsheng Z. et al., 2015, *The Business Mode Innovation in Big Data Era*, Eastern Academic Forum.

Young-Mo K. et al., 2015, *A Study on the Internet of Things (IoT) Applications*, International Journal of Software Engineering and Its Applications.

Ziefle M., Röcker C., 2011, *Medical Technology in Smart Homes: Exploring the User's Perspective on Privacy, Intimacy and Trust*, International Computer Software and Applications Conference.

SITOGRAPHY

3GPP, 2017 http://www.3gpp.org

Acotel, 2018 http://www.acotel.com/index.php/2018/01/29/acotel-ed-e-on-al-via-il-test-dello-smart-metering-su-contatori-2g/

Agenda Digitale, 2017 https://www.agendadigitale.eu/infrastrutture/ecco-le-vere-innovazioni-dietro-ai-nuovi-contatori-elettrici-smart/

Apple, 2017 https://www.apple.com/it/ios/home/

AREA, 2017 https://www.arera.it/it/operatori/smartmetering.htm

British Gas, 2017 https://www.britishgas.co.uk/home-services/home-cover/

Bundles, 2017 https://www.bundles.nl

Business Insider, 2017 http://www.businessinsider.com/tesla-investing-350-million-gigafactory-hiring-500-workers-2017-1?IR=T

Corriere Comunicazioni, 2018 https://www.corrierecomunicazioni.it/media/internet-of-things-al-decollo-agcom-sim-m2m-aumento-4-milioni/

Digital Trends, 2018 https://www.digitaltrends.com/home/ces-2018-xfinity-2018-interview-daniel-herscovici/

Digital Life, 2017 https://my-digitallife.att.com/learn/home-security-and-automation

Deutsche Telekom, 2017 https://www.telekom.com/en/media/media-information/archive/dt-is-making-million-households-smart-494522

E.On, 2017 https://www.eon-energia.com/it/casa/climasmart/termostatointelligente.html

Edison Pulse, 2016 https://edisonpulse.edison.it

Electrek, 2017 https://electrek.co/2017/01/30/electric-vehicle-battery-cost-dropped-80-6-years-227kwh-tesla-190kwh/

Enel, 2017 https://startup.enel.com/it/media/news/d201703-innovation-hub.html

Engie, 2017 https://www.engie.it/engie-partner-di-nest

ENI, 2017 https://www.eni.com/it_IT/media/news/2017/06/eni-entra-in-talent-garden-nuova-energia-allinnovazione

Engadget, 2018 https://www.engadget.com/2018/01/10/amazon-virtual-dash-buttons-sdk/

Estra, 2018 https://www.estra.it/posts/news/notizia-estra-prima-utility-in-italia-a-sperimentare-i-contatori-2-0%20/485

European Communication, 2018 https://www.eurocomms.com/industry-news/12788-o2-uk-to-shut-smart-home-service-after-low-take-up

Forbes, 2017 https://www.forbes.com/sites/howardbaldwin/2015/01/22/when-big-data-projects-go-wrong/#64460b3c6427

GE Appliances, 2018 http://products.geappliances.com/appliance/gea-support-search-content?contentId=34271

GFK, 2017 http://www.gfk.com/insights/press-release/small-domestic-appliances-trending-to-convenience-health-and-connectivity/

Google OnHub, 2018 https://on.google.com/hub/

Handelsblatt, 2017 https://global.handelsblatt.com/companies/big-appliances-are-getting-smarter-slowly-820099

Hera, 2017 http://www.heracomm.com/hera_thermo/

Iren, 2017 https://prodotti.irenmercato.it/iren_casa_sicura

LG, 2017 http://www.lg.com/uk/support/smart-diagnosis

Radio Rentals, 2017 https://www.radio-rentals.com.au

Samsung, 2018 https://news.samsung.com/global/all-in-on-ai-part-1-homecare-wizard-enabling-smart-appliances-to-diagnose-themselves

Samsung, 2017 https://www.samsung.com/us/explore/connect-home/

Smart Kitchen Summit, 2016 http://www.smartkitchensummit.com/smartkitchenblog/2016/8/31/drop-partners-with-bosch-to-integrate-its-kitchen-operating-system

Tado°, 2017 https://www.tado.com/gb/press/tado-joins-forces-with-E.ON-UK

V by Vodafone, 2018 https://shop.v.vodafone.com/IT/

Whirlpool, 2018 http://www.whirlpoolcorp.com/yummly-2-0-will-integrate-curated-cooking-experiences-into-whirlpool-kitchen-appliances/

Xfinity, 2017, https://www.xfinity.com/learn/home-security

ACKNOWLEDGEMENTS

Firstly, we want to thank prof. Tumino for the big opportunity of a thesis work with the Internet of Things Observatory.
Then we express our gratitude to Giulio and Giorgia, for their support and precious advises.

Thanks to my parents, with patience they clear my way, supporting me in each important decision and making me ambitious and humble in achieving my life goals.
Thanks to my sister, precious partner of my live.
Thanks to my true friends, irreplaceable supporters. In particular to my dear friend and co-author Andrea.

Alessandro

I wish to express my infinite gratitude to my family for their support and advice throughout my life, without them this important achievement would have been impossible.
A special thanks to my friends and classmates for their support and friendship which made these years the best of my life so far. In particular, I would like to thank Alessandro, my co-author and dear friend.
Last, but most important, I express my sincere love and gratitude to Gloria, a wonderful girl with an endless patience.

Andrea