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The Italian telecommunication supply chain: an economic analysis
of the main network suppliers

La filiera delle telecomunicazioni in Italia: un'analisi economica
dei principali fornitori di reti

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ABSTRACT

L'obiettivo della tesi è sviluppare un'analisi economica della filiera industriale del macrosettore delle telecomunicazioni, ossia quello che include operatori storici come Sirti, Italtel, Ceit (e altri meno noti), che operano come fornitori e subfornitori e realizzatori di apparecchiature e sistemi per le telecomunicazioni per gli operatori finali di servizi (ad esempio, TIM, Open Fiber, Fastweb, Linkem, etc.). Questi fornitori (e subfornitori) operano come produttori ed installatori di apparecchiature, reti e sistemi per le telecomunicazioni, in primis centrali telefoniche, cabinet e più in generale, l'installazione delle reti a banda ultra-larga fisse e mobili (5G), che siano interrate, palificate o wireless.

Lo studio si è focalizzato sulla valutazione dello stato di salute del settore nel periodo 2010-2020, sia guardando agli indicatori complessivi, sia entrando nel merito di singoli casi di indebitamento, mis-management e crisi aziendale, ad esito della crisi strutturale di investimenti generata dal monopolio di fatto di TIM (almeno fino al 2016, quando Open Fiber ha iniziato ad investire).

Nell'ultimo decennio infatti, dopo l'uscita dei due volumi a cura dei Proff. Frova e Pontarollo, patrocinati da ANIE (associazione che rappresentava le imprese elettroniche ed elettrotecniche italiane), il settore ha subito un'intensa trasformazione. Nuove aziende sono entrate, altre sono uscite.

Abbiamo quindi selezionato le poche aziende medio-grandi rimaste, che sono rappresentate nella nuova associazione di categoria Anitec-Assinform per la componente delle reti e dei sistemi.

Il filo conduttore è stato studiare i fatti salienti ed aggregati di queste aziende, raccogliendo dati e documentazione utili a supportare l'analisi di settore, oggi di importanza cruciale per sostenere e realizzare gli investimenti (anche pubblici) per la digitalizzazione del paese.

Ad esempio, i dati di interesse sono stati quelli relativi ad imprese attive, addetti, tipo di apparati e sistemi telecom da esse prodotti, quote di mercato ed investimenti, etc. derivanti da report, pubblicazioni, bilanci e banche dati per l'ultimo decennio.

A corredo della parte empirica sui dati di settore, è stata svolta un'intervista all'amministratore unico dell'azienda locale Netop S.r.l., Giacomo di Napoli, che è risultata di fondamentale importanza per ottenere una visione d'insieme sul settore e sulla trasformazione recente della filiera.

INTRODUCTION

The aim of this thesis is to study the evolution of the Italian supply chain of the telecom macro-sector in the period 2010-2020. In particular, the focus has been analyzing the industrial segment that includes historical network suppliers and sub-suppliers and others less known, acting as subcontractors and manufacturers of telecommunications equipment and systems for the final service operators (for instance, TIM, Open Fiber, Fastweb, Linkem, etc.).

The intention is to analyze the salient and aggregate facts of this evolution, collecting data and documentation that can support an applied analysis of the sector, today of crucial importance to assist and implement ongoing public investments for the digitization of the country.

In fact, in the last decade, after the release of the two volumes by profs. Frova and Pontarollo, patronized by ANIE (the only Italian federation representing electronic and electrical engineering companies), the sector has undergone an intense transformation. New companies entered, others left.

Chapter 1 will deal with a theoretical perspective on the supply chain, also focusing on the telecommunication sector in order to strategically analyze the specific activities of companies and how they interact.

Chapter 2 will provide micro-case studies for the analysis of the evolution of the sector and the transformation of the Italian telecommunication industrial segment. The focus is on specialized suppliers (Pavitt,1984). In particular, mobile network suppliers (ZTE, Huawei Technologies Italia, Ericsson, Nokia solutions and networks Italia and Samsung Electronics Italia) and fixed network equipment providers (Sirti, Site, Ceit and Italtel) will be analyzed. Here, a case study approach was chosen to undertake the research in order to increase the quality and quantity of data obtained (Gummesson,1991). Data were collected from a large number of sources: archival data in the form of annual reports, internal company magazine articles, contracts, and internal reports. For example, data of our interest has been those related to active companies (number and names), employees, type of telecom equipment and systems produced by them, market shares and investments.

To conclude, chapter 3, the core of the thesis, will present a financial statement analysis referred to the period 2010-2020 with the most representative benchmarks for a sectorial study. For a coherence matter, it has been circumscribed just to fixed network suppliers because mobile network suppliers' available data refer to many segments other than just telecommunication. To complement the financial statement analysis, an interview was carried out.

1. THE SUPPLY CHAIN OF THE INDUSTRY

1.1 Defining the value chain

The value chain is a concept brought by Michael Porter in 1985, defining the system of instruments for a strategic analysis of a company's activities.

The value chain separates and distinguishes those relevant activities, how they interact and how products (and services) move along all of them.

Thus, it represents a systematic way of analyzing each of these activities in order to determine the source of the firm's relative cost (its cost efficiency relative to its competitors) and its differentiation on the market.

In competitive terms, the value added acquired along the value chain represents the price the final consumer is willing to pay for that product or service.

Going deeply, the value added can be created when the total revenues are higher than the total costs, thus the firm is able to create a product or service whose price exceeds costs.

In order to construct a value chain, the level to take into consideration is the business unit, not the division or the corporate level because the idea is that products move along the chain and they gain value added which is higher than the sum of added values of all activities.

The idea of value chain is founded on seeing the organization as a *value system*, composed by subsystems of inputs, transformation processes and outputs.

After the product is created by the firm, it is passed along the value chain through distributors and finally, it arrives to the final customer.

Thus, the value system starts from all the activities which employ material inputs (raw materials, equipment) and immaterial inputs (technology and information), acquired from external market suppliers, or directly made by the firm.

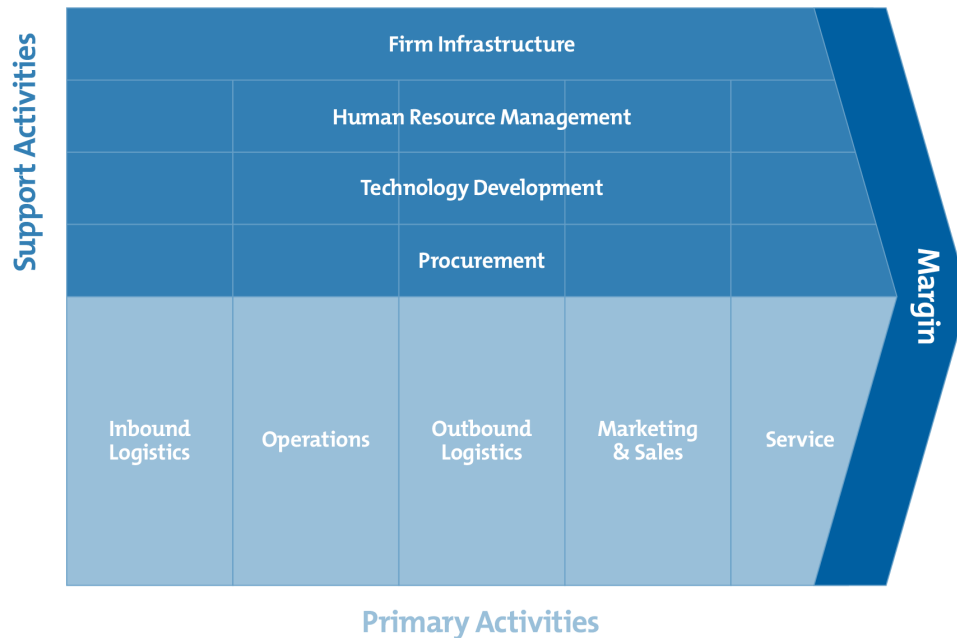
Moreover, suppliers have their value chain as well, an upstream value which delivers all the inputs requested and purchased by the firm.

However, this is not just a matter of delivering products, because suppliers can have other effects, influencing the firm.

This implies that it is possible to identify different value systems and numerous value chains which differ on the basis of strategic choices made at the beginning and for the future.

Most companies involve lots of activities in the process of converting inputs into outputs. Anyway, within an industry or a sector, it is possible to recognize a common value chain made up of primary or support activities, which is the model theorized by Michael Porter (refer to figure 1.1).

Figure 1.1 – Porter’s value chain



Source: https://www.mindtools.com/pages/article/newstr_66.htm

The model allows a very concrete and schematic way of seeing a firm business, highlighting the crucial points of each activity, from the product creation, marketing, delivering and customer service as well as internal activities which are functional to the achievement of the competitive advantage.

Starting from primary activities, there are:

- ❖ *Inbound logistics*, which comprehends all the activities related to receiving, storing, and disseminating inputs internally and as a consequence, it is related to the relationships with suppliers;

- ❖ *Operations*, which are represented by all the activities involving the transformation of inputs into outputs such as production, assembling, packing and testing;
- ❖ *Outbound logistics*, which refer to the processes of delivering products or services to customers such as storing of final products, distribution of products to final customers and material handling;
- ❖ *Marketing and sales*, referring to promotion, channel selection, pricing activities in order to induce final customers to buy;
- ❖ *Service*, which are all the activities aimed at maintaining the product or service working effectively after it is bought by the client.

Support activities instead are the following:

- ❖ *Firm infrastructure*, which consists of management, planning, finance, accountability, legal assistance and quality activities which are fundamental to support the entire value chain and must be considered jointly;
- ❖ *Human Resource management*, comprehending the selection-hiring process, training, motivation, rewards of employees, who are a fundamental source of value. Also dismissing and firing processes are here contemplated;

- ❖ *Technology development*, representing technological competences and knowledge in terms of know-how. They evidently reflect on the quality of products and services as well as on the company processes;
- ❖ *Procurement (or purchasing)*, which includes vendors and negotiating prices in order to acquire inputs and resources.

Both types of activities in the Porter's value chain have the purpose of creating the *margin*, which is the gain from the difference between revenues and costs after all the activities have been carried out. The aim is to obtain profitability for the firm, creating value for the customer through the ability of being distinctive from competitors on the market.

Under these circumstances, it is evident that this model is mostly suited for large organizations that produce physical goods. Anyway, for all the other types of organizations, the model can be used as well and in this case, it would be necessary to adapt the model to the case study.

In addition, each activity may be vital to competitive advantage depending on the industry.

In fact, considering the telecommunication sector, which is the core of our analysis, some differences can be identified. For this sector, technology development is not a support activity, but a primary activity determining the firm's competitive advantage.

1.1.1 The value chain and the competitive advantage

Competition is what can determine the success or the failure of a firm and it implies the degree of suitability of its activities, which in turn determines its performance.

As a matter of fact, it is crucial to deeply understand the value chain, which as it is written above, separates and distinguishes all the relevant activities for a company.

In using the value chain, some activities can also be further disaggregated because the analysis can bring important differences for the competitive advantage. Instead, some other activities can be combined if they are found to be irrelevant for the analysis.

Thus, understanding the value chain means understanding different categories of activities from which competitive advantages can derive. Every company should carefully analyze its specific competitiveness related to each activity in order to focus its competitive strategy in the best way. In particular, the competitive strategy means searching a profitable and sustainable competitive position against the industry competitors.

To do so, it is important for the company to look at the connections and interdependencies among competitive activities of the value chain, those which create value in order to optimize resources and their management. In fact, interrelationships within business units can strongly affect competitive

advantage in one industry and they actually represent the main method by which a diversified firm creates value, thus they are the support for the strategy.

To synthetize, differences among competitors' value chains play a key role in the source of competitive advantage.

Moreover, the concept of the value chain can be applied to specific economic entities so that five different aggregation levels¹ can be identified:

1. *Technology value chain*, where specific technologies generate value. In this case, innovation is crucial for the survival and growth of the firm. More than technology value chain, it could be useful to refer to *innovation value chain* composed by interrelationships and complementarities among different activities in the process of innovation. In this model, several factors are investigated:
 - a. The sources of knowledge and their relationships;
 - b. The effect of sources of knowledge on innovative activities brought by technology based firms;
 - c. How innovation outputs can influence the performance of firms.

The knowledge of the innovation value chain helps the company to focus the attention on the interrelations among the activities, for instance

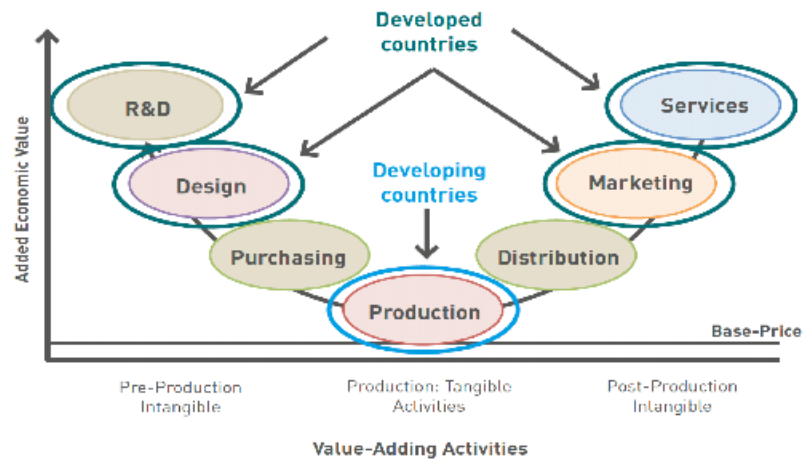
¹ In "*La catena del valore nell'industria delle telecomunicazioni in Italia*" (Frova,1998) the author identifies just four different aggregation levels. However, as it will be described in the second chapter, the telecommunication sector and in particular, the mobile network suppliers are mainly composed by MNE, thus the global value chain model is added here.

the external R&D (direct company engagements and open innovation) can influence internal R&D carried out by the company.

In our analysis, technology value chain could represent a useful model in describing the telecommunication sector.

2. *Industry value chain*, which studies the value added determined among different sectors (the sum of which represents the technological supply chain).
3. *Firm value chain*, which analyzes the ability of a company to generate value with respect to a competitor company through specific activities and competitive position. Thus, it represents a comparison among different companies within the same sector.
4. *Business value chain*, mapping all the different business areas and identifying the value added generated by each business (or company division), thus determining the relevant activities able to create a competitive advantage.
5. *Global value chain*, developed by multinational enterprises which invest in foreign countries by establishing affiliates which are in turn able to support the activities in the country of origin. The aim is to optimize profits and to locate production, distribution, and other supporting activities in different countries to increase efficiency and efficacy (refer to figure 1.2).

Figure 1.2 – The global value chain represented by the so called “Smile curve of high-value activities”



Source: https://www.researchgate.net/figure/smile-curve-of-high-value-activities-in-global-value-chains_fig1_305719326

1.1.2 The telecommunication supply chain

Based on the ISIC², the OECD sees the telecommunication industry as a combination of:

- ❖ Manufacturing industry, whose companies provide the main physical bases and infrastructures for services;
- ❖ Services industry, which deals with information processing and communication through physical and electronic instruments.

² Third revision of the International Standard Industrial Classification (1998).

This dichotomy within the telecommunication industry, is also present in the description of the supply chain for the same industry.

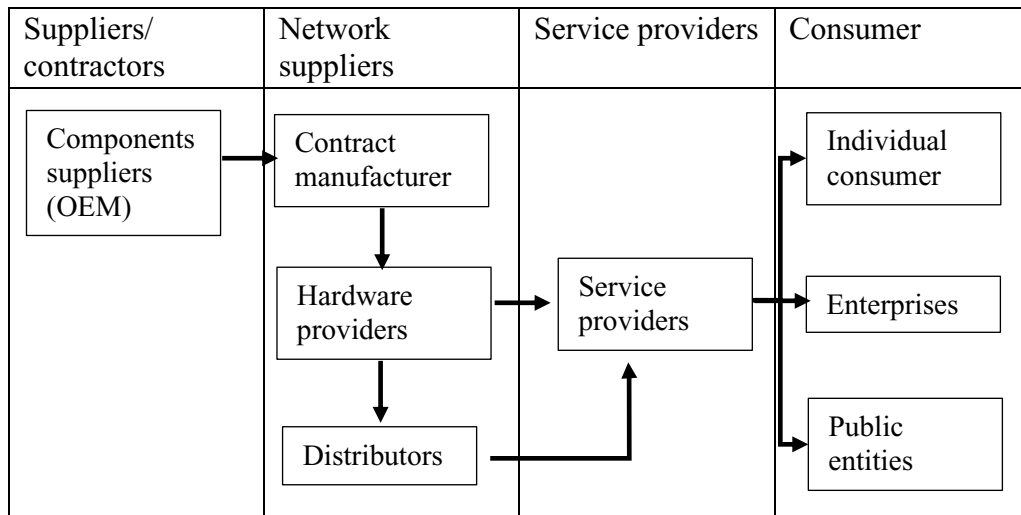
Starting from upstream actors along the value chain (refer to figure 1.3), there exists the components suppliers namely those which supply equipment, cables, networks, transmission and commutation systems and radio mobile transmitters. Thus, this part is mainly composed by all the instruments supporting ICT technology.

The following part of the value chain is composed by network suppliers, thus infrastructure providers, hardware providers, which supply telecommunication networks, satellites, and informatic connections.

The third part of the value chain instead, is made up of service providers, in charge of the electronic transport of data (networking services, data diffusion, phony, and television).

Lastly, the ultimate part refers to the demand, composed by the final individual customer, enterprises, and public institutions. The final consumer has numerous and differentiated needs which implies the necessity of different telecommunication structures, in terms of fixed and mobile networks.

Figure 1.3 – A scheme for the telecommunication supply chain



Source: own elaboration on “Supply chain management in telecommunication industry: the mediating role of logistics integration” (Noraini A. & Saifudin A. M., 2014)

However, the value chain described above just represent the “big picture” of the industry as it does not go deeper on the specificities of the telecommunications equipment and network suppliers value chain.

The core of telecommunication equipment suppliers is represented by the system integrators, which function as the OEMs.

For example, companies such as Cisco, Alcatel and Lucent and Nortel Networks are system integrators or OEMs.

Their final customers are the network suppliers, which as it is written above, provide telecommunication infrastructures and networks (transport networks, metropolitan area networks and access networks).

Furthermore, the system integrators (OEMs) largely use outsourcing³ for assembling tasks. They outsource these activities to electronic manufacturing specialists (EMSs), which are represented by the contract manufacturers.

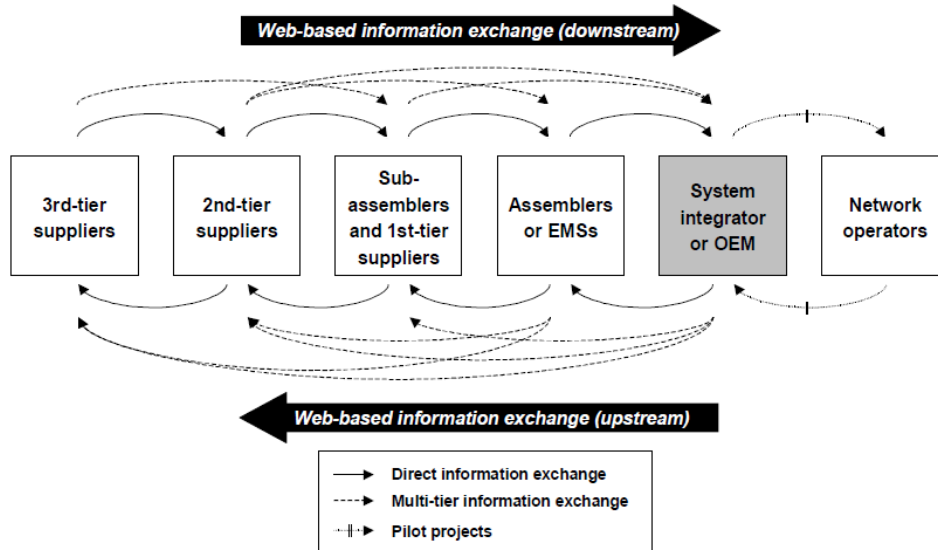
First tier suppliers supply parts or systems directly to EMSs (refer to figure 1.4). They usually work with a variety of companies, but they are often strongly connected with one or two EMSs.

Tier 2 companies are instead suppliers which have no great importance for the supply chain as they are usually limited in their activities and they usually possess less technical advantages than first tier suppliers.

Tier 3 suppliers instead, produce and manufacture electrical components and they also carry out subsystem assembling activities.

³ The outsourcing phenomenon will be the core argument of the 1.2.2 paragraph.

Figure 1.4 - Telecommunications equipment and network suppliers supply chain



Source: An empirical investigation of the impact of electronic collaboration tools on performance of a supply chain (Lefebvre et. al., 2003)

The system of activities in the telecommunication sector is based on different technological interdependencies among the numerous actors along the value chain. Every actor contributes to the creation of value added in the telecommunication system and ICT sector.

Each actor does not create value individually, but mostly in co-operation with the others, as the value added is transferred along the value chain in different ways.

Thus, the intricacy of interactions must be considered, also because each actor along the value chain might be concerned in other different value chains.

As a consequence, each actor should be evaluated for its specific and concrete role, both in absolute and relative terms with respect to the others.

This implies the role of value chains is fundamental: they incorporate, create and transfer knowledge and innovation, building the basis for the development of the industry.

1.2 Decomposition of telecommunication industry

1.2.1 From value chain to value networks

The term “value network” is an emerging concept in the organization theory and it was firstly introduced by Clayton Christensen in 1995.

He defined the value network as “*the context within which a firm competes and solves customers' problems*” (Clayton and Rosenbloom, 1993), capable of influencing incumbents and new entrants' innovation. Basically, he found out that already existing companies in the industry passively head technological development on the basis of present customers' needs. On the other hand, new entrants actively capture customers' necessities through the developing of new technologies, thus establishing technological growth, and gaining a competitive advantage.

This technological progress brought by new entrants might overcome the improvement requested by the market (by customers) and as a consequence,

new entrant companies can establish new value networks and constitute a threat for incumbents.

The ability of new entrants to create value networks and gain competitive advantages stays in the fact that technology development runs faster than current customers' needs.

However, in some industries, incumbents have been the market leaders for many years by exploiting numerous technological innovations based on their established organizational and technical knowledge.

In this case, the established companies are leading innovators, they undertake risks and sustain costly component technologies, thus they act as pioneers in the industry, whereas new entrants represent the technological followers.

Despite this, they can be attacked by hostile new entrants which affect their established businesses so that they should be prepared to what has been called "the attacker's advantage" (Foster, 1986).

The attacker's advantage is related to three factors:

1. Technological disruption brought by the new entrant, so that new capabilities are required and the value already created by incumbents might be lost;
2. How incumbents respond to it. While some incumbents are not capable of facing the attacker's advantage, others succeed through the analysis of the organizational dynamics. In other terms, they focus their attention

on organizational and structural matters in order to face new technological frameworks. In fact, the technological capability might be a limit if not combined with organizational paradigms;

3. The value network, also defined as “*the context within which the firm identifies and responds to customers' needs, procures inputs and reacts to competitors*” (Clayton and Rosenbloom, 1993).

In this case, the presented literature is perfectly suitable to describe the telecommunication industry.

Since 1980, the telecommunication industry has been facing some drastic changes which have led to new possibilities as well as new difficulties for infrastructure and service suppliers. Despite this, other radical changes are expected in the industry, both in terms of infrastructures and services in the context of the new economy.

Indeed, the already existing telecommunication value chain has been progressively deconstructed because of new entrants and profound structural changes in the industry such as quick technological progress and growing market changes.

As a consequence, the telecommunication industry represents a really complicated scenario, full of disrupted innovations which require new paradigms in terms of market strategies and positioning.

This is why the telecommunication value chain is becoming a value network.

The difference among these terms is that the value network is characterized by several entry and exit points for which activities occur at the same time (not subsequently).

This fact is really evident as the industry is no more composed of direct and long-lasting relationships between the actors, but the majority of relationships are hinged.

This implies the existence of complex value chain (no more linear) so that it is more suitable to talk about value network made up of all the numerous companies that in the industry sell and buy goods and services.

For instance, network suppliers and sub-suppliers might buy equipment not just from one supplier, but from numerous of them. Or the company may decide to produce the components internally. This is a “make or buy” choice, based on the transaction cost theory: the choice is based on the comparison among the total costs to be incurred in the two cases, also taking into account both characteristics of external availability (market transactions) and available resources within the firm (hierarchy transactions).

The variables affecting these transactions are several (for instance, the economies of scale reachable by suppliers) thus the decision is basically taken by comparing the value of specialization against the value of buying externally⁴.

⁴ This theme will be deeply analyzed in the next paragraph, which will deal with the outsourcing phenomenon in the telecommunication industry.

Also the technological development and increasing information availability have influenced this process: they allow the disintegration of activities and processes.

Obviously, the deconstructed value chain can occur when it is possible to disaggregate vertical integrated business models and organizational contexts using new and disrupted technology.

In this fragmented context, companies focus their activities on few stages or few segments along the value chain. Those for which they hold a competitive advantage:

- ❖ Product innovation;
- ❖ Customer relationship management;
- ❖ Infrastructure management based on economies of scale.

The majority of telecommunication firms perform these activities within the same organization, even though it would be better to separate them as they have different characteristics. In fact, splitting up these activities would have allowed companies to focus on innovation, enhancing quality and price reduction too. For example, a company could use innovative technology to create less costly high capacity fiber optical networks with power cables which can also be exploited by other telecommunication companies or by large business users.

Moreover, this would have permitted to exploit economies of scale.

In this decomposed scenario, companies would result in performing and consolidating similar activities, capable of developing expertise also in other areas: innovation on one hand, customer relationships on the other.

As a consequence, the decomposition process implies a radical renovation in the telecommunication industry, made up of complicated relationships among different actors, which demonstrate the diversity in terms of business models.

In the “*Deconstruction of the telecommunications industry: from value chain to value networks*” (Li and Whalley, 2002), the authors identify new different business models emerging from the telecommunication deconstruction process in the industry (refer to figure 1.5).

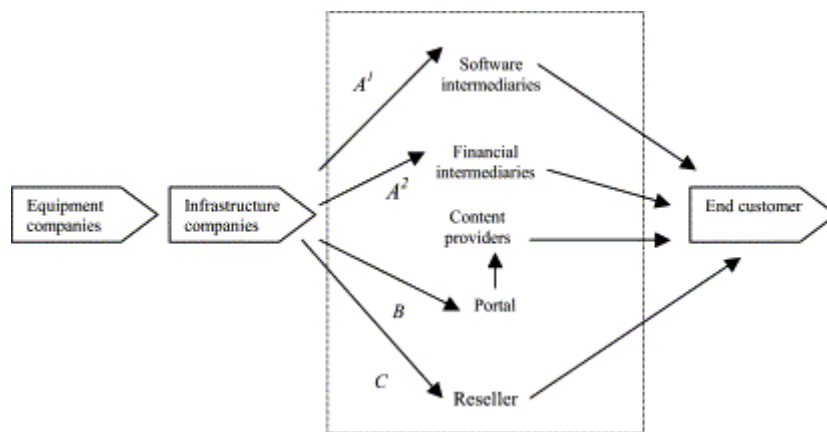
Starting from A^1 and A^2 , software and financial firms act as intermediates between infrastructure and equipment companies and the final customer. In A^1 case, the equipment companies can enter into the software market. This is the case of Ericsson and Nokia⁵ which entered the software operating system market in 1998. As a consequence, they developed new services, enhanced revenues and new commercial opportunities.

The B course refers to companies that act as aggregators because they integrate portal services provided by others, so that the relationship they are able to establish with them represents their competitive advantage.

⁵ Those two mobile network suppliers will be further analyzed in the second chapter.

Lastly, the route C is represented by resellers which buy capacity from infrastructure companies and focus their attention on the final customer through cost advantage. In order to do so, they focus on the activities they are able to perform better, thus customer relationship management.

Figure 1.5 – Decomposition of the telecommunication value chain



Source: “Deconstruction of the telecommunications industry: from value chain to value networks” (Li and Whalley, 2002)

To survive in this complex environment, each actor needs to understand and focus on its position along the value network, taking care of evaluating the emerging business models, different from traditional ones. This implies they should specialize in their competitive advantages (technology, customer relationship management and infrastructure management), being able to generate revenues and value.

1.2.2 The outsourcing phenomenon

Outsourcing is the term referring to a highly strategic decision involving turning over the management and decision-making (related to an activity or a process) to an outside organization or company. By taking this decision, companies have decided to focus on their core activities, externalizing non-core or support activities or services.

Outsourcing is not a new circumstance in the industry, it has been widely used as it might allow businesses to increase returns on investments, share risks, acquire new competencies and skills, and set up a long-lasting competitive advantage in the industry. Indeed, industry operators have transformed merely clients and vendors' relationships into strategic ones.

These necessities have been driven by market changes and business dynamics involving whatever kind of industry:

- ❖ Increasing competition;
- ❖ Emerging third world companies;
- ❖ Technological changes;
- ❖ New business models.

Telecommunication industry has experiences extensive outsourcing because it is “characterized by modular product architectures and shorter product life cycle, which has led organizations to increasingly specialize in a limited number of key areas” (Marshall et al., 2007). More in detail, in the telecommunication

industry the trend has been outsourcing IT management and supporting services, whereas in the last few years, the emerging situation has been outsourcing network management, billing processes, marketing and branding, and tower infrastructure management (Patil and Patil, 2014). As a consequence, outsourcing has moved from traditionally focusing on supporting areas of the business to the inclusion of key areas such as manufacturing, marketing and information systems.

The ascertained tendency is that telecommunication companies outsource installation, commissioning and maintenance of network infrastructure to system providers, working together as strategic partners. Furthermore, they also outsource tower management, once managed by network suppliers. This is important because towers (with their active and passive components⁶), form the 70% of telecommunication networks.

And the reasons of outsourcing phenomenon are various:

- ❖ Savings in operational costs. For instance, there could be savings in investments for infrastructure. In fact, infrastructure sharing has been widely used phenomenon, especially for telecommunication industry as towers for wireless communication are outsourced to tower management companies;

⁶ Active components are antennas and electronic parts installed next to the tower, whereas passive components are power systems in support of electronics.

- ❖ The possibility to develop new skills and competences working with the different external actors⁷. In particular, companies widely consider competences for services as non-core so that the best solution for them is to develop those competences outside the organization. This is also due to the difficulty in obtaining new set of skills as the technology progresses;
- ❖ To maintain and further develop core competences within the firm, having the possibility to invest on them;
- ❖ To have resource flexibility (also in changing specifications), avoiding delays in the processes, thus reacting rapidly to market changes and being more responsive to customer requirements;
- ❖ To maintain or acquire competitive advantage as telecommunication companies continue to evolve in the global industry;
- ❖ To focus on innovation in terms of improving processes as well as products or services;
- ❖ The possibility to share risks and returns, where both parties gain through collaborative relationships (win-win situations). For instance,

⁷ Outsourcing could be also seen as a way of applying internal capabilities and external collaboration as complementary activities because external collaboration allows the presence of capabilities that are not created internally.

one party could exploit outsourcing by easily entering in the market of the partner, taking its market share for granted;

- ❖ Investments for infrastructures, which nowadays represents a serious issue to consider, especially after the exponential growth of cloud services. Companies need to consider if further investing in building infrastructures as the trend is moving towards big data and cloud infrastructures;
- ❖ Mutually beneficial and strategic partnerships (value networks), not just with a single actor, but with a multitude of them (*“multisource for selecting outsourcing”*), developing collaborative relationships, thus achieving higher level of success in outsourcing. Thus, rather than focusing on a short-term view (cost reductions), outsourcing phenomenon emphasizes long-term strategic boundaries.

This trend towards outsourcing has implied suppliers to intensify competences and proactively enhance capabilities (Sturgeon and Lee, 2001).

Indeed, telecommunication industry is mainly composed by large and expert turn-key suppliers, which have also strengthened the outsourcing tendency.

In fact, the increasing competitive scenario has forced companies to give higher responsibilities to suppliers in those areas such as equipment manufacturing and network installation.

Anyway, telecommunication companies can undertake different and contrasting outsourcing strategies (Berggren and Bengtsson, 2004). For instance, while Nokia has been based on integral product design and low outsourcing utilization, Ericsson's strategy has been to largely outsource activities.

Moreover, many studies have confirmed that several telecommunication companies have embarked upon extensive outsourcing strategies in order to focus on being system integrators, thus managing activities of suppliers.

In this new eco system, telecommunication companies need to always strive for innovation, having the possibility to do it through outsourcing processes.

2. EMPIRICAL ANALYSIS: CHARACTERIZATION OF THE MAIN ITALIAN NETWORK SUPPLIERS

2.1 THE MOBILE NETWORK SUPPLIERS

2.1.1. ZTE Italia S.r.l.

ATECO: *46.43.10* (Wholesale trade of household electrical items, electric audio and video consumer good)

ZTE Corporation (before Zhongxing Semiconductor Co. Ltd.) is a Chinese company in telecommunications and information technology founded in Shenzhen (China) in 1985.

It is a listed integrated telecommunications equipment manufacturer and a global leader company in the supply of products and services for the telecommunication sectors, offering solutions to more than 500 final operators in 160 different countries in the world.

In particular, ZTE Corporation carries out the following activities:

- ❖ Purchasing, selling, importing and exporting activities both for private and public customers;
- ❖ Distribution of software, hardware, machinery and systems for telecommunications;

- ❖ Consultancy, training and maintenance activities for the products and services sold.

This company develops mobile devices and business enterprise solutions, especially regarding 5G sectors and providing integrated end-to-end innovations to deliver value to customers, businesses, and government. In fact, the core value of the company is technology innovation and it invests more than 10% of its annual revenues in R&D activities, becoming one of the most important international company that proactively contributes to the creation and definition of new telecommunication standards.

As a matter of fact, from 2009 it has become the third biggest company selling GSM (Global System for Mobile Telecommunications) devices in the world.

Regarding the Italian branch, ZTE Italy was founded in 2005, guaranteeing its presence on the European market for over 16 years.

In 2017, ZTE Italy became ZTE Italia (ZIT) changing its name to highlight the strategic position of this branch for the multinational company. Indeed, ZTE Italia is a landmark for the European Hub and the headquarter in Milan is going to become the European Capital of this group.

The headquarter in Milan is not the only one as we can count another one in Rome and one in Pozzuoli plus 13 offices along the entire national territory.

The Italian branch controls two subsidiaries:

- ❖ ZIS or ZTE Italia Servizi, which was founded in 2017 in Milan and it represents its legal site. Its activities deal with the implementation, management, and maintenance of ICT infrastructure, IoT solutions and peripherals and its presence reflects the strategic positioning of the company in the national territory;
- ❖ ZIRC or ZTE Italia Innovation & Research Center, which was founded in April 2018 in the center of Italy, L'Aquila, which represents its legal site. In particular, this company focuses its activities on the design, development and commercialization of a software platform and end-to-end 5G experimentation and services. Moreover, it deals with the definition, design and commercialization of a methodology for the feasibility, test execution and creation of a pre-5G and 5G network. Here, groups of experts and researchers create and implement all the activities planned in the 5G pre-commercial experimentation project, presented by “Ministero dello Sviluppo Economico” in the areas of Prato and L'Aquila. This has represented a way to invest in R&D in Italy as well as an effective help for L'Aquila after the earthquake of 2009.

ZTE Italy is mainly composed by two business units:

1. Devices, dealing with the commercial implementation of automotive segment and the commercialization of mobile telephony products with the main final operators in the national territory;

2. Network, which regards the selling activities of a complete products portfolio, ranging from telecommunications solutions wireline and wireless to services, up to fixed and mobile devices at competitive costs.

Among the partners, ZTE Italia S.r.l. counts TIM, Vodafone, Wind-Tre, Open Fiber, Linkem and other European companies.

In recent years, ZTI decided to set up fundamental strategic agreements and operations in the sector of infrastructures network and mobile devices both at national and regional level.

Starting from 2016, ZTI decided to be a partner of Wind-Tre S.p.A. in order to create the unique Wind-Tre network (*"The Golden Network"*) for the consolidation and modernization of the present mobile telecommunication networks as well as to favor the reduction of digital divide, strengthening Italy's leadership role in the European technological landscape.

This represented a development and growth program which also comprehended the increase in the employment level, improving technicians' skills and expanding the number of involved people in the related industries (Temraz,2010).

In September 2016, ZTE Italia adjudged the modernization project for the fixed network with the customer Telecom Italia in order to expand the diffusion of broadcast signal videos in the city of Siena.

Then, the year 2017 was fundamental for some important strategic partnerships and projects that are worth mentioning:

- ❖ The partnership with Open Fiber for the creation of ultrabroad band networks along the national territory;
- ❖ The national project in the cities of Prato and L'Aquila for the 5G development by the Italian "Ministero dello Sviluppo Economico" (MiSE) mentioned above. In particular, this project aimed at the creation of pre-commercial 5G experimentation in the cities of Prato and L'Aquila and its conclusion is going to be in 2021. The specific object is to promote the so called "5G city" where innovative services can be supplied, creating a real and strong consequence both in terms of social and economic utility. Moreover, there has been the Public Administration, small and medium enterprises, Florence and L'Aquila universities helping to develop and carrying on this project.

At the national and local level, in 2018 ZTE started collaborations with over 100 Italian companies.

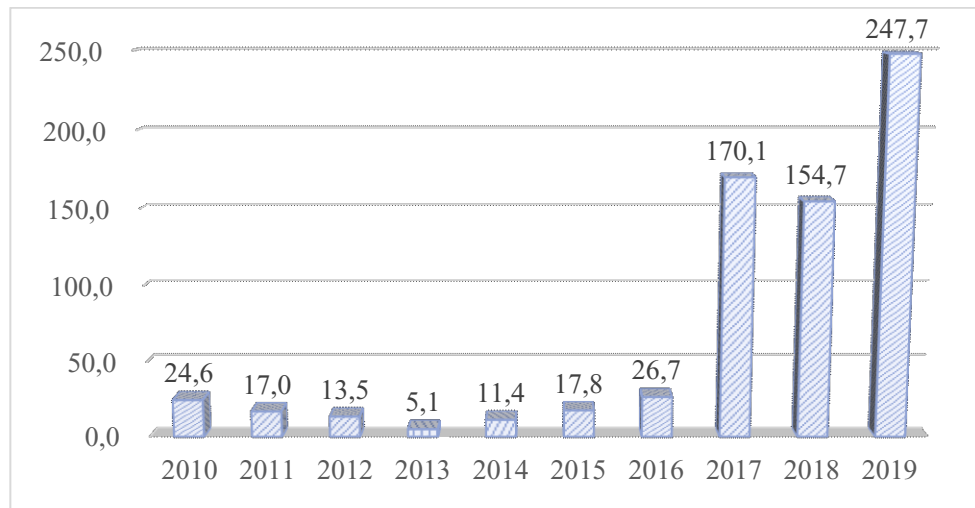
For example, in 2018 ZTE subscribed an agreement with the city of Rome to design and create network infrastructures needed for the new digital services development and for the implementation of new Ultrabroad band networks. This project, called "#Roma5G" was comprehended in the investments plan of the company and it was also aimed at developing and training future managers

and enhance the digital ecosystem of the city, allowing the city of Rome being one of the first cities in Europe having 5G networks. Thus, the capital city aimed at covering a fundamental role in the high-connectivity services provided by the national territory.

In fact, the will has been to allow the country of Italy being a central hub for ZTE activities and operations in Europe, making this country the center of 5G experimentation and services. To make this possible, in 2018 ZTE carried out a long-term strategy which consisted of an investment of 600 million of euros totally for five years.

In the last few years, ZTE has registered an exponential development and growth in revenues moving from 26 million of euros (2016) to 247 million of euros (2019), with a growth in revenues of about 827,4% in four years (see the graph 2.1).

Graph 2.1 - The evolution of ZTE revenues



Legend: figures in millions €. The graph comprehends revenues coming from ZTE Italia S.r.l., ZTE Italia Servizi S.r.l. and ZTE Innovation and Research.

Source: own elaboration on Aida key financial and employees.

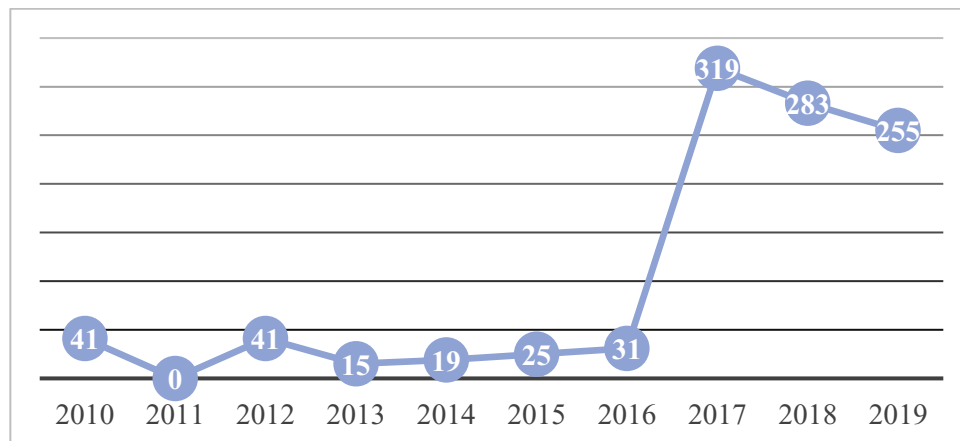
Although the trend of revenues evidently decreased from the year 2010 to 2013, reaching the lowest pick with 5 million of euros (2013), from 2014 it has been increasing, except for the year 2018 due to the beginning of the investment plan and to the high cost of Italian frequencies for 5G.

Moreover, from the graph 2.1 it is noticeable that there has been a significant variation in values. In fact, while the trend registered the highest value of revenues of 26 million of euros in the period 2010-2016, from 2017 onward the values has been rising enormously. Consider that from 2016 to 2017, the variation in revenues was of 143 million of euros.

The value of revenues in 2017 rose enormously, also in a disproportionate way and this could be due to the beginning of the strategic partnerships mentioned above as well as to the opening of ZIS or ZTE Italia Servizi.

The effects of the embedded acceleration in 2017 were conspicuous as the company moved from about 31 to 319 employees (refer to graph 2.2) who were a lot more (about 2.000 employees in total) considering all the related companies.

Graph 2.2 - Evolution of the ZTE employees



Legend: The 2011 value is anomalous. The number of employees comprehends the one working for ZTE Italia S.r.l., ZTE Italia Servizi S.r.l. and ZTE Innovation and Research.
Source: own elaboration on Aida key financial and employees.

In particular in 2017, ZTE Italia reached revenues of 170 million of euros, with an EBITDA of 4.3 million of euros and a net income of 2,11 million of euros.

In 2019, the company reached approximately 248 million of euros of revenues, but the market in Italy opens future possibilities of growth.

The company reached this value by focusing on its main business channels, thus actively participating to the building of networks for final operators (also at a global level) and contributing to the evolution of 5G technology and optic communication. In doing so, the company has built its main competitive advantages in terms of standards, patents, products and solutions as well as technologies (Christensens et al, 1993).

Indeed, in 2019 ZTE declared 1.424 standard essential patents for 5G and just as many patents demands to the European Telecommunications Standards Institute (ETSI). This means that having the ownership of a standard patent is one of the main expressions of the strength of the mobile segment and of the company, which has in turn offered its patents for 5G to the industry.

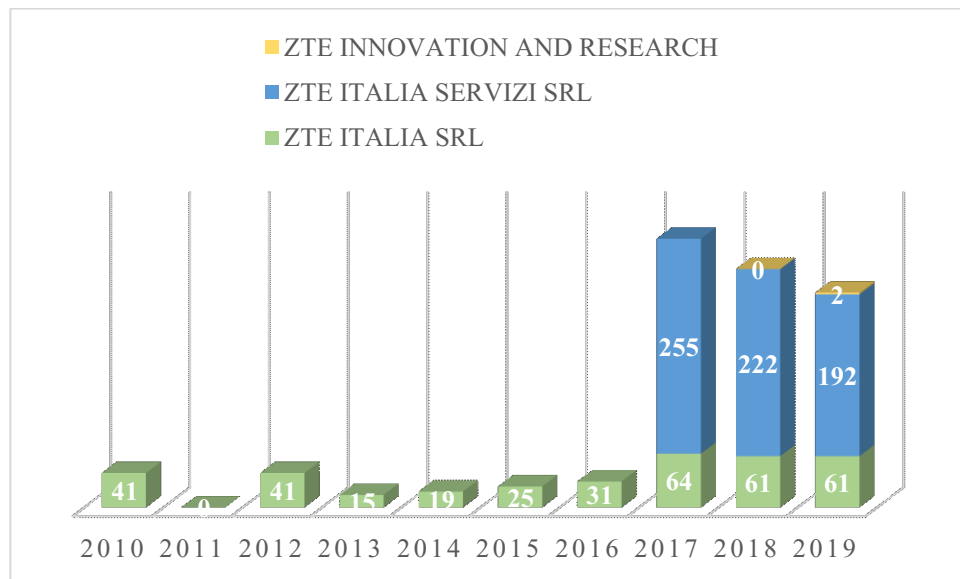
As it has been already said, ZTE is focused on 5G as the main strategy for the development and R&D in 5G related sectors such as wireless, networks and devices and this is demonstrated by the fact that in 2018 the amount of investments in R&D represented the 12% of the revenues.

Despite this, the composition of employees among ZTE Italia, ZIS and ZIRC is particularly unbalanced (see the graph 2.3) towards ZTE Innovation and Research as just two researchers are employed.

In fact, in the last few years the majority of employees has been employed in ZTE Italia Servizi (the 80% of employees works for ZTE Italia Servizi).

Thus, this fact highlights the importance of activities such as the implementation, management, and maintenance of ICT infrastructure and IoT solutions for the Italian branch.

Graph 2.3 - The composition of employees for ZTE Italia, ZIS and ZIRC



Legend: The 2011 value is anomalous as well as ZTE innovation and research 2018 value.
 Source: own elaboration on Aida key financial and employees.

2.1.2 Huawei Technologies Italia S.r.l

ATECO: *46.52.09* (Wholesale of other electronic telecommunications equipment and other electronic components)

Founded in 1987 in Shenzhen by Ren Zhengfei, Huawei Technologies Co. Ltd. is a Chinese telecom giant in the development, production and commercialization of Information and Communications Technology (ICT) infrastructure and smart devices, operating in 170 countries.

It is a private company entirely owned by its employees, as there is an employee shareholding scheme which comprehends more than 100.000 employees.

This company supplies integrated solutions regarding: cloud services, smartphones, tablets, and telecom networks, also providing solutions that are secure and competitive for private and public entities and companies operating in the financial, energy, transport, and production sectors.

In fact, among the products and solutions this company provides, there are:

- ❖ Firewall and gateways for applications and services;
- ❖ Routers;
- ❖ WLAN and access points;
- ❖ Other solutions for Data Center, CloudWAN and IoT.

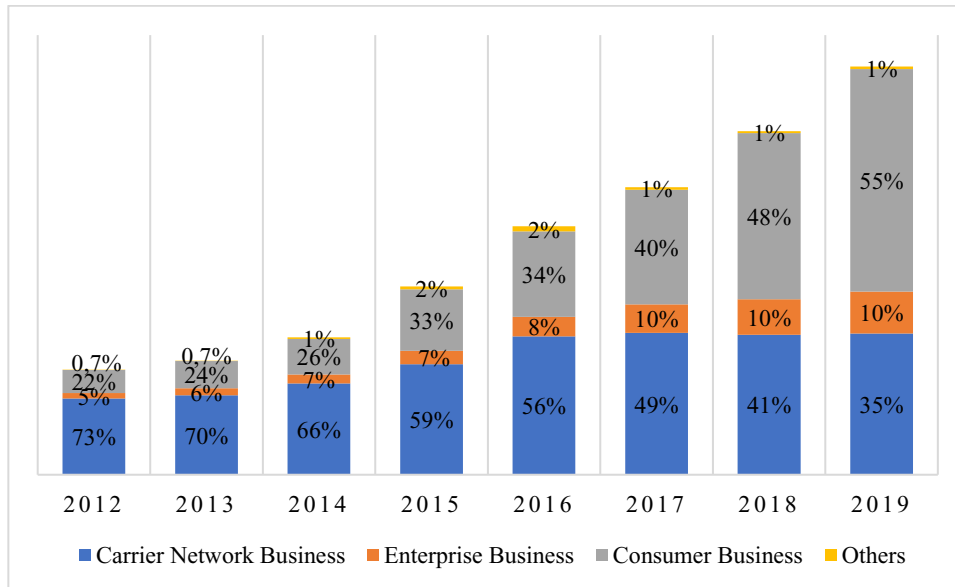
As a matter of facts, the company's core business can be distinguished among three businesses:

1. Carrier network Business Group (BG), which deals with wireless networks, fixed networks, global services, carrier software, core networks and network energy solutions;
2. Enterprise BG, which provides organizations with digital technologies in the area of cloud computing, big data, connectivity and IoT;
3. Consumer BG, which is obviously referred to the smartphone segment.

Considering the production of mobile devices, it has had an evolution during the years (Cricelli et al, 2002). In fact, while in 2012 this segment represented just the 22% of revenues (refer to graph 2.4), in 2019 the percentage weight has more than doubled reaching 55% of revenues to the detriment of telecommunications equipment (represented by Carrier Network Business segment).

This means that in the last few years, Huawei's core business segment has changed, in particular from 2018 when the Consumer BG weight became the highest.

Graph 2.4 – The progressive weight of Huawei’s three business segments



Legend: The % weights are calculated in terms of revenues.

Source: own elaboration on <https://www.statista.com/statistics/368519/revenue-of-huawei-by-business-segment/>

Moreover, this company relies on partners and customers which are at the center of the business so that its strength on the market is mainly due to partnership and intense investments in R&D, meeting customers’ needs and expectations and allowing the creation of a long-term customer value (Fransman, 2001).

Partnership are made with stakeholders such as suppliers, industry organizations, open source communities, universities, standard organizations, and research institutes in order to create joint innovation which allows the birth of a symbiotic and powerful industry ecosystem made up of open source communities, industry alliances and organizational collaborations (Kawashima,

2002). It is a shared ecosystem driving technology and the development of the industry (Battistella et al., 2012).

As a matter of fact, this company globally created 16 R&D centers, 36 joint innovation centers and 45 training centers with a total amount of investments in R&D of about 40 billion of euros in ten years. In fact, it invests more than the 10% of its annual revenue in R&D, where about the 45% of its employees is employed.

In fact, Huawei has had a strong and active role in the growth of the ICT industry as together with carriers and final operators, creating more than 1.500 mobile networks.

The Italian branch “Huawei Technologies Italia S.r.l” was founded in 2004 and is present in the national territory through two headquarters in Milan and Rome, 10 offices, 4 R&D centers and one Business Innovation center.

In Milan it is located the global center for Research and Development which was founded in 2011. This center is the headquarter with wide responsibilities also in global terms and it is focused on microwave and wireless technologies for high frequencies used for 5G applications. This implies that Milan is the Huawei capital of microwave technologies.

Regarding the project, from 2007 to 2009 it participated to the creation of HSDPA and HSUPA network in several South regions of Italy (in particular, Basilicata, Calabria, Puglia, and Sicily) for Telecom Italia.

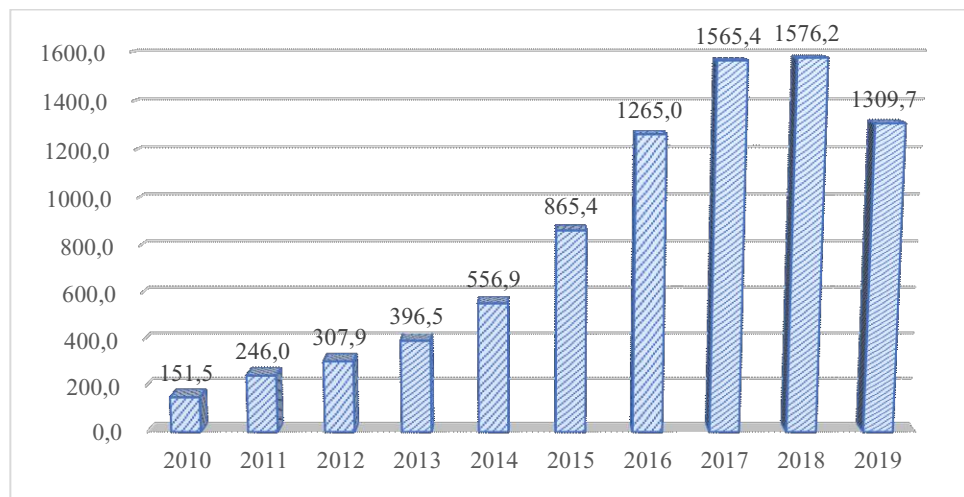
Moreover, there were some important projects regarding the FTTC and FTTH technologies development, the contribution on the evolution of fixed networks for the access and transport of final operators and on the modernization plan for the mobile network with single RAN for Telecom Italia, Wind and Vodafone. Being a company with a strong advocacy for joint ventures, it started several partnerships and agreements with local network suppliers and governments:

- ❖ In 2012 the company created EDGE tests together with MiSE;
- ❖ In 2013 they established an agreement with Vodafone for the creation of ultra-fast EDGE mobile phone network;
- ❖ In 2014 they established an agreement for a triennial cooperation with Telecom Italia in order to create the Business Innovation center;
- ❖ In 2016 the company created the Joint Innovation Center in Cagliari together with CRS4 (the R&D center of Sardinia region), local public administrations and universities. It has been the first center dedicated to research projects on “Smart and safe city” for companies and public administration.

Following the graph 2.5, it is evident that the trend for the revenues has been increasing until 2018. In 2019 instead, the revenues seemed to decrease moving from a value of 1.576.238.000€ (2018) to 1.309.651.000€ (2019), thus counting a variation of -16,9% in one year. In fact, in 2019 the economy experienced a slowdown and the company tried to focus on ICT infrastructure and smart

devices, continuing on investing in order to create value for customers. In particular, 3,1 billion of euros has been allocated for the investment plan for Italy in order to strengthen the relationship and connection with universities because it was considered crucial for the economic growth.

Graph 2.5 – The evolution of Huawei revenues

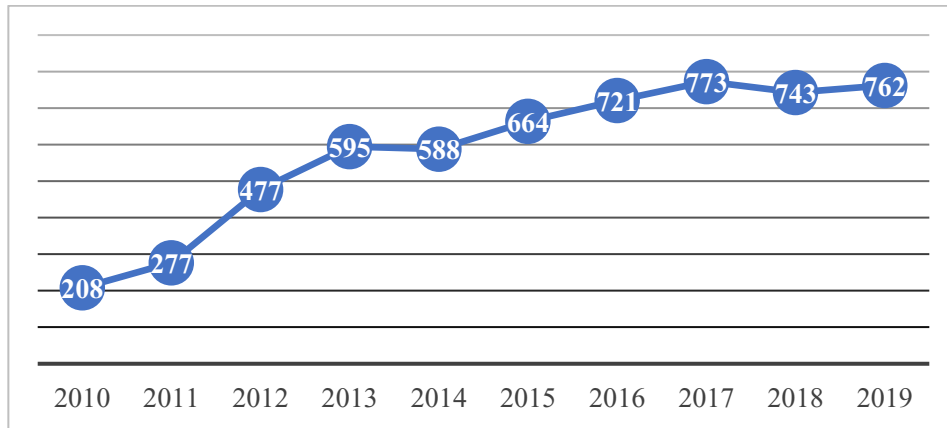


Legend: figures in millions €.

Source: own elaboration on Aida key financial and employees.

Regarding the employment situation, (following the graph 2.6) it is evident that the trend is quite increasing, with a peak reached in 2017 with 773 employees.

Graph 2.6 - Evolution of Huawei employees



Source: own elaboration on Aida key financial and employees.

2.1.3. Ericsson Telecomunicazioni S.p.A.

ATECO: 33.20.02 (Production and trade of electronic equipment for radio and telephones, and railway signaling)

Founded in 1876 in Stockholm by Lars Magnus Ericsson, it is a Swedish multinational company which operates in 180 countries. It supplies ICT technologies and services, software, and it creates network infrastructures for final operators as well as public administration and companies from different industries.

This company has consolidated its leadership role, also developing communications systems in several sectors (from traditional fixed telephone

network to new generation networks, to IP and ultrabroad band networks, arriving to GSM, GPRS radio-mobile and UMTS networks).

In Italy, Ericsson is present for more than 80 years with “Ericsson Telecomunicazioni S.p.A.” which is actually a supplier of devices for the main final operators (both for fixed and mobile networks) such as TIM, Wind-Tre, Vodafone, and other regional operators.

The Italian branch was founded in 1918 when Ericsson was able to enter the Italian market investing its capital in FATME (“Fabbrica Apparecchiature Telefoniche e Materiale Elettrico”) which was an Italian company operating in the electronic and telecommunications sectors in Rome and in SEI (SIELTE – “Società Impianti Elettrici e Telefonici S.p.A. which presently operates in the creation of telecommunication networks).

From 1918 this company has brought more than 100 years of innovations in the telephony sector and mobile broad band.

After six years, in 1925, Ericsson received the public commission of creating the telephonic network for the south of Italy. This commission would have lasted for five years, a period during which it was created the telephonic network setting more than 60 thousand kilometers of cables in the south of Italy.

From this point onward, Ericsson would have brought several innovations and changes. In 1930, the company created the first Bakelite telephone, becoming the first in Italy to use the technology of printing plastic and thermoplastic

materials. This would have influenced the design of all the future fixed telephones.

Between the years 1950-1960, the company focused its attention on studying and creating the national plan for the tele selection, which was the system aiming at direct calling without using a switchboard.

As a matter of fact, in 1975 Ericsson created and applied the intercity telephone exchanges (AKE type) to the Italian telecommunication network and the very first intercity telephone exchange operated in Palermo in the same year.

In 1978, the R&D center was created in Rome with the first aim of adapting the equipment coming from Stockholm to the Italian market. Actually, this center has taken on the important role of being the global center of expertise for the whole Group.

Nowadays, in Italy the R&D centers are three and they are located in Genoa, Pisa and Pagani (Campania).

Just after four years from the opening of the R&D center, in 1982 the company installed the first digital telephone exchange called AXE in Naples. It rapidly became the most widespread digital telephone exchange in the world, and it represented a real disruption in the telecommunication sector as its size was seven times less than an electromechanical telephone exchange and it was characterized by higher efficiency.

In the 90's Ericsson started to deal with mobile networks and built the radio base stations for the national country.

Moreover, in 1996 Ericsson together with TIM made a partnership to create the prepaid card, a Made in Italy innovation which was a factor contributing the development of mobile phones all over the world, allowing everyone to possess a mobile phone, even the youngest.

After few years, it became partner of Tre Italia for the tender for UMTS frequencies in Italy. Thus, it built the third generation mobile network in very little time, installing 2.000 base stations in just one year.

Moving to the twenty-first century, the company can enumerate several important partnerships and projects:

- ❖ In 2013, the collaboration between Ericsson, the Italian high school of Pisa and CNIT (“Consorzio Nazionale Interuniversitario per le telecomunicazioni”). This partnership allowed the achievement of a real record which took place on Telstra network in the connection between Sydney and Melbourne in Australia. In fact, it allowed the creation of the technology able to transmit data at the rate of one terabit per second.
- ❖ In 2016, the partnership between Ericsson, TIM and some other companies created the project called “5G for Italy” allowing the

beginning of the very first 5G network experimentations (which permitted the realization of a record velocity of more than 20 Gbps). The aim was to create an open ecosystem for the research and implementation of 5G and to accelerate the digitization process in Italy.

For this reason, Ericsson can be considered a leader company in the 5G sector.

- ❖ In 2017, Ericsson together with TIM activated a 5G millimeter wave antenna in Italy.
- ❖ In 2018, Ericsson participated to the “5G EVE” organized by the European Union. This infrastructure project represented a European 5G validation platform aimed at testing advanced 5G infrastructures in Europe as well as at interconnecting European countries in order to create a unique 5G end-to-end facility.
- ❖ In 2019, Ericsson participated to the “5G Growth”, a project that would have lasted until November 2021 aimed at pursuing technical and business validation of 5G technologies, by providing an infrastructure which is able to cover connectivity needs across different industries.

The headquarter was established in Rome and in particular, in Italy Ericsson carries out the activities regarding:

- ❖ New generation optical networks;
- ❖ Network control and management solutions;
- ❖ Integrated photonics;
- ❖ Virtualization and cloudification of the core network;
- ❖ Solutions for legal interception;
- ❖ Systems for automatic license management.

The Italian branch totally counts 1.842 employees, among which 700 are researchers employees (meaning that the 38% of the employees are researchers).

This is also confirmed by the fact that in 2018 Ericsson globally invested in R&D activities allocating about the 18% of the global revenues and from its birth, obtained 49.000 essential patents for telecommunication sector.

As it has written above, the first R&D center in Italy was the one in Genoa. Just here, the R&D counts 400 researchers employees (on a total of 700 in Italy) who produce every year more than 30 patents.

In Genoa, the company is present from the year 1978 and currently there are three centers in Genoa, Pisa and Paganini which work for the 5G development and the evolution of network infrastructures and technologies. In fact, the 26% of essential patents for 5G has come from Europe and in particular, Ericsson has been contributing with its knowledge taking part with a 16% of total patents.

As a matter of fact, the R&D centers has created more than 700 patents in the last twenty years, thus highlighting the fundamental role of the Italian R&D center for the development of networks, digital services and IoT. This allows the development of advanced scientific and design skills, thus innovative solutions which are actually oriented to cloud services. All these factors are made possible thanks to the connection with universities, institutions, companies, and startups as well as the innovative projects aimed at accelerating the digitization process of the national country.

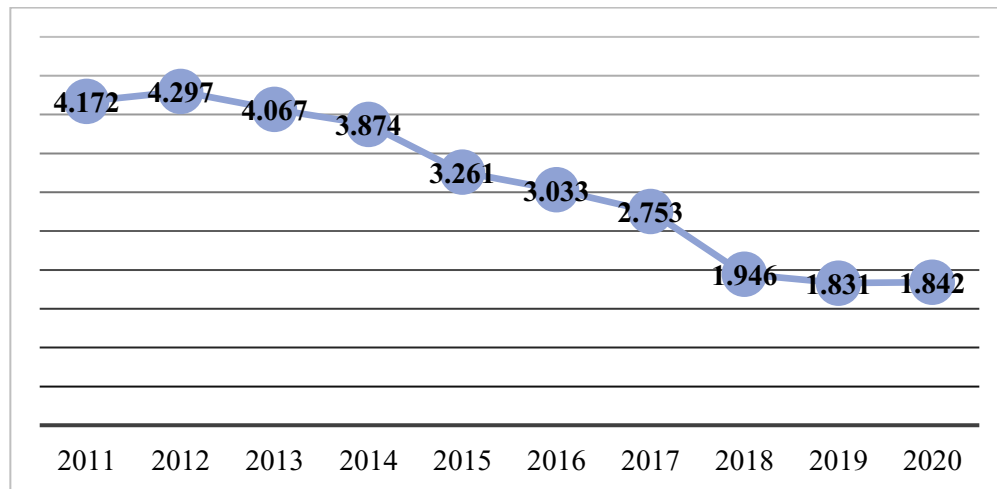
Moreover, within the three R&D centers there are also the so called “innovation garages” which represents real technological laboratories (focused on 5G industry and cybersecurity) for students, startups, and local companies.

Considering the employment evolution trend, it is particularly evident from the graph 2.7 that the number of employees has been decreasing from 2012, which actually represented the only year facing an increasing number of employees as 125 employees were hired (moving from 4.172 in 2011 to 4.297 employees in 2012).

Thus, a part from this positive variation in 2012, taking into account the highest and lowest value (the one of 2012 and 2020), the number of employees has been drastically reduced with a variation of 58,1%. This negative percentage is due to many collective dismissals undertaken by the company over the years.

In fact, in May 2015, this company launched a collective dismissal procedure for 60 employees employed in the Solution and Service department in Milan, Rome, and Venice and for another 150 employees in the telecommunication sector. Anyway, in November 2019, the company signed a contract with the Italian Ministero del Lavoro and labor unions regarding the introduction of innovative social safety nets from January 2020. In particular, the company stated the employment of at least 30 young employees and formation courses for more than 1.500 operators.

Graph 2.7 - Evolution of Ericsson employees



Source: own elaboration on Aida key financial and employees

From the graph 2.8, it is quite evident that Ericsson faced numerous reductions of revenues during the years.

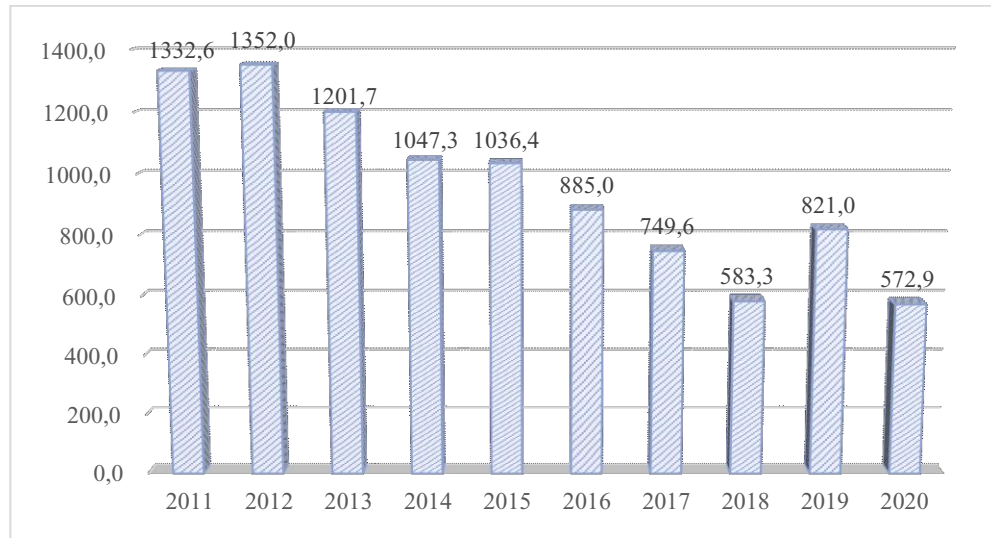
In fact, in recent years there has been a transition period with a reorientation for the company in line with the global strategy, aimed at focusing on the core business of networks and services for final operators.

In 2018 financial report, the company gained revenues for 583 million of euros, which meant a reduction of 22% with respect to the previous year, as well as a profit of 7,3 million of euros which, however, is the half of the previous year.

Two are the possible reasons of those detrimental results:

- ❖ The increase in competitiveness in the market;
- ❖ The transition period with a reorientation in line with the global strategy, which meant a reorganization and transformation of the company, also with transferring of company divisions. This meant additional costs and the surrender of a part of profits.

Graph 2.8- Evolution of Ericsson revenues



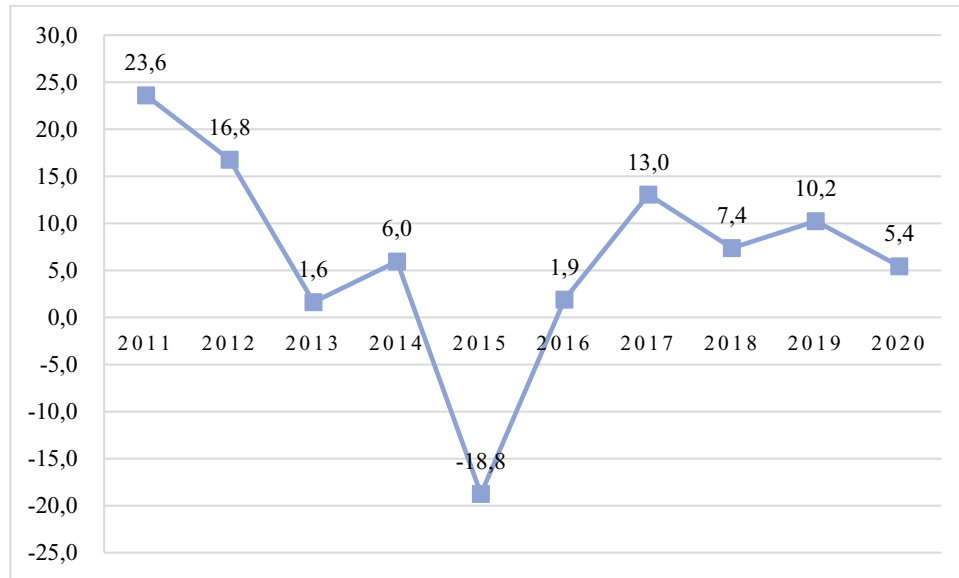
Legend: figures in millions €

Source: own elaboration on Aida key financial and employees.

The decrease in revenues also reflected the loss in net profits. In fact, looking at the graph 2.9, it is evident that 2015 net profit faced a drastic decrease touching -18.765.417€ due to extraordinary costs for -37.195.665€ (the highest value from 2011 to 2020).

In addition, in 2015 the company faced the cost for the opening of the “Cloud Lab”. This laboratory dealt with network function virtualization (NFV) and software-defined networking (SDN) technologies for cloud services, thus aimed at accelerating innovation and co-creation process with the main final telecommunication operators.

Graph 2.9 – Evolution of Ericsson net profit



Legend: figures in millions €

Source: own elaboration on Aida key financial and employees

2.1.4. Nokia solutions and networks Italia S.p.A.

ATECO: 33.20.02 (Installation of electrical and electronic telecommunications equipment, radio-television transmitters, electrical and electronic appliances excluding inside buildings)

Nokia Corporation is a Finnish multinational company operating in telecommunication, information technology and consumer electronics sectors. It was founded in 1865 by Fredrik Idestam and its main headquarter is in Espoo (Finland). Nokia Corporation has an organizational scheme based on functional

areas which represent the main activities of the company. Indeed, there are two departments:

❖ *Nokia Technologies*, which is focused on R&D for new technologies, consumer products and patents. As a matter of fact, Nokia has had a crucial role in the sector of mobile telephony, through the development of GSM, 3G, LTE and 5G standards.

❖ *Nokia Networks*, which deals with software and network infrastructure services, thus the core business of the company. In particular, Nokia Networks is composed by six different sub-departments:

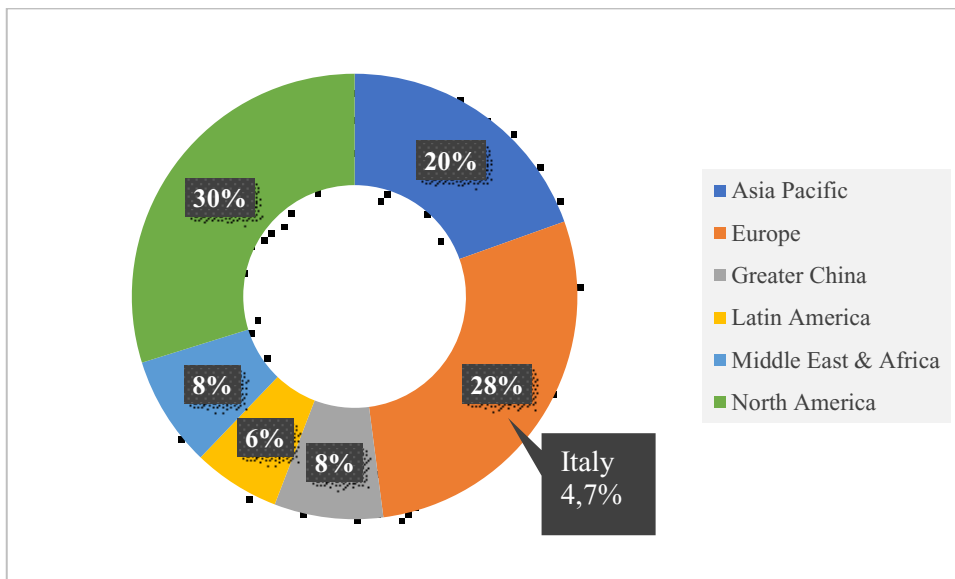
- a. Mobile networks, which deals with products and services for mobile access technology, core, and radio access network and microwave radio link products. Thus, it implies the presence of key technologies such as 5G, O-RAN and vRAN;
- b. Global services, which deals with network services such as network planification, installation and maintenance;
- c. Fixed networks, which comprehend all the products and services for network infrastructure for fixed access;
- d. Nokia Software, namely software products and services;
- e. Nokia Enterprise, which includes all the products and services for companies and public administration;

- f. IP/Optical networks, which consist of all the activities regarding IP Routing, Optical Transport, IP video, IP portfolio and packet core.

Generally speaking, in 2020 this company totally employs 89.978 people in 100 different countries with different subsidiaries (see the table A1), reaching 130 countries for its business and a net sales volume of 23.3 billion of euros in 2019.

As it can be seen in the graph 2.10, the European market represents the second most important market just after the one of North America. Among the 28% of weight related to the European market, Italy represents just the 4.7%.

Graph 2.10- The % weight of Europe with a particular focus on the Italian market



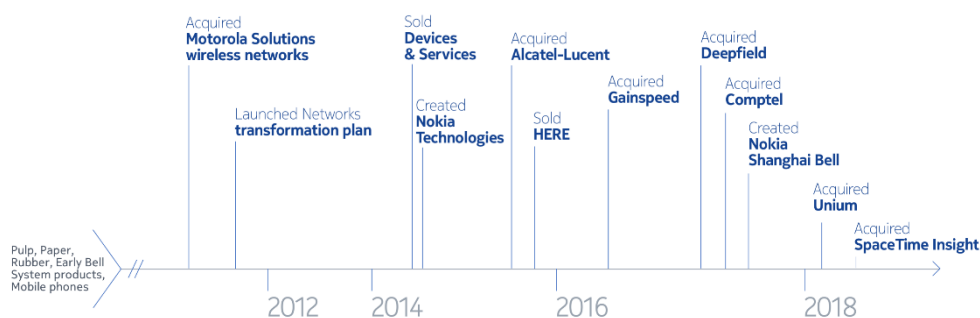
Legend: The percentages are calculated on the Nokia sales 2019.
 Source: own elaboration on Aida key financial and employees and on https://www.nokia.com/system/files/2020-03/nokia%20in%202019%20annual%20report_1.pdf

As it is shown in the table A1, the Italian subsidiary is Nokia Solutions and Networks Italia S.p.A. (“NSN Italia S.p.A.”), and it is located in Vimercate (North of Italy, Monza e Brianza).

This denomination replaces the previous one (Nokia Siemens Networks Italia S.p.A.⁸) when Nokia bought Siemens participation in September 2013 because of a re-organization process (refer to Figure 2.1) at a local level aimed at rationalizing all the Italian companies’ activities.

The process of mergers and acquisition continued until January 2019 with the incorporation of Alcatel-Lucent Italia S.p.A. in Nokia Solutions and Networks Italia S.p.A.

Figure 2.1 – Nokia re-organization process during the years



Source: <https://inno3.it/2019/09/18/nokia-linnovation-hub-di-vimercate-si-specializza/>

⁸ Nokia Siemens Networks Italia S.p.A. (NSN) was established through a joint venture after the division of the activities conducted by Nokia Italia S.p.A. in March 2007. In particular, the division between the Nokia activities regarding the networks and the Siemens activities related to fixed and mobile networks.

In Italy, Nokia is an important partner for final operators, public administration in the creation of mobile networks, optic and microwave transport as well as cloud and customer experience management services.

During the years, this company has contributed on the development of telecommunication infrastructure of the country, making Italy the location for its main R&D centers. In fact, they are established in Vimercate, Milan, Rome, Rieti, Battipaglia, Naples, Trieste where the activities focus on research, design, sales, installation, and maintenance of access networks, fixed and mobile transport networks, as well as networks applications and solutions.

In particular, in Vimercate there are two R&D laboratories which develop technologies for the world markets :

- ❖ The first one is related to microwave transport networks, which represent the focus since the beginning;
- ❖ The second one focuses its attention on transport on radio links and optic transport. The Nokia global research is focused on optic transport, mobile network and IP & optical network, which allows Italy to be the global excellence center;
- ❖ Last but not least, the data analytics, an activity that employs a competence center composed by 80 dedicated employees who manage the data coming from the networks.

Vimercate represents a real innovation hub, which also comprehends the so called “Nokia Bell Labs”, where partners and customers can develop common ideas, participate to formation courses (“Education Hub”), training for employees and test new technologies. Thus, Vimercate constitutes a technology center related to the development of products for networks management, virtual and augmented reality for 5G and analytics.

Indeed, all the Nokia strategy is focused on 5G in order to be prepared to the commercial introduction of the new technology which redefines the levels of network capacity, connectivity, latency, and reliability.

Furthermore, Italy is considered an important center to manage all the commercial activities in the Mediterranean area.

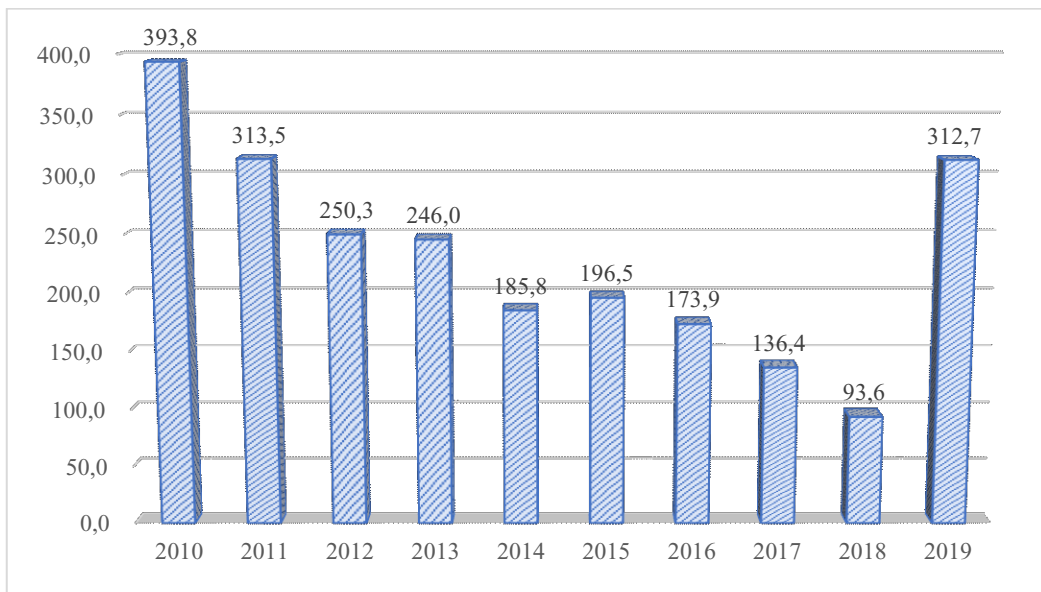
The Italian subsidiary generates 312,7 million of euros in sales in 2019 and it is evident from the graph 2.11 that the last year faced a big development in terms of sales driven by 5G, a competitive end-to-end portfolio and the strength of the operational execution.

Anyway, looking at the same graph, there is not a year-on-year growth in terms of revenues as the trend is decreasing and the lowest value is encountered in 2018 whereas the highest in 2010.

During the years, the company has decided to concentrate on the mobile broad band and in order to face market changes and competition, it decided to reduce costs (also

labor costs). The objective has been to increase productivity and competitiveness (Noraini et al., 2014).

Graph 2.11- Evolution of Nokia revenues



Legend: figures in millions €

Source: own elaboration on Aida key financial and employees

The Italian subsidiary has 1.353 employees, among which 1.150 are employees at Vimercate and 203 are employed for R&D activities, so the 17,6% of employees are researchers.

As it is shown in the graph 2.12, the employment trend is quite unstable during the years, touching the lowest value in 2017 and the highest in 2019.

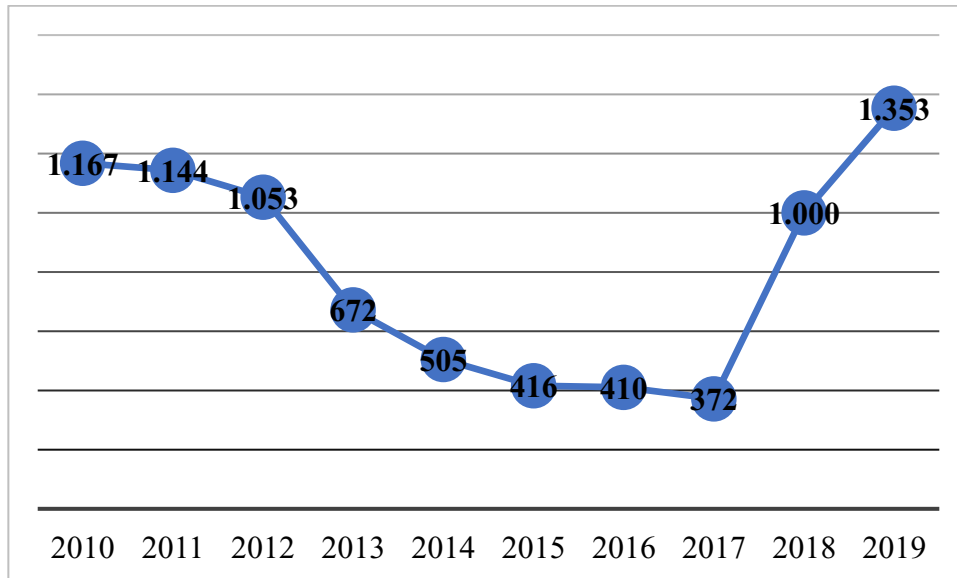
In fact, the company has decided to take up a restructuring plan from November 2011, aimed at a reorientation of the business, thus a collective dismissal of about 500 employees from 2012 (that year saw the highest negative variation in terms of dismissal as 381 people were fired).

Dismissal affected the site of Cassina de' Pecchi, near Milan, but also the sites of Rome and Naples.

Another collective firing was taken up in 2014 with the consequence of a serious negative balance in terms of employment, so that the labor unions criticized this process denouncing the state of neglect for R&D and other core business activities in Italy. Indeed, trade unions and workers announced protests aimed at the removal of dismissals and blaming the company to have a unilateral behavior and to prefer outsourcing to a relaunch of the Italian sites.

Essentially, their criticism was against the Italian release which created a business limited to commercial and assistance activities.

Graph 2.12 - Evolution of Nokia employees



Source: own elaboration on Aida key financial and employees

2.1.5. Samsung Electronics Italia S.p.A

ATECO: *46.43.10* (Manufacture, maintenance of electrical appliance, audio and video consumer electronics)

Samsung Group is a South Korean multinational company founded by Lee Byung-chul in 1938 as a trading company.

It operates in 74 countries, counting 2.208 suppliers (first tier) and 287.439 employees globally. In Europe, Samsung operates with 3 R&D centers and 75 subsidiaries, as it is shown in the table A2.

It comprehends several affiliated businesses which over the years have been diversified, but just in 1960 the company went into the electronics industry, which nowadays represents its main focus.

In fact, there are numerous industrial affiliates in the group:

- ❖ Samsung Electronics, which represents the largest information technology company in the world, consumer electronics maker and chipmaker⁹;
- ❖ Samsung Heavy Industries;
- ❖ Samsung Engineering;
- ❖ Samsung C&T Corporation;
- ❖ Samsung Life Insurance;
- ❖ Samsung Everland;
- ❖ Cheil Worldwide.

Regarding the first one, Samsung Electronics is a multinational company operating in electronics and information technology and in particular, its products wide from computers, air conditioners, digital television, mobile phones, active-matrix organic light emitting diodes, printers monitors, refrigerators, semiconductors, and telecommunication networking equipment.

⁹ This achievement is measured in terms of revenues of the year 2017.

Generally speaking, Samsung Electronics enters into four businesses (synthetized in the table 2.1):

1. Consumer electronics (CE) concerning visual display business, digital appliances business, printing solutions business. Here, TV is the core product;
2. IT & Mobile Communications (IM) which deals with *mobile communication business* and *network business*. In the mobile communication business, the main products are smartphones, tablets and wearables and everything related to them (such as hardware features, high-definition cameras, software capabilities but also cloud, IoT, 5G end-to-end solutions). Instead, the network business, provides next-generation infrastructure and solutions, thus the core of our analysis (5G radio and core network equipment, user devices and chipset);
3. Device solutions (DS) regarding memory business, system LSI business (APs and camera sensor chips), foundry business for the production of semiconductors and LED business;
4. Harman International Industries, Inc. producing automotive electronics components.

Table 2.1 – Synthesis of the main Samsung Electronics businesses

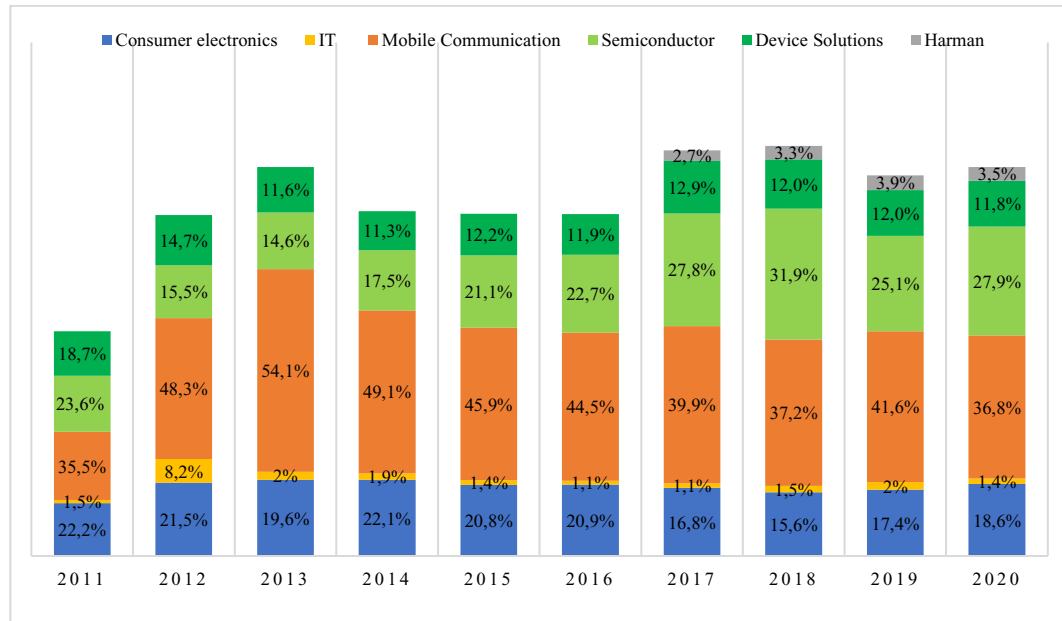
Division	Key products
CE	TVs, monitors, refrigerators, washing machines, air conditioners, etc.
IM	HHPs, network systems, computers, etc.
DS	DRAM, NAND flash, mobile APs, OLED panels for smartphones, etc.
Harman	Digital cockpits, telematics, speakers, etc.

Source: https://images.samsung.com/is/content/samsung/assets/global/ir/docs/2020_business_report.pdf

Being Samsung focused on different segments, our analysis could be tarnished by some values that are not of our intent research (the ones referring to Consumer Electronics, Mobile Communication, Device Solutions and Harman International Industries). As a matter of fact, business segments have been deeply analyzed.

As it is shown in the graph 2.13, the Mobile Communication segment represents the prevalent in terms of revenues (the segment in orange), while IT constitute the minority. Thus, in this case, our analysis is jeopardized by a business segment that is not of our interest, implying a difficulty in terms of comparability among the mobile networks suppliers.

Graph 2.13 – The progressive weight of Samsung’s business segments



Legend: the % weights are calculated in terms of revenues. The database shows two values in 2011 and 2012 classified as "others". For their irrelevant presence, they have intentionally not been considered.

Source: own elaboration on <https://www.statista.com/statistics/630434/samsung-quarterly-revenue-by-segment/>

In order to have a feasible comparison with the other network suppliers, the average weight of each business segment has been calculated (refer to table 2.2).

This will be helpful when considering the evolution of Samsung revenues from 2011 to 2020 (see graph 2.14).

Table 2.2 – Average weight of Samsung business segments (%)

	% Average
Consumer electronics	19,6%
IT	2,1%
Mobile communication	41,1%
Semiconductor	22,9%
Device solutions	13,0%
Harman	3,3%

Source: own elaboration on <https://www.statista.com/statistics/630434/samsung-quarterly-revenue-by-segment/>

For representing its minimal portion of business, in 2015 some news media argued that Samsung Electronics was considering selling its network business which manufactures mobile telecommunication systems. However, this never happened as the company asserted that:

- ❖ It has strong business relationships with several operators in US, Japan, Korea, South Asia and Europe;
- ❖ It has always developed and commercialized technologies such as 2G, 3G and 4G, investing about 8,4 billion of euros every year in mobile telecommunication systems and devices, in particular for next generation technologies (SDN/NFV and 5G).

In Italy, it is present through the commercial subsidiary, Samsung Electronics Italia S.p.A. which was established in 1991 and it is located in Milan.

In its very first beginning, the Italian subsidiary commercialized televisions, video recorders and their first electrical appliances, employing just 13 employees and gaining 10 million of euros of revenues¹⁰.

In Italy, Samsung has seen a profound and constant growth:

- ❖ In 2001, the number of employees increased reaching 87 employees, arriving to a revenue of 500 million of euros;
- ❖ In 2004, it gained revenues for 690 million of euros with 145 employees;
- ❖ In 2007, its revenues touched 1,4 billion of euros with 222 employees.
- ❖ In 2009, it was the market leader in nine product categories, confirming that Italy was an important country for Samsung's market in Europe as it had the 28% of market share. This growth has continued during the years.

Despite this, from 2011 to 2020, the revenue trend has not faced significant variations, growing on average by 2,5%¹¹ (consider the graph 2.14).

Anyway, getting to the bottom, it is noticeable that in the last few years, the revenues decreased and that from 2019 to 2020 the revenue trend remains flat.

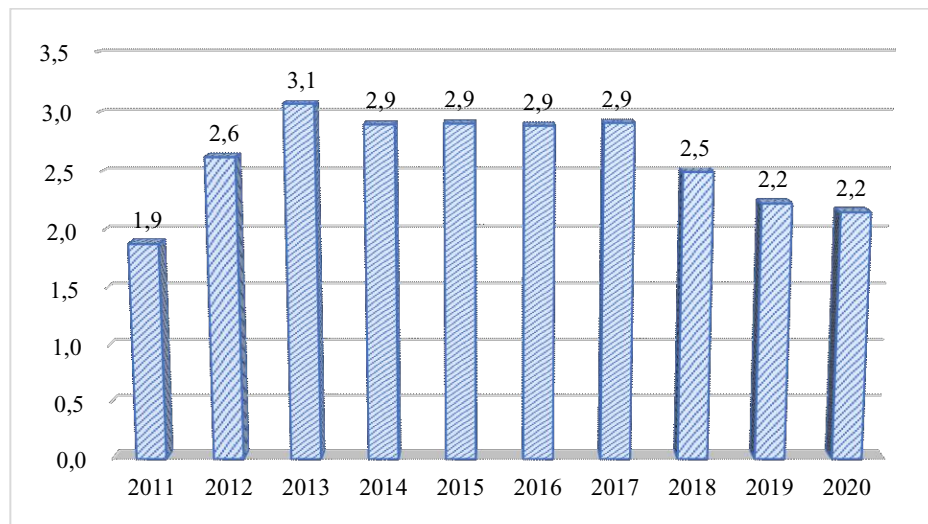
Indeed, the year 2020 started well as in the first 10 weeks the revenue growth

¹⁰ This data refers to 31/12/1991.

¹¹ This percentage value has been calculated through the average of each variation among the years.

was of +3-4% with respect to the previous year. Then, with the lockdown situation, sales plummeted by 40-50%.

Graph 2.14 – Evolution of Samsung Electronics total revenues



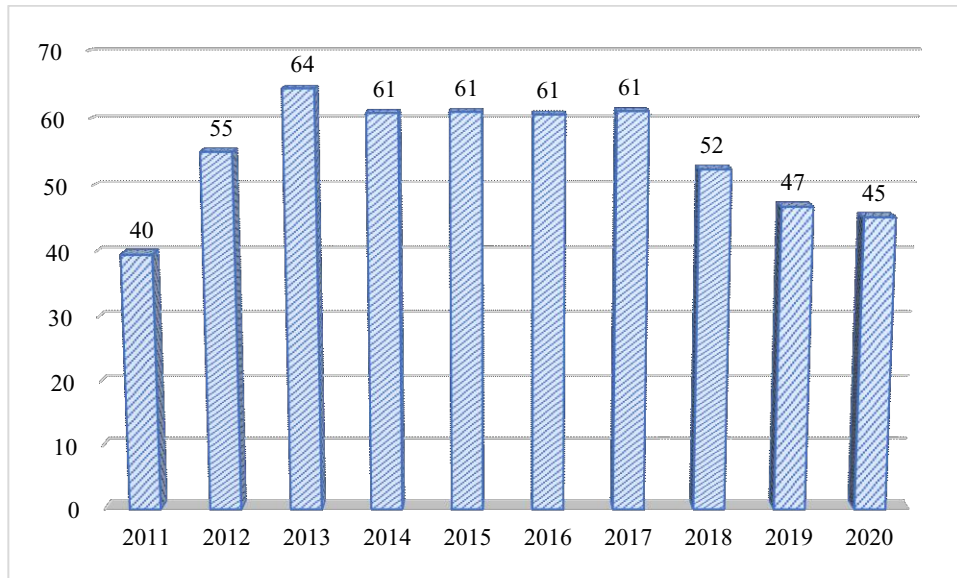
Legend: figures in billions €

Source: own elaboration on Aida key financial and employees

Nevertheless, as it is written above, the graph 2.14 comprehends all Samsung Electronics business segments, thus it does not represent the real intent research of the thesis. Thus, a deep-dive analysis on revenues for the IT business segment has been conducted. As a matter of fact, the one to consider is graph 2.15 which represents the portion of revenues (2,1% of the total¹²) just referring to IT business segment.

¹² Recalling the table 2.2 - Average weight of Samsung business segments (%)

Graph 2.15 – Evolution of Samsung Electronics IT revenues



Legend: figures in millions €

Source: own elaboration on Aida key financial and employees

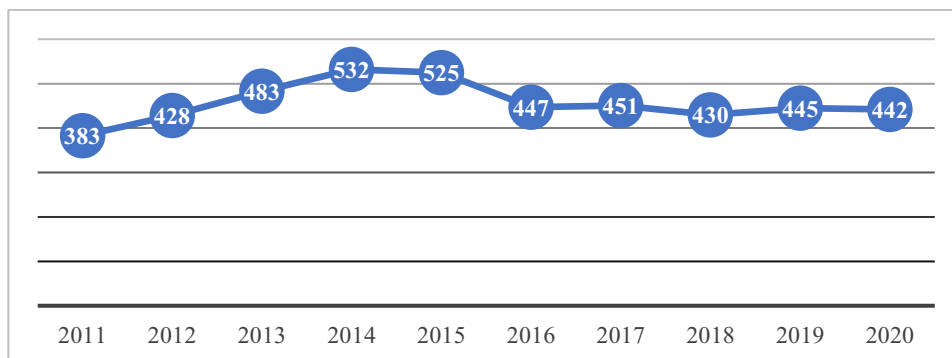
Looking at the graph 2.15, the underlying trends are mainly three:

- ❖ From 2011 to 2013, revenues increased with a positive variation of 62,8%. This represents the only expansion period in the business segment;
- ❖ In 2014, revenues decreased of 5,6% with respect to the previous year, but then until 2017, the trend remained flat;
- ❖ Last, from 2018 to 2020, the business segment faced a decrease, touching the second lowest value among the contemplated years.

Also in the case of the employment situation (refer to graph 2.16), three underlying trends could be defined:

- ❖ From 2011 to 2014, the number of employees increased of 38.9%;
- ❖ In the following year, the number of employees did not considerably change and from 2015 to 2016 there were 80 dismissals;
- ❖ From 2016 on, the trend has continued to be quite stable.

Graph 2.16 – Evolution of Samsung Electronics employees



Source: own elaboration on Aida key financial and employees

2.2. THE FIXED NETWORK SUPPLIERS

2.2.1. Site S.p.A.

ATECO: 43.21.02 (Installation of electronic systems also including maintenance and technical assistance)

Established in 1947 by Sauro Borghi and Roberto Carroli in the center of Italy (Bologna), Site S.p.A. is a leader company in the furniture of system integrator services (in terms of design, installation, integration, maintenance, and post-selling services) as well as in the creation of infrastructure and technological plants for the development of telecommunication networks.

During the period 1948-1980, they realized a telecommunication network for the Italian SIP (“Società Italiana per l’esercizio delle Telecomunicazioni”), and after some years in 1991-2000, they became the founders of the Omnitel operator and partner of those which developed national radio-mobile networks. In 2011-2014 they created the brand KIRETI for the integration of telecommunications systems in the national territory.

Nowadays, it is a solid reality which has contributed as system integrator to the Italian national technological development since its origin. For over 70 years they have been building networks, infrastructures, and systems and offering

services for telecommunication to constantly support the development of innovation and integration.

Telecommunication is the heart of the company which can be considered a real reference in the Italian market (this fact will be confirmed also in the interview).

The telecommunication area of the company is divided into:

- ❖ Fixed networks (design of access networks and transport; creation of copper and fiber optic systems; equipment installation and testing; maintenance and technical assistance);
- ❖ Mobile networks (design of mobile radio networks; creation of sites; creation of dedicated indoor or outdoor radio coverage systems; maintenance and technical assistance);
- ❖ Networks and systems for security and control (design and installation of security and control devices);
- ❖ Networking & IT (structured cabling, LAN, and WAN networks; routing & switching; Unified Communication, collaboration, video conference and Wi-Fi).

In doing so, they develop solutions in order to have a global and dynamic vision of the territory and to control infrastructures and systems (Richardson, 1972).

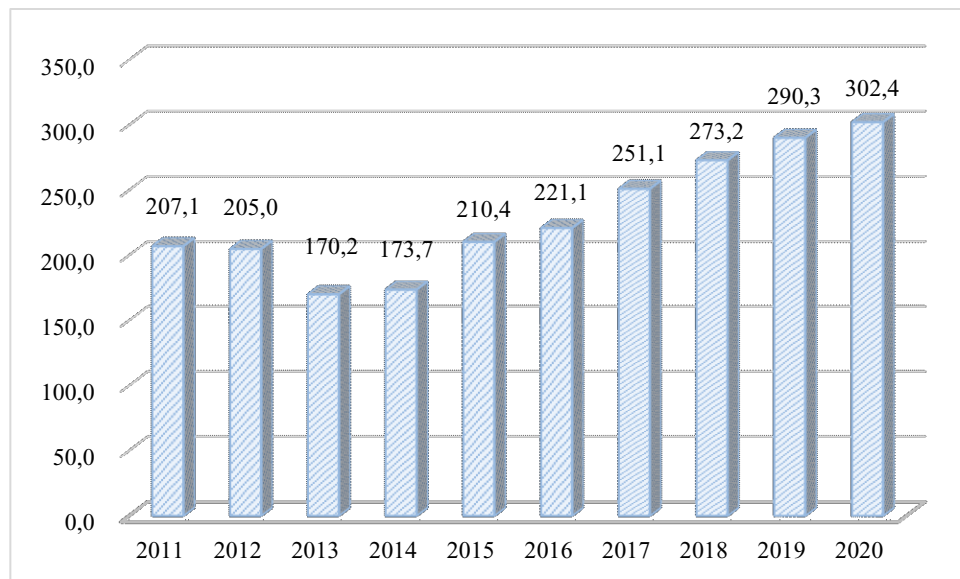
Site S.p.A. has 2.083 employees and 35 operative locations in 13 regions.

Indeed, they are internationally present through their representative locations in

Algeria, Emirates and Morocco, where they have acquired some important

orders. In the last few years, Site has been registered a significant development and growth in revenues moving from 221 million of euros (2016) to about 302 million of euros (2020), with a growth of about 36% in four years (see the graph 2.17). Despite the Covid-19 pandemic, the year 2020 saw a significant growth compared to 2019, a result that continues to consolidate the positive trend of recent years. The improvement of the financial position is mainly due to the general good quality of customers through new modes of invoicing and new operations for credit transfer. Thus, the revenues value has been following an increasing trend, except for the years 2013-2014.

Graph 2.17 – The evolution of Site revenues



Legend: figures in millions €

Source: own elaboration on Aida key financial and employees

Their investments are 100% Italian, which in 2020 grew by 7% (they did not vary during 2020 because of the pandemic) and they are mainly focused on:

- ❖ Research and innovation, which represents the highest part of investments in immaterial immobilizations (refer to table 2.3) followed by industrial plants and machineries (see table 2.4);
- ❖ The support to public and private projects through activities that follow the scientific research and socio-sanitary assistance;
- ❖ Continuous focus on health and job security with a particular commitment towards security protocols respectfulness;
- ❖ Ever-increasing focus on environmental performances;

Table 2.3- Investments in immaterial immobilizations

Investments in immaterial immobilizations	2019 Investments
R&D and marketing	1.050.631
Industrial patent rights	141.490
Licenses and trademarks	-
Ongoing immobilizations	-
Other immaterial immobilizations	182.719
Total	1.371.840

Legend: revenues in thousand €.

Source: https://www.sitespa.it/wp-content/uploads/2021/04/bilancio-di-sostenibilita-e-cop_2020.pdf

Table 2.4 - Investments in material immobilizations

Investments in material immobilizations	2019 Investments
Lands and buildings	-
Industrial plants and machineries	808.773
Industrial and commercial equipments	429.025
Ongoing immobilizations	-
Other material immobilizations	464.101
Total	1.701.899

Legend: revenues in thousand €.

Source: https://www.sitespa.it/wp-content/uploads/2021/04/bilancio-di-sostenibilita-e-cop_2020.pdf

Among the partners and customers, this company has: Vodafone, Fastweb, Tim, Open Fiber, Huawei, and Nokia. Some projects for these clients are noteworthy. In recent years, Fastweb has significantly increased its investment for the development of its network, capable of providing ultrabroad band services. Thus, the performance of a supplier such as Site was crucial as it represented a highly strategic infrastructure provider (Temraz, 2010).

Site started from the network design guiding the customer for the choices to be made until the management of the involved third parties such as Enel for the electrical connection of the cabinets and Telecom Italia for the copper connection with the cabinet. Today, over 90 cities are connected to Fastweb ultrabroad band and Site has operated in over 20 of these, creating about 2.600 road cabinets in order to provide ultrabroad band connectivity.

This project has represented for Site an opportunity to grow from FTTS (“Fiber To The Street”) to FTTH (“Fiber To The Home”) which allowed connections

up to 1 Giga in 2018. Thanks to this project, Site acquired a contract for the maintenance of the FTTS network.

Indeed, after three years, the company has grown building FTTH infrastructures for other final operators such as Open Fiber in order to have several Italian regions accessing to FTTH internet network.

Another interesting project is the one for Vodafone, which needed to expand the backhauling network without burdening its operations structure. In particular, the project consisted of forty HUBs to integrate the existing network in order to renewing and improving the high levels of reliability for Vodafone's customers. Site successfully completed the project in a relatively short time and for this reason, it was considered as a key player at national level.

To validate what it has been said so far, some financial data are reported in the table 2.5.

Table 2.5 – Revenues from sales divided by different business areas

Type of areas	Revenues							
	2016	%	2017	%	2018	%	2019	%
Electric energy distribution networks	15.751	7%	19.571	8%	26.136	10%	24.071	8%
Fixed telecommunication networks	122.861	56%	163.442	65%	173.315	63%	196.699	68%
Mobile telecommunication networks	22.757	10%	15.657	6%	17.896	7%	17.753	6%
Railway systems	33.992	15%	24.526	10%	19.178	7%	18.430	6%
Networking	11.263	5%	17.425	7%	17.786	7%	17.546	6%
Plant engineering projects	14.436	7%	10.496	4%	18.845	7%	15.849	5%
Total	221.060	100%	251.117	100%	273.156	100%	290.348	100%

Legend: revenues in thousand €.

Source: https://www.sitespa.it/wp-content/uploads/2021/04/bilancio-di-sostenibilita-e-cop_2020.pdf

The financial year of 2019 has been closed with a value of production of 285.833.392€ and with a profit of 1.103.523€ which takes into account the amortization of material and immaterial immobilization and reserves to the allowance for doubtful accounts for 4,77 million of euros. The reduction of the production value has been caused by the late beginning of some orders and construction sites that have influenced the results.

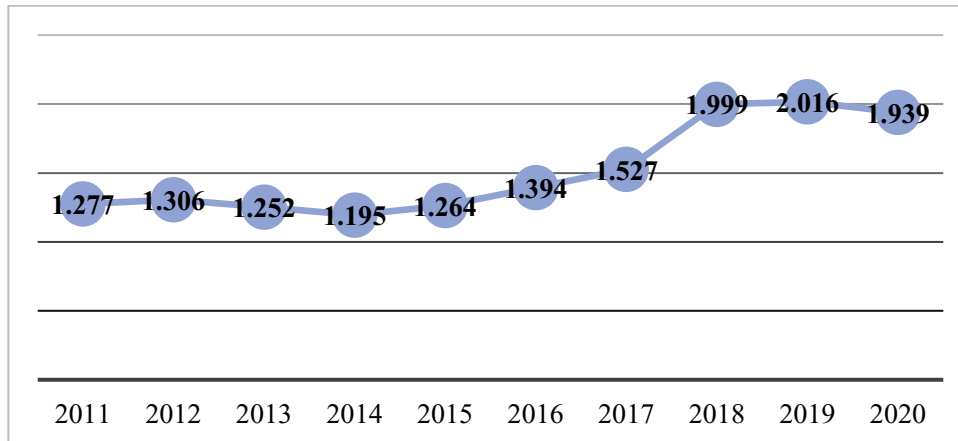
Regarding the employment situation, consider the graph 2.18, from which it is evident that from 2011 to 2020 the trend has been fluctuating.

Until 2015, the trend seemed to be quite stable with no considerable variations. From 2016 the number of employees significantly increased, reaching the pick in 2019 with 2.016 employees. Maybe due to Covid-19 pandemic, moving to 2020 the number of employees has been decreased, counting 1.939 people working for this company (77 less than 2019).

However, Site has developed new instruments to promote new development, innovation, and growth factors. Thus, this company continuously invests in formation, also despite the pandemic, during the year 2020 some formative courses were done to improve technical and soft skills¹³.

¹³ In particular, from the year 2020, Site is part of “ELIS” which has permitted to access to the Italian academy of electrical network in order to participate to the Community for Ultrabroad band as an active partner with Open Fiber and some other important market players in the field of optic fiber.

Graph 2.18 – Evolution of Site employees



Source: own elaboration on Aida key financial and employees

2.2.2. Sirti S.p.A.

ATECO: 33.20.02 (Installation of electrical and electronic telecommunication equipment, radio-television transmitters, electrical and electronic appliances)

Sirti S.p.A. (“Società Italiana Reti Telefoniche Interurbane”) was founded in 1921 by Vittorio Bruni Tedeschi and Pietro Pirelli in Milan.

Nowadays, it is a successful company operating in the telecommunication sector for the design, creation, and maintenance of big telecommunication infrastructures as well as competences of managed services, special projects for System Integration and Smart Solutions. It also operates in the energy sector and provides digital solutions for the companies.

In particular, the activities in the telecommunication sector the company carries on are:

- ❖ Design, creation, and documentation of fixed and mobile networks with innovative methodologies to maximize productivity;
- ❖ Urban and rail transport (railways, subways, trolleybuses);
- ❖ Traditional and innovative signaling systems such as ACC devices (Central Computer Apparatus) and CTC (Centralized Traffic Control);
- ❖ Underground or overhead cable telecommunication networks (for WDM, SDH, ATM and IP transmissions) and mobile radio networks in the GSM-R (Global System for Mobile communication – Railways);

Just after four years from its foundation, Sirti became bigger including in the share ownership the Western Electric, ITT and Siemens societies, which allowed it to be an Italian leader in the installation of telephone communications networks.

In the year 2000, Sirti S.p.A. was sold to Wiretel and its stock market title increased a lot until the year 2008, when the company was delisted from the stock market.

In 2013 it created the LTE network for Wind with the company Huawei, winning together the announcement promoted by the final operator.

The year 2016 represented a crucial point for the company because of the ultrabroad band project in Italy. With more than seven thousand municipalities to be connected, it has been the most important Telco project of the last 30 years. In 2019, the company bought Wellcom Engineering which was a specialized society in cyber security in order to strengthen its position on the market.

Nowadays, it is present on the national and international territory as it is composed by foreign branches in Europe and middle East and Italian controlled companies in the sector of energy, Telco, and IT system & cyber security.

Directly or through the societies of the group, Sirti operates for other companies, public entities and all the organizations that need services in terms of design, creation, supplying, process management and maintenance.

With its competences and know-how, Sirti is able to be the so called “technological advisor” in different markets and sectors.

In Italy, Sirti has 30 branches located along the territory and coordinated by the general management of Milan and by the four regional operational structures.

In the city of Milan, Sirti has its head quarter, which represents its directional center with about 350 people working there. Moreover, in the head quarter Sirti holds its project center, NOC (Network Operation Center) and the new Data center.

In addition, the company has its ICT center for software development, the OSS (Operational Support System) and system integration based in Rome.

The research and development center for railway signaling is in Genoa whereas in Turin there is the reference center for the construction and maintenance of copper networks, new generation fiber optic networks and mobile radio networks for the main operators.

Regarding the international presence, Sirti has been carrying out important project in several countries since 1970. In fact, it touches Europe, Latin America, Middle East and Africa through which technological and social development. In particular, since 1970 Sirti is present in Saudi Arabia where it contributed to its telecommunication network development.

Moreover, since 1980 this company is present in Libya where it created the majority of the infrastructures of the country, also constituting a Libyan branch to better cover the territory.

In 2008 Sirti and the Libyan Post Telecommunication and Information Technology (LPTIC) constituted a joint venture called “LIDIA” (Libyan Italian Digital Infrastructure Architects) which allowed the company to strengthen its business presence from telecommunication sector, infrastructure, transport, and energy to railway sector.

In United Arab Emirates, Sirti is present as a project society and subcontractor for activities regarding telecommunications, security, electric and mechanic system.

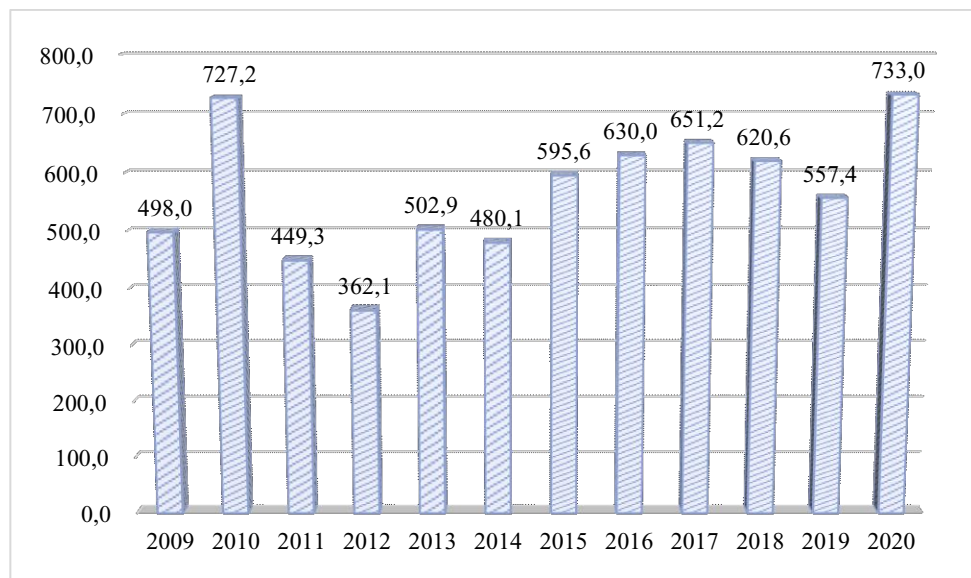
Finally, Sirti is present in Qatar through a joint venture called “MENA” (Middle East and North Africa) with the holding society GSSG (Ghanim Bin Saad Al Saad & Sons Group). The aim of this project is to significantly increase the business potentiality and penetration in those regions. In particular, MENA has the objective of developing fixed and mobile telecommunication infrastructure, energy transportation systems, security systems, ICT projects and solutions for smart cities.

Pontarollo (2000) foresaw the future perspective of Sirti. He predicted the core business would have been the telecommunication business unit but he also stated the importance of joint ventures to aggregate new partners and to obtain new synergies and higher efficiency.

Considering the graph 2.19, the revenue trend is evidently quite unstable during the examined years. Anyway, Sirti has been reaching a position of solidity and in particular, in 2020 it closed the year with a revenue of 733 million of euros, which was increasing with respect to 2019 (+31,5%) despite the pandemic. The 2020 result is also the highest from 2009 to 2020 and it could be mainly related to: +20% for the Digital Solutions business unit, which reached 202 million, thus becoming the engine of the company’s growth for its increasingly digital positioning; +10% for the Energy business unit, which reached 64 million of euros and +3% for the transport business unit which reached 64 million of euros.

Instead, telecommunication business unit, which is the core of the company, closed flat with 403 million of euros in the year 2020, and it could be due to the pandemic emergency which stopped many projects. But the company stated its willing to continue growing on optical fiber and 5G.

Graph 2.19 – The evolution of Sirti revenues



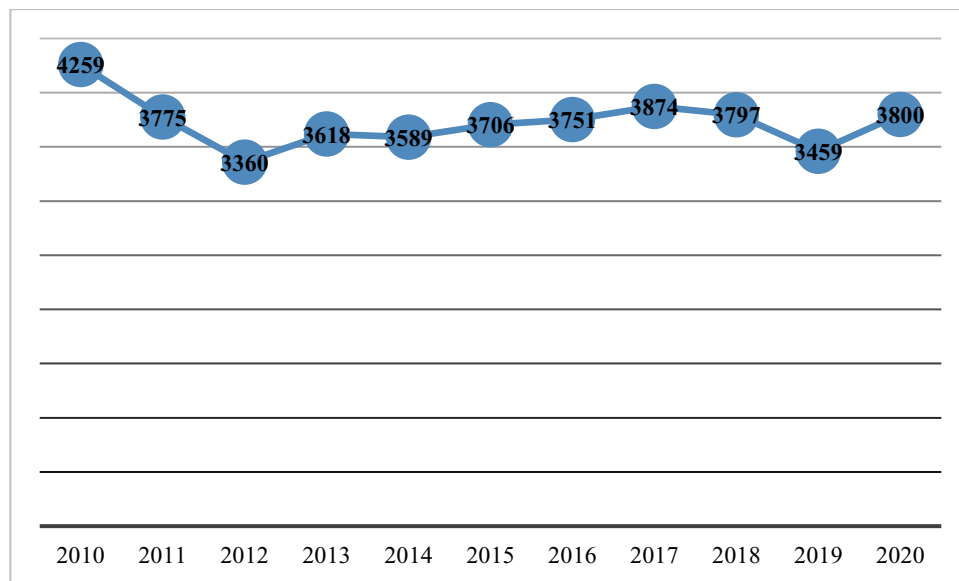
Legend: figures in millions €

Source: own elaboration on Aida key financial and employees

Referring to the employment level stated in the graph 2.20, in the year 2009, the company had 4.738 employees in Italy, and at that time the employment level was decreasing with respect to the past years¹⁴.

Thus, it can be stated that from the year 2009, the situation regards employment redundancies has been worsening, nowadays counting 3.800 employees which means a reduction of about 12%.

Graph 2.20 - Evolution of Sirti employees



Source: own elaboration on Aida key financial and employees

¹⁴ In “*Convergenza tecnologica e industria degli apparati e dei sistemi per le telecomunicazioni*” (Pontarollo,2000), it is shown that Sirti employment levels reached more than 10.000 employees from1995 to 1998, touching a peak of 11.446 in 1997.

2.2.3. Ceit S.p.A.

ATECO: 42.22.00 (Construction of equipment and cables for telephones, public lighting systems, public bodies in general)

This company was established in 1989 in the center of Italy (Chieti, Abruzzo), but it has its origins in 1950. In fact, Ceit S.p.A. was born from the merging process of some companies operating for Telecom Italia S.p.A., thus it encompasses the experiences of eight companies¹⁵.

In fact, it is one of the first companies to whom TIM and other final operators entrusted for the creation and development of telecommunication networks.

Nowadays, it is a leader company in the development of telecommunication, transport (RFI) and energy networks and plants, thus there is a strong differentiation in the distributed services (Telecom, Open Fiber, Acea, ENEL and Renewable energies, Railways, and mobile telephony).

Indeed, Ceit S.p.A. has always kept and pursued technological development through the expansion markets, the acquisition of new knowledge and the creation of strategic alliances and its mission is to maintain a relevant position in the market.

¹⁵ These eight companies were: CIT of Pescara (PE); LETA of Ascoli Piceno (AP); CIET of Ancona (AN); CET of Lanciano (CH); ELCA of Verona (VR); IRT of Mestre (VE); ITEA (Milan, Rome, and Bari); FIT located in Arluno (MI).

Ceit is part of the IGEFI Group S.r.l., a holding which holds the totality of Ceit quotes and operates in the telecommunication, construction, real estate, environment, geotechnics, oil, and gas sectors. This holding consolidates an annual profit of about 1 billion of euros. Belonging to a diversified and competitive group allows Ceit to gain and exchange technical and managerial know-how, to share strategic experience on the market as well as technologies and processes. Thus, having this financial and capital solidity is an important guarantee for customers and suppliers (Cricelli et al., 2002).

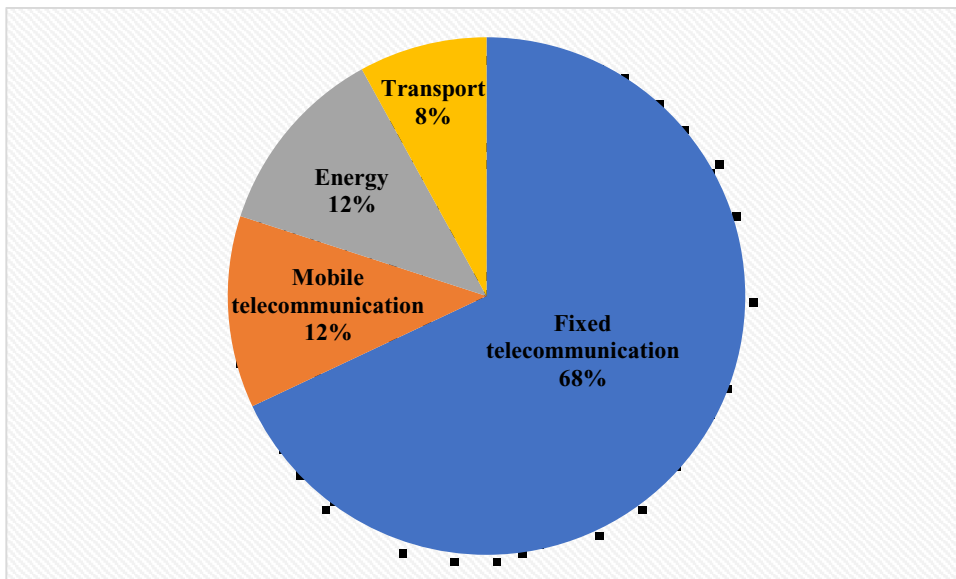
All these factors allow it to have a fundamental role in the global scenario of the construction and maintenance of infrastructures in the telecommunication (core business), transport, and energy sector.

Ceit currently operates both in the national and international territory, focusing on the following activities (synthetized in the graph 2.21):

- ❖ Creation of radio-mobile networks; ultrabroad band networks; installation of HFC networks, supplying of equipment for CATV networks; supplying and installation of fiber optic junction networks; testing of fiber optic networks; supplying and installation of transport networks based on SDH technology.
- ❖ Transmission and switching systems.

- ❖ Distribution of high, medium, and low voltage electricity, creation and design of overhead and underground lines, construction of primary and secondary substations.
- ❖ Railway traffic signaling and control systems.
- ❖ Construction for electric traction and automatic blocking systems.
- ❖ Construction of tunnel safety, motive power and lighting systems.

Graph 2.21 – Percentage weight of Ceit business segments in terms of revenues



Source: own adaptation on <https://www.ceitnet.it/azienda/>

This company counts 924 employees, 60 main customers and 42 operational sites which allow it to operate along the entire national territory.

In particular, the company has its legal and administrative headquarter in Chieti, and two main operative centers (one in Chieti and the other in Milan). Moreover, the company has other operative locations, which can be mobile and of lowered dimensions due to contingent needs (for instance, opening of new construction yards) and related to the contract duration.

Regarding its customers and partners, Ceit counts final operators, technological vendors, tower companies and other operators.

Before taking into consideration which are the main partners and customers, it is crucial to identify which are the activities brought by Ceit for them:

- ❖ Creation of radio stations and radio links, DAS systems and Smart Metering;
- ❖ Executive project, technological systems, cables, antennas and equipment installation as well as commission and testing;
- ❖ Fiber connections;
- ❖ Preventive, corrective and evolutive maintenance, extraordinary technological systems decontamination.

First of all, Ceit is one of the main sub-suppliers of TIM both for the fixed and mobile telephony, being a network in several regions such as Lombardy, Veneto, Lazio, Abruzzo, Puglia and Calabria. Here, it has to construct telecommunication infrastructure made of copper and fiber optic, create

systems for networks maintenance and services, also as a unique system for other licensed operators (OLO).

This collaboration started in 1995 with the “SOCRATE” project in several Italian cities. “SOCRATE” stayed for “*Coaxial Optical Development Access network Telecom*” and it was an initiative brought by Telecom Italia from 1990s in order to spread the development of cable television in Italy.

Nowadays, this collaboration still continues with other projects such as FTTC and FTTH projects along all the cities of the peninsula.

All these factors allow Ceit to be a TIM strategic partner also for other programs among which there is the Centrals decommissioning.

Moreover, it is considered an important player for new radio-mobile technologies implementation, creation of radio stations, installation, integration and commissioning for technological equipment and systems.

Another fundamental partnership is the one with the final operator Fastweb, for which Ceit has been creating distribution networks along the Italian territory and participating in interconnection projects with other suppliers' infrastructures.

Furthermore, it participated to the deployment of FTTS network in numerous cities, where it has been entrusted for the installation and commissioning of more than three thousand cabinets.

Another relevant activity is the maintenance of Long Distance networks, MAN and Cabinet FTTS in several regions such as Puglia, Calabria, Marche, Abruzzo, Veneto, Molise, and Umbria, working with challenging service level agreements.

Among all the customers and partners of Ceit, it is worthy to consider Open Fiber, which chooses this company for the FTTH project in several Italian cities of Lombardy, Marche, Abruzzo, Sicily regions.

In addition, Ceit deals with assurance and delivery activities and it is involved in the C&D areas of numerous Italian regions.

Infratel and Vodafone are the other two strategic partners and customers.

For Infratel, Ceit has designed, created, and maintained all the fiber optic infrastructures for the ultrabroad band in Lombardy, Sardegna, Calabria, Marche, Abruzzo, Veneto, Lazio, and Umbria.

For Vodafone instead, Ceit is considered as a global partner for deployments projects on mobile and fixed networks. Indeed, for the radio-mobile infrastructure, Ceit deals with the radio station creation, installation, networks interconnections, integration and technological systems commissioning as well as extraordinary maintenance for sites.

Thus, Ceit holds a fundamental role in the FTTH Vodafone development on more than 50 Italian provinces and it is also involved in network sharing programs with other suppliers.

In fact, during the years Ceit has also collaborated with:

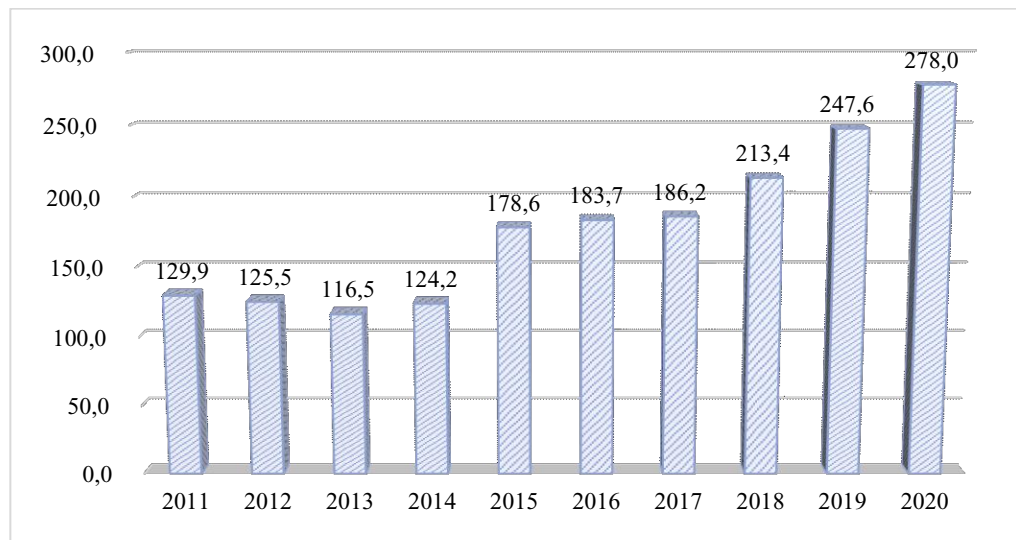
- ❖ Technological vendors such as Huawei, Nokia, Ericsson and ZTE for deployment projects, installation, testing and system networks maintenance. This was possible thanks to the profound knowledge about telecommunication infrastructures, resources and instruments availability as well as the spread presence in the territory.
- ❖ Tower companies for which Ceit has deployed new multi-operators and multi-standard networks. Moreover, it has developed Distributed Antenna Systems (DAS) for 5G coverage. This was possible thanks to the knowledge Ceit has acquired about Italian radio-mobile networks, antenna, systems and equipment installation as well as maintenance of the sites.
- ❖ Other operators for which Ceit has worked in order to cope with big and minor infrastructures. This could be done thanks to the flexible organization, the capillary presence on the territory and technological development competences.

Nowadays, Ceit is ready for 5G infrastructures and for new challenging ultra-broad band technologies such as Small Cell deployment, DAS and new services brought by IoT and Industry 4.0.

In the last six years, Ceit has doubled the business volume, touching 278 million of euros of revenues (see graph 2.22), but generally speaking, from 2014 to

2020 the revenue trend has always increased. Also for this reason, it has been pointed as one of the most dynamic society of the market

Graph 2.22 – Evolution of Ceit revenues

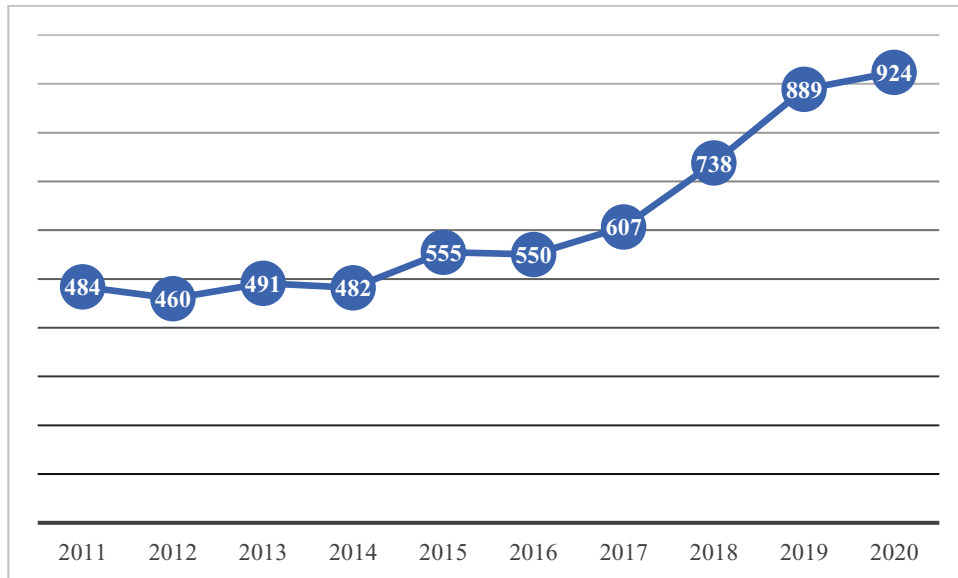


Legend: figures in millions €

Source: own elaboration on Aida key financial and employees

Regarding the employment level (see graph 2.23), it is evident that the number of employees has been increasing during the years, at least in broad terms. The small reductions encountered from 2011 to 2016 could be due to the final operators' decisions to cut orders to the company.

Graph 2.23 - Evolution of Ceit employees



Source: own elaboration on Aida key financial and employees

2.2.4. Italtel S.p.A.

ATECO: 26.30.29 (Manufacture of other electrical and electric telecommunication appliances)

Founded in 1921 in Milan as “Società Italiana Siemens per Impianti Elettrici”¹⁶, Italtel S.p.A. is a multinational society which operates in the ICT and telecommunication sector, which comprehends the design, development, and

¹⁶ Until the 28th of December 1999, Italtel was controlled by the group Siemens Ag and by Telecom Italia through a joint venture.

installation of solutions for new generation network systems based on IP protocol.

Since the beginning, Italtel has been a primary actor in the domestic telecommunication market history but nowadays, it also deals with networks, data center, digital security and IoT.

The solutions it offers consist of engineering and consulting services based on Network Functions Virtualization (NFV) and Software Defined Networking (SDN). Thus, its reference market (target) is composed by service providers, Telco providers, public and private companies with a focus on vertical market such as energy, industry, defense, finance, and smart cities.

In 1998, this company faced a profound crisis. Its profits had a loss of 14% with respect to the previous year due to extraordinary costs for the triennial restructuring plan (1999-2001) in which the company should have decreased the resources and assigned complementary activities to other companies (outsourcing).

After one year, the above-mentioned joint venture was definitely disaggregated because of technological changes, market developments and finally, new strategies.

The market demand for systems deeply changed and evolved because of the reduction of investments from the final operators (Fransman, 2001). At that time, this happened because the financial situation was influenced by the

financial crisis coming from Russia and South-East Asia which represented strategic areas for this company.

Moreover, considering the Italian telecommunication market, the period 1990-1999 was strongly characterized by the presence of new final operators and the privatization of Telecom Italia, which reduced its investments.

Indeed, Italtel sold to Siemens the 100% of Siemens Information and Communication Networks, with its activities regarding radio-mobile networks and transmission systems and equipment, counting 7.300 employees.

On the other hand, Telecom Italia acquired the 100% of the activities of Italtel regarding fixed networks systems and phony.

In 1999, Italtel Systems, whose main activity was the installation of UT commutation systems, were sold to Tecnoeudisia S.p.A., which was previously a supplier of Italtel and the number of employees was drastically reduced arriving to 3.200 employees.

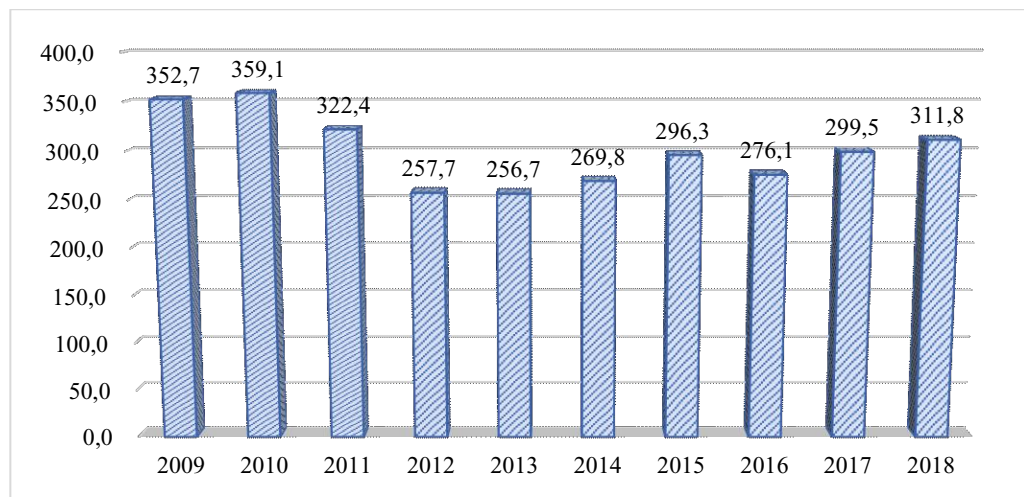
It was evident that while all the other companies already started a profound vertical disintegration process (Marshall et al.,2007), for Italtel it was brought by all these mergers and acquisitions steps described so far.

From the year 2000, the renewed Italtel wanted to be one of the main suppliers for telecommunication networks, allowing the increase in income revenues and profits, as well as in the value created by innovation and partnerships with other sub-suppliers.

Italtel has had its headquarters and R&D activities in Italy but it has been also internationally present with foreign branch offices in 13 different countries (Netherlands, Belgium, Deutschland, France, Poland, Spain, U.K., Argentina, Brazil, Ecuador, Peru, US, and Chile).

In particular, in Settimo Milanese (Milan) this company has had several plants dedicated to the validation of the solutions provided to customers and its R&D laboratories both in Milan and in Palermo, while in Rome the company has had its sales and commercial offices. In 2015 the company's revenues increased from 269,8 to 296,3 million of euros (refer to graph 2.24), the EBITDA increased a lot compared to the precedent year from a negative value of -1,3 million of euros to 12,3 million of euros, but the loss touched -24,3 million of euros.

Graph 2.24 – Evolution of Italtel revenues



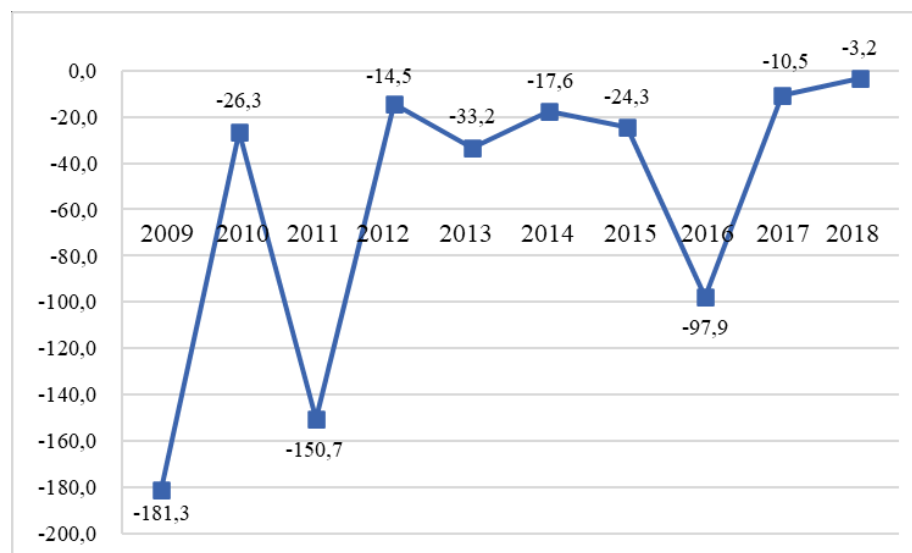
Source: own elaboration on Aida key financial and employees

From 2009 to 2018, this company never reached positive profits (refer to graph 2.25), the indebtedness was high and as a consequence, Italtel needed a strong partner which could allow it to survive and support its development.

In the following year, the financial situation worsened because of the very high cost of debt which had weighted on the financial statement, thus the creditors were forced to find an emergency solution with the conversion of part of the debt into capital risk, bringing the share capital amount to 2 million of euros.

In 2017, Italtel revenues counted 299,5 million of euros (+8,5% compared with the value of 2016), composed by the domestic market (188,1 million of euros) and the international market (111,4 million of euros).

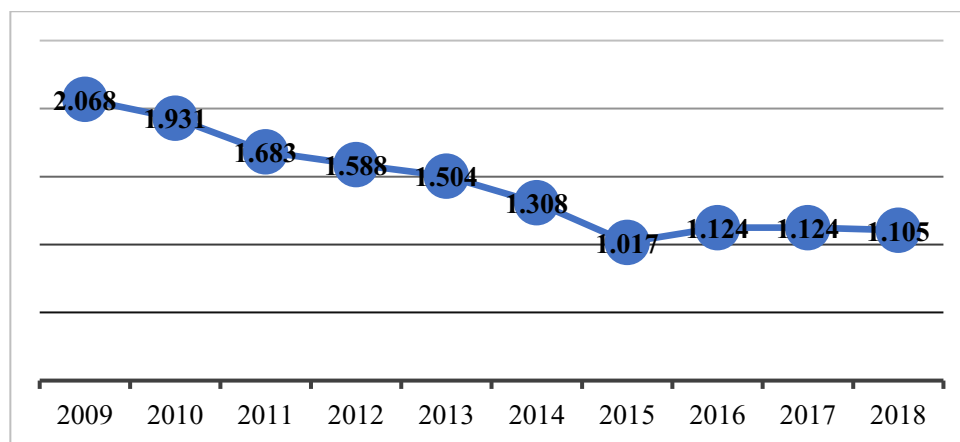
Graph 2.25 – Evolution of Italtel net profit/loss



Source: own elaboration on Aida key financial and employees

Anyway, the arduous financial position of this company also reflected the employment levels, which followed a decreasing trend, halving the number of employees from 2009 to 2018 (as it is shown in the graph 2.26).

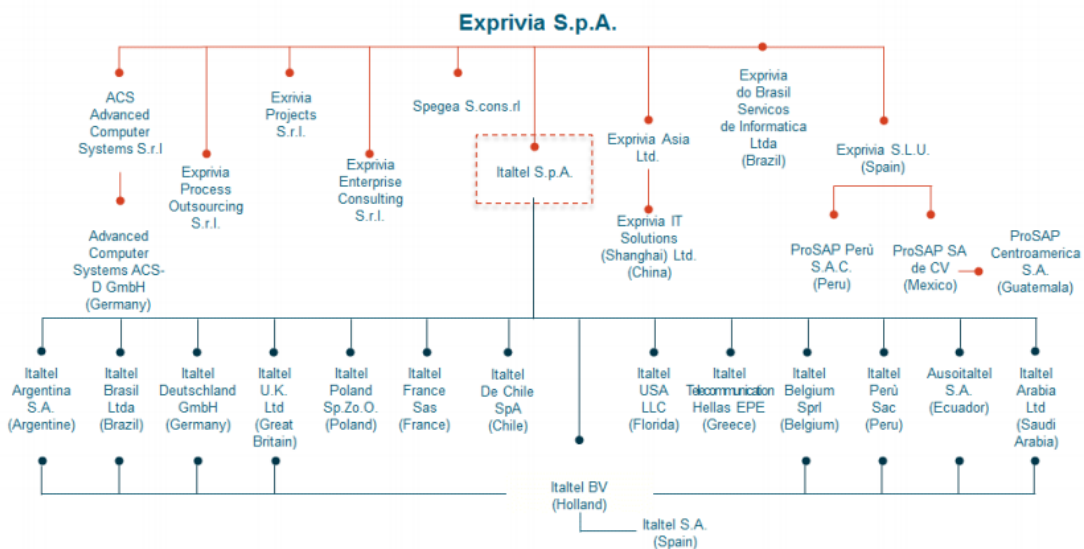
Graph 2.26 - Evolution of Italtel employees



Source: own elaboration on Aida key financial and employees

However, after some years of renovations and reconversions, in July 2017, Italtel became controlled by Exprivia S.p.A. (see figure 2.2), a quoted society in the stock market, which acquired the 81% of the company's ordinary capital after 2 years of negotiations. The remaining 19% of capital has been taken by Cisco Italia S.r.l., totally controlled by the Group Cisco System International BV and Cisco Systems Inc. Group.

Figure 2.2 – Exprivia organizational structure



Source: https://www.exprivia.it/exprivia-resources/images/file/exprivia_strategic_plan_2018-2023.pdf

The two companies seemed to be highly compatible and could be integrated with each other because Italtel had 75% of revenues in the networks and telecommunications sector, and only 25% in finance, energy, transport, defense, and public administration. On the contrary, Exprivia was much more concentrated on these sectors.

In theory, this process was considered advantageous for both companies and in particular for Exprivia because 45% of the Italtel profits were coming from foreign branches and it could have been interesting to expand Exprivia's boundaries abroad.

In fact, the group Italtel/Exprivia aimed at being one of the most fundamental Italian industrial group in the digital technologies, covering both the demand coming from the digital transformation and the whole ICT value chain (from infrastructure components to applications and services).

Furthermore, considering the fact that the telecommunication sector was moving towards virtualization and cloud service (Paleologos et al., 2013), this was an opportunity Italtel would have exploit, to use IT skills Exprivia had.

On the other hand, Exprivia could move its product abroad, especially in Latin America and gave Italtel useful skills for enlarging its market.

The objective at that time was to make the ratio EBITDA-debt closer under the threshold of 3% in order to allow Italtel to exit from a condition of indebtedness and out of the “non-performing loan” position.

The aim, at least at the beginning, was to create a group with 600 million of euros of profits, able to increase its potentialities in order to develop its competitiveness on the market.

The group planned to act in accordance with the strategic plan 2018-2023:

- ❖ The EBITDA margin was expected to grow reaching 76 million of euros (from 3,5% to 9,3% on revenues);
- ❖ The overall revenues were expected to reach 760 million of euros and the group was expected to start generating value in the year 2018;

- ❖ The net debt was planned to be reduced from 226 million of euros to 119 million of euros so that the ratio net debt/EBITDA was planned to touch the value of 1,5 in 2023;
- ❖ Focus on the key areas and countries such as Spain, France, Germany, Peru, Brazil, Argentina, and Columbia. In fact, the growth was expected to be caused by the international market which would have represented the 51% of total revenues in 2023 (strong internationalization strategy). However, also the Italian market was expected to increase in terms of volume and profits.

Despite this, since the beginning of 2019, some deviations from the expectations contained in the strategic plan 2018-2023 were seen because of unfavorable and unpredictable factors:

- ❖ External factors:
 - a. The accelerating weakening of the telecommunications market in Italy, where the most important customers decided to decrease investments on telecommunication networks, which represented the core business for Italtel;
 - b. The very high investments for the 5G tender ended in 2018. This imposed a drastic review of the investment plan for the final operators, contributing on the weakness for the network infrastructure (Sturgeon et al, 2001);

- c. A reduction in revenues due to the necessity of required executive permits, the optimization for reaching stringent economic targets defined by the customer, requiring more time than expected and therefore, decreasing the production speed;
 - d. A strong downsizing of the telecommunication market on foreign markets for which an important customer of the company decided to postpone or block some projects;
 - e. A relevant economic crisis in the country of Argentina, which caused a devaluation of the currency and therefore, of the Italtel credits which brought to a further downsizing of revenues;
- ❖ Internal factors:
- a. The group Exprivia/Italtel did not follow the primordial expectations due to a delay in the beginning of the commercial and operational action because the international market was not ready for its offered products and services;
 - b. Overestimated competitiveness of Cisco products;
 - c. Overestimated product position, not considering the relevant entering barriers;
 - d. Combined to all these external factors, it is worthy considering that Italtel business was still strongly focused just on telecommunication sector and on a limited number of customers. For this reason, when

those clients reduced their investments, Italtel faced some relevant consequences because the reduction in revenues was not capable of manage the amount of fixed costs.

- e. Moreover, Italtel participated to the so called “project BUL” (“Banda Ultra Larga”) whose aim is to develop an ultra-broad band network throughout the national country to create a public telecommunications infrastructure in line with the objectives of the European Digital Agenda.
- f. The innovative components this company started to develop such as Cyber Security, Cloud, IoT, Smart Working as well as Ultra Broad Band telecommunications and 5G were still very residual compared to the traditional offerings.

Regarding the financial aspects, Italtel faced a severe strain in its cash flows due to lower margins and the Cisco commercial politics (which was often independent from ordering timing of final customers).

Due to the persistence of an imbalance in the financial flows, Italtel was constrained to create a debt restructuring process to ensure the rebalancing between cash inflows and outflows.

All these elements (combined with the belief in the validity of the strategic plan) had led to the failure in creating the new industrial group between Exprivia and Italtel.

Nowadays, Italtel has begun a research process in order to find a potential investor or more (both in the national and international market) to restructure the company. In December 2020, Italtel formulated and presented two offers. One for Exprivia and the other for an industrial group, PSC Group, whose offer has been preferred because of its project more centered in the Italtel traditional core business. The 5th of February 2021 Italtel presented the admission application for the composition with creditors and the PSC proposal will guarantee that the all the assets and liabilities of Italtel will be assumed by PSC. In fact, this latter company has proposed 44 million of euros for Italtel rescue and relaunch with the support of banks and eventually PSC will hold the majority. But the operation is also going to include TIM (which will hold the 18%) and a company called Clessidra. Among these 44 million of euros, TIM will invest them for the 20-25% of Italtel capital. Thus, Exprivia and Cisco will “leave the scene” but Cisco will always remain the major supplier.

As a matter of fact, to relaunch this company, the aim is reaching 350 million of revenues in 2023 and 450 million for 2026.

From this conclusion, it is evident that among the considered case studies, Italtel is an example of the intense transformation of the sector. New companies have entered, others have left.

3. EMPIRICAL ANALYSIS: INTERVIEW AND ECONOMIC AND FINANCIAL ANALYSIS

3.1 Interview with the CEO: NETOIP

To further analyze the micro case studies in a more concrete pattern and to corroborate what it has been said in the chapter 2, an interview was conducted.

The interviewed person was Giacomo di Napoli, the sole administrator of Netoip S.r.l., a local small but reputed telecom operator.

Even if the focus of the thesis is not studying the final operators' segment, the possibility to talk with a person with a deep knowledge and expertise of the sector (and, as a consequence, of network suppliers such the ones considered) was an opportunity to seize.

Netoip S.r.l. is a relatively young company as it was established in 2008 when Giacomo di Napoli started to create the first wireless network to provide VPN and VoIP to some important customers.

The first tests were focused on creating a network suitable for the transport of VPNs and VoIP for companies, trying to lower and stabilize the latency times of networks, thus increasing their performance and lower their jitter, a fundamental operation for the passage of VoIP.

Taking advantage of fundamental partnerships with important carriers at national level both in terms of connectivity and telephone traffic, this company

has been acquiring a considerable slice of the local market by acquiring different customers coming from different sectors (automotive, radio-television, energy and companies from fixed telephony).

Anyway, during the interview, the questions concerned the supply chain, as this company has a network of installers and hookups for final connections on Open Fiber network.

The questions made were the following:

- 1. Are there difficulties in finding network suppliers and system equipment suppliers to establish the connection (if the company needs them)? Or is Open Fiber that do it on their behalf?*
- 2. Do you deal with network suppliers such as the one considered? If the answer is yes, which one is the most solid and reliable?*
- 3. Which are the most significant obstacles in the relationship with network suppliers and system equipment suppliers? Which are the supply chain problems in the NGA broadband sector?*
- 4. On which part of the network the investments are focused? Which are the major investments of fixed network suppliers?*
- 5. Which will be the future perspective?*

What has emerged from the Giacomo di Napoli's answers is reported hereafter.

In the telecommunication sector it is difficult to maintain positions with the already existing giant companies. Once it was said that technology changes

every six months, namely every six months there are significant technological changes. Nowadays, this belief is overturned because every month there can be innovation so that companies need to keep up with times. In this sense, Giacomo stated he is used to work six months or one year ahead because he works looking and thinking on what he will do at the end of 2022. This is the consequence of a very nervous market so that companies have to be fast and economic.

Thus, the Italian telecommunication sector, at least in the mobile segment, it is very competitive and it guarantees big companies instead of small ones.

Netoip also works for network suppliers and system equipment suppliers because it owns a service company which works for Sirti, Ceit, Alpitel, Sielte and Tiscanet¹⁷ for example.

These companies are easy to find, despite the fact that, for a smaller operator such as Netoip, they represent a little too big in terms of dimensions. Thus, it can be concluded that smaller operators are looking for smaller network suppliers and system equipment suppliers. For instance, Sirti does not sign a contract with a final operator without a national presence on the territory so that

¹⁷ What emerged from the interview was that Tiscanet is an Italian company which has been working for TIM for five years and it has become TIM's backup company. It is a company established in Caserta (south of Italy) which has presence on the territory, especially in the center of Italy, covering Emilia Romagna, Abruzzo, Umbria, Lazio where it has one or two construction sites. It started with a competitive bidding process with TIM, but it also works for others (Open Fiber, Fastweb and Netoip for instance) because it is considered the one within everyone's means. While Sielte and Sirti are present in each part of the national territory, Tiscanet is more focused on the center of Italy.

smaller final operators are not its typical clients. Therefore, Sirti signs contracts with companies having an interest in operating in different Italian regions.

However, they are very useful companies because they allow final operators to have a slender structure by subcontracting everything. They both do network and delivery, assurance work so that final operators do not need to have a structure.

They make road works and installation, they make excavation, manhole extraction, passage of pipes, microtubes and fiber stacking. In addition, they carry out the installation of the wiring of underground muffles and muffles on the pole and on the wall, reaching customers' articulated drawer and finally, they also produce apparatuses.

Basically, Sirti and Sielte make the same activities and they have also added mobile telephony i.e., installation of the pylon, installation of the cells, passage of cables and construction of the shelter at the base.

In some parts of the mobile, Sirti enters into competition with Nokia, Samsung and Ericsson¹⁸, by using the mobile network devices (Sirti does never buy, it always uses equipment owned by final operators). These mobile network suppliers sell pieces to Sirti which assembles them later on. So, there is a certain convergence, even if the specialization is not in electronics.

¹⁸ This confirms the choice of analyzing the five global giants in the second chapter (Samsung, Ericsson, Huawei, ZTE and Nokia).

In outsourcing, Sirti works for the final operator, it takes the apparatus and substitutes it when the apparatus breaks (thus, it concerns assembly activities). Sirti does not do the vertical anymore but relies on subcontracts because of higher margins (they are profitable operations to connect single-intervention road networks).

Thus, to respond to the first question, it is not difficult to find network suppliers and system equipment suppliers, it is complicated to sign a contract with them, at least for smaller final operators because they have particular necessities.

Among the ones considered, Giacomo indicates Sirti as the most solid and reliable in relationships because it has the most important national orders until now. Sirti has the maintenance of the entire fiber network (thus it has the 95% of the Italian operators in hand), the optical fiber of the highways and railways. That is, it has orders that have been very solid for many years and it is also a company that has been working for TIM since 1970 (the first optical fibers date back to these years).

As it will be shown in the following paragraphs with the financial statement analysis, this technical solidity is in contrast with the economic and financial aspect, also confirmed by Giacomo. In fact, Sirti has had some ups and down in the past 10-12 years, especially after the crisis which forced this company to face periods of layoffs. Nowadays, it has been recovering, but it takes the past situation with it.

Regarding Ceit S.p.A. instead, it is a profit-making reality because it uses subcontracts for the majority, doing almost nothing on its own. It has a very thin structure, keeping high margins, as it will be described after.

As far as Italtel S.p.A. concerns, the interviewed does not hear about this company anymore. Its decline started 12-13 years ago when VoIP increased and traditional phone line started disappearing. Nowadays, TIM is shutting down Italtel centrals (it will shut down all of them in 2023/2024)¹⁹. To solve its problem, this company tried to follow the path of Sirti, also supplying DSLAM (Digital Subscriber Line Access Multiplexer), but the Chinese suppliers have had the majority. This has led to Italtel presentation of the admission application for the composition with creditors and the PSC proposal.

Regarding the investments, from the interview has emerged that it is necessary to invest on the last mile. Currently, Italy has a fairly large backbone network to transport the bandwidth flows around the country and the regions. There is still a lot to do, but it means there is not a big shortage for companies. For the next five and six years, companies should invest in fiber and on laying the fiber up to the users' houses. Then in the future, companies should invest on services because there will be no longer the "race" to bring the infrastructure, but the competition will be on inventing services to keep that fiber.

¹⁹ The first Italtel plant shut down was the one in Trento and it happened in 2020.

3.2 Economic and financial analysis of the fixed network suppliers

The financial statement analysis is useful to investigate the sector based on the four fixed network suppliers. At this point in fact, the financial statement analysis has been circumscribed just to fixed network suppliers.

The reason why mobile network suppliers have not been included in this analysis is that the available data resulted to be too much “contaminated”. If considering Samsung Electronics S.p.A. for instance, this company does not only refer to telecommunication business segment but it also comprehends consumer electronics (concerning visual display business, TV, digital appliances business and printing solutions business).

This multitude of business segments combined with the limited accessibility to data and tools to identify the specificities of each company are the reasons behind this choice.

Anyway, they have been included in the second chapter because they form the telecommunication sector, thus they deserve to be considered.

Before effectively starting, some annotations are fundamental to be made.

AIDA²⁰ database is the one used for the analysis and it proposes detailed

²⁰ AIDA is the acronym for “*Analisi Informatizzata Delle Aziende*” and it is a database distributed by Bureau van Dijk, which contains exhaustive data and information on Italian companies. It shows a company’s profile, balance sheets, financial data and indicators, as well as ratings and credit risk analysis. The following is the link to AIDA website: <https://aida.bvdinfo.com/version-2021727/home.serv?product=AidaNeo>

balance sheets, reclassified taking into consideration the IV EEC directive scheme.

First of all, not all the financial exercises of the companies taken into consideration are present in the database (AIDA presents complete information within a 10-year range). In particular, the starting and last financial exercises of some companies could be missing due to their unavailability so that as much as possible some integrations have been included (sources will always be referenced).

Moreover, the analysis is based on non-consolidated balance sheets, not including companies which are not functional to the sector analysis.

The period within the analysis has been led is 2010-2020 and the sector has been analyzed in terms of profitability, investments and financial stability, which are the most representative benchmarks for a sectorial study.

Firstly, profitability defines a business' ability to make profits relative to revenues (Paolucci, 2016). This benchmark can be investigated through four different profitability indexes:

1. EBITDA (*“Earnings Before Interest, Taxes, Depreciation and Amortization”*) calculated as operating revenue plus total depreciation, amortization and write downs.
2. ROI (*“Return On Investments”*) calculated as the net operating margin over the total assets.

3. ROE (“*Return On Equity*”) calculated as profit (or loss) over equity.
4. ROS (“*Return On Sales*”) calculated as the net operating margin over total sales.

The EBITDA is an essential dimension to provide judgements over the effective performance of a company and on its value. Otherwise, those judgments cannot be expressed just considering net profit (Gummerson,2000). In fact, two similar companies in terms of dimensions, which operate in the same sector and characterized by the same net profit, can have a different EBITDA considering the operative and financial management. The difference stays in different OPEX (Operating Expenditure).

In our analysis, Ceit S.p.A. is the only one having an increasing and always positive trend in EBITDA (refer to table 3.1).

Table 3.1 – The EBITDA index in the period 2010-2020

EBITDA	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Site S.p.A.		11.103.331	10.785.180	8.348.754	8.029.865	9.337.104	7.664.851	13.694.582	9.590.220	9.040.184	8.028.839
Sirti S.p.A.	31.336.240	28.123.000	21.001.000	7.382.000	29.196.000	28.674.000	20.887.000	17.969.000	26.235.000	10.111.000	
Ceit S.p.A.		12.425.392	12.439.245	12.841.344	12.323.969	17.620.756	21.862.922	26.167.705	24.268.001	26.680.912	29.644.556
Italtel S.p.A.	3.158.000	3.390.000	20.510.000	-6.696.000	-1.386.000	12.378.000	-9.563.000	11.072.000	18.060.000		

Legend: Site S.p.A. and Ceit S.p.A. EBITDA values for 2010 are not available. For Italtel S.p.A instead, after the acquisition by Exprivia, the Italtel balance sheet are not obtainable as consolidated within the Exprivia group.

Source: own elaboration on Aida key financial and employees.

A positive EBITDA means that the company is profitable as the increase in revenues remunerates more than proportionally the operating costs (for

instance, those for the design of access networks and transport; creation of copper and fiber optic systems; equipment installation and testing; maintenance and services, as well as for labor costs).

In fact, Ceit S.p.A. has consolidated its market positioning during the years, thanks to the enhancement of internal resources and the insertion of technicians and assistants (training investments). This has permitted the improvement of its coverage on the territory, meaning a progressive exploitation of its assets.

For Site S.p.A. and Sirti S.p.A. the trend is always positive but decreasing during the years. More in detail, for Site S.p.A. there cannot be found significant EBITDA variations during the years, whereas for Sirti S.p.A. is the same situation except for the years 2013, 2017 and 2019 which saw a deep decrease in the index. Going further with the analysis, it will be evident that those years were characterized by worsening also in the other profitability indicators (as we will see later).

Negative EBITDA is a consequence of the investments made by the firm. In fact, in 2013 Sirti S.p.A. adjudged the Wind “Build The Network” contract (BTN) which provided the full outsourcing management of network infrastructures for the customer. Then, 2019 is the second lowest EBITDA value encountered as the precedent year was of profound transformation with great structural changes and strong competition affecting telecommunication market.

In the Italtel case instead, the trend is generally increasing from 2010 to 2018, even if negative values can be found in 2013, 2014 and 2016. These negative values are due to write-downs of goodwill, assets and in particular, development costs and deferred tax assets as well as labor costs. All these elements influenced the financial results of these years, showing deviations from the 2012-2017 business plan, such as to constitute the assumption of failure for the company. Regarding the ROI index instead, refer to table 3.2. ROI is a profitability index which measures the economic result with the financial means invested in the company, thus it allows to evaluate the profitability for investors.

Table 3.2 - The ROI index in the period 2010-2020

ROI (%)	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Site S.p.A.		8,41	9,68	7,93	5,53	7,58	4,39	11,48	4,50	3,84	3,35
Sirti S.p.A.	1,00	1,89	0,75	-10,75	3,47	3,37	1,26	-0,67	3,06	-1,97	
Ceit S.p.A.		26,16	21,02	23,93	23,25	27,33	n.s.	29,34	23,08	23,60	20,81
Italtel S.p.A.	-9,59	n.s.	-4,81	-11,06	-9,07	-2,73	n.s.	-0,84	1,35		

Legend: Site S.p.A. and Ceit S.p.A ROI values for 2010 are not available. For Italtel S.p.A. instead, after the acquisition by Exprivia, the Italtel balance sheet are not obtainable as consolidated within the Exprivia group.

Source: own elaboration on Aida key financial and employees.

Site S.p.A. shows the same trend as the one for EBITDA, decreasing but still positive, meaning that they are spending more but unable to see proper returns. For Ceit S.p.A. the trend is generally flat as no particular variations are visible during the years. For Sirti S.p.A. and Italtel S.p.A. instead, the situations are different.

First of all, Sirti saw positive returns on investment for the majority of the years considered, a part from the years 2013, 2017 and 2019 which as it is written above, represented periods of serious crisis for the company.

In this case, a negative ROI is a consequence of a negative net operating margin (NOM) due to incurred losses (indeed, the highest loss of €42.727.000 can be found in 2013).

When it comes to Italtel, the ROI values are all negative but increasing because of high capital expenditure (CAPEX) for immaterial immobilizations such as patent rights as well as for lands and buildings. A positive value can be found in 2018 because of an improvement in the net operating margin so that revenues improved more than proportionally with respect to operating expenses. Considering the denominator, the total assets were slowed down by Exprivia acquisition of Italtel 81% of capital, allowing Italtel to enter into an economically consolidated group.

In a capital-intensive industry such as the one considered (Cantoni, 2011), the key metric is return on capital, especially when the industry's growth shrinks (Gummerson, 2000). Revenues and EBITDA are useful, but the fundamental end-point is ROI.

As a matter of facts, it can be concluded that ROI performance for telecommunication fixed network suppliers industry is not good (and this is worsened by the fact that investments returns are visible after several years).

As regards ROE, refer to table 3.3. ROE is fundamental to consider as it offers the measure of the total return invested resources give (net to the taxes).

Table 3.3 - The ROE index in the period 2010-2020

ROE (%)	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Site S.p.A.		2,48	8,45	1,00	1,04	4,01	2,50	13,30	5,32	3,12	3,59
Sirti S.p.A.	-35,02	-40,52	-2,10	-96,08	-6,46	9,05	0,87	-4,13	8,83	-31,78	
Ceit S.p.A.		23,41	28,20	25,06	24,55	30,89	34,17	34,49	33,09	30,29	30,49
Italtel S.p.A.	-22,53	n.s.	n.s.	-50,47	-37,56	-103,91	n.s.	-29,36	-10,63		

Legend: Site S.p.A and Ceit S.p.A roe values for 2010 are not available. For Italtel S.p.A instead, after the acquisition by Exprivia, the Italtel balance sheet are not obtainable as consolidated within the Exprivia group.

Source: own elaboration on Aida key financial and employees.

For Site S.p.A. and Ceit S.p.A. this value has been positive and increasing, meaning that they both have had positive and improving net profits so that their financial and fiscal areas did not affect the operating income.

As regards Sirti S.p.A., the index started very negative in 2010 (-35,02%) until 2014 and it was mainly due to Sirti's capital strengthening through an approved increase in capital for a total of 38 million of euros to which must be added another 38 million of bond loans resulting from the conversion of part of 400 million of debt by banks. The agreement between the banks and shareholders also provided the renegotiation of the debt with a reset of covenants, a rescheduling, and the renegotiation of the pricing.

The negative values also appeared in 2017 and 2019 in line with the other indicators described so far. Anyway, in the last few years, Sirti launches the

2021-2024 plan which includes capital strengthening through the conversion of 50 million of debts and rescheduling of the remaining debt at the end of 2024 by Pillarstone shareholder.

Lastly, for Italtel S.p.A., the return on equity has been facing a perpetual negative value, coming from the presence of losses, in turn caused by negative operating income.

The last profitability index to analyze is ROS (refer to table 3.4), which expresses the rate of profitability of sales, meaning that higher the ROS, higher is the margin on sales (Paolucci,2016). Thus, if the net operating margin increases more than proportionally with respect to revenue increase, the company is more efficient from the operating point of view.

Table 3.4 - The ROS index in the period 2010-2020

ROS(%)	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Site S.p.A.		3,45	3,35	2,86	2,82	2,76	1,65	3,61	1,67	1,49	1,24
Sirti S.p.A.	0,42	1,24	0,79	-6,31	2,57	2,06	0,72	-0,36	1,75	-1,52	
Ceit S.p.A.		8,92	9,02	10,46	9,47	9,37	11,42	12,25	10,68	10,05	10,02
Italtel S.p.A.	-10,61	-49,10	-3,56	-11,79	-8,50	-2,30	-28,29	-0,58	0,85		

Legend: Site S.p.A and Ceit S.p.A roe values for 2010 are not available. For Italtel S.p.A instead, after the acquisition by Exprivia, the Italtel balance sheet are not obtainable as consolidated within the Exprivia group.

Source: own elaboration on Aida key financial and employees.

For what concerns Site S.p.A., the ROS index decreases during the years, despite remaining always positive, which implies the company still keep preserving its operating efficiency.

Considering Sirti S.p.A. instead, from 2010 this index is increased and positive, a part from the years 2013, 2017 and 2019 for the reasons already exposed. The increasing value is mainly due to a significant improvement in revenues, also thanks to the ultra-broad band project started in 2018 which brought generation connectivity infrastructures in more than 7.000 Italian municipalities.

For Ceit S.p.A. this index is always positive and increasing with the highest peak in 2017 which can be due to the positive returns coming from the assignment of ultra-wide band network²¹ started in 2015.

Ultimately, Italtel S.p.A. returns on sales index persisted on being negative from 2012 to 2017 due to the constantly negative net operating margin (and revenues always positive). The only positive ROS is the one in 2018 because of a positive value of the net operating margin. The reason could stay in the contractual extensions with Open Fiber S.p.A. development of the ultra-broadband network for the “white areas” of the country. The first contracts date back to 2016, meaning that the effect of investments and activities are delayed over time.

To evaluate the investments, an analysis has been already carried out through the ROI index. To complete what concerns investments, a further ratio is provided: ROT (*Return On Turnover*), calculated as revenues over total assets

²¹ This project consisted of the executive design and construction of fiber optic infrastructure, including the supply and installation of fiber optic cable and subsequent maintenance of the infrastructure in the Abruzzo region.

(refer to table 3.5). This represents an important efficiency indicator as it expresses the ability of the invested capital to “transform” into sales revenues. The ROT variation over time gives an indication of the effectiveness of the production factors (invested capital) with respect to revenues. Mathematically, it is also calculated as ROI over ROS. On a concrete level, the ROT also reports the number of times the invested capital is transformed during the year into sales revenues (this is the representation Aida gives for this index).

Table 3.5 - The ROT index in the period 2010-2020

ROT	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Site S.p.A.		1,09	1,20	1,18	1,00	1,14	1,14	1,22	1,14	1,21	1,13
Sirti S.p.A.	1,05	0,71	0,52	0,71	0,65	0,82	0,94	0,96	0,93	0,72	
Ceit S.p.A.		1,37	1,20	1,19	1,22	1,42	1,53	1,24	1,20	1,27	1,19
Italtel S.p.A.	0,48	0,60	0,53	0,50	0,58	0,64	0,67	0,75	0,74		

Legend: Site S.p.A and Ceit S.p.A roe values for 2010 are not available. For Italtel S.p.A instead, after the acquisition by Exprivia, the Italtel balance sheet are not obtainable as consolidated within the Exprivia group.

Source: own elaboration on Aida key financial and employees.

Despite different trends among the four companies considered, what is most important to highlight looking at the table 3.5 is that the invested capital is able to transform in sales revenues for a maximum of about 1 time a year. In some cases, when the ROT values are near the zero, it means that neither one time a year the invested capital transformation into revenues happens. As a consequence, lower is the ROT, poorer the business management efficiency, namely its ability to yield a return.

The investments undertaken by these companies engender a financial need to fill through different sources of financing: debt or equity. Three different ratios will be analyzed throughout this part.

The first one is Debt/Equity ratio (refer to table 3.6) which expresses the ratio between debts and net assets, thus it is used to verify the degree of company dependence to external financial resources. This ratio should not exceed the value of 1, otherwise the economic and management autonomy is lost; on the contrary, if the ratio is near the zero value (or at least lower than 1), the financial structure is balanced.

Table 3.6 - The Debt/Equity ratio in the period 2010-2020

DEBT/EQUITY	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Site S.p.A.		2,14	1,40	1,17	2,10	1,57	1,86	1,36	1,60	1,95	1,87
Sirti S.p.A.	3,10	4,58	3,14	5,66	8,01	7,16	4,25	4,42	3,95	5,77	
Ceit S.p.A.		0,29	0,74	0,46	0,40	0,51	0,33	0,50	0,79	0,71	0,86
Italtel S.p.A.	2,57	-8,5	-5,7	3,43	4,73	10,2	-3,9	5,08	5,88		

Legend: Site S.p.A and Ceit S.p.A roe values for 2010 are not available. For Italtel S.p.A instead, after the acquisition by Exprivia, the Italtel balance sheet are not obtainable as consolidated within the Exprivia group.

Source: own elaboration on Aida key financial and employees.

Among the four considered case studies, just Ceit S.p.A. seems to have had debts values less than the total of its own assets, thus it can be stated that it has been in a safe financial position over the years. For the other companies, the

situation is more critical because they all have values higher than 1 as the debt amount has been pretty high (probably due to an aggressive financial strategy). In particular, for Italtel S.p.A. there were three negative values (in 2011, 2012 and 2016), meaning that the company has negative shareholder equity. This is the representation of a company with more liabilities than assets, thus indicating the company faces the risk of bankruptcy (which in turn, is what happened). Anyway, the underlying tendency is to use debt rather than equity to finance companies necessities.

The other index to consider is the Financial Expenses to Sales ratio (see table 3.7), which is coherent with the previous one. In fact, for those which largely utilize debt to finance, the Financial Expenses to Sales ratio is decreasing over the years.

Table 3.7 - The Financial Expenses to Sales ratio in the period 2010-2020

FINANCIAL EXPENSES/SALES	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Site S.p.A.		1,75	1,84	1,61	1,72	1,36	1,01	0,83	0,81	0,74	0,62
Sirti S.p.A	3,58	6,48	6,35	1,57	2,64	1,68	1,21	1,14	1,19	1,89	
Ceit S.p.A.		0,14	0,33	0,40	0,48	0,36	0,27	0,20	0,21	0,28	0,29
Italtel S.p.A.	5,04	8,78	5,93	2,31	1,68	3,32	3,19	2,62	2,44		

Legend: Site S.p.A and Ceit S.p.A roe values for 2010 are not available. For Italtel S.p.A instead, after the acquisition by Exprivia, the Italtel balance sheet are not obtainable as consolidated within the Exprivia group.

Source: own elaboration on Aida key financial and employees.

The last indicator to evaluate the financial stability is the net financial position (NFP), shown in table 3.8. Analyzing the table, it is evident that for the majority, those companies extremely rely on debt instead of auto financing to cover investments.

Table 3.8 - The NFP in the period 2010-2020

NFP	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Site S.p.A.		56.018.259	36.687.436	31.097.468	54.908.949	28.068.440	26.939.661	8.155.720	17.148.899	5.900.473	-894.417
Sirti S.p.A.	169.275.208	180.966.000	196.081.000	193.110.000	224.658.000	215.333.000	249.035.000	156.362.000	162.279.000	248.815.000	
Ceit S.p.A.		8.100.514	21.252.010	13.708.503	8.392.266	-4.384.922	-7.888.761	-2.617.713	14.168.367	25.898.203	19.045.567
Italtel S.p.A.	244.742.000	305.527.000	276.518.000	183.339.000	192.667.000	204.004.000	240.306.000	169.703.000	168.756.000		

Legend: Site S.p.A and Ceit S.p.A roe values for 2010 are not available. For Italtel S.p.A instead, after the acquisition by Exprivia, the Italtel balance sheet are not obtainable as consolidated within the Exprivia group.

Source: own elaboration on Aida key financial and employees.

Despite the possibility to rely on debt financing, liquidity is a risky factor for network suppliers as companies might not be able to cover eventual liabilities with current liquidity assets or money. In fact, “lack of liquidity can lead to failure of a business in meeting short-term obligations and this can lead to insolvency. Therefore, a business has to invest in current assets keeping in view the short-term obligations, so that all the day-to-day operations of the business run smoothly.” (Khan and Raj, 2020).

3.3 Main results

From the analysis carried out, the emerging framework is contrasting because what it has been described so far has generated development scenarios and alarming future situations at the same time.

It is evident that the industrial sector within the telecommunication value chain plays a fundamental role. The importance of fixed network suppliers and their role of sub-suppliers, stays in their contribution in the value production which is upstream developed for final telecommunication operators.

As stated before, we have assumed the four fixed network suppliers (Site S.p.A., Italtel S.p.A., Ceit S.p.A. and Sirti S.p.A., namely the major sub-suppliers for final operators), could represent the dynamics of the segment where they operate.

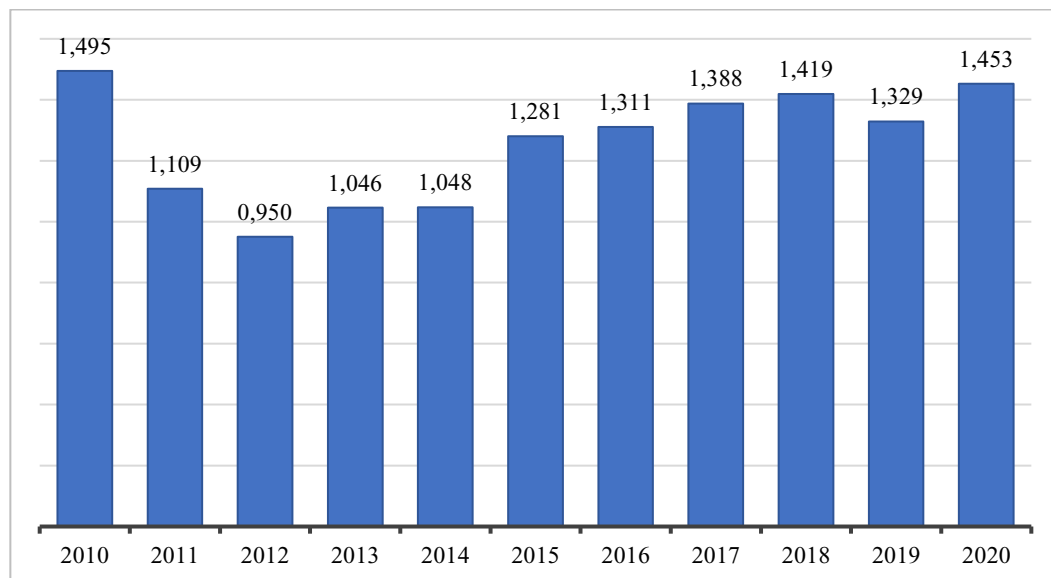
To verify the validity of our interpretations, in this section the fixed network suppliers analysis will be also compared with the total market dynamics of the entire telecommunication supply chain reported by Asstel (2020)²².

First of all, considering the revenues of the different actors along the value chain, it can be stated that they have been generally decreasing if considering the period 2010-2014, then inverting the trend until 2018 (refer to graph 3.1). Moreover, in 2019 it is evident there was a decrease of about 100 million of

²² We could not have access to the entire report, but only to a few slides.

euros, representing a reduction of 6,3% with respect to the precedent year. Anyway, the reduction seems to be neutralized in 2020, due to the Covid-19 factor which has made really evident the central role of telecommunication infrastructures. In fact, the forced permanence of people staying in their houses implied an increase in demand for fixed lines.

Graph 3.1 – Aggregate revenues of the four fixed network suppliers

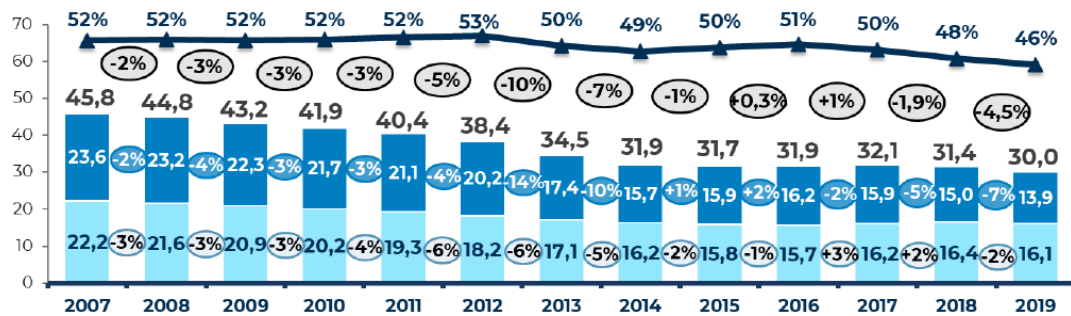


Legend: values are in billions of euros. Here an assumption has been made. Missing the Italtel S.p.A. 2019 and 2020 revenues, they have been calculated doubling the first semester values (the only available values), thus assuming no variations between the two semesters within a year. 2010 revenues for Site S.p.A. and Ceit S.p.A. are unavailable, but in order to have a good comparison, 2010 revenues have been calculated as the average of the remaining years. Source: own elaboration on Aida key financial and employees.

As a consequence, the Asstel report (Asstel, 2020) confirms the general trend lines of the sector, characterized by a hyper-competitive context based on a

reduction of prices and consequently of revenues (see graph 3.2). In fact, the Italian dimension in terms of revenues has been subjected to a recession, especially for the year 2019.

Graph 3.2 – Telecommunication network suppliers’ gross revenues from 2007 to 2019



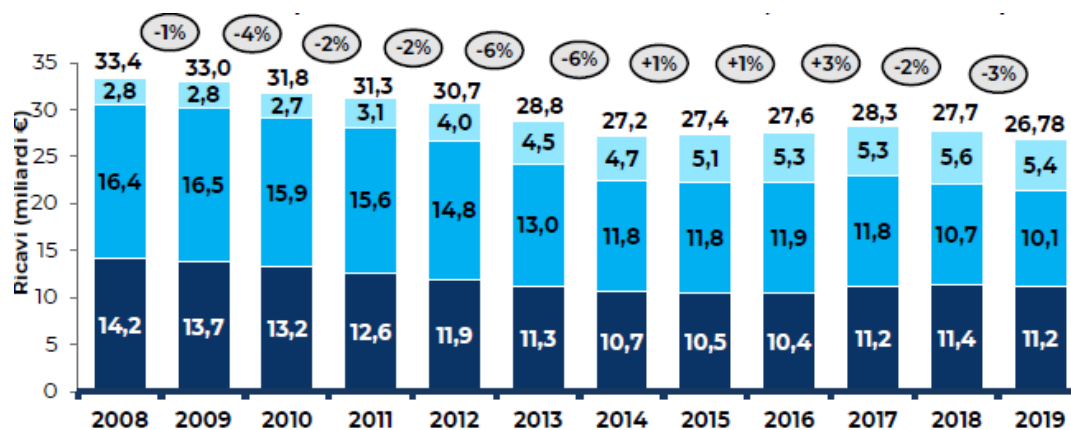
Legend: values are in billions of euros. Light blue is for fixed network suppliers whereas dark blue is for mobile ones. The line above the graph represents the mobile in % (total).
Source: Asstel, 2020

The graph 3.2 confirms the general tendency which characterized the fixed network suppliers, a decreasing trend for the majority of years, where it emerges that 2019 was a particularly difficult year for the economic accounts of telecommunication suppliers. In fact, they recorded an overall decline in gross revenues of 4,5% due to the strong competitive scenario, which marked a deep decline and also a contraction in revenues for fixed network suppliers after some years of growth.

These elements are the consequences of a drop in prices (especially in wholesales services).

Furthermore, considering the net revenues of the entire telecommunication industry (refer to graph 3.3), namely the expenditure of businesses and consumers for telecommunication services, they recorded an overall loss of approximately 1 billion of euros, which represents a -3% with respect to the previous year.

Figure 3.3 – Telecommunication industry revenues from 2007 to 2019



Legend: values are in billions of euros. The darkest blue is for telecommunication fixed suppliers, blue is for mobile network suppliers whereas light blue is for devices suppliers.
Source: Asstel, 2020

The 2019 value which counted 26,78 billion of euros, is the lowest if considering the period 2008-2019 and this is mainly due to a decrease in revenues from mobile services (-5% on average considering the same period).

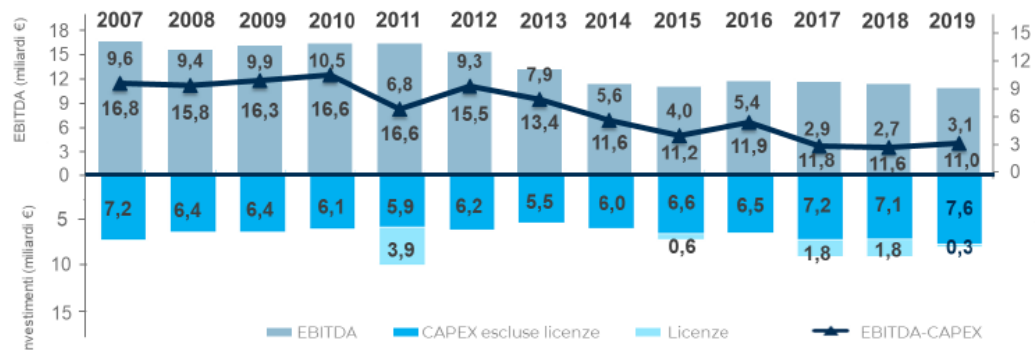
From 2018 in fact, prices started to be very aggressive among competitors and this trend continued also in 2019, due to the entering of new firms. Despite revenues decrease, final consumers consume more and the ultra-broad band adhesion increases, proving again the competitive scenarios among prices. In addition, there is a reduction of revenues from fixed services, diminishing of 2%.

Totally, considering 2008-2019 period, the telecommunication value chain has lost 6,7 billion of euros which corresponds to a decrease of 20%.

Despite the decreasing trend for revenues, what emerges from our analysis is that the profitability is not completely eroded as the EBITDA margin is still positive, even if decreasing. Once again, our findings are validated by Asstel 2020 report, where a further comparison between EBITDA and CAPEX has been carried out. The value of EBITDA-CAPEX for telecommunication network suppliers implies that their good marginality is absorbed by the cash flows necessary to support significant investments in the sector (see figure 3.4).

Despite 2019 was a particularly serious year for the telecommunication suppliers, the EBITDA-CAPEX rose due to minor investments for licenses, reaching the value of 3,1 billion of euros (anyway, one of the lowest values among the years considered). Thus, what emerges is an alarming situation for the future.

Figure 3.4 – EBITDA-CAPEX comparison for the years 2007-2019



Legend: values are in billions of euros.

Source: Asstel, 2020.

The investments are for the majority for infrastructures, and they reach a total of 7,9 billion of euros in 2019, of which 500 million of euros are for infrastructures (+8% with respect to the precedent year). In the last few years, the main focus has been investing in 5G because technologies and applications such as IoT, Big Data, AI, Cloud Computing and Cyber Security (the backbone of the next digital future) need to be supported by ultra-broad band (UBB) infrastructural networks (fiber optic and 5G²³).

Thanks to the investments made by network suppliers, in recent years there has been a strong growth in fast broadband coverage (>30 Mbps) and in particular,

²³ This is also demonstrated by the numerous projects undertaken by the companies we have considered so far. For the majority in fact, the investments have been directed to 5G infrastructure (for instance, refer to table A1 in the appendix) to promote and enhance ultra-broad band networks. After the licenses acquisition in 2018 the 5G development continues, today Italy is one of the first European country for the number of covered cities and experimentations.

those companies producing and managing telecommunication towers have benefited from the investments²⁴.

Despite this, 2019 was not characterized by an important share of investments in licenses due to payments in installments of 5G frequencies as the majority of expenditure was sustained in 2018. Thus, in 2019 total investments have decreased, both those for infrastructures and for licenses (-1 million of euros with respect to 2018), reaffirming above findings.

However, the total tendency of network suppliers is to have a decreasing return on investments but still positive, meaning that they are spending more but unable to see proper returns.

The considerable investments and costs associated to the technological improvement entails the necessity to make use of external financial resources. Indeed, the analysis of the debt situation has highlighted a particular dependence of telecommunication network suppliers to use debt rather than equity to finance investments.

²⁴ In fact, companies producing towers have faced an increase in investments and they have also seen the birth of spin-off companies, which allowed the widening of the market.

CONCLUSIONS

The expectations observed in Pontarollo (2000) were of a relevant market growth, in particular the one for mobile telephony and data transmission, where the convergence between voice and data could have contributed to revitalize the segment of fixed networks.

The forecasts of experts said that the sectoral growth would have continued and even accelerated, especially for those companies which produced systems and networks.

Unfortunately, from the led analysis, those expectations were wrong.

Network suppliers have been facing a profound transformation process made up of re-allocation of invested capital, externalization of assets and a necessity to increase the network capacity in the areas characterized by higher traffic density.

The structural and results differences within the telecommunication industry could be explained through some specific characteristics of the considered companies, in particular their ability to handle market's challenges.

Above all, the considered industry is structured as a network system where it is not easy to create development conditions and to compete. Over the years,

several have been the companies which tried to enter and remain into this market, and the majority of them have drastically failed²⁵.

From our analysis, it has emerged that fixed network suppliers suffer from lower profitability performance identified by a lower (but still positive) EBITDA margin. Indeed, they have been capable of making profits but operating costs are generally less remunerated by the increase in revenues (a part from Ceit profitability, which grew considerably from 2011 to 2020). Indeed, the revenue growth has been not enough to grant higher operating income.

This decreasing index has been the direct implication of massive investments to handle with the right assets for dealing with new technology as well as to face market forces. In this sense, it is evident that technological innovation has produced significant impacts, not just on products and services, but it has also radically implied their survival on the market.

In fact, the two priorities in telecommunications have been fiber optic networks, whose implementation has already begun and 5G, the new generation for mobile networks. In particular, fixed network suppliers invested on the last mile, but not sufficiently, meaning that the strategies on investments should be focused on fiber and on laying the fiber up to the users' houses.

²⁵ In the ATECO analysis carried out at the beginning of the entire research, what has emerged is that the majority of companies in this sector have revenues for less than 100 million of euros. Moreover, lots of them have interrupted their activities for failure or because they were wound up.

The investments are for the majority for infrastructures, and they reach a total of 7,9 billion of euros in 2019, of which 500 million of euros are for infrastructures (+8% with respect to the precedent year).

The year 2019 saw a revenue decrease of about 100 million of euros, representing a reduction of 6,3% with respect to the precedent year, thus it has been a year of high management complexity which has brought a significant reduction of the EBITDA margin and an increase in using debt as a source of financing (this scenario is not in line with what happened in 2018, when the profitability and debt financing improved).

In fact, for the majority, the financial strategy has been focused on exploiting debt and equity instead of using internally generated cash flows.

A part from Ceit S.p.A., the other considered companies are not in a safe financial position. The situation they face is riskier because they all have debt/equity ratio values higher than 1, meaning the debt amount is pretty high and they can incur in insolvency.

In particular, this situation was influenced by the major telecom operator and customer (such as TIM) which reduced volumes, eroded prices, and determined an excess of capacity due to its decision of insourcing.

This implies a necessary growth in the EBITDA and cashflow coming from 5G components, cyber security, IoT, data analytics and cloud services, from projects regarding the enhancement in the ultra-broad band networks for Telco

infrastructures, from the creation of networks with service providers and tower companies.

This volume improvements will be allowed thanks to a strategy of transformation (which is actually ongoing)²⁶, even if in a hyper-competitive context where customers will divert investments on 5G and IoT.

For the future, a further acceleration on digitalization processes is expected, not being able to leave the UBB network development out of consideration.

²⁶ Especially due to the effects of Covid-19 pandemic, which has reduced costs and allowed an increase in the demand for fast connections.

Appendix

Table A1- Nokia significant subsidiaries around the world as of December 31, 2020

Company name	Country of incorporation	Parent holding %	Group ownership interest %
Nokia Solutions and Networks Oy	Finland	100.0	100.0
Nokia of America Corporation	United States	-	100.0
Nokia Shanghai Bell Co., Ltd ⁽¹⁾	China	-	50.0
Nokia Technologies Oy	Finland	100.0	100.0
Nokia Solutions and Networks India Private Limited	India	-	100.0
Nokia Solutions and Networks B.V.	Netherlands	-	100.0
Nokia Solutions and Networks Japan G.K.	Japan	-	100.0
Alcatel-Lucent International S.A.	France	-	100.0
Nokia Solutions and Networks Branch Operations Oy	Finland	-	100.0
Alcatel Submarine Networks S.A.S.	France	-	100.0
Nokia Solutions and Networks do Brasil Telecomunicações Ltda.	Brazil	-	100.0
Alcatel-Lucent Participations S.A.	France	-	100.0
Nokia Solutions and Networks Korea Ltd.	South Korea	-	100.0
Nokia Spain, S.A.	Spain	-	100.0
Nokia UK Limited	United Kingdom	-	100.0
Nokia Canada Inc.	Canada	-	100.0
Nokia Solutions and Networks Italia S.p.A.	Italy	-	100.0
Nokia Solutions and Networks GmbH & Co. KG	Germany	-	100.0
Nokia Solutions and Networks Australia Pty Ltd	Australia	-	100.0
Alcatel-Lucent S.A.S.	France	-	100.0
Nokia Solutions and Networks Limited Liability Company	Russian Federation	-	100.0

(1) Nokia Shanghai Bell Co., Ltd. is the parent company of the Nokia Shanghai Bell Group of which the Nokia Group owns 50% plus one share with China Huaxin, an entity controlled by the Chinese government, holding the remaining ownership interests. Refer to Note 33, Significant partly-owned subsidiaries.

Source: https://www.nokia.com/system/files/2021-03/Nokia_Form_20F_2020.pdf

Table A2- Some of Samsung Electronics' consolidated subsidiaries around the world as of December 31, 2020

Subsidiary	Date established	Major business	Assets as of Dec 31, 2019	Ownership	Classified as major subsidiary (Y/N)
Europe/CIS: 75					
Samsung Electronics (UK) Ltd. (SEUK)	Jul 1995	Electronic goods sales	2,767,563	Over 50%	Y
Samsung Electronics Ltd. (SEL)	Jan 1999	Subsidiary management (overseas)	6,512	Over 50%	N
Samsung Semiconductor Europe Limited (SSEL)	Apr 1997	Semiconductor and display panel sales	87,256	Over 50%	Y
Samsung Electronics GmbH (SEG)	Dec 1984	Electronic goods sales	2,687,535	Over 50%	Y
Samsung Electronics Holding GmbH (SEHG)	Feb 1982	Subsidiary management (overseas)	993,490	Over 50%	Y
Samsung Semiconductor Europe GmbH (SSEG)	Dec 1987	Semiconductor and display panel sales	887,060	Over 50%	Y
Samsung Electronics France S.A.S (SEF)	Jan 1988	Electronic goods sales	1,688,580	Over 50%	Y
Samsung Electronics Italia S.P.A. (SEI)	Apr 1991	Electronic goods sales	1,287,050	Over 50%	Y

Legend: The assets are in KRW million.

Source: https://images.samsung.com/is/content/samsung/assets/global/ir/docs/2020_Business_Report.pdf

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