INFORMATION & COMMUNICATION TECHNOLOGY

2020

INVEST IN ITALY

ITA ITALIAN TRADE AGENCY

INVITALIA

FOREWORD ON METHODOLOGY

The data contained in and employed for the present report was collected by Cerved Group through the exclusive processing of information from both public and private sources. The term 'public sources' is intended here as those available to the public, from institutions including but not limited to the OECD, the Italian National Statistics Institute (Istat), Assinform/NetConsulting, and the European Commission.

The term 'private sources' is intended here as Cerved Group's proprietary databases on the major companies that operate in the information and communications technology (ICT) industry.

All data collected has been cross-checked by comparisons between several sources, for instance OECD data with Istat data. The data has then been aggregated to build a complete picture of the ICT sector as a whole.

All tables and graphs have been prepared by Cerved Group based on proprietary data and/or data from the public sources listed above.

The companies included in this aggregation process for this sector are those registered under the following economic activity (Ateco) codes:

- 58.2 – Software publishing
- 62 – Computer programming consultancy and related activities
- 63.11 – Data processing, hosting and related activities
- 63.12 – Web portals
- 74.10.21 – Graphics and web page design

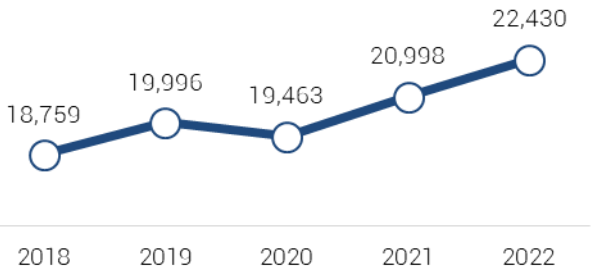
This has enabled our analysis to be structured with an overview of the ICT sector in its entirety.

ICT AT A GLANCE

ITALIAN COMPANIES' INVESTMENTS IN INNOVATIVE SOFTWARE AND DIGITAL TECHNOLOGIES ARE PROPORTIONALLY IN LINE WITH THOSE OF AMERICAN AND OTHER EUROPEAN COMPANIES. HOWEVER, RESEARCH AND DEVELOPMENT SPENDING BY ITALIAN COMPANIES IS ABOVE AVERAGE, THANKS TO A MAJOR BOOST IN 2009, ESPECIALLY IN THE MANUFACTURING SECTOR.

100,604	431,778
COMPANIES	EMPLOYEES

THE ITALIAN ICT MARKET, 2018-2022
(in million euros unless specified)



ICT AT A GLANCE

IN 2018, INWARD FDI FLOWS IN "SOFTWARE PUBLISHING, COMPUTER PROGRAMMING AND CONSULTANCY, AND INFORMATION SERVICE ACTIVITIES" ACCOUNTED FOR 1.0% OF THE TOTAL AFTER A 40.7% INCREASE FROM 2017.

FDI STOCKS ROSE SHARPLY, FROM $327 MILLION IN 2017 TO $798 MILLION IN 2018

ICT HUBS IN ITALY

HIGHLIGHTS

The ICT sector is playing an increasingly strategic role in Italy, as it now provides fundamental contributions to all other sectors of the economy. On the back of the Covid-19 pandemic, the central importance of digital products and services for overall economic development has solidified further. Being equipped with advanced systems, networks and other digital services have enabled businesses and institutions to mitigate the effects of the lockdown, particularly thanks to a boost from 'digital enablers' including cloud technologies, the internet of things and mobile technology. Investments in ICT have increased in all sectors of the economy, from services to manufacturing, with a major increase in the public sector as well.

The supply side of the ICT sector is fragmented, with a large number of businesses of every shape and size, from branches of major multinationals to local SMEs. There is a higher concentration of businesses in the northern regions of the country, where 50% of Italian ICT companies are located.

Technology hubs also play a key role in the sector. They attract innovative businesses, promote technology transfers, and contribute to the development of new businesses. There are noteworthy tech hubs located in 9 Italian regions: Lombardy, Liguria, Piedmont, Veneto, Friuli Venezia Giulia, Emilia Romagna, Lazio, Abruzzo and Sicily.

R&D spending by Italian ICT companies reached $2.29 billion in 2017 (the latest year with data available), 7.5% more than in 2016 and amounting to 10.6% of total R&D spending across all sectors. The highest portion of R&D spending in ICT came from the "Computer programming, consultancy and related activities" segment, with a 23.5% year-on-year increase.

HIGHLIGHTS

The main developmental trends in the sector for the near to medium term are:

- digital enablers: cloud computing, big data, wearable tech, internet of things, and cybersecurity;
- digital transformers: artificial intelligence, machine learning, augmented analytics, blockchain, robotics, virtual/ augmented reality, quantum computing, and autonomous objects

HIGHLIGHTS

Opportunities for the sector stem from the following areas:

- digital transformation
- innovation
- tech hubs
- new legislation

The **critical success factors** in the ICT sector are:

- skills
- research & development
- commercial offering

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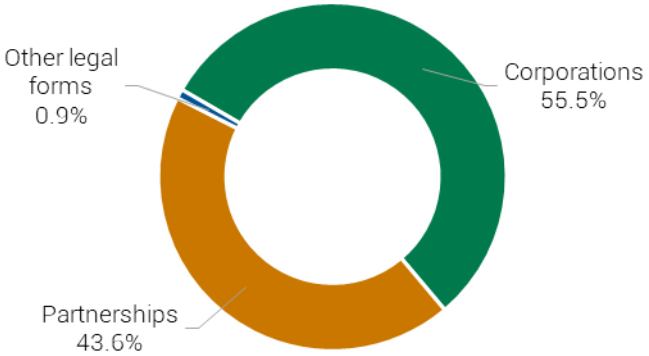
SECTOR CHARACTERISTICS

The Italian information and communications technology (ICT) contains a large number of businesses of every shape and size, from branches of major multinationals to local SMEs. Some operators are specialised in very specific sub-segments, while others are active in both software and ICT services so as to take advantage of synergies that can be generated between the two markets. There are over 100,000 active businesses in all, but over 70% of which have fewer than five employees. There is a higher concentration of ICT businesses in the northern part of the country, where about 50% of the companies are located. Lombardy covers a very important role, hosting nearly one-fourth of the country's ICT businesses. Another 24% are located in central regions, highly concentrated in Lazio, where there are major opportunities to do business with central government bodies. The remainder are located in the southern and island regions, most of which are located in the regions of Campania, Puglia and Sicily.

According to business registry figures, there are also numerous startups and innovative SMEs in the sector (3,583 in all).

DISTRIBUTION OF COMPANIES BY LEGAL FORM

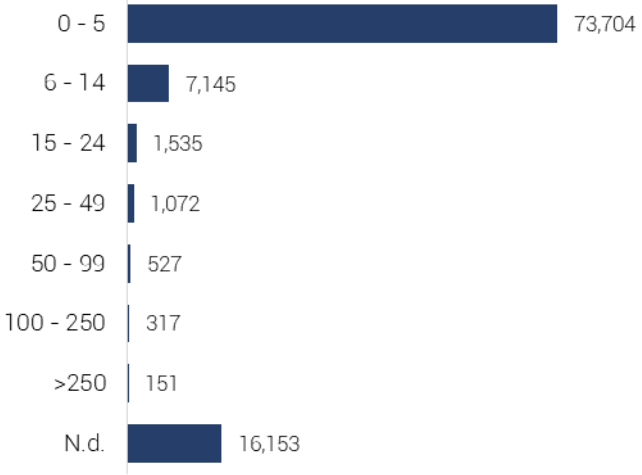
(total = 100,604)



Source: Cerved illustration

KEY CHARACTERISTICS

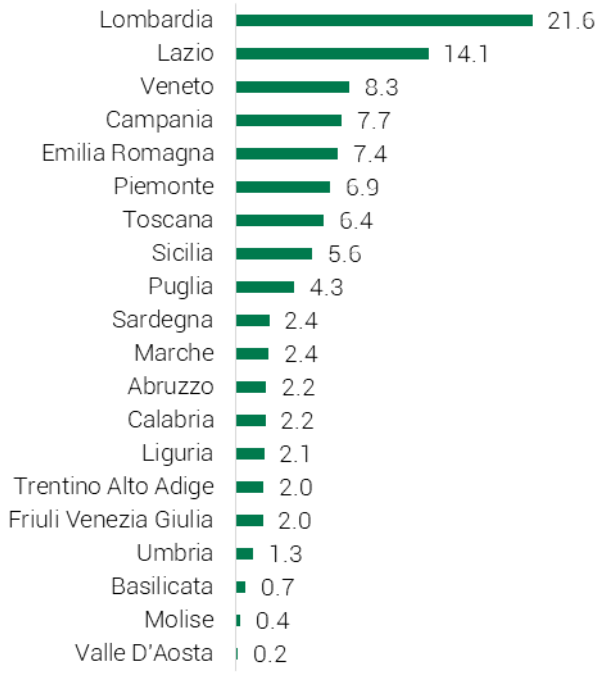
BREAKDOWN OF COMPANIES BY NUMBER OF EMPLOYEES



Source: Cerved illustration

REGIONAL DISTRIBUTION OF COMPANIES

(total = 100,604)



KEY CHARACTERISTICS

ICT companies' products and services can be broadly subdivided into the following areas:

- software production: the design and development of products and solutions, which may be standard or customised to meet specific client needs. This segment includes applications, middleware and system software; whole solutions may be delivered to users either on-site or in the form of cloud computing services.

- system integration and technical assistance services: implementation for a client of ICT solutions developed by a third party, along with related assistance and maintenance activities.

- outsourcing services: where specified computing and ICT infrastructure activities are handled on behalf of a client;

- consultancy: technical and organisational advice and strategic support are provided to a client in developing and implementing IT strategies and solutions.

KEY CHARACTERISTICS

THE LEVEL OF DIGITISATION OF ITALIAN BUSINESSES

According to Istat (Italian National Institute of Statistics, a public research organisation, is the main producer of official statistics in the service of citizens and policy-makers) permanent census figures published in August 2020, over the three-year period from 2016 to 2018, more than three-fourths (77.5%) of all Italian businesses with ten or more employees invested in or used at least one of the eleven technologies identified in the survey as a key factor of digitisation. These eleven technologies are: project management software, cybersecurity, fibre optics, the internet of things, big data, 4G/5G cellular networks, robotics, augmented or virtual reality, cloud computing and 3D printing. The combined use of infrastructures and applied technology is seen as an indicator of digital maturity.

Most businesses use a limited number of these technologies, instead prioritising infrastructural investments and leaving the door open to subsequent adoption of applied technology. In fact, according to Istat's (Italian National Institute of Statistics) report on its business digitisation surveys, the digitisation process among Italian businesses seems to occur in two distinct phases, or in multiple phases in some more complex situations. It is evident that first of all, the technical and cultural conditions must be established before digitisation can be completed in a second phase through the adoption of more useful and efficient applications that enhance productivity.

The same study also measured the "digital maturity" level of Italian businesses, not based on the intensity of their digital investments, but rather on the extent to which they combined different technological solutions identified as being complementary.

The first level, defined as "non-systematic", is the set of companies that adopted at least one project management software application between 2016 and 2018 and also made limited investments in infrastructural technology such as cloud computing and fibre-optic internet connections. These business have clearly recognised the potential of digital technologies, but due to their limited size or particular line of business, have struggled to establish a systematic transition towards a more intensely digitised organisational structure.

KEY CHARACTERISTICS

A more numerous set of businesses (about 45% of the total, accounting for 28% of all employees and 21.6% of value added) belongs to the second level, defined as "constructive" in their efforts to pinpoint a clear digital strategy. They recognise the importance and benefits of tackling the challenges and seizing the opportunities of mobile internet connections. Such connections are used increasingly, not only in service sectors but even at manufacturing plants, establishing the right conditions for integrating other technologies such as the internet of things or, in general, remote sensing technology. It is interesting to note that this set of businesses believes it to be essential to invest in security: there is a positive correlation between digital maturity and a perceived need to ensure the security of one's equipment and systems.

The third set of businesses, called the "experimenters", have reached a level of digital maturity where they are testing out various ICT solutions, combining them with each other in order to gain further advantages in terms of efficiency and productivity. This group is beginning to make significant investments to monetise flows of information (big data) as well as in simulations and robotics. It is also the group with the highest number of businesses with over 100 employees, so it is the leading set in terms of the number of employees and total value added (35.3% and 37.9% of the total, respectively), as well as in terms of financial wealth and technical capabilities.

Finally, the fourth set of businesses, defined as fully "mature", consists of companies that integrate a wide variety of advanced technologies available, and represent a model for the business community, even if only 3.8% of all businesses belong to this category.

COMPANIES (a) DISTRIBUTED BASED ON DEGREE OF DIGITAL MATURITY

Activity	Non-systematic	Constructive	Experimental	Mature	Total
All business	47,091	74,815	36,424	6,281	164,611
Percentage	28.6%	45.4%	22.1%	3.8%	100.0%

a) businesses with more than 10 employees

Source: Cerved illustration of Istat (Italian National Institute of Statistics) data

KEY CHARACTERISTICS

The degree of digital maturity of Italian businesses with at least ten employees can be briefly assessed in the following four points:

1) about three-fourths of companies are committed to making digital investments, with prospects of a further spread in digital activities;

2) companies with under 100 employees are predominantly at the "constructive" stage of their own digitisation strategy;

3) many companies with over 100 employees, on the other hand, are at the difficult stage of experimenting with new technological and organisational solutions;

4) only 3.8% of Italian businesses (though they account for 16.8% of all employees and 22.7% of value added) are already at a digitally mature stage, with a higher portion considered mature in the North-West (4.7%), among companies with over 500 employees (23%) and among industrial companies (5.2%).

COMPANIES (a) DISTRIBUTION BASED ON DEGREE OF DIGITAL MATURITY AND NUMBER OF EMPLOYEES

Activity	Non-systematic	Construc-tive	Experi-mental	Mature	Total
10 to 19	29.1%	50.5%	18.1%	2.3%	100.0%
20 to 49	29.5%	42.1%	24.2%	4.2%	100.0%
50 to 99	27.3%	33.1%	32.5%	7.1%	100.0%
100 to 249	24.5%	26.3%	38.6%	10.6%	100.0%
250 to 499	19.0%	21.7%	44.3%	15.0%	100.0%
Over 500	12.8%	15.0%	49.2%	23.0%	100.0%

a) businesses with more than 10 employees

Source: Cerved illustration of Istat (Italian National Institute of Statistics) data

KEY CHARACTERISTICS

As for the sector breakdown of investments in digitisation, excluding the ICT sector itself, we see a high concentration of investments made (as well as of those forecast for the next three years) in the manufacturing sector, especially in terms of simulation between interconnected machines, advanced automation, cooperative robotics and intelligent systems, 3D printing and applied artificial intelligence. Next in line are companies registered under economic activity code G ("Wholesale, retail and repair of motor vehicles"), which are planning to invest especially in fast internet connections (fibre-optics and ultra-broadband), mobile internet (4G/5G), big data processing and analysis, as well as in cybersecurity.

KEY CHARACTERISTICS

ACTIVE BUSINESSES (a) THAT INVESTED IN DIGITAL TECHNOLOGIES BETWEEN 2016 AND 2018

Economic activity code	internet-based technology	broadband internet connection	4G/5G mobile connection	internet of things	artificial intelligence applications	immersive technology	big data processing & analysis	advanced automatione, cooperative robots and intelligent systems	other technology areas	3D printing	interconnected machine simulation	cyber-security	investment in at least one form of digital technology
B: extraction of minerals from caves and mines	174	120	117	25	21	4	14	11	136	37	14	94	243
C: manufacturing	33,510	24,455	18,778	3,857	7,277	736	2,305	5,689	23,599	4,557	7,192	19,581	40,810
D: supply of electrical energy, gas, steam and air conditioning	334	296	216	76	93	15	83	37	241	8	22	235	379
E: supply of waterworks, waste management and treatment	1,223	900	810	188	118	22	75	55	585	14	71	566	1,319
F: construction	10,886	7,655	7,602	938	559	161	297	288	4,267	444	441	4,011	11,666
G: wholesale, retail, motor vehicle repair	23,441	18,853	13,294	2,550	2,968	470	1,777	1,470	11,694	865	975	11,133	25,878
H: transport and logistics	7,476	5,160	4,956	1,104	598	109	348	269	3,161	138	254	3,053	8,028
I: accommodations and restaurants	14,094	10,665	7,986	1,208	932	303	713	288	3,477	302	171	3,292	14,656
J: information and communication services	4,628	4,012	2,733	1,004	1,630	500	1,274	531	3,024	315	354	2,829	5,191
K: financial and insurance activities	1,558	1,339	982	154	358	43	303	155	1,175	36	51	1,159	1,759
L: real estate	458	357	263	29	40	6	27	9	228	8	N.d.	224	510
M: professional, scientific and technical activities	5,913	5,114	3,503	617	1,045	325	757	297	3,750	443	386	3,515	6,573
N: rental, travel agencies and business support services	6,326	4,837	4,214	538	702	146	522	226	2,822	182	243	2,717	6,735
P: education	985	820	479	88	134	56	115	41	463	91	60	406	1,059
Q: healthcare and social assistance	2,087	1,710	1,024	200	255	58	137	123	1,362	186	197	1,278	2,376
R: arts, sports, entertainment and leisure activities	1,197	883	707	112	118	38	74	37	415	41	37	394	1,263
S: other services	1,950	1,560	1,156	176	136	30	86	57	839	50	78	799	2,078
TOTAL	116,240	88,736	68,820	12,864	16,984	3,022	8,907	9,583	61,238	7,717	10,546	55,286	130,523

a) businesses with more than 10 employees
Source: Cerved illustration of Istat (Italian National Institute of Statistics) data

KEY CHARACTERISTICS

ACTIVE BUSINESSES (a) INTENDING TO INVEST IN DIGITAL TECHNOLOGIES BETWEEN 2016 AND 2018

Economic activity code	internet-based technology	broadband internet connection	4G/5G mobile connection	internet of things	artificial intelligence applications	immersive technology	big data processing & analysis	advanced automatione, cooperative robots and intelligent systems	other technology areas	3D printing	interconnected machine simulation	cyber-security	investment in at least one form of digital technology
B: extraction of minerals from caves and mines	252	174	176	49	85	15	56	36	174	48	67	129	274
C: manufacturing	37,042	31,114	21,812	8,388	13,952	2,563	5,758	11,138	30,659	9,071	12,287	26,018	45,044
D: supply of electrical energy, gas, steam and air conditioning	315	263	212	119	150	31	129	77	292	20	36	287	383
E: supply of waterworks, waste management and treatment	1,296	1,086	873	347	314	71	201	174	848	96	157	818	1,454
F: construction	11,020	9,176	8,085	1,965	1,408	543	838	843	6.678	1,659	1,026	6,113	12,275
G: wholesale, retail, motor vehicle repair	23,013	20,009	14,855	4,518	5,184	1,458	3,602	2,750	14,787	2,197	2,102	14,098	26,021
H: transport and logistics	7,513	5,915	5,381	1,602	1,284	321	817	722	4,264	442	556	4,083	8,280
I: accommodations and restaurants	14,493	12,595	8,811	2,217	2,151	778	1,576	1,003	5,534	738	519	5,187	15,324
J: information and communication services	4,490	3,930	2,989	1,646	2,379	942	2,009	1,006	3,690	431	688	3,498	5,152
K: financial and insurance activities	1,579	1,354	1,122	314	600	101	505	306	1,382	61	94	1,375	1,839
L: real estate	428	341	262	65	98	21	80	27	289	32	23	275	494
M: professional, scientific and technical activities	5,506	4,816	3,722	1,180	1,840	648	1,389	701	4,706	761	734	4,427	6,531
N: rental, travel agencies and business support services	6,112	5,176	4,393	1,114	1,363	438	998	662	3,793	468	499	3,642	6,754
P: education	977	821	577	171	264	148	218	86	600	164	87	547	1,072
Q: healthcare and social assistance	2,178	1,930	1,253	472	573	203	337	331	1,793	395	325	1,688	2,579
R: arts, sports, entertainment and leisure activities	1,235	1,045	837	179	253	105	164	90	658	98	80	624	1,347
S: other services	1,997	1,795	1,245	343	288	100	191	163	1,037	112	109	1,006	2,173
TOTAL	119,446	101,540	76,605	24,689	32,186	8,486	18,868	20,115	81,184	16,793	19,389	73,815	136,996

a) businesses with more than 10 employees
Source: Cerved illustration of Istat (Italian National Institute of Statistics) data

KEY CHARACTERISTICS

INFRASTRUCTURE: 5G COVERAGE

Network coverage for next generation access (NGA) expanded last year, but by only once percentage point, now reaching 89% of Italian households, which is three points above the EU average of 86%.

In terms of preparations for the fifth generation (5G) network, Italy is currently third in Europe: 94% of the spectrum harmonised at EU level for wireless broadband has been assigned. Experimentation for 5G began in 2017 and is still ongoing, under both the Ministry for Economic Development's "5 Cities for 5G" programme and separate initiatives agreed between telecommunications operators and municipalities. In 2019, some Italian operators began marketing 5G offers in major cities. Italy issued a call for tenders for three "5G pioneer bandwidths" in 2018; the 3.6 GHz and 26 GHz bands have already been assigned and are now available, while the Italian authorities are still adopting measures needed to make the 700 MHz bands available by 2022. This constitutes a delay to the 30th June 2020 deadline set in EU Decision no. 2017/899 on UHF bands; it is mainly due to the complexities involved in migrating broad sections of the population to advanced transmission standards. Commercial services for 5G have been launched in some of the bands that have already been assigned and are available. The 26 GHz spectrum is currently being used mainly for fixed wireless access (FWA) tests.

DIGITISATION OF ECONOMY AND SOCIETY INDEX (DESI), 2020(a) - CONNECTIVITY

	Italy			EU
	DESI 2018	DESI 2019	DESI 2020	DESI 2020
Fast broadband coverage (NGA) (b)	87%	88%	89%	86%
4G coverage (c)	91%	97%	97%	96%
5G preparation (d)	N.d.	60%	60%	21%

a) data referring to the previous year for each index

b) % of households

c) % of households (average between operators)

d) % of total 5G spectrum assigned and available for use by end 2020 according to pioneer 5G tender in each EU member state

Source: European Commission: Digitisation of Economy and Society Index (DESI), 2020

KEY CHARACTERISTICS

INFRASTRUCTURE: DIGITAL PUBLIC SERVICES

With regard to digital public services, Italy is ahead of the EU average in the completeness of services offered online, both for businesses and in terms of open data.

By establishing the new Ministry for Technological Innovation and Digitisation in September 2019, the Italian government marked a significant step forward in digital public service policy. The "Italia 2025" strategy assigns a central role to government agencies as architects of innovation and digitisation in Italy.

Implementation of major e-government projects were ramped up in 2019.

To begin with, Electronic Identification, Authentication and trust Services (eIDAS) systems compliant with EU regulations were extended substantially, to reach 5.5 million citizens as of January 2020 (from 3.4 million at the beginning of 2019). Likewise, use of electronic identity cards, also pursuant to the EU eIDAS regulation (Public Digital Identity System), has risen: 99.9% of Italian municipalities are now able to issue electronic ID cards, covering 97.8% of the population.

KEY CHARACTERISTICS

Centralisation of digital vital statistics records into the National Resident Population Registry is another huge project that aims to consolidate all individual records, currently held by around 8,000 separate local public bodies, into a single register, as well as to simplify vital statistics record-keeping and make it more efficient.

Implementation of this project has improved in 2019 and 2020, with coverage of target public bodies rising from 21% at the start of 2019 to 68% at the start of 2020.

The number of electronic payments made in favour of public bodies (through the PagoPA system) has risen noticeably, from around 13,000 transactions in 2018 to 42,500 in 2019 (the most recent figure available).

On the cybersecurity front, in 2019 Italy launched a pilot programme for a national platform to combat cyber-attacks. This platform enables automated exchanges of information between various public bodies concerning IT risks, with the aim of preventing such attacks and dealing with any present threats.

Italy received €316 million in EU regional development funds for projects related to e-government services and applications.

KEY CHARACTERISTICS

DIGITISATION OF ECONOMY AND SOCIETY INDEX (DESI), 2020(a) - DIGITAL PUBLIC SERVICES

	Italy			EU
	DESI 2018	DESI 2019	DESI 2020	DESI 2020
E-government users (b)	30%	37%	32%	67%
Pre-filled forms (c)	33	48	48	59
Completeness of online services (d)	89	91	92	90
Digital public services for businesses (e)	81	82	94	88
Open Data (f)	NA	NA	77%	66%

a) data referring to the previous year for each index

b) % of people who sent filled forms to public authorities, over the internet, previous 12 months

c) amount of data that is pre-filled in public services' online forms - score (0 - 100 scale)

d) share of administrative steps related to major life events (birth of a child, new residence, etc) that can be done online - score (0 - 100 scale)

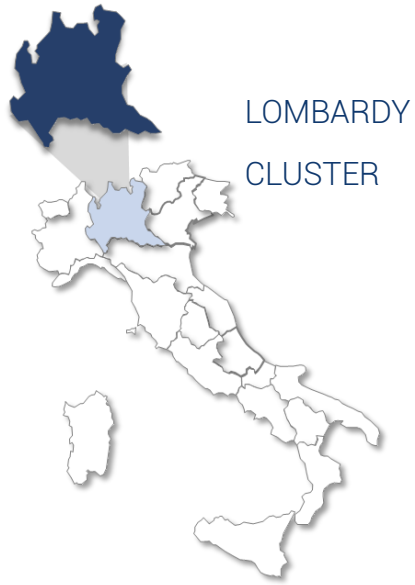
e) the indicator broadly reflects the share of public services needed for starting a business and for conducting regular business operations that are available online for domestics as well as for foreign users. Services provided through a portal receive an higher score, services which provide only information (but have to be completed offline) receive a more limited score - score (0 - 100) includes national and trans-national initiatives

f) this composite indicator measures to what extent countries have an Open Data policy in place (including the transposition of the revised PSI Directive), the estimated political, social and economic impact of Open Data and the characteristics (functionalities, data availability and usage) of the national data portal - % of maximum score

Source: European Commission: Digitisation of Economy and Society Index (DESI), 2020

KEY CHARACTERISTICS

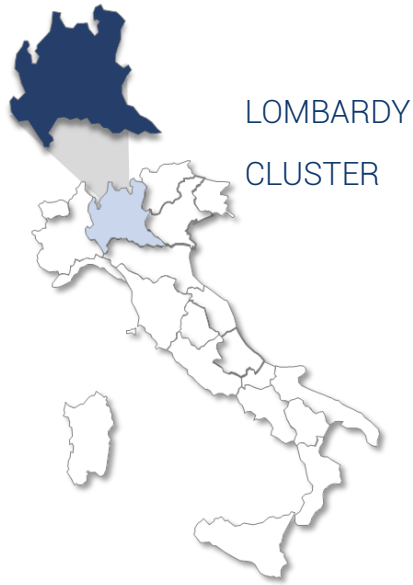
ICT HUBS IN ITALY



Lombardy has Italy's largest ICT district, especially owing to the Milan hub, which stands out as a leader in all areas of technological specialisation. This leading position stems mainly from Lombardy's strong production base: it is home to the country's leading manufacturers of semiconductors and telecommunications equipment. It also has a well-structured commercial and support service network, as well as a high concentration of metalworking and automotive industry players, which have developed close ties with ICT hubs in step with the growing importance of technological applications to be competitive in these sectors.

Within this context, the ICT & Services for Business group of Assolombarda (the Lombardy business association) is one of the most widely represented institutions in the region that promotes relationship building between stakeholders around ICT matters. As enabling technology for the Business 4.0 (evolution of "Industry 4.0", is a National Plan that offers support to companies for investments, digitization of production processes, enhancement of workers' productivity, training of appropriate skills and development of new products and processes) project spreads, particularly internet of things applications, this group's Board has focused its efforts on developing a digital culture among businesses in the region, especially small to medium industrial firms, accompanying their progress towards Business 4.0 goals.

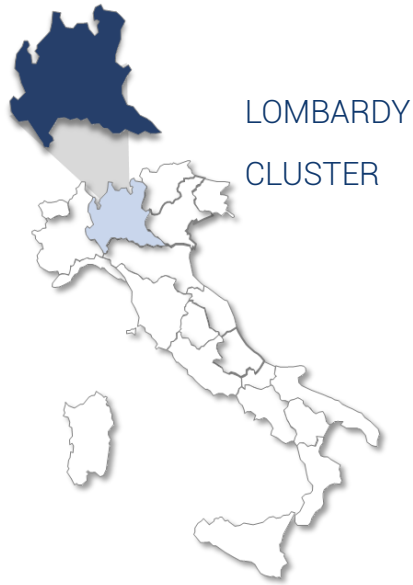
KEY CHARACTERISTICS



The Board of Assolombarda's ICT & Services for Business works on four areas:

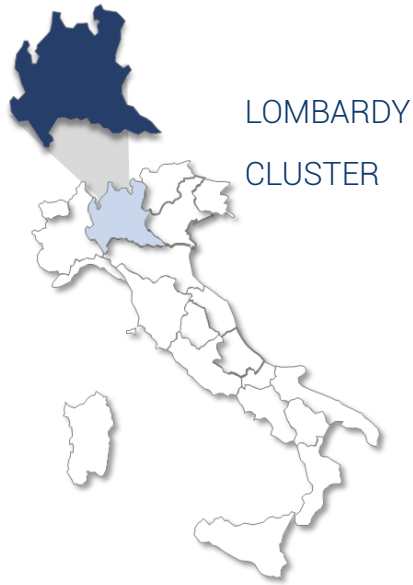
- Professional services for businesses: the group planned and endorsed third year laboratory-based studies for the undergraduate programme in Sciences at the University of Milan-Bicocca. Four labs were attended by representatives of major national and international companies, which were also involved in the planning and management of the lab sessions. The group also advanced the HR Innovation Mindset #startupMood, for innovative human resources and diversity management. It has worked on the effects of Industry 4.0 on corporate organisation and on managing industrial relations in order to reconcile 'traditions' with more innovative models. These efforts have focused on the sweeping changes taking place in the country's social and productive fabric, offering students skills along with ideas for reflection and comparison on themes at the forefront of organisational innovation and workplace relations.

KEY CHARACTERISTICS



- Industrial services for businesses: the group drafted and carried out a study to learn businesses' priorities with regard to public tender processes, and then set up a roundtable discussion and workshops on this topic. Thanks to the participation of experts in the field, hailing from leading institutions and firms, these workshops tackled the institutional framework under the 'minimum environmental criteria', illustrating how to harmonise these criteria with the new tender rules and discussing the legal aspects, competitive opportunities and strategic prospects for businesses related to the new 'Green Public Procurement' process. Furthermore, the group is currently activating a working group on the mass catering sector. With labour unions, this section of the group also reactivated roundtable discussions regarding an update to the national labour contract for multi-services; thanks to contributions from corporate representative, critical issues were discussed and proposals were advanced to help consolidate the network of businesses in the section
- Telecommunications: this section helped promote the association's activities aimed at developing a digital society, such as the experimental alternating work/school project with secondary schools and telecommunications businesses. This alternation project seeks to develop students' digital skills and knowledge of digital businesses, and is co-designed by the students themselves, local businesses and local schools.

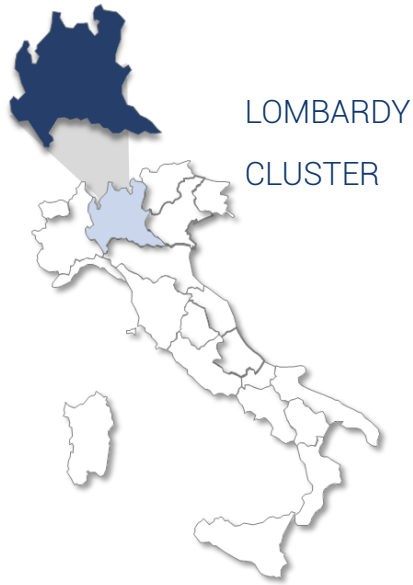
KEY CHARACTERISTICS



- Innovative tertiary companies: this section of the Board has run roundtables on experiences of 'SmartMilano', in which member businesses have provided input as to which 'smart' connectivity technologies are needed in order to make Milan a 'smart city of the future'. It has also worked on the SmartBuilding project, aiming to propose solutions to create a model of excellency for high-tech buildings.

Based on a proposal from the ICT & Services Group's Board, back in 2013 Assolombarda presented a project to remodel the Expo 2015 grounds after the exposition, to turn it into an innovative hub, called the MIND - Milano Innovation District project. The plan was to create an innovation hub for the Life Sciences, Healthcare, Biotech and Pharma, Agrifood, Nutrition and Data Science industries. MIND was formed via a public-private partnership between Arexpo (the Expo site owner) and Lendlease (the company responsible for construction planning on the site), also involving the nearby Galeazzi Hospital, the University of Milan, the Human Technopole research institute and the Triulza foundation.

KEY CHARACTERISTICS

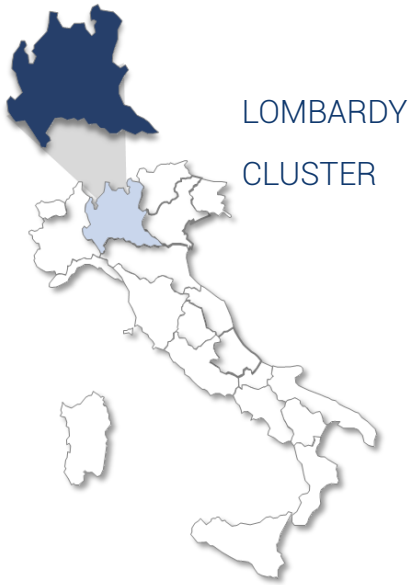


Outside of Milan, the **Monza & Brianza Green and High Tech District Foundation**, established in 2008 through a joint initiative of the Monza-Brianza provincial government, the Association of Municipalities for a Milano Brianza High -Tech District, the Monza-Brianza provincial manufacturers' association, and the local Chamber of Commerce, Industry and Agriculture. This foundation operates in two sectors, energy and ICT, and its main purpose is to bring together technologically-inclined companies so as to encourage further industrial development through synergies between them.

New networks are created between individual businesses, with a focus on SMEs that possess innovative technologies, products or processes, expanding the district's dynamics towards an ever greater number of companies and a broader spectrum of the supply chain, with initiatives for industrial development, land redevelopment and internationalisation projects.

This foundation currently has about 120 members, including 90 businesses, 11 universities and research centres, 10 professional associations, 8 public bodies and 3 financial institutions.

KEY CHARACTERISTICS



LOMBARDY

CLUSTER

Also based in Lombardy is the **Cremona Digital Innovation Hub**, a project of the CRIT cooperative founded in 2012 by local ICT companies Gamm System, Incode, Linea Com, MailUp and Microdata Group, in partnership with the Cremona campus of the University of Milan. This hub contains a set of companies that together cover all of the main segments of the ICT sector. This hub specialises in the "Smart Land" paradigm, a concept that goes beyond the Smart City model by adapting it to the realities of the great many small towns throughout Italy, focusing on digital revolution for agriculture, which is indeed one of the pillars of the national 4.0 policy. The goal is to unify knowledge and skills so as to encourage the adoption of digital technologies by local communities, which will then improve both quality of life and the competitiveness of the local economy.

KEY CHARACTERISTICS

In 2017, the Region of Liguria reorganised its regional innovation hubs: coordination of two of them (SOSIA and TRANSIT) has been assigned to the SIIT (Intelligent Integrated Systems Technology) cooperative, which was established for the purpose of building integrated cooperation between major manufacturers, local SMEs, the University of Genoa and various public sector institutions, research institutions and financial companies, with a special focus on developing industrial and technology transfer research activities.

The SOSIA research and innovation hub, which has about 90 members including public sector institutions and firms, aims chiefly to plan and carry out programmes, projects and activities in three fields: environmental risk management and monitoring, cybersecurity for critical infrastructure, and innovative ICT systems for the 'smart factory' and industrial automation.

- Environmental risk management and monitoring: research and development of applications via close cooperation between stakeholders operating in the field, enabling the integration of prevention and mitigation measures, monitoring and alert systems, along with emergency management (for hydro/geological risk, air/ground/water pollution, flooding and coastal erosion). Roadmaps are drawn up to aid the development of a detailed environmental recovery and maintenance plan for the Liguria region. The programme will be based not only on the sensible integration of existing systems, applications, products and technologies, but also on merging in innovative elements from new projects.

KEY CHARACTERISTICS

- Cybersecurity for critical infrastructure: includes industrial control systems for power generation and electrical energy distribution, supply chains and transport. Also includes data security, from digital identity and applications to emerging computation models (web, mobile, cloud and internet of things). In this segment, SOSIA also works on applied security and security-by-design, along with secure sharing of information and classified documents, with platforms for cybersecurity training. It is drafting an innovative cybersecurity development plan, through the creation of regional excellence centres for research and manufacturing.
- Innovative ICT systems for the 'smart factory' and industrial automation: the main initiative in this areas is the SharedLab-Liguria and National Smart Factory Cluster, with systems for customised production, as well as strategies, methods and tools for industrial sustainability, methods to enhance the value of factory workers, highly efficient productive systems, innovative production processes, advanced and adaptive production methods, along with strategies for managing new generation production systems.

The TRANSIT (Technology and Research, Networks, Security and Intermodal Transport) research and innovation hub has 68 members between firms and public bodies. It operates in the field of automation, supervision and security in within the transport and logistics sector, specifically focusing on intermodal transport, including technological, organisational, operational and institutional aspects of the processes covered by relevant regional institutions.

KEY CHARACTERISTICS

Some of the key projects that the SIIT cooperative is working on are:

- TECDOC (Digital Technologies for Complex Organisations), providing beneficial support to complex organisations to plan, coordinate, monitor and effectively and efficiently manage their manifold operations. Specific application platforms have been studied and developed in order to smoothly integrate processes, services and technology for these organisations' particular activities. The organisations involved in the project, selected from both the industrial and the service sectors, are those considered 'business communities', that is, aggregated communities of firms, government agencies, universities and research centres that work in the same field and share common goals and common tools to achieve them. The specific organisations involved in the project are: Cetena, Ericsson Telecommunications, Elsag Datamat, Consorzio PMI (C&C Sistemi, Fos, Hub Telematica, I.LOG, NIS), the University of Genoa (DIBE, DIST), and the ICT Department of the National Research Centre (CNR).

KEY CHARACTERISTICS

LIGURIA

CLUSTER

- SINTESIS (Integrated System for Smart Security Distribution). This project created an innovative structure to manage information based on the 'network-centric operation' concept to optimise distribution, service quality and time-critical processes. In addition to ensuring that the system will function along with other existing systems, this fosters organisational and operational synergies between players in the sector. The project's main research goal was to apply this new 'cognitive model' to the security sector. In summary, processing nodes were developed that transform signals and sensory events into information that is measurable for security purposes (smart sensory nodes and cognitive nodes). An autonomous cycle of perception, analysis, decision and action can therefore be put in place, making the system similar to human processes, analytical and evaluative abilities, yet infinitely faster and correlated to the complexity of situations and the need for real-time solutions. The institutions involved in this project were Elsag Datamat, Selex Communications, Ansaldo STS, Selex Sistemi Integrati, Consorzio PMI (Aitek, NIS, Selesta Ingegneria, TP, TechnoAware), the University of Genoa (DIBE, DISI, DIST), and the ICT Department of the National Research Centre (CNR).

KEY CHARACTERISTICS

LIGURIA

CLUSTER

- Extended modular automation: a project carried out in line with some large companies' strategic inclination towards 'extended automation', consisting in the use of teams of advanced robotic systems that operate autonomously and cooperate in harsh environments, highly characterised by one or more of the following aspects: hazards, complexity, and lack of structure. These are all applications that, given the high robotic and advanced automation content, have elicited great interest from many local SMEs associated with competence centres in Genoa and La Spezia.

  The institutions involved were Selex Sistemi Integrati, Oto Melara, Ansaldo Energia, Elsag Datamat, Cetena, Bombardier Transportation Italy, Ericsson Telecommunications, Consorzio PMI (Aitek, Genova Robot, Graal Tech, Horizons, Medservice, Telerobot), and the University of Genoa (DIBE, DISI, DIST).

KEY CHARACTERISTICS

- Healthcare: smart patient management systems for the full diagnostic and therapeutic cycle. This project consisted in researching and developing new applications of ICT innovations in the medical equipment sector, to find solutions that can optimise all phases of patient management, from standardising the diagnosis to aiding physicians in the treatment process and supporting functional rehabilitation. The goal is to build a system that can neatly integrate new sensors and interactive diagnostic and monitoring systems using new effective and safe technology, in order to then plan, coordinate and monitor diagnostic and patient management activities with new and safe devices that are precise and flexible, to optimise treatment in terms of both time and non-invasiveness. The institutions involved in this project were Esaote, Softeco Sismat, Consorzio PMI (TAU, FOS, CAP Research), the University of Genoa (DIBE, DIST, DISI), University of Genoa - Savona Campus (DIBE, DIST), and the ICT Department of the National Research Centre (CNR).
- MAREA (Monitoring and Rescue Automation): a project aiming to form "teams" of autonomous terrestrial, surface aquatic and submarine surveillance and monitoring vehicles, which will be able to monitor and intervene to safeguard infrastructure, structures and their surroundings, with a special interest in large hydroelectric plants. The project is also working on post-disaster monitoring and intervention scenarios, such as earthquakes and other severe environmental or structural events. The institutions participating in this project are Oto Melara, Selex Galileo, the University of Genoa (DIST, DIBE, DIMEC), CNR (ISSIA), Canova Tech, FOS, Graaltech, Hyla Soft, INSIS, Medservice.com, TechnoAware and Telerobot.

KEY CHARACTERISTICS

The region of Emilia Romagna displays a very technologically-focused industrial fabric. Home to the world-famous "Motor Valley", it is a region with a plethora of initiatives, associations and clusters to support research and innovation. Specifically, the Aster cooperative for innovation coordinates a network of **ten different tech hubs** with a total of 20 locations throughout the region, each specialising in different fields. The Bologna-Ozzano hub specialises in pharmaceuticals, advanced therapies, medical devices and biotechnology; the Bologna National Research Centre works on sensors, automation, packaging, electronic medical equipment, lighting, energy and the agri-food industry; the Ferrara hub specialises in mechanical engineering, ICT, electronics and automation, biotech, agri-food, material science and energy; the Forlì-Cesena hub in artificial intelligence, big data and agri-food; the Modena hub and mechanics, materials, ICT and life science; the Parma hub in agri-food, biotech, pharmaceuticals, translational medicine and ICT; the Ravenna hub in energy, environmental science, nautical applications, innovative materials, composites and restoration projects; the Reggio Emilia hub specialises in mechanics and mechatronics, environment and energy, and agri-food; and the Rimini hub focuses on the materials industry, fashion, cosmetics and packaging. The main ICT-related activities of these tech hubs are described below.

KEY CHARACTERISTICS

EMILIA ROMAGNA CLUSTER

Ferrara Tech Hub

- Project I4S Industry 4.0 Secure: This is a project to analyse vulnerable areas in information security where there are 'connected' production plants and smart machines in operation, including all industrial IoT devices typical of Industry 4.0 systems. Modern fog models and edge computing, along with virtualisation and software-defined networking tools are used to identify the most appropriate technological solutions to improve the degree of security and resiliency to cyber-attacks. The results of this project should enable more cyber-secure production plants and connected machines to be built, in order to ensure greater protection of personal and corporate data, and thus to maintain operability and keep all critical processes running even in the event of an attack. The partners involved in this project are: the University of Modena and Reggio Emilia, MechLav, the ICT Inter-Departmental Research Center of Alma Mater Studiorum – University of Bologna, Consorzio T3 LAB, Romagna Tech, VEM Sistemi SpA, Bonfiglioli, and SACMi.
- SBDIO I4.0 Project: a research project for industrial applications of big data technology, in the move towards a service economy, through the transformation of goods and products into services, production process improvements in factories, and post-sales services outside the factory. Two main lines will be examined: automation and industrial food production. Five industrial research labs are participating: CIRI ICT and CIRI MAM, both of the University of Bologna, MECHLAV of the University of Ferrara, AIRI of the University of Modena and Reggio Emilia, and T3LAB), along with seven local companies (Imola Informatica, Italianasoftware, Sacmi, Carpigiani Group, Gea Procomac, Injenia and Cineca).

KEY CHARACTERISTICS

EMILIA ROMAGNA CLUSTER

- SmartChain Project: seeks to design and build innovative platforms useful for local businesses by developing solutions based on blockchain technology for secure integrated information management related to supply chains; the aim is to overcome problems currently affecting blockchain-based systems. This project is being carried out by five industrial research labs (belonging to 3 different universities and a research centre), and also has three participating firms.

- Project Comprendo: The goal is to build a prototype for a platform that will enable users to quickly and efficiently develop inclusive educational videogames. The Comprendo platform's ultimate aim is thus videogames that help enhance execution functions in children and young people with special educational needs. This is to be achieved by combining innovative technological elements such as augmented reality and gamification, to be fine-tuned by the technicians working on the project. These elements will not only be available for videogame developers, but can also serve as a methodology to support the effective use of these technological tools in general. The project leader is the Future Technology Lab of the University of Parma; the total project cost is €830,623.

KEY CHARACTERISTICS

Forlì-Cesena Tech Hub

With four different sites in the province, the Forlì-Cesena tech hub consists of three inter-departmental industrial research centres (CIRI) equipped with solid technical and scientific infrastructure. The hub makes its skills and equipment available to businesses for innovative projects in artificial intelligence, ICT, agri-food, and aeronautics and aerospace technologies. The ICT CIRI in particular addresses the following fields of application: energy (ICT for solar power, solar intensity forecasting and urban energy efficiency), environment sensors and monitors, microelectronics for chemical and biochemical sensors, wireless communications, sensor networks, localisation and positioning tools, planning energy-efficient radio/mobile networks, processing and analysing images and videos, embedded viewing systems, cloud computing and related applications and services, network infrastructure, telecommunications systems and networks, network security, business intelligence and data mining, logistic optimisation and geographical modelling, navigation support systems, as well as sentiment analysis.

KEY CHARACTERISTICS

The most noteworthy projects carried out by the CIRI ICT Lab are:

- **HABITAT: Home Assistance Based on Internet of Things for Autonomy for All**. HABITAT is a project that aims to provide families, caregivers, care home operators and anyone else with a need for personal support in daily activities, with greater security and at the same time the ability to maintain a suitable lifestyle. The solution is a platform based on advanced internet of things (IoT) technology that enables domestic environments to be reconfigured to progressively adapt to the needs of its inhabitants, monitoring behaviour of those who, due to aging or illness, require special attention in their family or communal home. HABITAT advances new types of furniture and new functions for everyday objects which, when run by a system that is transparent to the user, yield a home with new potential for inclusiveness, with a view to de-hospitalisation and home care.

KEY CHARACTERISTICS

- **SACHER (Smart Architecture for Cultural Heritage in Emilia Romagna).** Given Italy's vast and diverse cultural heritage, cultural institutions have been deploring a lack of innovative tools that could facilitate management of the enormous repository of existing data and integrate the various databases of myriad public and private sector cultural entities in an efficient manner. SACHER is responding to this need through a federated cloud platform that will enable access to data on tangible cultural items coming from various external sources, and provides services to process the data, conduct research and present the data in an intuitive format that is easy to manage for those that are not IT experts. SACHER is intended for cultural institutions that specialise in ordinary and extraordinary maintenance operations for cultural heritage structures and goods, thus to the personnel of public bodies, but also to citizens and tourists interested in enjoying the nation's cultural heritage.

KEY CHARACTERISTICS

EMILIA ROMAGNA

CLUSTER

- Sentiment Analysis Systems for Business Intelligence. The Social Business Intelligence system implemented allows unstructured textual data generated on and collected from the web to be interpreted and analysed, in order to extract both qualitative and quantitative assessments of the content. In particular, this system goes beyond the limits facing web monitoring and sentiment analysis systems currently in use. The current systems cannot integrate the data with firms' existing information systems and thus cannot perform related analyses. It is also impossible to implement analyses based simultaneously on internal data and unstructured data taken from the web. The Social Business Intelligence system, on the other hand, enables navigation of data extracted from the web, which is semantically enriched subsequently via a text mining process to shed light on the content and frequency, with semantic polarisation, so that the informative value of big data can be exploited.

KEY CHARACTERISTICS

- Middleware for private cloud management based on open-source technology. The CIRI ICT labs have also created a private cloud computing distribution platform based on open-source software, as a valid alternative to costly industrial solutions currently available on the market but typically designed for large companies. This platform can integrate data processing, storage and network resources deriving from different physical locations in a single system. Based on open source software (OpenStack, OpenVSwitch, Apache Web server and Collectd) along with innovative systems management middleware that supports efficient management of two types of network services (web server plus Dropbox-like network storage), this platform provides automatic scale-out failover mechanisms so as to minimise service downtime in the event of problems and to promptly handle unforeseen load spikes.

- Embedded automatic viewing systems. Creation of a low-cost embedded viewing system using smart cameras, based on economical embedded hardware where the optical, acquisition sensor, processing and communication functions are integrated into one device. This aspect reduces the unit cost, but makes it more difficult to build and thus requires precise designing. In this context, the CIRI ICT unit is offering its expertise in the design, building and management of embedded viewing systems for automatic localisation, offering a low-cost multi-camera system that is versatile and easy to use, can calibrate itself, and reliably and rapidly tracks objects of interest.

KEY CHARACTERISTICS

Modena Tech Hub

The Modena hub houses eight accredited industrial research labs at the High-Tech Network of Emilia Romagna, including the Artificial Intelligence Research and Innovation Center (AIRI, formerly Softech-ICT), an inter-departmental ICT research centre supported by the Enzo Ferrari Engineering Department and by the Marco Biagi Economics Department of the University of Modena and Reggio Emilia.

The hub's current projects include:

- POLIcy Support systEm for smart citY data governancE (POLIS-EYE). This is a project to develop a public policy decision-making support system for optimal Smart City administration for tourism. It seeks to analyse, jointly with businesses, the data and requirements connected with the tourist sector in order to create integrated forecasting and decision-making models that can be applied on the ground. For this project, a Smart City software platform will be developed in which the data will feed dynamic viewing panels. Through these panels, not only will daily support be provided for employees' daily tasks, but broad strategic support will be provided to decision-makers and stakeholders in the tourism sector. PolisEye is being conducted by five industrial research labs belonging to three universities and a research centre, and has six participating firms. The project is expected to be completed by the end of June 2021.

KEY CHARACTERISTICS

- SUPER (Supercomputing Unified Platform – Emilia Romagna): The SUPER project's aim is to build an advanced digital infrastructure for big data volume computing and processing, for the consolidation of services that enable outstanding research and technological innovation over a broad spectrum of applications, with a particular focus on supercomputing, genomics, regenerative medicine and biological databases, advanced materials and innovative production systems. The project is expected to be completed at the end of 2022, with €4 million allocated for its first phase, while no more than €3.5 million is to be allocated for the second phase.
- IDEHA (Innovations for data processing in cultural heritage): IDEHA will create an open IT platform for cultural heritage, joining digital content from traditional repositories with information generated in real time by users or by environmental sensors. One key feature is its aggregation, processing and understanding of data via new technologies in order to design services for various types of users (technicians, researchers, tourists and more), who can be profiled through specific multimodal applications such as mobile apps and employed on a large scale at a variety of cultural sites large and small throughout the country. Government funding for the project amounts to €4,522,448.49, over a 30-month period set to end on 30th April 2021.
- SBDIO I4.0, in partnership with the Ferrara tech hub (see entry under the Ferrara hub for details).

KEY CHARACTERISTICS

EMILIA ROMAGNA

CLUSTER

Finally, we highlight three projects in place to combat the spread of the Covid-19 pandemic:

- Inter-Homines: artificial intelligence and computer vision services for real-time computing of distances between people and of the dynamic risk of contagion in public places and in workspaces. The project, which has received funding from the Emilia-Romagna Region of almost €120,000, has received recognition from the international scientific community with the Best Demo Award";

- OpenAir: a system that automatically detects the required social distancing in open spaces, created to support the local police force;

- COVID SKUNK: real-time identification of gatherings of people through cellular network data, in an effort to prevent the spread of Covid-19.

KEY CHARACTERISTICS

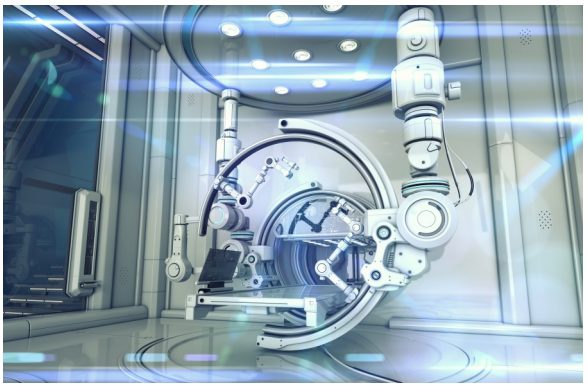
EMILIA ROMAGNA CLUSTER

Parma Tech Hub

The Parma tech hub hosts six research centres including the Future Technology Lab, competence centres for Industry 4.0 technologies such as augmented reality, radiofrequency & identification, IoT, cyber physical systems, big data & analytics, simulation and horizontal/vertical integration.

Its currently active projects are:

- TEAM SAVE (Enabling Technologies and Materials for Advanced Solutions for Electric Vehicles): This project aims to develop – and bring to the mass market – new technologies to integrate nanomaterials, additive manufacturing and secondary raw materials for recycling in the production of electric vehicle components that will be lighter, functional, durable, cost-effective and environmentally sustainable. An essential aspect in this context is the adoption of more advanced IT solutions; the project's budget is €130,000 and it is scheduled to be completed by July 2021;



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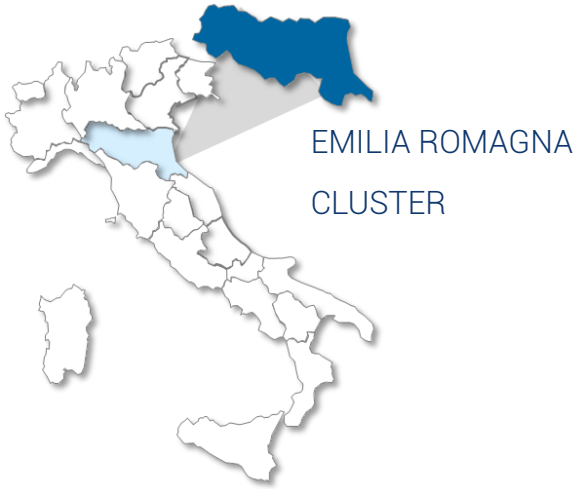


- PLEINAIR (Free and inclusive parks for intergenerational recreational and physical activities): this project's goal is to make people more aware of their health and to promote an active lifestyle at all ages through 'smartly' equipped parks with 'smart' outdoor furniture and objects, such as recreational equipment with sensors. These objects will be able to recognise users' presence and dynamically adapt to their voices and performance. This is an industrial project co-funded by the Emilia Romagna region through the POR FESR 2014-2020 programme managed by DataRiver Srl, in partnership with the Future Technology Lab – UNIPR, Teknehub Lab – UNIFE, CIRI-SdV – the inter-departmental research centre of life science and technology for health, and AIAS (Associazione Italiana Assistenza Spastici); the industry partners are ERGOTEK S.r.l., Sarba S.p.A. and mHealth Technologies S.r.l. The project's budget is €232,500, and it is scheduled to be completed in July 2021;

- Comprendo, in partnership with the Ferrara tech hub (see entry under the Ferrara hub for details).

KEY CHARACTERISTICS

In the north-west region of Piedmont, Torino Wireless has focused the attention of a network of companies of all sizes, as well as of both public and private research centres that are developing innovative solutions for many different sectors. This network is comprised of around 2,500 businesses active in the area and over 50 public sector institutions. Its activities include supporting innovative research, helping SMEs digitise, working on smart city projects, business networking, and setting up an integrated service system to help companies find new commercial, industrial and technological partnerships abroad, thereby encouraging innovation and technology transfers and promoting SMEs' participation in tenders called by the European Commission. Torino Wireless has two main clusters: the ICT Innovation Hub and the National Technological Cluster on Smart Communities.

KEY CHARACTERISTICS

The **ICT Hub**, formed by the regional government in 2009, is a network that brings together key actors in innovation: SMEs, large companies, along with public and private research institutes, to develop both research projects and new business opportunities. This hub currently has 232 members. Its goal is to foster new innovations and to increase businesses' competitiveness on the market by supporting their high-tech research and development projects that have high potential and could have an impact on the local economy. Since 2009, the ICT Hub has obtained funding for 148 research and innovation projects, generating a total of around €47 million across the region.

The **Smart Communities Cluster**, which currently has 157 members, aims to increase Italy's capacity for innovation related to the theme of 'smart communities' and to carry out projects for applied solutions in key sectors for economic development. The fields it addresses are therefore the mobility of people and goods, security, environmental protection and sustainability, information security and data management, digital administration, and relations between public bodies and citizens. The cluster's distinctive strategic actions include setting up a national roadmap for research and innovation on smart communities, which is updated each year. This roadmap is then put to use through the portfolio of smart community-related projects conducted by its member businesses and research institutes. This portfolio currently contains 96 project ideas, which have garnered a total of €193 million in funding.

KEY CHARACTERISTICS

LAZIO

CLUSTER

The Rome Tech Hub is the main ICT cluster in the central region of Lazio, and it is composed of two separate hubs, which have distinct locations and concentrate on different fields. The **Castel Romano Tech Hub** focuses on R&D in new materials, life science, the environment and the green economy, whereas the **Tiburtino Tech Hub** boasts two certified business incubators: *Spazio Attivo Roma Tecnopolo di Lazio Innova* and *l'Incubatore di Innova S.r.l.* The Rome hub now houses over a hundred companies that operate in eight different sectors of the economy, including ICT, electronics, telecommunications, aerospace, environment and the green economy, research and technology transfer.

Given its location in the nation's capital, where there is a significant number of ICT businesses, the Tiburtino Tech Hub is a major ICT centre for both local and nationwide entrepreneurs, hosting many small businesses with a specialised high-quality offering of open-source, web and mobile solutions, customisations for large companies, along with automation and facilities management solutions.

The Tiburtino Tech Hub's ICT cluster is located near the "Tiburtina Valley", Rome's technology district, and therefore represents developments across the entire metropolitan area: over 40% of all businesses headquartered in the area are members of the Tiburtino Tech Hub.

KEY CHARACTERISTICS

LAZIO

CLUSTER

Another field of substantial activity is innovation, research and technology transfer. In a geographical context where there are numerous research institutes and the entrepreneurial mix is predominantly micro, small and medium sized businesses, technology transfer between research centres and businesses is an essential element to fulfil the region's productive potential and lay the foundations for stable, valuable interactions between research institutes and companies. Lazio's regional government indeed recognises the importance of its science and technology districts boosting the region's competitiveness in general. The Tiburtino Tech Hub has the tools to provide concrete support to businesses that value technological innovation as a real competitive factor, providing a concrete contribution to building a bridge between researchers and businesses.

The projects carried out by the Tiburtino Tech Hub include:

- Integrated Cultural Analysis Neural Platform (ICANP). This project consists in building an integrated platform that can offer a series of services to use and make the most of local cultural heritage in museums and at archaeological sites. It also involves promoting and producing events that take advantage of innovative technology. The platform will be accessible to users mainly via a mobile app with a series of options. The app will also be available for users on site for high-tech accompaniment at specific points of interest, with interactive guides and storytelling features. It is being developed by Neural Research S.r.l., for a total investment of €250,000.

KEY CHARACTERISTICS

LAZIO

CLUSTER

- **Principles of Cognitive Ergonomics for commercial success in human to AI algorithm interactions**. By analysing actual cases of commercial success, this project aims to pinpoint the principles of cognitive ergonomics at work in the technological processes that led to success, particularly in the interactions between artificial intelligence algorithms and human users. This will enable the researchers to look for new potential applications and thus stimulate further related R&D. The project is open to interested interdisciplinary researchers and university students. It is being developed by Neural Research S.r.l.

KEY CHARACTERISTICS

LAZIO

CLUSTER

- **EasyWallet:** This research project was established to set up an electronic payment services that employs new generation computing technology. EasyWallet is an innovative deposit, withdrawal and money transfer system. Its goals is to implement a low-cost circuit through high-tech solutions that ensure a fast user-friendly experience that can bring about a sharing economy based system with high potential for companies operating in the tourist industry, particularly in Sardinia. The platform joins a community of business users (for which it provides money management services) with a consumer community, so it address both B2C and B2B relations. The project proposal foresees introducing mobile app solutions that will be integrated with a blockchain to set the standard for faster, more secure and more reliable services than previous technologies can offer. Advanced by TrustMyPhone, a Mashfrog group company that specialises in mobile projects, in partnership with the Mathematics and IT department of the University of Cagliari, this research project is being conducted under the 2014-2020 EU Regional Development Fund (POR FESR 2014-2020) and has received €243,030.93 in subsidies.

KEY CHARACTERISTICS

LAZIO

CLUSTER

- Social Energy Network (SEN): This is a project to create a system to monitor and manage low-voltage electricity production and consumption. The goal is to optimise the power generated by existing solar, wind and co-generation plants, and to ensure that the energy produced is shared according to a distributed generation paradigm and demand-response dynamics. The SEN project is being carried out in pilot format involving three apartments connected to both the SEN network and the energy provider's network, to show how energy produced but not consumed by a home equipped with solar panels can be used by other homes without the need to request energy to be supplied by the main energy provider. Energy flows are handled, monitored and measured in accordance with Italian legislation and condominium policies. Using monitoring and metering software, the individual owner of a power generation unit can know who he/she has sold energy to, and can deduct this amount directly from condominium energy bills, rather than selling back to the main energy supplier, which is an advantage given that unplanned energy re-uptake on the electricity network can cause more harm than good. Co-funded by the EU under the Lazio 2014-2020 regional development plan, the SEN project's partners include 5EmmeInformatica (coordinator), Mashfrog plus, Top Consulting & Services, Azzero CO2, and the Electronic Engineering Department of the University of Rome - Tor Vergata. This project has received € 665,692.13 in subsidies.

KEY CHARACTERISTICS

LAZIO

CLUSTER

- HoloSeg. This project consists in evolving software for the segmentation and three-dimensional reconstruction of anatomical parts, starting from CT scans or MRIs. It is being conducted by the Mashfrog company in partnership with a local paediatric hospital, Ospedale Pediatrico Bambino Gesù.

HoloSeg will provide added features for planning surgical operations through holographs and 3D printing, which surgeons can use to pinpoint the specific positioning for metal plates for bone reconstruction, or to identify the optimal point for inserting surgical screws, along with the optimal angle and depth of insertion as well as the fastening direction. The experiments on which HoloSeg is based will allow for wider research and surgical planning through augmented reality and holograms. HoloSeg foresees augmented visualisation of anatomic models and of information needed for surgical operation planning, by integrating the platform with Microsoft Hololens for augmented reality. A visor enables the wearer to view purely digital models, inserted as holograms, in real surroundings. The user can then move around digital objects to observe them from different angles. Led by Mashfrog in partnership with the Mathematics and IT department of the University of Cagliari, this research project is being conducted under the 2014-2020 EU Regional Development Fund (POR FESR 2014-2020)and has received €203,300.99 in subsidies.

KEY CHARACTERISTICS

LAZIO

CLUSTER

- Tourist Wallet: Aiming to contribute to the Lazio regional government's Smart Specialization Strategy to develop tourism in the area, this is a blockchain technology-based project to speed up the ongoing digital transformation, in an effort to create major new business opportunities by using virtual money for payments and reservations.

  Tourist Wallet is a solution designed for the business world that should also make payments easier for tourists and travellers. It is centred on creating a network of businesses that operate in the tourist industry in Lazio, including hotels, restaurants and producers of local goods; users can set up an account with these businesses and complete payments or cash withdrawals. The advantage is that the transactions can be managed cashless, yet securely and transparently thanks to blockchain. Cash can instead be used for services or traders that do not yet have digital payment methods, such as local outdoor markets. Tourist Wallet will play an important role of improving the visibility and reputation of digital transactions among local businesses.

KEY CHARACTERISTICS

LAZIO

CLUSTER

The opportunity to run one's own digital transaction records will also enable data on consumer behaviour to be collected, analysed and shared among businesses in a certain area or on aggregate by regional institutions. All this will improve the services offered, bring better efficiency and quality to the tourism system based on appropriate indicators, and enable planning for actions to respond effectively to tourists' needs.

The project is led and coordinated by Mashfrog Group in partnership with Foodiestrip, an innovative food sector startup, along with the Information Engineering Department of the University of Rome - Tor Vergata, which is contributing its technical and scientific knowledge towards cutting-edge entrepreneurial initiatives.

KEY CHARACTERISTICS

ABRUZZO

CLUSTER

The Abruzzo Tech Hub is an industrial district designed to develop '4.0' businesses, currently with around 30 member companies having a wide variety of specialisations such as biotech, aerospace, telecommunications and computer software. This development has been facilitated by the historical local presence of primary players in the aerospace, pharmaceutical, automotive and electronics industries.

The Abruzzo hub hosts the ZIRC-ZTE Italia Innovation & Research Center, which conducts experimental research in 5G technology. In partnership with the University of L'Aquila, it is composed of groups of researchers who contribute to formulating and testing new forms of usage for 5G technology in its pre-commercial phase, with support from the Ministry of Economic Development, conducted in and around the towns of Prato and L'Aquila.

KEY CHARACTERISTICS

FRIULI VENEZIA GIULIA

CLUSTER

The DITEDI (Digital Technologies District) is the north-eastern Friuli Venezia Giulia region's ICT cluster; it promotes digital culture and networking among over 100 digital and innovative businesses, with the aim of enhancing competitiveness both on the Italian market and internationally. The main areas of interest for this cluster are data analysis, the internet of things, machine learning, cloud services and cybersecurity. Active since 2009, it is officially recognised by the Friuli Venezia Giulia regional government as the agency of reference for digital culture issues; it has organised over 150 seminars and technical workshops, in which over 5,000 people have participated.

Some of the cluster's notable development projects are:

- Industry Platform 4 FVG (IP4FVG): this is Friuli Venezia Giulia's Digital Hub, a regional platform created to speed up businesses' digitisation processes, with a special focus on SMEs. IP4FVG supports companies in adopting new technologies geared towards the digital transformation of manufacturing processes and promotes technology updates among local IT operators.

KEY CHARACTERISTICS

FRIULI VENEZIA GIULIA

CLUSTER

- International Summer School on Artificial Intelligence (AI-DLDA): this 'summer school' provides in-depth analysis on the state of affairs in research on artificial intelligence, embracing the most advanced areas of study and the latest industrial applications of big data, computer vision, human-computer interaction, robotics, cybersecurity, biomedical computing, deep learning and serious games. The International Summer School on Artificial Intelligence caters to students, researchers and PhD candidates, as well as to managers and head engineers of advanced manufacturing companies and even ICT sector professionals.

- DITEDI of the universities of Udine and Trieste have jointly launched a study to analyse the economic trend in the region's ICT sector, with in-depth investigation into business strategies and the competitive environment, partly in light of the Covid-19 emergency. This research work will form an important basis of knowledge for future development projects and regional action policies.

KEY CHARACTERISTICS

FRIULI VENEZIA GIULIA

CLUSTER

- Mapping the region's ICT sector skills: the objective of this activity, carried out in partnership with Area Science Park, is to learn more about current knowledge in Friuli Venezia Giulia's digital ecosystem and to generate a map of the companies within it, to enable integration of skills present across the IP4FVG platform as well as to identify the best examples of digital transformation achievements. DITEDI launched this initiative through a survey sent to businesses in the sector that have made innovation and Innovation 4.0 their main line of business.

- Technical Provider for Manufacturing 4.0: this is a webinar-based group organised by DITEDI led by key technical providers in the Friuli Venezia Giulia region, during which ICT companies discuss their activities and present a range of technological points, accompanied by solutions developed for manufacturing businesses to achieve digital transformation.

KEY CHARACTERISTICS

SICILY

CLUSTER

On the island of Sicily, a notable institution is the **Parco Scientifico e Tecnologico della Sicilia (PSTS)** (Sicily Science and Technology Park). This is a cooperative company whose owner-members include the Region of Sicily itself and by research centres and businesses that operate in various sectors of the economy.

Formed in 1991 on a virtual model, it evolved into a concrete entity in 2001 with a network-centred organisation able to integrate, coordinate and nurture the operations, projects and relations of its various stakeholders. PSTS has become a catalyst for product demand and innovative processes devised by SMEs, for realising the region's research potential, not only in traditionally strategic sectors like agri-food, environment and cultural heritage, but equally in emerging sectors like information society technologies, applied biotechnology, bioenergy and innovative materials. In addition, PSTS is coordinating the establishment of a regional biomedical district with 51 participants including businesses, research centres and science parks, whose purpose is to support biomedical research and innovation. Its Catania headquarters currently house three companies that are conducting research on vaccines and other medicines.

KEY CHARACTERISTICS

SICILY

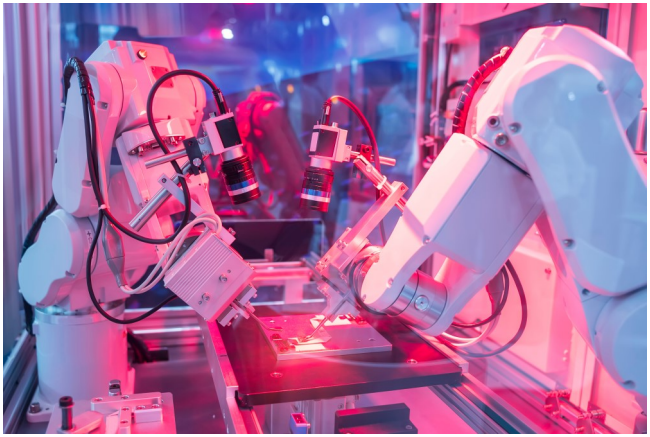
CLUSTER

A more recent notable development is that the European Commission's Digital Europe Programme – which was established to support the digitisation of the European society and economy – foresees building a network of European digital innovation hubs (EDIHs) to ensure industrial transition towards the digital age. One of these hubs could pop up in Sicily: the regional committee for productive activities, education and professional training is composing a candidature and activating a network of regional innovation players with the aim of building a partnership to become a candidate for a regional hub for digital innovation. The most recent project tenders include:

- 3DLab-Sicilia: this project seeks to create and promote the first regional infrastructure of laboratory certification centres and industrial demos for virtual/ augmented reality applications and 3D visualisation. The PSTS will need to contribute to WP4 activities in the implementation and validation of previously identified use cases. The tender process ended on 6/8/2020 and the project is scheduled to be completed on 2/9/2022.
- I KNOW (Interregional Key Networking for Open Innovation Empowerment): this project aims to support the establishment of innovative startup companies and to provide SMEs a competitive edge. The PSTS will contribute by structuring a multimedia platform to support various open innovation projects. The tender process ended on 17/9/2020 and the project is scheduled to be completed on 28/2/2021.

KEY CHARACTERISTICS

The **Veneto District for Computing and Advanced Technology** seeks to play an active role in supporting the north-east region's culture of innovation, so as to foster the development of a regional 'net-based economy' and to support local manufacturers and service providers on the global market with the aid of a network of ICT companies.



KEY CHARACTERISTICS

COMPETENCE CENTRES

One aspect of Italy's national Industry 4.0 Plan is competence centres (CCs), which are effectively innovation hubs composed of public-private sector partnerships involving at least one research institute and one or more businesses. The purpose of CCs is to foster continued professional development in companies, especially SMEs, and to implement innovative industrial research projects for the Industry 4.0 Plan.

On 7th April 2020, an agreement was signed by the High-Specialisation 4.0 Competence Centres funded by the Ministry for Economic Development (there are eight such CCs in the country) and by the Digital Innovation Hub (DIH), which is run by Confindustria, the Italian manufacturers' association. This agreement not only establishes an official partnership between the CCs and the DIH, but also highlights their aims to act as coordinators on European networks, in a system aligned with the Digital Europe Programme for 2021-2027, for which around €9.2 billion in EU funds are budgeted.

The Competence Centres' projects include:

- Turin Polytechnic University: the Manufacturing 4.0 programme advances a wide range of activities linked to innovative manufacturing processes (e.g. additive, laser-based and other world-class manufacturing methods), to technology development such as cooperative robotics and new materials, use of new ICT such as IoT and big data, as well as to energy efficiency and to the development of new business models. Numerous major companies that have expressed interest in participating in this project, such as 4D Engineering, ENI, FIAT-Chrysler, General Electric, Leonardo, STMicroelectronics and Thales Alenia Space Italia.

- Milan Polytechnic University: Made in Italy 4.0 acts as an industrial competence centre for digital manufacturing, providing SMEs with the tools needed to digitalise. Private sector partners of this project include Adecco, Bosch, Brembo, Hitachi Rail, Hyperlean, IBM, Siemens and Whirlpool.

KEY CHARACTERISTICS

- Alma Mater Studiorum Bologna is setting up the BI-REX (Big Data Innovation & Research Excellence) centre, which will assist SMEs in procuring technology for big data, cybersecurity and robotics. With 49 private sector businesses, this group also includes the Catholic University of Ferrara, Modena - Reggio Emilia and Parma, along with international research centres such as CNR and INFN.

- Scuola Superiore Sant'Anna: Artes 4.0 (Advanced Robotics and Enabling Digital Technologies & Systems 4.0) in Pisa will work on research projects, technology transfer and professional training in robotics and enabling technologies. This network is comprised of 13 universities and research centres plus 146 businesses.

- University of Padua: SMACT is a project that will specifically focus on social networks, mobile platforms and apps, advanced analytics, big data, cloud computing and the internet of things, in order to improve SMEs' production processes and help them innovate their products and business models.

- Federico II University of Naples: Industry 4.0 will encourage the spread of innovation tools within a vast spectrum of related enabling technologies, with a focus on social technologies and blockchain. Private sector companies involved in this project include Ansaldo, ENI, Ericsson, Italferr, Nestlé Italy, Telecom Italia and TT Tecnosistemi.

- National Research Council (CNR): the Start 4.0 project will focus its activities on applying Industry 4.0 enabling technologies, including IoT, blockchain and big data. It will also focus on security and on application fields for ports, transport infrastructure, water production and power generation. The Region of Liguria, seaport authorities and the Italian Chambers of Commerce union will also be involved in the project, along with private sector firms such as Ansaldo Energia, Ansaldo STS, ABB, Cetena, Iren and Softeco.

- La Sapienza University of Rome: Cyber 4.0 is a project devoted to cybersecurity that offers businesses guidance, training and support for innovative projects and related research.

KEY SECTOR DATA

MARKET VALUE: ICT SERVICES, SOFTWARE AND SOLUTIONS

In 2019, the Italian computer software and ICT services market rose by 6.6% year-on-year to reach a total revenue value of €19.996 billion. The effects of the Covid-19 pandemic will negatively affect the sector in 2020, when total revenue is forecast to decrease by 2.7% to €19.463 billion. Greater losses are expected in the ICT services segment, where a 3.7% drop is projected, due especially to reduced outsourcing, consulting and data centre assistance services; by contrast, cloud computing services should maintain a positive trend despite a slowdown in growth from previous years. The ICT software and solutions segment is forecast to decrease by a more moderate 1.1% to a value of €7.613 billion, with more noticeable drops in middleware and systems software sales.

ITALIAN ICT SOFTWARE AND SERVICES: DEMAND TREND BY BUSINESS AREA, IN VALUE, 2018-2022

(in million euros unless specified)

			Forecasts			% Chg.	% Chg.	% Chg.	% Chg.
	2018	2019	2020	2021	2022	2018-19	2019-20	2020-21	2021-22
ICT Services	11,623	12,302	11,851	12,823	13,624	5.8	-3.7	8.2	6.2
ICT Software & Solutions	7,136	7,694	7,613	8,175	8,805	7.8	-1.1	7.4	7.7
Italian Market	18,759	19,996	19,463	20,998	22,430	6.6	-2.7	7.9	6.8

Source: Cerved illustration of Assinform/NetConsulting data, 2020 Report

KEY SECTOR DATA

As for the demand side, Assinform/NetConsulting[(a)] figures show that in all sectors of the economy, demand for ICT products and services grew in 2019: the growth continued to be driven by the industrial and banking sectors, which recorded 4.8% and 3.8% increases from 2018, respectively. However, even higher growth rates were witnessed in insurance (5.3%) and the utilities (4.9%), although from a lower expenditure base. It should also be noted that spending on ICT by local government bodies rebounded after several years of decreases influenced by spending reviews.

The Covid-19 health emergency has put the brakes on digital spending in 2020, as business was interrupted for the majority of Italian companies. Although the scenario is still marked by uncertainty, it is expected that digital spending will drop furthest in the sectors whose activities were affected most during the lockdown and in those where demand has fallen most subsequent to the lockdown, such as transport, retail (fashion &apparel, accessories, electronic goods), telecommunications and media, defence (especially the industrial component) and insurance. However, digital expenditures are expected to rise for central and local government agencies, which have allocated massive funds, as well as for the healthcare sector, although to a lesser extent than last year. There will merely be a slowdown in growth among banks and energy and utility companies, although individual companies may experience very different trends.

a) Assinform is the national association of Information & Communication Technology companies operating in Italy. NetConsulting is a company that offers consulting and market intelligence services to clients and vendors in the digital technology sector

DIGITAL MARKET BY SECTOR, 2019

(% of total)

Source: Cerved illustration of Assinform/NetConsulting data, 2020 Report

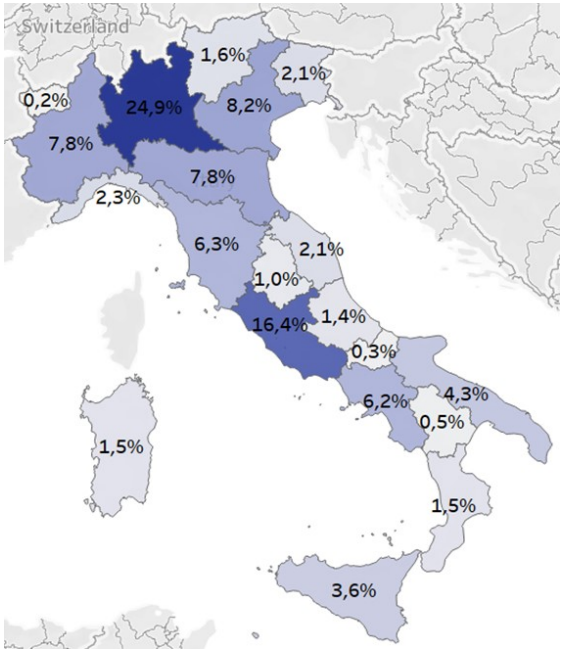
KEY SECTOR DATA

From a geographical perspective, the digital market remains heavily concentrated in the north-west of the country, while central Italy is where the market value is smallest. Lombardy and Lazio are the two regions with the highest share of the total business and consumer ICT market values (24.9% and 16.4%, respectively). These are in fact respectively the nation's financial and political capitals, where there is the highest density of private sector firms including multinationals, as well as of central government bodies.

Digital spending dynamics in 2019 show that the North-West was the biggest driver of growth, with a 2.9% year-on-year increase. Central regions were less buoyant but the trend was still upward (+1.5%). In the North-East, the ICT market rose by 2.3% in 2019 thanks especially to 3.5% growth in the Trentino Alto Adige region.

DIGITAL MARKET BY REGION, 2017-2019

(in million euros unless specified)



Source: Cerved illustration of Assinform/NetConsulting data, 2020 Report

KEY SECTOR DATA

ICT SOFTWARE AND SOLUTIONS BY SEGMENT

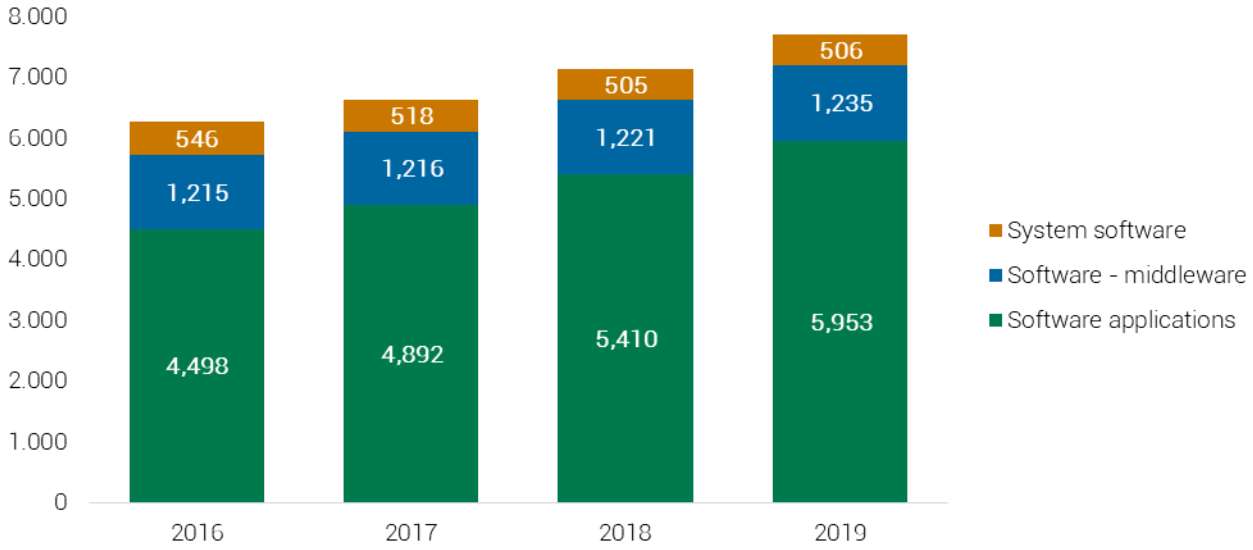
The ICT software and solutions portion of the overall Italian ICT sector reached a total market value of €7.694 billion, 7.8% more than in 2018 thanks to a good trend in applications (+10%), which account for over 75% of the total value. This segment benefited above all from higher spending on internet of things (IoT) solutions, as this technology is being adopted more and more widely across many sectors and along a diverse range of production lines and on web platforms. Digital outlets are in fact playing an increasingly important role in sales and marketing activities. As regards to other components of this segment, there was a broadly stable trend in horizontal and vertical business solutions, as this is becoming a mature market and in light of increasing migration to cloud-based solutions and ERP solutions; for these reasons, clients' investments in this area are rather limited, tending to simply maintain platforms already in use.

The middleware segment trend was flat, especially because a growing portion of the demand for this type of product is now being met through cloud services or through infrastructural outsourcing. Within this segment, there are nonetheless some niches where demand is growing, such as solutions for governance, corporate information and security: all of these are significant factors in the broader context of digital transformation.

Finally, the systems software component has been experiencing a decline in demand for several years now, led by all major hardware products. The spread of cloud-based solutions nevertheless makes it necessary to adopt virtualisation components that enable companies to implement this type of arrangement.

KEY SECTOR DATA

SOFTWARE MARKET BY SEGMENT, 2016-2019
(in million euros)



Source: Cerved illustration of Assinform/NetConsulting data, 2020 Report

KEY SECTOR DATA

COMPUTING SERVICES BY SEGMENT

In 2019, the ICT services segment's total Italian market value reached €12.302 billion, up 5.8% from 2018. This upward trend was sustained by the more innovative expense items, particularly cloud-based services. Excluding private cloud services, turnover in this sub-segment rose to €2.83 billion in 2019 after another upsurge of over 20%. This dynamic growth is driven by several factors, most notably the major investments made in recent years to develop broadband and ultra-broadband infrastructure in Italy. According to the Ministry for Economic Development, at the end of last year Italy's broadband coverage (next generation access provided as either FTTC[(a)] (Fiber To The Cabinet) or FTTH[(b)] (Fiber To The Home) at a speed of at least 30Mbps) covered 74.3% of all buildings in the country, 28% of which were covered by ultra-broadband technology (very high capacity networks (VHCN), defined as a speed of at least 100mbps).

The leading sub-segment of ICT services, however, remains outsourcing services, which despite being on the downswing for the past few years, still accounts for over 30% of the total segment value. The IT outsourcing services component actually saw a positive trend, whereas the telecommunications and call centre component, along with data processing services, experienced a decrease.

The development and systems integration sub-segment is worth about one-fourth of the ICT services segment and benefited last year from a tendency among clients to implement infrastructure projects and applications designed for innovation, based especially on the adoption of innovative technologies such as cloud computing, cybersecurity,

In 2018, the security portion in particular benefited from major investments made to achieve compliance with the General Data Protection Regulation (GDPR). This growth in corporate investments in new processes and innovative technology had positive impacts on consulting activities, as many major companies have experienced a need to draft new business models in support of digital innovation. artificial intelligence, wearable devices, IoT and blockchain.

a) FTTC - Fiber To The Cabinet: fiber connection to the street cabinet, copper connection to the inside of the user's home. Very common in small centers, it does not offer the performance of "pure" fiber, as it assumes a route (usually 300-500 meters) on old cables.

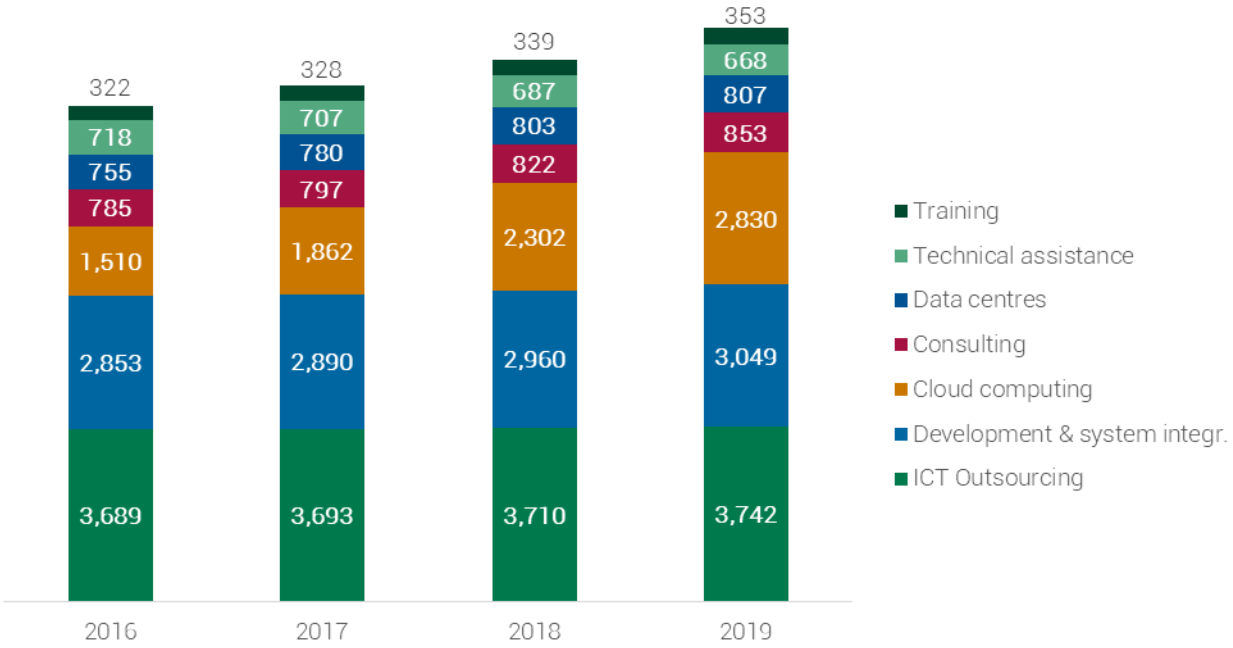
b) FTTH - Fiber To The Home: Technology that brings the fiber directly into the user's home with high performance

KEY SECTOR DATA

Data centre services also experienced a positive trend last year, despite competition from cloud-based services. Companies invested in renewing and updating their data centre systems in order to improve flexibility, agility and scalability – these are all qualities needed in order to carry out innovative projects. Training activities also grew thanks particularly to demand for training initiatives designed to expand professionals' digital skills both within and outside of ICT departments. Indeed, new digital transformation initiatives require a variety of very specific professional skills.

KEY SECTOR DATA

ICT SERVICES MARKET BY SEGMENT, 2016-2019
(in million euros unless specified)



Source: Cerved illustration of Assinform/NetConsulting data, 2020 Report

KEY SECTOR DATA

DIGITAL ENABLERS

The term 'digital enablers' refers to all the main technological models and concepts that make it possible to transform a traditional business model into a digital model, along with the related products and services offered by companies.

In 2019, the digital enabler market grew by 15.2%, remaining one of the key drivers in the implementation of digital transformation plans.

Spending on digital enablers will continue to grow in 2020, although the dynamics will be different in the various sectors of the economy, due to both typical business dynamics and to specific factors related to the pandemic: the overall digital enablers market is forecast to rise by 7.4% to a total value of €15.066 billion.

KEY SECTOR DATA

DIGITAL ENABLER MARKET BY BUSINESS AREA, 2018-2022

(in million euros unless specified)

			Forecasts			% Chg.	% Chg.	% Chg.	% Chg.
	2018	2019	2020	2021	2022	2018-19	2019-20	2020-21	2021-22
Mobile Business	3,855	4,145	4,420	4,721	5,082	7.5	6.6	6.8	7.6
Internet of Things	2,960	3,501	3,632	4,044	4,565	18.3	3.8	11.3	12.9
Cloud Computing	2,302	2,830	3,284	3,922	4,601	23.0	16.0	19.4	17.3
Cybersecurity	1,006	1,137	1,239	1,373	1,535	13.0	9.0	10.9	11.8
Big Data	913	1,060	1,067	1,203	1,367	16.1	0.7	12.7	13.7
Wearable Technology	563	642	611	683	762	14.1	-5.0	11.9	11.6
Web management platforms	423	479	554	625	697	13.3	15.6	12.7	11.6
AI/Cognitive	135	215	235	285	380	59.3	9.3	21.3	33.3
Blockchain	20	22	24	29	32	10.0	9.1	20.8	10.3
Total	**12,176**	**14,030**	**15,066**	**16,884**	**19,021**	**15.2**	**7.4**	**12.1**	**12.7**

Source: Cerved illustration of Assinform/NetConsulting data, 2020 Report

KEY SECTOR DATA

ARTIFICIAL INTELLIGENCE

Artificial intelligence (AI) can be defined here as the set of hardware and software that enables activities to be executed automatically that would normally require human intelligence. In other words, AI is equipment that can perceive the human external world by collecting both structured and unstructured data, processing that data and converting it into information, knowledge and decisions that are useful to humans.

Artificial intelligence can also be subdivided into two main threads: 'weak' and 'strong' AI. The former refers to technological systems that can simulate some cognitive functions of human beings, though they are unable to achieve the real typical intellectual capacity of humans. The latter, on the other hand, are truly 'knowledgeable systems' that can develop intelligence without having to emulate thought processes or cognitive abilities similar to those of humans, but instead develop knowledge in an autonomous manner. The way in which an AI system functions is based largely upon four different levels: comprehension (i.e., the recognition of textual, visual and other content, and the extrapolation of information), reasoning (linking the information gathered via algorithms), learning (specific functional systems to analyse input and process output, as is the case for machine learning and deep learning), and interaction (between machine and human, using natural language).

KEY SECTOR DATA

AI constitutes a digital disruption in all sectors of the economy. Algorithmic business models are becoming dominant, and any sector that begins to shape its business model according to the ability to forecast the probability that a given event in the future will occur is bound to experience radical changes in dynamics. For this reason, businesses that are the first to adopt artificial intelligence by revising their strategies will carve out a competitive edge over competitors that will be difficult to overcome.

At present, the main fields of application for artificial intelligence in Italy are:

- Sales and marketing

  Solutions that integrate expert systems enable complex problems to be resolved; these necessarily require the services of a sector or subject expert. Expert systems are systems that allow logical, inferential procedures to be implemented automatically. Through an inductive or deductive reasoning process, a conclusion is reached based on the analysis of facts and circumstances. More specifically, expert systems based on rules take advantage of what are known as 'if-then' principles in programming language.

  Such systems are particularly useful in commercial configurations where the sales proposal is very complex due to the nature of the products being marketed, the number of possible permutations of individual solutions, or the variables that can affect results and therefore affect decision-making about how much of a product to produce and at what price to market it. Complexity rises in correlation with the number of variables (such as size, number of components, materials, combinations of raw materials, which affect physical, mechanical or chemical properties).

  One example of an expert system is SECLARO, a 'rule engine' where a product programmer can ask the user a series of questions. The accumulation of experience through question-and-answer sets gradually speeds up and makes configuring the right solution more effective and adapted to the client's needs, forming a knowledge base for the company that grows continuously.

KEY SECTOR DATA

In a solution finalised by Myti (digital project company that realizes projects, products and solutions in the digital field), the question-and-answer 'engine' is in the form of a common web interface. The 'if-then' rules are built up by an expert in the field, but the system can ask the questions to a non-expert user and, based on the answers given, ask further questions to help the user (which could be the seller, for instance) to make a selection; it also helps appropriately configure a complex product or detailed sales range offering.

Voice assistants also use artificial intelligence, to recognise human language and to learn and analyse the habits and behavioural patterns of users. Immediate analysis of the huge mass of data available can be useful for understanding people's attitudes and needs in order to improve customer care, user experiences and assistance/support services, and can even predict purchasing behaviours, from which communications strategies and/or service offers can be constructed.

The importance of artificial intelligence marketing (AIM) should also be noted: this is a branch of marketing that employs the latest AI technology, such as machine learning and natural language processing (NLP), in combination with mathematical and statistical techniques as well as behavioural marketing techniques. AI and machine learning algorithms are used in an effort to persuade people to take a specific action, buy a certain product or access a certain service (in other words, to respond to a call to action).

KEY SECTOR DATA

- Healthcare

  An advantage of AI is that it improves many technological systems already used by persons with disabilities. These include voice systems, which have been improved to the point where completely natural communication and relations take place even with people who are unable to speak. Yet it is in the field of diagnosis and treatment of cancers and rare diseases where the new capabilities of AI will truly be witnessed. Certain cognitive systems that can detect, analyse and learn from an infinite set of data (including scientific publications, research, medical records, drug information, etc.) at a speed unimaginable to human beings, are already available on the market today. This can speed up the diagnostic process, which is often so critical for rare diseases; it can also lead to suggestions for optimal courses of treatment for specific cancers or diseases. Furthermore, virtual assistants based on AI technology have begun to be used more frequently in surgical operation rooms, lending support to reception personnel and/or to first aid personnel.

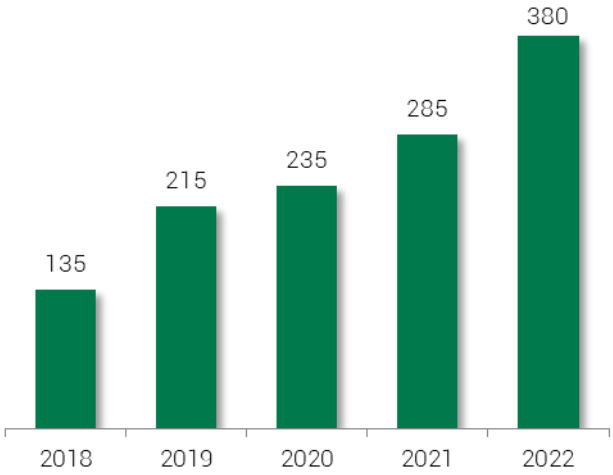
- Supply chain management

  Optimising and efficiently managing supply and distribution chains often requires sophisticated analysis. In this area as well, AI is proving effective, allowing companies to connect and monitor their entire chains and all players involved along them. One very significant case in which AI has been applied in this field is in order management. In this case, AI technologies have not just sought to simplify the processes, but have brought together entire processes, from purchase to inventory, from warehouse to sales point, even including integration with marketing departments to predictively manage supplies as a function of the results of promotional or advertising campaigns. In the manufacturing sector, AI solutions implement the 'smart manufacturing' paradigm of enhancing production process automation and optimising assembly lines. This is how 'intelligent' manufacturing lines are created, as new-generation AI technology is deeply embedded into advanced manufacturing techniques to create machinery with greater cognitive and learning capabilities. The introduction of AI techniques also enables monitoring and auto-correction to be applied to manufacturing processes, as well as to increase production quantities on-demand.

KEY SECTOR DATA

ITALIAN ARTIFICIAL INTELLIGENCE MARKET, 2018-2022

(in million euros)



Source: Cerved illustration of Assinform/NetConsulting data, 2020 Report

The Italian research world for AI is supported by an extensive range of top-notch national centres such as the Artificial Intelligence and Intelligent Systems (AIIS) Laboratory of the *Consorzio Interuniversitario Italiano per l'Informatica* (CINI) [Inter-University Information Technology Cooperative], the Italian Institute of Technology (IIT) and the Institute for Computing and Networks for High Services (ICAR) of the National Research Council (CNR). To boost both AI sector competitiveness and the use of AI applications in the public sector, the Italian government will increase the public funds available and will encourage public-private risk capital partnerships. One such initiative is Smart & Start Italia, a Ministry of Economic Development incentive that aims to generate the conditions for the spread of new entrepreneurships across the country, as well as to support technology transfer policies and enhance the extent to which the results of both public and private sector research projects translate into an economic boost. In particular, this initiative funds business plans with budgets ranging from €100,000 to €1.5 million to experiment with and test blockchain, artificial intelligence and internet of things applications.

KEY SECTOR DATA

Furthermore, in order to make Italy's AI sector more attractive on an international scale, the government intends to strengthen existing policies for attracting foreign talent, such as the EU Blue Card (special residence permits for highly skilled foreign workers) and the Italia Startup Visa programme (visas granted to innovative entrepreneurs from all over the world).

Some of the most notable artificial intelligence programmes in Italy are:

PROGETTO HUMANE-AI-NET

HumanE AI Net is a network of European research centres, universities and key industry representatives that combines knowledge of AI with key actors in related areas such as cognitive sciences and social sciences, which is a fundamental step in developing a European brand of AI that is truly focused on the human aspect.

The biggest challenge is to develop solid and reliable AI systems that can actually understand humans, adapt to complex and varied environments in the real world, and interact appropriately in complex social settings. The goal is to facilitate AI systems that improve human abilities and make individuals and society as a whole more responsible, respecting autonomy and human self-determination.

The stated goals of this project are:

- Generate synergies between the research centres involved in order to develop scientific foundations and technological discoveries.
- Develop close ties between the network's various research centre members, contributing towards a sustainable, human-centric European AI community.
- Closely synchronise HumanE AI Net's work on scientific and technologically discoveries with the needs expressed by both industry and society to promote synergies and to reinforce Europe's position in the global market.
- Facilitate cross-fertilisation and knowledge transfer between the network's research centres and industries, by means of 'human resources' and active use of AI-on-demand platforms.
- Help spread the group's 'humane' AI technology among European SMEs.

KEY SECTOR DATA

- Contribute to innovation and to the creation of new startups doing business in human-centric AI.
- Contribute to the AI4EU AI-on-demand platform.
- Liaise with and collaborate on related national and European initiatives.
- Contribute to the public and political debate over AI and its consequences, through direct events for the general public as well as for political decision-makers.
- Establish a virtual laboratory as an 'online store' for AI for researchers and professionals, both within and outside of the cooperative, in order to disseminate the latest knowledge and lower the threshold required for additional students and researchers to be able to profit from the progress made and thus be able to make further progress.
- Actively cultivate the spread of knowledge throughout the entire European AI community.

KEY SECTOR DATA

PROJECT INSECTT

Technological developments in consumer electronics and in industrial applications have intensified in recent years. The internet of things (IoT) constitutes a revolutionary change for many sectors such as healthcare, construction and the automotive industry. The insect project's aims is to look into evolving the IoT towards a 'merger' with artificial intelligence. This idea of 'artificial intelligence of things' is seen as the natural progression of both AI and IoT, and as reciprocally advantageous. AI enhances the value of IoT through machine learning, transforming data into useful information. At the same time, the IoT enhances the value of AI through connectivity and data exchanges.

The overall goals of the InSecTT project are to:

- Provide intelligent processing of data applications and of cutting-edge communications features, to facilitate real-time application and applications that are critical for security.
- Develop secure, reliable industrial-grade solutions that can repel cyberattacks and withstand harsh network conditions.
- Provide measures to gain trust and acceptance among users, and to make AI and machine learning explainable.
- Develop and test AI applications distributed for systems and conditions that are critical for security.
- Develop IoT solutions for wireless devices with energy and data processing constraints, even those that must operate in varied or harsh environments.
- Provide solutions that can be replicated in industrial fields of application.
- Adopt a methodological approach with a complete supply chain, from academia to designers and systems integrators, component suppliers, to app and service developers, other suppliers and end users.

KEY SECTOR DATA

THE NVIDIA AI NATION PROGRAMME – NVAITC TEMPLATE PROPOSAL

The CINI-NVIDIA AI Nation programme is a three-year partnership between CINI (National Interuniversity Consortium for Informatics) and NVIDIA (global leader in visual computing and AI computing) researchers in AI themes, especially deep learning and HPC (High Performance Computing). The programme incorporates several different initiatives in Italy such as tutorials and workshops, along with the opening of an NVAITC (NVIDIA AI Technology Center) - NVIDIA AI Technology Center, where work will be performed on specific research projects with hubs of the CINI AIIS Lab. This NVIDIA-CINI AI Nation partnership does not involve either its own monetary funding or shared hardware. Rather, NVIDIA will simply share resources (worth around €2 million over three years), most notably software, personnel to facilitate joint research in machine/deep learning and associated topics, and support for best usage of Italian HPC resources.

NVIDIA selected Italy as a scientific partner for several reasons, most of all:

- the CINI AIIS Lab: Italy is one of only a handful of countries in the world that has established such a widespread and well-structured AI research network that can guarantee scientific excellence.
- the presence of CINECA, with its NVIDIA-based computing resources and future resources for EU and Italian investments for pre-exascale HPC; some of CINECA's computing resources will be devoted to the AI Nation and NVAITC programme, thanks in part to a memorandum of understanding that has been in place for some time already between CINI and CINECA.

KEY SECTOR DATA

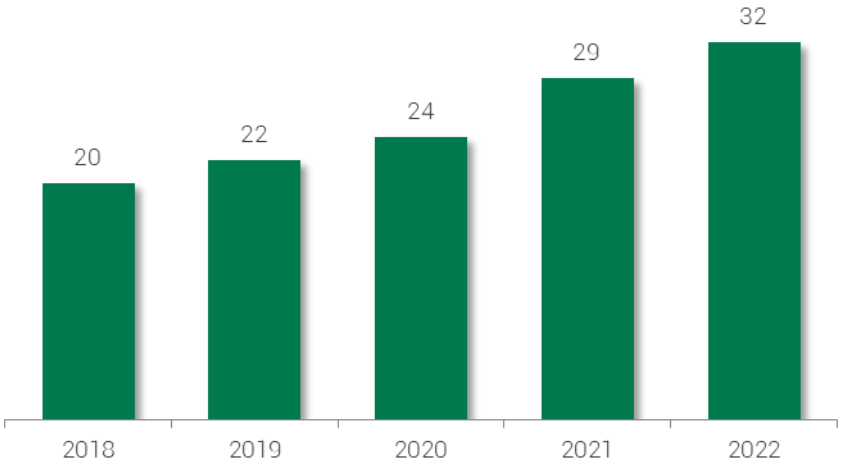
The digital enablers closely associated with artificial intelligence are:

- Blockchain

  In 2019, the blockchain market in Italy reached a value of €22 million, up 10% year-on-year. According to Assinform/ NetConsulting, this segment will witness a series of experimental phases, chiefly in the banking, insurance and agri-food sectors, as well as among public sector clients.

ITALIAN BLOCKCHAIN MARKET, 2018-2022

(in million euros)



Source: Cerved illustration of Assinform/NetConsulting data, 2020 Report

KEY SECTOR DATA

The economic sectors most affected are finance and healthcare. As an emerging technology, blockchain is having a significant transformative impact on the financial sector. Blockchain solutions can eliminate intermediaries to reduce costs and improve consumer confidence around financial services. Also, the financial sector can use blockchain to improve IT security, to manage extended value chains, and to speed up sale contract executions. In fact, given that robotics and AI will continue to spread in financial services, giving rise to more localised services, blockchain will play a crucial role in IT security, especially in the fight against fraud and money laundering. Blockchain has the potential to change the function of the financial industry from the way we know it today. It will give CFOs tools to make them key commercial partners in the strategic planning process when a transaction can be executed so efficiently and reliably.

In Italy, the banking sector is the only one in which blockchain has moved forward from the experimental phase to a systemic project. This project, known as the 'interbank check', revolves around using distributed ledger technology (DLT) for banks to keep reciprocal accounts for the purpose of checks between them to verify and reconcile transactions made between two institutions that generate entries in their respective accounts in Italy, as well as to manage receivables and payables.

This project went through a three-year experimental phase involving 16 Italian banks, coordinated by AbiLab. They had first experimented, on the verification process, with the Corda platform of the R3 cooperative (a software company, part-owned by major global financial institutions, that develops commercial applications of blockchain technology). In March 2020, production began on the new platform, with the ambition of extending it to 200 banks. The basic principles of the new banking operations will be: complete visibility of both one's own transactions and of the counterparty's corresponding transactions; fast cash flow management in terms of reciprocal accounts, with daily instead of monthly reconciliation; sharing between counterparty banks of verification rules on transactions in a symmetrical manner; and integrated management of communications and processes in the event of an imbalance.

KEY SECTOR DATA

Among the 'big tech' players, Facebook is expected to launch Libra, a global currency that the company hopes will reach 2.4 billion social network users, while Telegram's Open Network (TON) will allow 240 million users of the messaging app to exchange value. Smart contracts and apps will be made possible on both Libra and TON, enabling the use of tokens.

In the healthcare sector, blockchain has advantages in terms of the ability to securely share data, thanks to encrypted, unalterable registers. For instance, creating medical records based on blockchain technology can facilitate administrative efficiency and increase researchers' access to historical patient data without compromising those patients' personal privacy. Furthermore, by improving information sharing along the supply chain for pharmaceuticals, it will be possible to have reliable, safe and traceable drugs, as well as to strengthen procedures for identifying counterfeit medicines on the global market.

- Machine learning, deep learning and neural networks

  Machine learning is a set of methods and systems that serve to 'train' artificial intelligence applications to learn, by correcting errors so that it will be able to perform tasks autonomously. Algorithms that allow such learning can be divided into three categories: those with didactic supervision (learning through input/output examples that illustrate certain behaviours); those without didactic supervision (learning through analysis of results); and reinforcement learning (also called 'meritocratic' learning, where a prize of sorts is given based on the achievement of pre-established objectives).

  For deep learning, the models are inspired by the human brain's structure and ways of functioning. The algorithms are accompanied by artificial neural networks designed for the purpose, that is, with computing models based on interconnections of information as is the case in human neural networks, except that the algorithms are equipped with very powerful quantum computing capabilities.

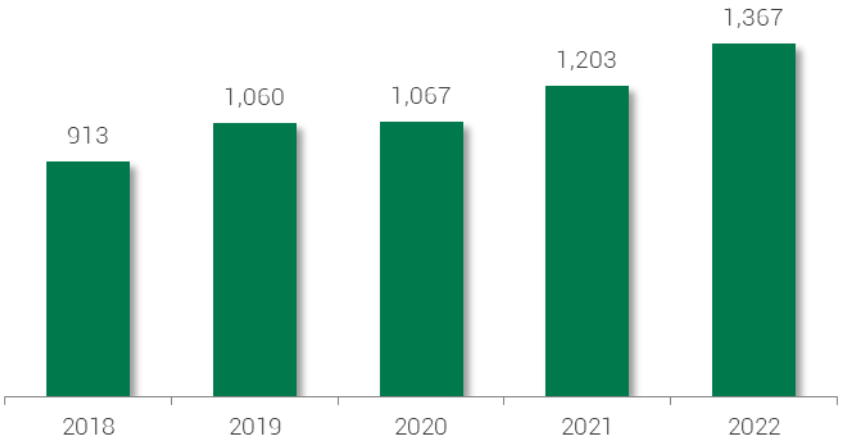
KEY SECTOR DATA

- Big Data

  According to Assinform/NetConsulting figures, the Big Data solutions market in Italy amounted to €1.06 billion in 2019, 16.1% higher than in 2018. About 85% of this market is composed of expenditures on software solutions, whether on-premise or in clouds (databases, acquisition tools, data processing, visualisation and analysis software, and other specific applications for corporate processes), along with related consulting, integration, development and implementation services. The remaining 15% of the big data market can be attributed to hardware systems, the majority of which related to storage and networking devices.

ITALIAN BIG DATA MARKET, 2018-2022

(in million euros)



Source: Cerved illustration of Assinform/NetConsulting data, 2020 Report

KEY SECTOR DATA

Big Data has taken on an increasingly strategic role within organisations. The data-driven strategy begins with organising and archiving a huge volume of both structured and unstructured data and information that companies possess.

According to Assinform/NetConsulting's 2020 report, the investments that Italian companies made in 2019 to build 'data lakes' (environments where they can store and organise various types of data, going beyond the traditional static, separate silos) continued to increase. Moreover, the big data market is sustained by a growing use of advanced analytical solutions whereby companies can extract value and insight from the data already at their disposal.

Many businesses are currently equipping themselves with data platforms, seeking to gain an integrated overview of their consumers (customer data platforms) or to store and process sensory-based data from internet of things applications on production plants and equipment, in order to optimise their production processes.

Never before has the importance of managing and processing data appropriately appeared so clearly: the Covid-19 health emergency has highlighted all the potential of using advanced big data analytical tools to monitor flows and movements of people, to monitor trends in the illness in an effort to contain or prevent further contagion; to trigger international cooperation; to foster the exchange of salient data on treatment and prevention, so as to ensure appropriate treatment will be given, to ensure that resources will be allocated efficiently and identify what collective efforts are needed to tackle the emergency. One can expect that in the near future, these technologies will become invaluable for improving the conditions of life, for curing and treating diseases, for protecting the most vulnerable people, and for forecasting events and correlated consequences with increasing accuracy.

KEY SECTOR DATA

- Augmented Analytics

  The term 'augmented analytics' was coined in 2017 by the Gartner research company, which estimates that this market will reach a global value of $13 billion by 2023, growing by 24% per year on average over the next five years.

  Augmented Analytics evolves from Data Analytics and consists in a new approach to analysing data that incorporates artificial intelligence techniques, including machine learning, deep learning and NLP. With Augmented Analytics, data considered useful that an organisation already possesses is identified, and the data can be supplemented with data from external sources that have not normally been processed. After having cleaned up and analysed this data automatically, an augmented analytics system identified anomalies and predicts the causes thereof. In the final phase of the process, insight and relevant operational suggestions are provided that are easy to understand and to apply by players on the market, The final decisions on actions to be taken are then left up to the human experts, but their decisions are informed in an enhanced manner by this advanced data processing system.

  Some examples of applied augmented analytics include: the DataLysm predictive marketing platform of tech company 3rdPlace, which pinpoints clusters of users most likely to make a purchase (including lead scoring B2B) and 'activates' these users; the Alternative Data Intelligence investment platform created by fintech company FinScience; the SEONanny platform from ByTek, which optimises data-driven search engine positioning operations, identifying trends and competitive anomalies; the VoiceLit platform by PaperLit, which can automatically analyse spoken requests on smart speakers and improve answers continually as a function of the user's real needs; the MobiLit digital publishing suite, again by PaperLit, which smartly adapts the order in which news articles appear in a magazine based on an analysis of previous behaviour; the DataLit.AI ad network for hyper-profiling and hyper-targeting, geared towards online publishers, bloggers, retailers and advertisers; and the Quantamental investment strategies offered by FinScience.

KEY SECTOR DATA

- Quantum Computing

  Quantum computing is the use of quantum mechanical phenomena such as superposition (as with subatomic particles, which can exist in superposed states) in order to execute data operations. It is based on the idea of the qubit (particle of an atom) replacing the traditional binary bit. That is, instead of codifying data in strands of zeroes and ones like open/closed statuses of a circuit, the qubits can be superposed to exponentially amplify the potential binary information to be codified. This condition is required in order to solve, within a feasible amount of time, extremely complex computations such as those needed in artificial intelligence systems.

  Quantum machine learning, then, is quantum-based information that combines the speed of quantum computing with the learning capacity and adaptability of machine learning and artificial intelligence principles. Some physicists have developed a machine learning algorithm based on quantum computing methods that can manage infinite volumes of data, that is, work on continuous variables with an infinite number of possible values.

KEY SECTOR DATA

- Autonomous objects

  Drones and other autonomous objects are currently a form of technology that lends itself to supporting IoT and mobile systems. Objects that fit into this framework include automobiles, robots and intelligent machinery designed for Industry 4.0 manufacturing processes, as well as autonomous objects that use AI to interact with the system and to execute tasks traditionally performed by human operators. From a hardware point of view, autonomous objects include robots (which operate entirely autonomously), vehicles and drones (which are moved and commanded by a human operator); in terms of software, there are applications and software agents that can operate by themselves to varying degrees of ability, coordination and intelligence. What emerges is thus a scenario in which each application, service or object incorporates the progress made by AI in automating and optimising processes.

  Specifically regarding drones, spending by Italian companies is on the rise. This is an emerging market estimated at around €100 million last year, fuelled most of all by small-scale companies.

  It is a segment that presents encouraging potential for growth over the years to come, thanks partly to EU market deregulation via a new regulation issued by the European Union's Aviation Safety Agency (EASA), which took effect on 1st July 2020.

  As for specific fields of application, drones have a wide variety of uses. They are used in agriculture for 'smart farming', to help manage emergency relief efforts, to monitor lands after a natural disaster, in the utility sector to perform inspections of impassable areas that previously required helicopter reconnaissance. The use of drones has thus led to substantial savings in numerous industries in terms of maintenance costs, among other aspects.

KEY SECTOR DATA

In farming, remote monitoring of crops using drones and IoT equipped sensors enables objective information to be gathered, yielding full visibility on goods and stocks, enabling farmers to adapt supplies and to avoid waste. However, there are still some limitations, such as limited connectivity to urban areas and limited digital skills of some operators on the value chain, which could present a barrier to this technology's development on the market. As for the first aspect, the advent of 5G should reduce connectivity obstacles.

Moreover, use of drones by government authorities to monitor citizens' movements has further intensified. To this effect, the relevant Italian authority body ENAC has issued exemptions to the police force to monitor movements of people in view of efforts to control the spread of Covid-19.

In all areas of application, the main drivers of innovation are vertical take-off and landing (VTOL), along with the growing integration of drones with AI. About 72% of ongoing advancements in drone technology are related to product innovations (45% new platforms, 27% innovative payloads), while the remaining 28% are related to innovative services where drones are used to provide them.

KEY SECTOR DATA

MAJOR ONGOING TRENDS IN TECHNOLOGY AND INNOVATION

CLOUD COMPUTING

Cloud computing has become a recurrent theme as a technological choice for companies, leading to growing hybridisation and IT environments, a phenomenon that will be further encouraged by the 'forced' distance-working arrangements made in many companies following the pandemic.

According to Assinform/NetConsulting figures, in 2019 the Italian cloud computing market rose by 21.5% overall to €3.282 billion. In more detail, public cloud systems registered the strongest increase (29.0%), followed by hybrid clouds (23.7%). The virtual private cloud segment rose by a softer 12.2%, whereas other private cloud revenue grew by 13.5% year-on-year.

Again according to Assinform, the market structure demonstrates that companies are taking a selective approach to cloud computing; it has not become an overriding model. Both public and private/virtual private clouds have been adopted, depending on the IT context, and are always combined with on-premise IT resources.

In 2020, the overall cloud computing market is expected to rise by 14.1% to an amount of €3.744 billion. Caution taken by businesses over uncertainty from the Covid-19 emergency will be more than offset by the sharp rise in remote working and in companies' need for greater flexibility and scalability when activating new digital services.

KEY SECTOR DATA

CLOUD COMPUTING MARKET BY MODEL, 2018-2022

(in million euros unless specified)

			Forecasts			% Chg.	% Chg.	% Chg.	% Chg.
	2018	2019	2020	2021	2022	2018-19	2019-20	2020-21	2021-22
Public Cloud	877	1,132	1,408	1,768	2,081	29.0	24.4	25.6	17.7
Hybrid Cloud	872	1,078	1,197	1,402	1,680	23.7	11.0	17.1	19.8
Virtual Private Cloud	553	621	679	752	840	12.2	9.5	10.6	11.8
Private Cloud	400	452	460	530	600	13.0	1.8	15.2	13.2
Total	**2,702**	**3,282**	**3,744**	**4,452**	**5,201**	**21.5**	**14.1**	**18.9**	**16.8**

Source: Cerved illustration of Assinform/NetConsulting data, 2020 Report

KEY SECTOR DATA

CLOUD COMPUTING MARKET (A) BY SECTOR, 2018-2022

(in million euros unless specified)

			Forecasts			% Chg.	% Chg.	% Chg.	% Chg.
	2018	2019	2020	2021	2022	2018-19	2019-20	2020-21	2021-22
Manufacturing	688	846	968	1,219	1,480	23.0	14.4	25.9	21.4
Retail and services	414	506	593	709	834	22.3	17.1	19.7	17.6
Banks	315	385	401	425	458	22.2	4.3	6.0	7.7
Utilities	237	292	344	414	490	23.1	17.9	20.4	18.3
Telecommunications & Media	214	259	300	354	411	20.8	15.7	18.2	16.1
Central gov't bodies	188	220	247	282	316	17.1	12.0	14.3	12.1
Travel & Transportation	153	189	222	267	316	23.0	17.8	20.3	18.1
Local public bodies	162	188	208	236	261	16.1	10.9	13.1	10.9
Financial and insurance	108	132	154	184	216	22.2	17.0	19.6	17.5
Healthcare	110	132	153	180	208	20.4	15.3	17.8	15.7
Defence	70	83	95	110	126	19.3	14.1	16.6	14.4
Consumer goods	44	52	61	72	85	18.5	17.3	18.0	18.1
Total	**2,702**	**3,283**	**3,744**	**4,452**	**5,201**	**21.5**	**14.1**	**18.9**	**16.8**

Source: Cerved illustration of Assinform/NetConsulting data, 2020 Report

KEY SECTOR DATA

The growing cloud computing market value shows that companies see this technology as an enabler for adopting the latest digital business models, especially:

- Big Data, Analytics and Artificial Intelligence / Machine Learning: cloud computing allows companies to store and archive data effectively, making it possible to analyse many different corporate and technological situations in real time, including through the use of AI algorithms;
- Internet of Things: cloud architecture constitutes a level of integration of any type of IoT architecture, supporting numerous digital models, as well as big data, advanced analytics, blockchain and data monetisation;
- Digital Office & Workplace: cloud architecture also provides an innovative way of working that facilitates cooperation, sharing, remote access, and thus improved productivity and more efficient operations.

A study by NetConsulting shows that the Infrastructure as a Service (IaaS) format of cloud computing is the most widely used type of cloud service. Respondents cited storage and backup services, web hosting, large server capacity and hosting services based on IaaS as the main advantages over traditional applications; these are in fact the most mature components of IaaS on the market. Platform as a Service (PaaS) cloud architecture has been adopted to a lesser degree, but is forecast to expand over the next two years, in line with potential growth in the inclinations of companies to conduct development activities and applications testing in-house.

Moving to the Software as a Service (SaaS) component of cloud computing, take-up has been concentrated in specific applications such as the Office Automation suite, along with CRM, BI, SRM and HCM solutions. Adoption of SaaS in general has been less frequent, as these tend to be applications that companies have already possessed for years, and migration to a cloud may present greater complexities and risks.

The same NetConsulting study also highlighted that along with private and public cloud architecture, hybrid cloud and multi-cloud models are also gaining a foothold on the market, especially among larger corporate clients, in line with the tendency towards a mix of IT environments in an effort to optimise operating costs.

KEY SECTOR DATA

In hybrid cloud computing, different configurations are combined with on-premise infrastructure and applications. Multi-cloud strategies are also developing, based on high selectivity, not only of architectures and services, but even of specific suppliers. Companies adopting a multi-cloud strategy tend to choose different cloud providers and a variety of methods of running the different IT environments, sometimes even within the same areas, depending on what components and resources are involved. It is a strategy that gives companies freedom from individual suppliers and service providers, allowing them to minimise 'lock-in' risk; a multi-cloud strategy also does not require complex orchestrations between various services already in use, so it is supportive of dynamic company choices that depend on workloads, performances and prices from one moment to the next. However, there are quite a few critical issues with this approach, including the need to work with and manage relations with several different providers, which means a proliferation of contracts, greater attention to governance and security issues; it also makes it more difficult for companies to achieve significant economies of scale.

KEY SECTOR DATA

INTERNET OF THINGS

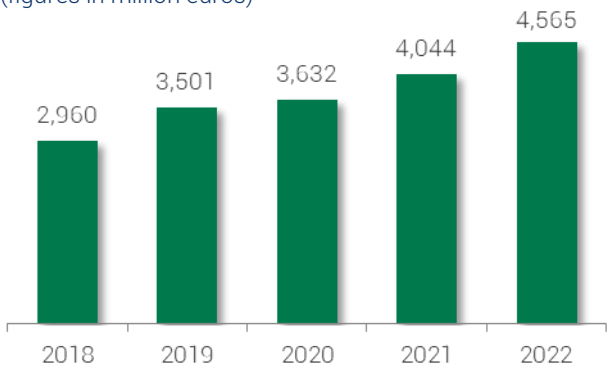
The Italian Internet of Things (IoT) market amounted to €3.501 billion in 2019, an increase of 18.3% from 2018. This market certainly proved to be a key areas of interest for investment among major Italian companies. In 2020, the total market value is expected to rise by a further 3.8% to €3.632 billion, and the growth rate is forecast to pick up over the next two years.

Research by Vanson Bourne on process and discrete manufacturing stresses the positive effects that IoT has had on businesses: 30% of the sample set of respondents believe that implementing, running and expanding IoT solutions constitutes the most important initiative for their organisations. Another 39% see IoT as a good means of improving and developing new products or services. Also, a whopping 97% claimed they obtained benefits from implementing IoT, and 37% reported an increase in sales.

The most notable industrial applications of the internet of things include predictive maintenance, which is the ability to connect machinery to devices that can directly signal any malfunction, production check or quality management procedure. IoT plays an important role in the Smart City paradigm as well: sensors can be used to monitor and guide lighting systems, as well as to collect information about air quality or about the presence of people in a given location. In the smart home, the IoT market spectrum is widening, with a growing offer of voice assistants, which allow smart devices to communicate and exchange data based on certain events.

ITALIAN INTERNET OF THINGS MARKET, 2018-2022

(figures in million euros)



Source: Cerved illustration of Assinform/NetConsulting data, 2020 Report

KEY SECTOR DATA

VIRTUAL REALITY (VR) AND AUGMENTED REALITY (AR)

Virtual reality combines software and hardware to create a virtual environment in which the user can become immersed. This digital space can be "lived in" thanks to VR headsets and accessories such as gloves, shoes and joypads to enrich the experience. Virtual reality (VR) and augmented reality (AR) are beneficial to companies' decision-making processes, product design, personnel training and professional development programmes, plant maintenance and even security verification processes. There are indeed many and varied applications of this technology for both B2C and B2B sectors, from marketing to advertising, retail to e-commerce, and from entertainment to medicine.

Both VR and AR technologies can provide a new frontier in cooperative work, enabling teams to simulate scenarios, reformulate industrial processes, become more efficient, and improve the experiences and safety of staff.

In the retail world, where the customer experience is rapidly changing, these tools help simulate a shopper's experience in a store, such as with digital changing rooms, special apps and LED displays to customise shopping experiences in a simple and satisfying way. In the automotive sector, 3D simulation brings added value: virtual reality has great potential for growth in this area, from engineering contexts to product communication. Even in a field like healthcare, AR and VR are useful for new professionals: doctors and nurses can in fact rapidly acquire new skills and learn the details of each step in a technical operation; they can follow results in real time using 3D simulators. Also, in light of the current Covid-19 situation, this technology helps medical staff avoid breaking distancing rules even in an emergency while still enabling the staff to carry on genuine communication with patients and develop interpersonal relationships.

KEY SECTOR DATA

In the industrial sector, VR and AR are enablers for total immersion in training exercises, which can thus be conducted in perfectly safe conditions. The platform simulates interactive scenarios where specific elements of the actual production plant scene are reproduced, with equipment and protection devices, and 'react' to the user's interactions.

Virtual reality is even having a significant impact on the tourism and real estate sectors. Firstly, scale models for buildings and particular architectural components can be configured in virtual environments. Secondly, virtual tours can be provided in order to present buildings or other locations of interest, opening up major opportunities for both service providers and consumers in these areas.

KEY SECTOR DATA

WEARABLE TECHNOLOGY

According to Assinform/NetConsulting data, in 2019 the Italian wearable technology market surpassed the €640 million mark after a 14.1% year-on-year increase. Following a natural slowdown in 2020 due to the pandemic, this segment is forecast to return to dynamic growth of around 12% for the next two years.

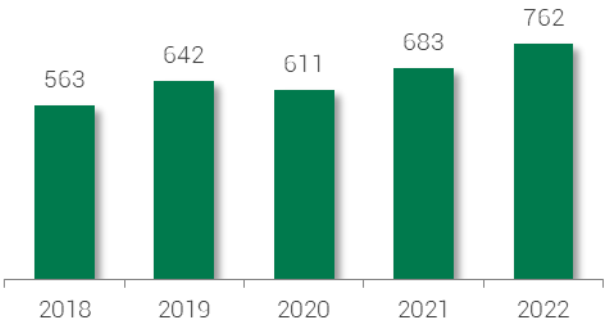
In terms of market value, smart watches remain the leading segment, along with ear-worn devices. According to a study by ABI Research, around 155 million wearable devices will be sold worldwide in 2021, more than 50 million of which will be used in logistics and/or industrial settings.

There are several fields of application for wearable devices in the manufacturing industry, as they provide both cost and time advantages. Examples include 'pick & place' warehouse processes, where workers are assisted in locating products in the warehouse, along with predictive maintenance and transport with smart devices in the production line. Other applications include using wearable devices to track vital information about workers and their environments, and thereby ensure worker safety.

The functions offered by smart devices will only broaden and applications will extend to 5G. Taken along with the development of virtual and augmented reality, wearables will be employed more and more in customer experiences, tied in with consumers' growing propensity to buy online and stores' growing integration between their physical stores and online retail channels.

THE ITALIAN WEARABLE TECHNOLOGY MARKET, 2018-2022

(figures in million euros)



Source: Cerved illustration of Assinform/NetConsulting data, 2020 Report

KEY SECTOR DATA

CYBERSECURITY

The Italian cybersecurity market, according to Assinform/NetConsulting figures, grew by 13.0% in 2019, reaching a total value of €1.137 billion. The security managed services and cloud security component leads the way in terms of cybersecurity investments, having risen by 14.7% last year to a total amount of €444.4 million. Other security services including system integration and specific training also brought in €423 million after 10.5% growth. This second category includes periodic activities such as assessments and vulnerability audits, along with related mitigation services. The highest growth rates in cybersecurity came from consulting (+15.4%) and security hardware (+15.6%). Consultancy services in 2019 rose to €60 million thanks to internal revision of processes in moves towards implementing security-by-design, to support compliance and risk management activities and to strengthen internal policies and procedures. The security software subsegment also rose by a substantial 12.9% last year; demand from companies was mainly concentrated in SIEM, identity governance and identity management solutions, particularly with the introduction of two-step authentication solutions imposed by the PSD2 directive and by other network security regulations (intrusion prevention and detection systems) and endpoint security.

For the current year, the impact of the Covid-19 emergency is projected to be limited, if not in contrast to other digital enablers. This is because adopting or extending remote working has given rise to a greater need to extend digital security to a greater number of remote users, with issues ranging from protecting physical devices to handling identification and access.

From a compliance perspective, the new legislation (the network information security (NIS) directive and the GDPR) have helped make corporate top managers aware of the IT risks involved, thus ensuring a priority place for cybersecurity systems and procedures.

KEY SECTOR DATA

CYBERSECURITY MARKET, 2018-2022

(in million euros unless specified)

			Forecasts			% Chg.	% Chg.	% Chg.	% Chg.
	2018	2019	2020	2021	2022	2018-19	2019-20	2020-21	2021-22
MSS and Cloud Services	388	444	491	549	612	14.7	10.5	11.7	11.5
Security Software	112	126	144	160	181	12.9	14.3	11.1	12.7
Security Hardware	69	80	87	101	116	15.4	8.4	16.5	15.0
Consulting	54	63	68	74	84	15.5	8.0	10.1	13.0
Other Services (System Integ., Training)	383	423	449	489	543	10.5	6.0	9.0	11.0
Total	**1,006**	**1,137**	**1,239**	**1,373**	**1,535**	**13.0**	**9.0**	**10.9**	**11.8**

Source: Cerved illustration of Assinform/NetConsulting data, 2020 Report


INTERNATIONAL PERSPECTIVE

INVESTMENTS IN VENTURE CAPITAL AND PRIVATE EQUITY IN ITALY

Analysing how investments in the ICT sector are distributed (including computers, communications and electronics), we see that it was the leading investment target sector by number of transactions, with 17% of the total.

Among companies that run in high-tech businesses, the number of transactions that took place in 2019 was 134, compared to 131 in 2018, and this was 36% of the total. In detail, the sub-segments with the greatest number of major investment transactions were medicine, ICT and biotechnology, which together covered 63% of all investment transactions in Italian high-tech companies last year. It is worthy of note that 71% of these high-tech transactions involved startup companies, and were characterised by an investment for a medium amount, well below the average for some other segments of the market.

INVESTMENTS IN VENTURE CAPITAL AND PRIVATE EQUITY IN ITALY

DISTRIBUTION BY SECTOR OF THE NUMBER OF INVESTMENTS COMPLETED IN 2019

Sector	Transactions	% of Total
Information and Communications Technology	64	17.3
Industrial goods & services	57	15.4
Medical	49	13.2
Retail	33	8.9
Food manufacturing	26	7.0
Consumer services	25	6.8
Biotechnology	22	5.9
Apparel manufacturing	19	5.1
Energy and waste management	16	4.3
Financial activities and insurance	14	3.8
Furniture manufacturing	11	3.0
Other manufacturing	9	2.4
Construction	7	1.9
Real estate	5	1.4
Transport	5	1.4
Agriculture	4	1.1
Chemicals and other materials	4	1.1
Total	**370**	**100.0**

Source: Associazione Italiana Private Equity, Venture Capital and Private Debt (AIPI) - Italian market, 2019

INVESTMENTS IN VENTURE CAPITAL AND PRIVATE EQUITY IN ITALY

DISTRIBUTION BY SECTOR OF MAJOR INVESTMENTS IN HIGH-TECH COMPANIES, 2019

Sector	Transactions	% of Total
Medical	33	24.6
Information and Communications Technology	30	22.4
Biotechnology	21	15.7
Financial activities and insurance	13	9.7
Energy and waste management	12	9.0
Industrial goods & services	8	6.0
Construction	6	4.5
Consumer services	6	4.5
Chemicals and other materials	2	1.5
Apparel manufacturing	1	0.7
Retail	1	0.7
Transport	1	0.7
Total	134	100.0

Source: Associazione Italiana Private Equity, Venture Capital and Private Debt (AIPI) - Italian market, 2019

INVESTMENTS IN ITALY

R&D EXPENDITURES

With a total investment of €2.6 billion in R&D in 2018, with a growth of 6.4% compared to 2017, the ICT sector has a primary importance in the R&D expenditure of companies in Italy. 50.1% of expenditure is incurred by IT software and services companies (+10% compared to 2017), while the share of expenditure by computer and equipment manufacturers continues to decline (+4.8% compared to 2017) and telecommunication services (+0.3% compared to 2017).

With regard to the composition of expenditure by sources of financing, the majority of expenditure is still self-financed by companies, with 2.2 billion euros, equal to 85.7% of total R&D expenditure in the sector and down from 87.4% in the previous year.

The expenditure financed by international operators reached €220.9 million, an increase of 18.4% compared to 2017; in addition, the positive dynamics of international funding to ICT sector operators is in contrast to the 7.5% decrease in the contribution from international funding sources to all other sectors. The Italian ICT sector is therefore able to attract capital from abroad for its R&D to a more dynamic extent than other sectors.

Finally, with regard to public and private non-profit institutions and universities, the funded expenditure reached €147.8 million (+22.6% compared to 2017).

INVESTMENTS IN ITALY

R&D EXPENDITURE IN ICT COMPANIES, 2017-2018
(figures in milllion euros)

	2017		2018		% annual growth
	million €	%	million €	%	
Manufacture of computer and other electronic equipment	758,4	31,2	794,9	30,7	4,8
Telecommunications	493,5	20,3	495,1	19,2	0,3
Software production, IT consulting and related activities	1.177,2	48,5	1.295,1	50,1	10,0
Total	**2.429,1**	**100,0**	**2.585,1**	**100,0**	**6,4**

R&D EXPENDITURE IN ICT COMPANIES BY SOURCE OF FUNDING, 2017-2018
(figures in milllion euros)

	ICT industry		Tot. Italian economy		% annual growth		% ICT/tot. Italian economy	
	2017	2018	2017	2018	ICT	Total	2017	2018
Companies (excluding private Universi-ties)	2.122,0	2.216,5	12.278,2	13.260,0	4,5	8,0	17,3	16,7
Public and private non-profit institutions, Universities	120,6	147,8	540,4	805,0	22,6	48,9	22,3	18,4
International investors	186,5	220,9	2.021,4	1.869,0	18,4	-7,5	9,2	11,8
Total	**2.429,1**	**2.585,2**	**14.840,0**	**15.934,0**	**6,4**	**7,4**	**16,4**	**16,2**

Source: Cerved illustration of Assinform data, October 2020

INVESTMENTS IN ITALY

FOREIGN DIRECT INVESTMENT (FDI)

In 2018, based on OECD data on foreign direct investments (FDI), inward FDI stocks in the "Publishing, computer programming and consultancy, information service activities" sector accounted for 1.0% of the total and increased by 40.7% from the previous year. Inward FDI stocks in telecommunications, on the other hand, accounted for a much larger 5.4% of the total, but fell slightly from 2017.

FDI POSITIONS(A): ITALY'S INWARD FDI STOCK, 2017 AND 2018
(figures in million USD unless specified)

	Inward FDI			
Activity	2017	2018	% Chg. 2017-18	% of Total 2018
Publishing, computer programming and consultancy, information service activities	2,972	4,183	40.7	1.0
Telecommunications	23,982	23,106	-3.7	5.4
Other sectors	397,789	399,122	0.3	93.6
All sectors	424,743	426,411	0.4	100.0

a) - FDI positions represent the value of direct investment stocks held at the end of the investment period
Source: Cerved Group illustration of OECD data

INVESTMENTS IN ITALY

FDI stocks in the "Publishing, computer programming and consultancy, information service activities" sector rose sharply, from $327 million in 2017 to $798 million.

INCOME FROM ITALY'S INWARD FDI STOCKS, 2017 AND 2018
(figures in million USD unless specified)

Activity	Income from inward FDI		
	2017	2018	% Chg. 2017-18
Publishing, computer programming and consultancy, information service activities	-327	798	n.s.
Telecommunications	538	-682	n.s.
Other sectors	23,785	32,750	37.7
All sectors	23,996	32,866	37.0

Source: Cerved Group illustration of OECD data

INVESTMENTS IN ITALY

FOREIGN-OWNED COMPANIES IN ITALY

In Italy, there are 205 companies active in the ICT sector that are at least partly foreign-owned; in 90 of these, foreign ownership constitutes a majority of the share capital. Most of these companies are located in northern Italy, employing 1,254 people combined (out of 1,696 among all foreign-owned ICT companies) and having achieved combined revenue of €107 million (out of just under €119 million).

FOREIGN-OWNED OR PARTLY FOREIGN-OWNED ICT COMPANIES, SEPTEMBER 2020

	Geographical Area		
	North	Centre & South	Total
Businesses at least partly foreign-owned:			
- Total Number	146	59	205
- majority foreign-owned	69	21	90
- % majority foreign-owned	47.3	35.6	43.9
Number of Employees			
- Total	1,254	442	1,696
- majority foreign-owned	837	285	1,122
- % majority foreign-owned	66.7	64.5	66.2
Aggregate 2018 Revenue (in € mn)			
- Total	107.0	11.6	118.6
- majority foreign-owned	99.2	0.1	99.3
- % majority foreign-owned	92.7	0.6	83.7

Source: Cerved calculations

PATENT SCENARIO IN ITALY

Data from the European Patent Office (EPO) indicate that in 2019, digital technology sectors took the top spot in the number of European patent applications.

Rising patent applications in digital communications (+19.6%) and information technology (+10.2%) demonstrate the fast-growing importance of technology related to the digital transformation. A key role in this dynamic is played by 5G network developments, while artificial intelligence is another driver, particularly the automatic learning segment, along with metadata processing and generation.

Compared to other EU countries, Italy's patent application numbers grew faster than average, with a total of 4,456 presented last year.

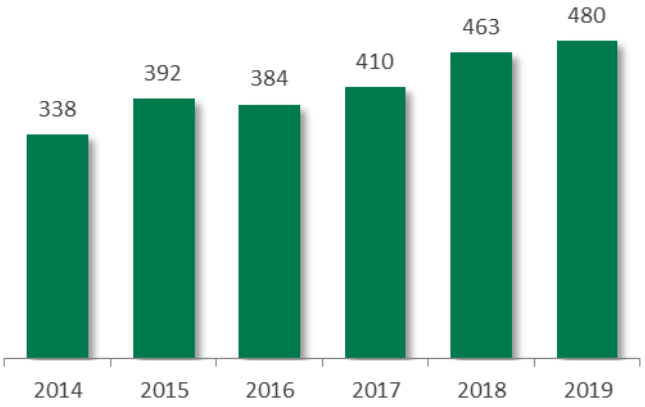
The 2019 patent index shows 1.2% year-on-year growth for Italy (compared to +1% in 2018), versus a European average of +0.9%. Over the period from 2014 to 2019, patent applications have risen by 22% overall. Lombardy stands out as one of the most innovative-centric regions in Europe, having witnessed a 6.2% rise in patent applications in 2019, moving from 13th to 12th in the table. Combining Lombardy with Veneto and Emilia Romagna, those three regions account for about 60% of all Italian patent applications.

Regarding the electrical engineering sector, Italian parent applications rose by 42% from 2014 to 2019, or by 7.3% per year on average, showing that the sector has developed greatly in recent years and demonstrating the major importance attributed to ICT tools. In 2019, 480 Italian patent applications were filed in this sector.

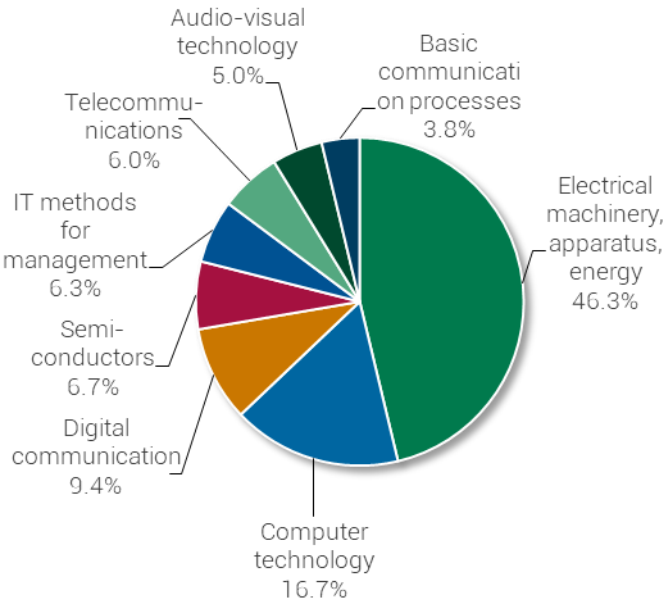
Of those, 46.3% were in the "Electrical machinery, apparatus, energy" segment (+4.2% year-on-year), followed by 80 applications in "Computer technology" (up 29% from 2018); in third position is "Digital communication" with 45 applications, then semiconductors, IT methods for management and telecommunications; rounding out the list were audio-visual technology and basic communication processes, segments in which innovative content is lower, but where there were nonetheless 42 applications filed, compared to 41 in 2018.

PATENT SCENARIO IN ITALY

ITALIAN PATENT APPLICATIONS IN ELECTRICAL ENGINEERING, 2014-2019



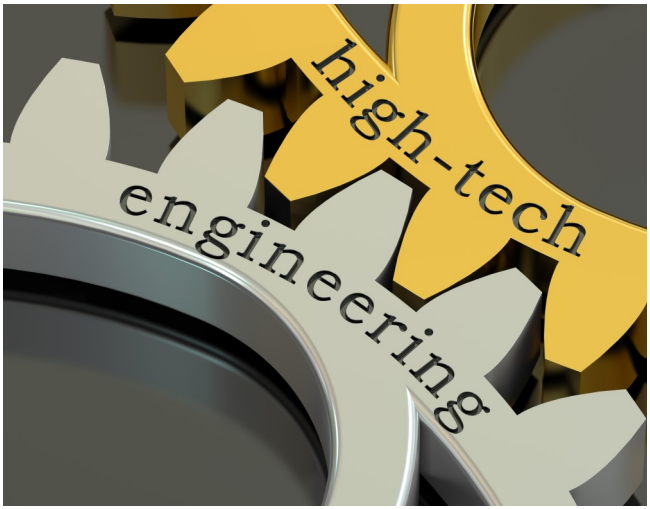
ITALIAN PATENT APPLICATIONS IN ELECTRICAL



Source: European Patent Office

INVESTMENTS IN ITALY

The Italian Ministry for Economic Development's section for Industrial Property Rights – Patent and Trademark Office has entrusted Invitalia, the national agency responsible for attracting investments and business developments, with the task of conducting actions to facilitate obtaining economic value for micro, small and mid-sized businesses from their patents. This initiative aims to support the innovative and competitive abilities of Italian SMEs by ensuring that their work on patents nationally and internationally can bear fruits. The incentives foreseen are for hiring specialised services for industrialisation and advanced engineering, organisation and development, as well as technology transfer. Capital account tax breaks are to be granted, assuming the minimum amount rule is followed, up to a maximum amount of €140,000. The new funds made available in implementing this measure amount to €25 million. Patent applications may be presented from 21st October 2020 until the funds run out in order to take advantage of the tax breaks.




INDUSTRY ACTRACTIVENESS

INDUSTRY ATTRACTIVENESS RADAR, 2020(a)

a) The smaller the area between the five points, which represent attractiveness factors, the more attractive the sector is for business.

THREAT OF NEW ENTRANTS

There are medium entry barriers to the ICT sector, chiefly composed of:

Investments needed for R&D activities and for personnel training, as great professional skills and knowledge are required to design and develop high-quality products and services.

Longstanding players' presence on the market: they have solid positions and thus manage to keep market shares high, with broad, loyal clientele;

Difficulties in developing products and solutions other than those already on the market or as an alternative to other highly customised solutions, which are unique and hard to replicate if developed over long-term relationships with built up with customers.

INDUSTRY ATTRACTIVENESS RADAR

BARGAINING POWER OF SUPPLIERS

Supplier bargaining power is low. Their influence is limited because the sector consists of predominantly intangible services and goods that do not require supplies of raw materials or other critical factors. Operators in the sector are also highly focused on keeping their operating costs under control due to the fiercely competitive context, and this has repercussions on suppliers themselves. Finally, it should be kept in mind that the largest ICT players tend to handle all phases of the production processes in-house, thereby limiting reliance upon external suppliers.

BARGAINING POWER OF BUYERS

Client bargaining power is medium, and greater than that for large-sized companies but relatively moderate among SMEs and consumer users. In general, it works to the customer's advantage that competition in the sector is fierce; operators have to compete with each other on pricing in order to avoid losing market share. Client bargaining power grows higher as the amounts of orders and tenders goes up, especially for high-volume projects with standard solutions, Nevertheless, demand for customised products and solutions is falling.

RIVALRY AMONG EXISTING FIRMS

Competition in the sector is very intense, as there is a large number of operators; this is not entirely mitigated by growing demand.

The ICT services segment offers possibilities for greater differentiation in terms of the ranges offered by different players. It can be adapted to customers' specific needs. The price is nevertheless a crucial element, as demonstrated by the continued reductions in professional rates charged for technical assistance services.

INDUSTRY ATTRACTIVENESS RADAR

The software segment is also highly competitive, with a focus mainly on prices, especially for widespread and standards products. The most customised solutions, which enable companies to differentiate themselves based on their solutions' features, are nevertheless less subject to the price-based competition factor.

THREAT OF SUBSTITUTE PRODUCTS

Alternative products have a low impact on this market. In the IT sector, one-off and custom software and services do often take on strategic importance, which makes it very difficult for solutions currently in use to simply be substituted by wholly different ones. This is because any potential substitute could not simply be implemented directly, but would first need to be customised and then integrated into the client's infrastructure before being adopted.

In the past few years, cloud computing has asserted itself as the substitute method of applying certain software solutions, through software as a service (SaaS) models. However, this constitutes only a different means of supplying and applying the same software applications. The IT services segment does not really have any true alternatives.

Regarding management of ICT activities within company clientele that operate in various manufacturing sectors, there has been a process of progressive replacement of personnel, as well as of internal skills, by outsourcing IT and IT infrastructure jobs, along with tasks related to basic company data handling. This outsourcing responds to a need among many large manufacturing and financial companies to focus on their "core" businesses. Concerning internal personnel, the software and service companies offer better flexibility, specialisation, better preparation and a broader perspective on the problems at hand.

OPPORTUNITIES

DIGITAL TRANSFORMATION

The digital transformation that has already been sparked by a growing number of Italian companies presents the ICT sector with a major opportunity. Digital transformation is an approach that is not simply about using new technologies, but presupposes having an organisational culture that evolves and supports transformation in terms of inclination to be innovative and to develop new know-how, digital professional training, new processes and ways of working, interaction with traditional business and confronting resistance to change.

In this context, client companies' new needs are driving developments of new solutions connected with technological innovations in the sector. One example is in the growing automation of production processes in the manufacturing sector, which could bring benefits in terms of productivity (increase in product quality, greater operational flexibility, more efficient processes, cost containment and a better customer experience), which in the workplace enable companies to remedy the issue of a declining working-age population.

INNOVATION

Innovation in solutions offered, beyond the general quality, is an aspect that provides a competitive edge. This can be seen in the growing amount of investments made in developing digital enabler solutions, which are technological models that are driving the transformation towards digital business models and digital offers put forth by companies. These enabling technologies constitute the key levers for implementing businesses' digital transformation plans, especially in sectors like transport (especially automotive) and logistics.

OPPORTUNITIES

TECHNOLOGY HUBS

Science and technology parks provide another important opportunity for the sector. These hubs serve as facilitators of technology transfer activities for businesses, above all SMEs and innovative startups. The hubs help speed up technology transfer processes on the market, optimising timing and resources, overseeing how research results are translated into finished products or a new industrial process that fosters economic growth, attractiveness to foreign firms, and well-being in the host region.

LEGISLATION

A further opportunity for the ICT sector stems from the regulatory scenario, which has increasingly moved to more effectively support a digital transformation among businesses, private sector spending on R&D and technological innovation, as well as a focus on environmental sustainability and improving skills in enabling technologies.

Within this context, the Italian government's Transition Plan 4.0, issued along with the 2020 financial law on 30th December 2019 (no. 304/2019), redefines the national tax incentive scheme for the National Plan For Business 4.0 (formerly Industry 4.0), through the following measures:

- Tax credit for investments in plant, equipment and intangible fixed assets: to support and provide an incentive for businesses that invest in new plant, equipment and intangibles in preparation for technological and digital transformation of production processes intended for locations within Italy.

- Tax credit for expenses on research, development, innovation and design: to stimulate private sector spending on research, development, innovation and design in an effort to boost Italy's competitiveness in these areas and to encourage digital transformation processes, circular economy and environmental sustainability.

OPPORTUNITIES

- Tax credit for 4.0 Training: to stimulate investments by businesses in personnel training and professional development on technological topics in order to facilitate the technological and digital transformation of businesses.

A key opportunity for the sector is associated with the "Recovery Fund", with which the European Commission is aiming to support member states financially during the difficult recover phase following the Covid-19 emergency. It is called Next Generation EU, and is an extraordinary measure that will receive €750 billion in funding. According to the latest news reports, Italy is expected to receive around €209 billion, of which €82 billion in subsidies and €127 billion in loans. These investments will go towards fostering an ecological, energy and digital transition in the country.

The digital transition has thus been assigned a primary role. Digitising all public sector bodies (including but not limited to local government agencies, the state education system, the national healthcare system and tax authorities) has been made a priority in order to make services more efficient and timely. The objective is to create a digital identity for each citizen and for each business in the country. In more detail, the infrastructure on which digitisation will be based will be enhanced via completion of the fibre-optic network and measures to further develop 5G networks. To this end, no part of the country (not even those considered less 'cost-effective') will be ignored. Measures will also be put in place towards technological innovation and digitisation of strategic supply chains such as agri-food, manufacturing and tourism, while cultural heritage will be strengthened and further measures will be activated for inclusive digitisation and bridging the digital divide.

In national recovery planning, the National Innovation Fund will therefore play a key role. This fund recently presented its investment guidelines for its 2020-2022 financial and business plan; the fund can now count on about €1 billion in funding, coordinated by state lender Cassa Depositi e Prestiti and by the Ministry for Economic Development.

OPPORTUNITIES

There are already four active funds, two for startups and innovative SMEs, one of which must be in the South of Italy; while one of the four must invest in venture capital funds, and the fourth in business accelerators and high-tech startups active in sectors with a high potential for growth.

CRITICAL SUCCESS FACTORS

SKILLS

In step with the evolving technologies being adopted by businesses, a digital culture needs to be fuelled, through which investments are made in personnel training programmes designed to expand professionals' digital skills both inside and outside of ICT departments. Indeed, new digital transformation initiatives require a variety of very specific professional skills, which are essential for designing and developing high-quality products and services.

RESEARCH & DEVELOPMENT

The market rewards companies that invest copiously in research and development. Here, we underline three relevant areas of activity:

- fundamental research: aimed at acquiring new theoretical and practical knowledge about observable facts and phenomena, without foreseeing direct commercial applications once that knowledge is acquired;
- industrial research devoted to acquiring knowledge and skills that can be used to develop new products, processes or services, or to improve existing products, processes or services substantially;
- experimental developments: for acquiring, combining, organising and using existing scientific, technological, commercial or other knowledge and skills, in order to develop processes or new or improved products or services.

In this context, we must stress the strategic importance of partnerships, which are a key factor for continued growth and for the spread of innovative technology developed. Such partnerships may be formed between ICT companies that specialise in different segments, or could be forged with economic actors that operate in other high-tech sectors, such as biotech, life science, automobiles or transport; it could even be with financial companies, utilities or companies in heavy industry, among which demand for ICT solutions is extremely high.

CRITICAL SUCCESS FACTORS

COMMERCIAL OFFERING

The range and format of products and services offered has taken on an increasingly central function in the sector. It is essential to be able to differentiate one's products, full solutions and services, and to build a range that is both broad and deep. The IT services segment offers more room for differentiation between operators, with more opportunities to adapt to specific client needs. However, pricing remains a crucial aspect, as demonstrated by the continual reductions in rates that professional IT service technicians charge. In the software segment, though, competition is chiefly focused on prices, especially for the more widespread and standardised products. Solutions that are more customised, with more differentiation of features, are however less subjected to price-based competition.

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