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ICT AND LOCAL DEVELOPMENT: A CASE STUDY OF THE METROPOLITAN AREA OF CAGLIARI

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Introduction

The success of the Sardinian ISP Tiscali, at the turn of the new millennium, was a new and critical event for Cagliari, the main town on the island of Sardinia, a region known for its beautiful landscape and slow pace of life rather than its economic fortunes. The local economy had suddenly gained a reputation for innovation and industrial success in the new field of information and communications technology. Was Tiscali an isolated episode? Or was it a symptom of a wider change in the industrial fabric of Cagliari and Sardinia?

This paper provides a broad description of the local infrastructure and economy in the Cagliari area, with a special focus on the sector of information and communication technology. It argues that, while the ICT sector has become in time a significant industrial reality in the Cagliari area, it has not reached the dimensions and status of a veritable technology district, and the drive for innovation and corporate success appears to have lost its momentum.

The first chapter offers an overview of the infrastructural endowment of the island of Sardinia and the Cagliari area in particular: transport, telecommunications, education and research. Chapter two describes the main features of the economy of the Cagliari Local Work System in 2001, the last available industrial survey. The local ICT sector is analysed in chapter three, while Tiscali's origin and evolution are described in chapter four. Chapter five investigates the legacy and role of Tiscali in the sector, based on the information obtained by discussions with other major ICT outfits in the Cagliari area. Our conclusions are presented in Chapter six.

1. General Description

The island of Sardinia, with its 24.089 square Km surface land, is the second largest island of the Mediterranean and one of the least developed areas of Italy. It is part of the aggregation of southern regions collectively known as Mezzogiorno[1], which are characterised by lower levels of development, occupation and education relative to both the (more affluent) north of Italy and the country average. Compared to other Mezzogiorno regions, Sardinia is more sparsely populated and more isolated from the mainland. Within the island there are also significant differences in the level of development and infrastructure endowment. Broadly speaking, the central-western mountains around Nuoro host the most isolated and traditional communities, whose economies are based on agriculture, sheep rearing and small crafts, while the coastal areas and the south tend to be more affluent and developed. If we were to rank the (current)

[1] The area known as Mezzogiorno includes six regions of southern Italy (Basilicata, Abbruzzo, Calabria, Campania, Molise, Puglia) and the two islands of Sicily and Sardinia.

four provinces in order of development, Cagliari would lead, followed by Sassari, Oristano and Nuoro[2].

Table 1: land and population (year 2000)

	SURFACE (km^2)	**POPULATION ('000)**	**POP /km^2**
Italy (1999)	301,268	57,679.9	191.5
Mezzogiorno	123, 063	20,850.15	169
Sardinia	24,089	1,648.04	68
Sassari Province	7,519	459.14	61
Oristano Province	2,630	156.64	60
Nuoro Province	7,043	267.99	38
Cagliari Province	6,895	764.25	111
Cagliari LWS	1,824	469.93	257

Source: Annuario Statistico della Sardegna 2003, Osservatorio Industriale della Sardegna, and ISTAT 2001

Cagliari is the main administrative and trading centre of Sardinia; it hosts the most important port and airport of the island as well as the key industrial areas; its Local Work System[3] (LWS) is the focus of our analysis. While the city has steadily lost inhabitants in the last ten years, and now numbers about 165,000, the metropolitan area which gravitates around it has continued to expand. Cagliari's LWS is today a large territory encompassing 32 small municipalities; it covers just 8% of the island territory but houses 28% of the population. It is one of the widest Work Systems in Italy as well as the most densely populated and urbanised on the island of Sardinia.

Infrastructure. Sardinia is characterised by a low level of local infrastructure, particularly in the area of transport, not only in relation to the national average, but also when compared to the average values for the Mezzogiorno regions.

Table shows the main indicators of general economic infrastructure for Sardinia and for the province of Cagliari. While the same indicators are not available for Cagliari's LWS, it is safe to infer that the metropolitan area would exhibit equal or slightly higher values than the province, since most infrastructures are concentrated in and around the town and access to it is therefore easiest for those near the city. In both areas the only item that exceeds the national value is that of ports. Indicators for the province of Cagliari are generally higher than those for Sardinia as a whole, with the exception of airports and road networks.

[2] Additional provincial administrative units will be formed in the coming months, following a referendum held in 2003.

[3] The Local Work System is an aggregation of municipalities that gravitate around a given centre, where workers and economic activity tend to converge. It is devised to account for workers who commute to a centre while residing in another.

Table 2: general infrastructure indexes (1999)

Italy =100	Sardinia	Cagliari province
Road network	63.2	54.5
Rail network	24.5	24.7
Ports	132.9	156.9
Airports	77.0	62.3
Energy and environmental network and infrastructure	30.5	51.4
Telecommunications networks and structures	32.8	51.6
Bank networks and services	48.1	60.4
General economic infrastructures	58.4	66.0

Source: Atlante della competitività delle province in www.unioncamere.it

The island is served by 70 ports and three international airports[4] (two in the north and one in the south). Based on the levels of traffic in 2003, all three Sardinian airports are classified as middle sized. Cagliari Elmas, the busiest Sardinian airport, moved a tenth of the passengers that went through Rome's airport in the same year[5]. The international airport serving Cagliari has been substantially renovated and expanded in 2003, but it still relies on just one runway.

The island has a very outdated network of roads and is the only Italian region without any motorway. As a result, connections are less safe and take a longer time. The ratio of roads to surface in Sardinia is lower than average: 12.9km/km^2 for state roads compared to 15.5 nationally and 17.6 in the southern regions. The limited accessibility and poor state of the local roads is a main factor contributing to the relative isolation of many local communities. According to the general infrastructure indicators discussed above, the province of Cagliari ranks 101st in Italy (out of a possible 103) for its road infrastructure and 98th for its rail network.

Rail transport too is largely deficient. Not only is the rail network extension limited (18m/km^2, compared to an Italian average of 55m/km^2), but, more importantly, its quality is extremely low: the network is not electrified and has the lowest percentage of dual track infrastructure in Italy (4% - the

[4] By way of comparison, the more populous island of Sicily, with nearly 5 million inhabitants, has 2 airports and 132 ports.
[5] Rome's airport handled 48 times the amount of goods that passed through Cagliari Elmas in 2003.

corresponding national figure is 38%). As a consequence, most of the passenger and goods traffic in Sardinia travels on the roads, thus compounding the inconvenience of the inadequate road network. In fact, public transport is mainly road based, and is complemented by the services of private operators.

Broadband. The indicator for telecommunication infrastructure puts the province of Cagliari at roughly half of the national average. However, these measurements, which refer to 1999, do not tell us much about the area's broadband endowments. Broadband is defined as "*mix of technologies that enable greater speed of communication in general and Internet access in particular, as well a high level of interaction, through innovative techniques/infrastructures*"[6]. Its development is a primary goal of the European Union.

The overarching objective of the latest EU Action Plan, e-Europe 2004, is to "*make Europe, by 2010, the most competitive and dynamic knowledge-based economy in the world, improving its employment level and social cohesion*"[7]. In order to realize this objective, Europe must be endowed with broadband infrastructure over which to offer innovative and competitive digital services. The key problem in doing this is the proverbial *chicken and egg* dilemma, that is the paradox that broadband networks will not be developed until there is demand for (broadband hungry) services and advanced services cannot proliferate without the appropriate infrastructure to support them. The Union therefore sees the joint development of broadband technology and interactive services as key to the real growth of the European Information Society, and has devised a range of incentives to stimulate broadband investments as well as the provision of advanced digital services.

Broadband can be offered through several technologies, wired and wireless. Presently, the most significant in Europe are: Universal Mobile Technology Standard (UMTS), Asynchronous Digital Subscriber Loop (ADSL), and cable modems. Cable modems are used in the fibre (or mixed coaxial-fibre) networks of cable TV operators; they are widely available in most major EU countries but hardly in Italy, where cable television is in its infancy[8] and only one operator, Fastweb, who does not operate in Sardinia, is investing in fibre to the homes to provide integrated cable TV and telecommunications services.

ADSL is the most popular of the xDSL family of wired broadband technologies, especially for residential customers. The Italian network's circuits at the level of the final user are short (on average 1.5 km), which means that

[6] from www.osservatoriobandalarga.it

[7] COM (2002) 263 final.

[8] Telecom Italia spun off a cable TV company called Stream in the early 90s, mainly to prevent entry in that market. Stream did very little cable business and eventually moved its offer on satellite to compete with the dominant operator Tele+. The two satellite competitors were bought by NewsCorp in 2003 and merged in the new Sky Italia.

most users can get high quality results from the xDSL technology. At the end of 2003, only 58,9% of copper twists had been used for xDSL nationally.

Figure 1: availability of broadband in Sardinia, Dec.2003

Source: Osservatorio Banda Larga, Between 2004

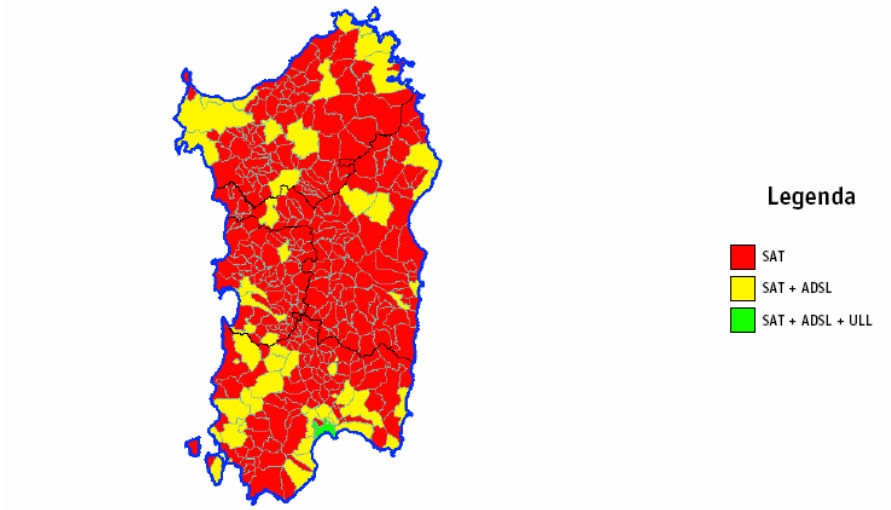

Figure one displays the coverage of different broadband technologies on the island of Sardinia: the red areas are reached only by satellite coverage, the yellow areas are covered by both satellite and ADSL and the green areas have also a third option of local loop unbundling (LLU[9]). Wired broadband coverage on the island is low: 41% to 55% of the population can get ADSL (as well as HDSL, SHDSL and UMTS). Fibre density in the network is also rather low[10]. There are less than 5Km of fibre per km² in both backbone and Metropolitan Area Networks[11]. New fibre MANs are planned for Cagliari (and two other local cities) in the near future.

Very few operators are investing in infrastructure on the island: with only three active competitors in 2004, Telecom Italia, Wind and 3, Sardinia is the last Italian region in the rankings for infrastructure competition. Less then 10% of the local population can access broadband with unbundling, and, as the map shows, only if located near the town of Cagliari. In mainland Italy LLU is available for a quarter of the population.

[9] LLU refers to the ability of a telecom operator to compete fully even in the last mile of the network

[10] The national average is higher at 75%.

[11] This indicator is the ratio of fibre posed over total km² of land in the region observed. Source: Osservatorio Banda Larga e Between, rapporto 2004. www.osservatoriobandalarga.it

Education and Research. The gap in development between Sardinia and the rest of Italy maintains in the field of education and research. Italy is not a particularly good performer, as far as education and research are concerned, given that nearly 70% of the population has not gone beyond 8 years of schooling, as shown in Table 3. Furthermore, OECD reported that, in 2000, Italy spent 2.3% of its GDP in Research & Development (R&D), secondary education and software[12], compared to an OECD average equal to 4.8% of GDP. Considering the low national level of investment in research, the picture for laggard Sardinia seems rather bleak.

Table 3: percentage of total population by education level, 2002

	SARDINIA	MEZZOGIORNO	ITALY
University degree and above	5.2	5.5	6.4
High school diploma	19.7	20.5	21.0
Vocational qualifications	2.4	2.2	4.4
Middle/Junior High diploma	33.6	30.0	29.0
Primary school or less	39.1	41.8	39.2

Source: Osservatorio Industriale della Sardegna, 2004

The vast majority of the island's population has low levels of education: in 2002 the proportion of Sardinians with only primary school exceeded 39%, while a further 34% has (the equivalent of) a high school diploma. In the same year, 5.2% of the Sardinian population had a university degree of any type, and the majority (60%) of these are women.

The two major cities, Cagliari and Sassari, host a local university each, but extra-mural courses are also arranged in smaller centres like Oristano and Nuoro. The University of Cagliari, created in 1620, offers around 30 degrees from its 10 faculties and 43 departments, including a three-year degree[13] in Information Technology within the department of Mathematics. The IT degree is opened to a limited number of students (210 in the AA 2004/05), divided between the main Cagliari campus and four small centres of the island, where lessons are offered as distant learning on ICT support. On average, the University has around 40,000 registered students, but considering the extremely high dropout rates of Italian universities (65%[14]), only a minority of the students is likely to obtain a degree. In fact, each year some 3300 new students graduate from the two Sardinian universities

[12] Only Portugal and Poland had lower values than Italy according to the 2003 OECD Science and Technology Scoreboard

[13] Shorter degrees (three instead of four years) have been recently introduced in the Italian higher education system to improve flexibility and reduce the drop-out rate.

[14] According to a research conducted by Fondazione Agnelli and reported by the national newspaper La Repubblica on 6.10.2000

As well as its core educational activity, the University of Cagliari conducts a wide range of research. It is organized in 14 (independent) research centres, spanning areas from sports to biotechnology.

A growing number of businesses are involved in Research and Development activities. In 2001, 177 production units in the Cagliari LWS were registered in the field of R&D, employing over 500 people, as illustrated by Table. While the number of units has grown on average 12% a year between 1999 and 2001, the number of workers has not grown proportionally, especially in the field of engineering and natural sciences. The average size of R&D firms in this field has hence decreased from 7.73 to 3.12 in the same decade.

Table 4: Research activity

	2001		**a.y.c. 91-01**		**ave.**
	units	**workers**	**units**	**workers**	**Size**
R&D engineering etc.	119	437	10%	1%	3,67
R&D social science	58	115	14%	9%	1,98
TOTAL R&D	**177**	**552**	**12%**	**2%**	**3,12**

Source: ISTAT 2001

In the field of ICT, the two most influential research centres of the island are Polaris, the Science and Technology Park, and CRS4, a non-profit consortium of public and private companies created within the Park. Both outfits were established as part of a European project designed to improve technology transfers within the Union. The regional administration governing Sardinia in the late 80s chose to invest heavily in the creation of local knowledge through a series of complementary measures, which included direct investment in research structures. The main project entailed setting up a consortium - named *Consorzio 21* after the law that established it (L.R. 21 of 1985) - charged with promoting, implementing and managing a Science and Technology Park for Sardinia. The consortium became operational in 1989 and it commenced its work by developing

- CRS4, a centre for international excellence and innovation in the field of computing and large scale calculations, established in 1990
- The Science and Technology Park, Polaris, a network structure for research and other services for businesses, whose headquarters officially opened in 2003.

CRS4 was charged with the mission of attracting investments and off-spinning technological start-ups. The centre's membership is shared by Consorzio 21 (representing the Sardinian administration), Techso, IBM Italy, ST

Microelectronics (member since 1993), Saras, Tiscali (since 1998) and the Universities of Cagliari and Sassari. The Department of Electrical and Electronic Engineering of the University of Cagliari, in particular, has an on-going cooperation protocol with the CRS4 centre and its eighty researchers. The first director of CRS4 was Nobel Laureate Carlo Rubbia, who was also in charge of the CERN research centre in Geneva (Switzerland). At the time (1990) the Geneva centre had gained a major role in popularising Internet, when its researcher Tim Berners Lee "created" the World Wide Web. Under Rubbia's leadership, CRS4 too rapidly developed significant expertise in the new fields of digital communication technologies, drawing to the island world class researchers and *state of the art* knowledge and experimentations.

CRS4 is widely quoted as the single most significant contribution to the creation of knowledge on the island in the last decade, supplying the *fertile soil* that nurtured the most innovative ICT companies in Sardinia. The local competences created by the centre were absolutely essential to the development of Tiscali. However, as CRS4 directors and local governments changed, and creating and funding local knowledge became a lower public sector priority. CRS4 professionals were asked to find private finance for growing shares of their output, and most public support was in the form of short term funds, thus preventing more visionary and long term projects to take off. Today CRS4 is hoping to restore its edge in pre-competitive research with the renewed leadership of Prof. Rubbia.

While CRS4 was established in relatively little time, setting up the Science and Technology Park Polaris required nearly ten more years: the Park's headquarters were officially opened only in June 2003.

Polaris is "*a system of advanced infrastructure for the localization of innovative firms and R&D centres, as well as a system of services for innovation aimed at local SMEs*"[15]. Its main objectives are:

- Supporting high-tech start ups in Sardinia
- Supplying a range of business services to promote technology transfer and innovation in local companies
- Attracting new investments to Sardinia

Polaris is articulated in four network centres and two main laboratories. The R&D centre located at the headquarters in Pula, near Cagliari, which also hosts CRS4, maintains the original specialisation in digital communication technologies, but also promotes research on pharmacology and genomics. The second research centre, based in Alghero on the north-western coast, specialises in biotechnologies applied to agriculture.

[15] Information from the official site www.polaris.c21.it (our translation).

Polaris' new headquarters are located in a beautiful nature park by Pula, some 30 km west of Cagliari. As well as libraries, laboratories, media centres and campus facilities, the technology park includes Polaris' Internet Farm, created for new high-tech firms. The idea is to co-hosts ICT companies in the same location in order to share central services as well as exploit synergies and knowledge spill-overs from CRS4. However, since the Internet Farm relocated in the Park, the 13 'incubated' ICT companies in Polaris have reduced to just six, with two more applying to move in the farm at the time of writing[16]. For some companies it was simply time to move the first steps alone, but for others the move may be motivated by the new location. Some of the Consorzio 21 professionals we interviewed suspect that the splendid isolation and distance from Cagliari, though suitable for research activity, may pose too many difficulties for the companies' commercial contacts and trade. An Internet farm addressing the needs of start-ups, like Polaris', deals by definition with small companies that are yet to grow. Furthermore, the vast majority of Sardinian companies remain very small - often a one-man-band - and therefore the research, business and sales personnel are often one and the same person.

2. The local economy

Sardinia's local economy represents a small portion of the Italian economy as a whole. In 2001 its gross domestic product (GDP) was €26.3 billion[17], which represents 2% of the national GDP. The island's share of national value added is also 2%.

Sardinia relies mainly on the tertiary sector, which produces over three quarters of the local value added, while industry contributes for nearly 20% of value added and agriculture provides the balance, as illustrated in

Table. Within the island, the area surrounding Cagliari has the greatest economic significance and produces nearly a third (32.33%) of the island's value added, even though it hosts 28% of the population. While Sardinia has a greater share of value added coming from agriculture than Italy as a whole (4.2% versus 2.7%), the metropolitan area of Cagliari produces only 1,8% of its total value added through agriculture, and is relatively specialised in the service sector. In fact, Cagliari's LWS has experienced a decline of the agricultural sector during the five years 1995-2000, which was partly absorbed by growth in services. Industry has remained relatively stable.

[16] The companies currently hosted in the farm are Axis, Leaderchip, Micro, Staget, Sardegna Innovazione, Edulife (only company to come from continental Italy). Econfidence and Look Up are expected to join in the near future. (source Consorzio 21 R&D dept.)

[17] source: Annuario Statistico della Sardegna 2003, table 10.1a

Table 5: 2000 value added by sector and geographical area

		€ millions	%
Italy	Agriculture	26,292	2.77
	Manufacturing	265,960	27.99
	Services	657,895	69.24
	Total	950,146	100.00
Sardinia	Agriculture	840	4.21
	Manufacturing	3956	19.81
	Services	15,177	75.99
	Total	19,973	100.00
Cagliari LWS	Agriculture	116	1.80
	Manufacturing	1190	18.43
	Services	5,151	79.77
	Total	6,457	100.00

Source: Crenos, Il Quadro Macroeconomico del Sistema Produttivo Locale di Cagliari, 2004

Value added per inhabitant is higher in Cagliari's LWS than in the island of Sardinia, and is closer to the average values of northern Italy. If we consider value added per worker, however, the values for Cagliari are closer to average values for the Mezzogiorno regions. This is due to the twin influences of work inefficiencies and of low employment levels, which are also, sadly, aligned to the levels prevailing in the Mezzogiorno.

Economic activity is relatively well concentrated in Cagliari's LWS, which hosts 38% of the total Sardinian production units[18]. In the 10 years leading to 2001 the number of units has increased in this area more than any other on the island: 2.8% per year on average in Cagliari, in contrast with an increase of 1.9 in the province and 1.4 in the island on the whole. *Real estate, rentals, IT, research, consulting* registered the highest activity growth rate. Unemployment level in Cagliari has remained more than double the national rate through the decade

The average size of local firms is 4.2 workers per firm, a reduction from the 1991 value of 4.8. The small dimension of firms is not just a Sardinian phenomenon: nearly 95% of Italian companies are micro (up to two employees). In Sardinia micro firms account for 97.4% of the total. Such small size is a constraint on firm's ability to grow as well as their ability to invest in new

[18] ISTAT data uses *local production units* rather than *firm*s, thus allocating production to the territory where it originates rather than to the firm's headquarters.

technologies and reap the benefits of ICT adoption. Recent research[19] has shown that in Italy it is the largest companies (250 employees and up) that are making the most of the new technologies: they were responsible for 56% of 2002 total IT expenditure even though they account for 0.07% of firms. The same research suggests that for small companies ICT investments imply organisational changes that they are not prepared to face. The small size of local firms, together with the low level of infrastructural development are the main constraints to growth and to inbound investment.

In Cagliari, w*holesale and retail distribution, auto repairs and personal goods* make up the largest sector of economic activity. It groups over 30% of the production units and employs 18.5% of the total. The second most important area of activity is *real estate, leasing, IT, research, professional services.*

The 2001 specialisation index show that Cagliari has a degree of relative specialization in heavy industry, particularly oil refineries, mostly a heritage of the investments conducted in the 1960-70. The largest industrial group on the island (SARAS) is active in this field. Here too the number of active firms has increased, but its workforce reduced by almost 3% a year. Other areas of relative specialisation in manufacturing include paper and publishing, which has been characterised by slow yet steady growth in the past ten years, mechanical repairs and installations (where employment has also increased), electrical and optical machinery and rubber and plastics. Within the service sector, *real estate IT, research and professional services*, transport and communications and financial services show the highest specialisation indexes.

3. Information and communications technology

Information and communications technologies[20] (ICTs) are at the core of the enormous world wide changes in production, distribution and lifestyle that materialised in the last 20 years. Their impact has been likened to that of major industrial turning points such as the introduction of electricity or railroads. In the nineties, investments in ICT have fuelled the longest period of non-inflationary growth in the United States, the largest producer and user of ICT in

[19] Assinform, Federcomin, Anasin. Occupazione e formazione nell'ICT – rapporto 2002

[20] We adopt here the OECD definition of Information and Communications Technologies: "*the combination of manufacturing and services that transmit, receive and display electronically data and information*" This definition therefore includes companies

I. whose products display and process electronic information
II. whose products use electronic processes to measure, control or record physical phenomena
III. whose activity facilitates communication and processing of information through electronic instruments

(from OECD: measuring the Information Economy, 2000). This is a wider definition than that adopted nationally by the Italian Ministry of Innovation and Technology, which includes mainly the firms active in the areas (i) and (iii) above. (from OECD: measuring the Information Economy, 2000)

the world, and have resulted in significant productivity increases in many other industrialised countries.

After analysing ICT investments in a number of countries, OECD research[21] has suggested that the countries that benefited most from their ICT investments were those that have sustained ICT investments with appropriate micro-economic reforms.

It has also been claimed that ICTs have the potential to change economic and social geography, since they abolish the economic significance of distance. The evidence on this claim, however, is less consistent. In the first place, distance is truly abolished only for goods or activities that are immaterial and totally digitizable, while for all other goods there is still a positive cost related to distance (both in terms of time spent travelling and cost of shipping). Secondly, ICTs can significantly reduce the costs of (remote) product specification, production schedules and quality control, but only insofar as the products are standardized and the relevant information easily 'codifiable'. The computer industry is a prime example of business transformed by Internet: price competition is driven by value added distributors who purchase components from the cheapest locations of the world, and assemble it to the specifications of the final purchasers. For products where frequent design changes and continuous improvements are important, the new technologies cannot effectively substitute face-to-face meetings because the relevant information is not easy to codify, and production is likely to remain close to the final market. In these instances, the new technologies are likely to cause faster product cycles rather than relocation to cheaper production locations.

Indeed, alongside the forces that pull production towards countries characterised by cheaper factor costs, there are opposite forces that push it towards sophisticated markets. Markets with a strong network of business and professional services, for example, will continue to attract firms even though they may not have the cheapest factor prices. Also, businesses that need specialised labour, such as ICT production, follow the spatial patterns of knowledge-intensive industries, and therefore tend to cluster around centres of excellence (be it in research and/or business) and become entrenched in them through virtuous circles of knowledge spill-overs and cumulative growth. Finally, firms prefer to locate in markets characterised by a degree of transparency. In other words, firms tend to go where it is easier to manage their business and to benchmark against other players.

On the other hand, the use of ICTs and Internet enable businesses to search the globe for clients (or conversely, for low cost suppliers) with greater ease and virtually no expense. EBay and Amazon are well known examples of businesses

[21] See OECD 2001 "The New Economy: Beyond the Hype" and OECD 2003 "ICT and Economic Growth. Results from countries, industries and firms".

that have gone global using the Internet as their exclusive marketplace. However, the power of internet as a global marketplace can be easily overstated. Though growing, e-commerce is still a minority activity in many European countries. In Italy, in particular, only 1.647 million out of 22 million users[22] regularly purchased from the web in 2003. As A.J. Venables has powerfully argued[23]: "*the internet is excellent for acquiring information, but information is a necessary but by no means a sufficient condition for completing a trade*".

ICTs in Italy. In Italy, many have looked at ICTs as the technological paradigm that could enable the country's Mezzogiorno to leapfrog technology and catch up with the more affluent northern areas. Indeed, while a few promising industrial clusters seem to emerge in the south, especially in Campania, Sicily and Sardinia[24], Italy as a whole did not exhibit evidence of an ICT-led general productivity increase in the 90s. Nationally, average growth of Labour Productivity in the mid nineties was 1.1%, a lower value than the previous decade, when it grew on average 2%[25]. A deceleration of Total Factor Productivity, which lessened its growth from 1.4% to 0.8% in the same period, caused the lower labour productivity level. In the present chapter we will briefly examine the national Italian context and then analyse the patterns of ICT production and diffusion in the Cagliari area.

The Italian ICT market was worth around 67.2 billion euros in 2003[26], thus making Italy the fourth largest market in the EU after France, Germany and the United Kingdom. Telecommunications take the lion's share of the market, with nearly two thirds of the total, and the service component of the telecommunications sector is responsible for half the national market.

When it comes to ICT production, Italy ranks 6th in Europe. Like all industrial production in the country, ICT production is concentrated in the north and centre[27]. Northern Italy has larger and more sophisticated businesses for the local ICT companies to service, as well as consumers with greater disposable income. Central government and publicly owned companies are headquartered in Rome and feed a healthy ICT local industry. Conversely, ICT companies in the south tend to be smaller and less specialised than their northern counterparts, as they address the simpler needs of small businesses and families

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[22] From Osservatorio Anee 2003, www.assinform.it

[23] Venables A.J.: Geography and International Inequalities: the impact of new technologies, May 2001

[24] see for example: Del Monte "Esiste un Nuovo Mezzogiorno? Alcuni Protagonisti del Sud nei Settori dell'Information and Communications Technology" 2002 and A. Ferrucci, D. Porcheddu "La New Economy nel Mezzogiorno" 2004

[25] see for example Brandolini e Cipollone, 2003, "Una Nuova Economia in Italia?" In Rossi, S. "La Nuova Economia: i fatti dietro il mito, Il Mulino.

[26] From EITO yearbook 2004

[27] North-western Italy, the most industrialised area of the country, hosts 30% of the national industry and 37% of the Italian ICT sector.

rather than the sophisticated demands of large corporations. Average ICT firm size is 6.22 nationally, 6.89 in north-western Italy and 4.92 in Cagliari.

On the supply side, the IT sector has a greater presence than telecommunications: it has five times the number of production units and twice the employment level. The IT industry is made up of many relatively small outfits (average size is only 4.81 workers per unit), and the top companies are usually the Italian chapter of large multinationals like Microsoft, HP, Cisco, and so on. In telecommunications, large companies are more common (average firm size is 13.14) and several of the industry champions are local firms, such as the incumbent Telecom Italia, the mobile phone company Wind (wholly owned by the electricity distributor ENEL) and, indeed, the Sardinian champion Tiscali. Several of the top revenue-making companies in Italy are telecommunication service companies.

ICT market in Sardinia. No information is available on the size of the local ICT market in Sardinia, but regional data on IT expenditure, which is summarised by Table below, is accessible through the national association of IT producers. In 2003 Sardinia spent over €230 thousand on IT, and if we assume the same ratio of IT to telecom expenditure as in Italy, then the ICT total is three times the IT expenditure. This *guestimate* of the local 2003 ICT market would then be in the region of €610 million.

Table 6: IT expenditure in Sardinia

Euro '000	**2001**	**2002**	**2003**
IT expenditure total	229,574	217,226	203,693
% of national IT expenditure	1.12	1.08	1.05
IT expenditure per employee (Italy = € 880)	429	400	372
IT expenditure as % of value added (Italy =1.65%)	-	-	0.80%

Source: Assinform 2004

Sardinia is among the five smallest IT regional markets in Italy, and accounts for just over 1% of the national total. Its relative weight has slightly decreased in the last three years. As the national IT market experienced a downturn in the last few years, so did Sardinian IT expenditure. In fact, the island experienced the largest negative variation in the country for the year: (-)6.2 %, compared to (-)3.2% nationally. Sardinia has also the negative record of the lowest level of IT expenditure per employee, which, at €372, is only 41% of the national average value of €880. Furthermore, this figure has declined by 7.1% in 2003 after contracting 6.7% in the previous year. The ratio of IT expenditure to locally produced value added also shows Sardinia trailing behind all other regions of Italy at 0.8%. The small size of the local market appears to be compounded by low levels of local investment in IT, putting Sardinia at the rear end of the national scale.

E-government is supposed to play an essential role in stimulating demand for advanced interactive services. The regional administration of Sardinia prepared a thorough plan for information society on the island in the year 2000[28], and with some updating the plan was approved in October 2002. Numerous initiatives to stimulate adoption of the new technologies and provision of innovative, interactive services are now in place. Generally speaking, e-government initiatives on the island can be divided into three main strands:

- Information Society projects developed and financed locally
- projects financed through EU regional development funds
- Projects co-sponsored by the Ministry of Innovation and Technology.

Local IS projects involve all levels of local government, from region to province to municipality and even community. The cornerstone of the Regional administration plan approved in 2002 was an infrastructural project, RUPAR, an acronym for "network of the *regional* PA", which so far has failed to materialise. The creation of a dedicated network for the regional administration, connecting public databanks and services to local administrations and other government bodies, should proceed in parallel with the development of a *national* RUPA. The Ministry for Innovation and Technology, however, has now replaced the concept of national and regional RUPA(R) with that of "system of public connectivity" (SPC), in view of the fact that the network must be an interconnecting system characterised by common technical and graphic standards. In 2004, Sardinia earmarked €3.14 million for further development of its broadband RUPAR.

E-learning is the other key project in the Sardinian information society plan; the project MARTE entails supply of IT labs in all schools (primary to high schools) as well as distance teaching and training for teachers.

Drawing on the EU regional funds, Sardinia set up the DIESIS projects[29], five pilot projects in the key areas of e-commerce, e-learning, e-tourism, e-government and knowledge management. The CRS4 centre coordinates the five areas and is directly in charge of the knowledge management pilot. Tiscali is also involved and powers the project's website. These projects, particularly the e-tourism module, were surrounded by controversy as local IT companies complained that tender procedures were clouded by political interference. The matter is presently in front of the administrative tribunal.

Three projects set up by Sardinian local administrations were also selected by the Italian Ministry for Innovation, which co-finances 50% of the undertakings

[28] Regione Autonoma della Sardegna, "Strategia per lo Sviluppo della Società dell'Informazione in Sardegna", Ott. 2002. Available from www.regione.sardegna.it

[29] DIESIS stands for Digital Innovative Exploits for a Sardinian Information Society. See www.diesis-sardegna.it

rated best in each of its two public competitions (in 2002 and 2004). Rather than infrastructure, all Sardinian projects aim to offer services for citizens and businesses.

ICT production. Sardinian ICT production is a small fraction of the national total: 2.4% of firms and 1.3% of workers. The local ICT sector represents 2.62% of Sardinian production units, and 3.47% of employed workers. This indicates a slightly higher incidence for the ICT sector in Sardinia than found in the Mezzogiorno regions taken together (2.21%) even though it remains below the national average value of 3.21%. Following a previous analysis of the ICT industry in Italy[30] we constructed concentration and specialization indexes for the island as well as the Cagliari area. The first indicator is simply the local quota of ICT workers over the national total, the second is a ratio of the local ICT concentration over the local quota of manufacturing and tertiary sector workers. The results, reported in Table 7, are very low for both Cagliari and Sardinia. When it comes to regional concentration, for example, the highest value was found in Lombardy, with 26.7% of national ICT workers. The above-mentioned 2001 research found the highest levels of relative specialisation (that is, values greater than one) in the LWSs of Milan (19.08), Firenze (2.43) and Genoa (1.92)[31].

Table 7: ICT concentration and specialization indexes

	concentration	specialisation
Sardinia	1.27%	0.65
Cagliari	0.70%	0.69

Source: our calculations from ISTAT 2004

Table 8 below describes the ICT industry by main sector in the national, regional and local context. The majority of Sardinian ICT firms (85%) are active in the IT industry, particularly in the area of IT services, and services altogether are predominant in the local ICT sector. Following the pattern of most local firms, the ICT outfits tend to be small (4.92 workers on average) and generally configured as "ditte individuali", i.e. the simplest form of individually-owned company. However, there is a much higher incidence of limited companies[32] in this sector than there is in the Sardinian industry on the whole (52.4% in the ICT sector vs. 27.6% in overall industry).

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[30] G. Iuzzolino, "Struttura dell'Offerta e Divari Territoriali nella Filiera dell'Information and Communications Technoloy in Italia", Banca d'Italia, Temi di Discussione # 421, 2001.

[31] The 2001 study used data from the 1996 Census, as the 2001data was not yet available, our calculations, using 2001 data, yield slightly different values of relative specialisation.

[32] While there is no exact equivalent to a British *Limited Company* in the Italian system, the "società di persone" and "società di capitali" which together make up 52% of companies, are the format closest to a limited company.

Table 8: Composition of the ICT sector - 2001

Local production units	Italy	Sardinia	Cagliari
manufacturing			
office equipment, computers and hardware	1,715	47	25
cables and wires	580	3	0
broadcasting and telco transmitters, receivers, components	9,680	224	71
instruments for navigation, measurements and control	2,404	33	22
equipment for monitoring and controlling industrial processes	1,162	5	0
distribution			
appliances, radio and TV equipment	8,808	119	67
office equipment and hardware	7,101	131	63
other industrial machinery	8,071	131	67
services			
Telecommunication services	2,186	59	32
Leasing of office equipment and hardware	253	5	3
IT and related services	84,102	1,720	758
TOTAL ICT	***126,062***	***2,477***	***1,108***

Source: our calculations from ISTAT 2004

ICT production. Cagliari is the main production base of the ICT sector in Sardinia, with nearly 45% of the island's units located in its metropolitan area. The service sector is predominant: 72% of production units and 75% of the workforce. On its own, the telecommunications service sector employs 28% of the sector total and exhibits the highest average firm size, at 49.19.

Table 9 shows that most of the ICT sectors have experienced positive growth in the decade considered. Among them, hardware production in particular has exhibited double digit growth in both production units and labour force. Conversely, manufacturing of cables and equipment for control of industrial processes have disappeared in the course of the nineties. IT and related services represent the second strongest growth with the ICT sector, for both production and employment.

Table 9: ICT production by sector in Cagliari, 1991 and 2001

	1991	2001	91/01	1991	2001	91/01	2001
	units		A.Y.C.	workers		A.Y.C.	ave size
manufacturing							
office equipment, computers and hardware	5	25	16.1%	24	101	14.4%	4.04
cables and wires	1	0	-	2	0	-	-
broadcasting and telco transmitters, receivers, components	76	71	-0.7%	642	476	-3%	6.70
instruments for navigation, measurements and control	17	22	2.6%	72	101	3.4%	4.59
equipment for monitoring and controlling industrial processes	1	0	-	3	0	-	-
distribution							
appliances, radio and TV equipment	73	67	-0.9%	378	268	-3.4%	4.00
office equipment and hardware	46	63	3.1%	198	218	1.0%	3.46
other industrial machinery	50	67	2.9%	172	224	2.6%	3.34
services							
Telecommunication services	39	32	-2.0%	1568	1574	0.04%	49.19
Leasing of office equipment and hardware	0	3	-	0	10	-	3.33
IT and related services	368	758	7.2%	1387	2479	5.8%	3.27
TOTAL ICT	**676**	**1 108**	**4.9%**	**4 446**	**5 451**	**2.0%**	**4.92**

Source: our calculations from ISTAT 2004

Table 10 provides a breakdown of the main areas of IT service. In 2001, the two key IT activities in Cagliari were data processing and software supply.

Table 10: IT services in Cagliari

	1991	2001	91/01	1991	2001	91/01	avrg
	units		A.Y.C.	workers		A.Y.C	size
consulting on system installation	19	16	-1.7%	107	27	-13.8%	1.69
Software houses	89	201	8.1%	400	1186	10.9%	5.90
data processing	192	318	5.0%	586	742	2.4%	2.33
database	4	7	5.6%	11	14	2.4%	2.00
hardware maintenance and repairs	41	66	4.8%	195	170	-1.4%	2.58
robotics eidomatics etc.	3	30	23.0%	27	75	10.2%	2.50
other IT activities (web)	20	120	17.9%	61	265	14.7%	2.21

Source: our calculations from ISTAT 2004

Data processing is conducted predominantly by small local accounting firms that prepare and certify accounts in electronic format. They represent therefore a "modernised" version of the legal / accounting profession. These firms have grown in number at an average rate of 5% a year (1991-2001), and in 2001 they employed nearly 750 people, showing an average size of just 2.33 workers.

Numbering 201 in 2001, software houses are the second largest group. They have increased at a yearly rate of 8.1% in the decade, generating an even larger increase (10.9%) in the number of workers employed in this sub-sector. Because of the presence of a few relatively large players (>100 employees), software houses have the largest average firm size in the local IT service sector, at 5.9.

In February 2004[33], the *Osservatorio Industriale della Sardegna* conducted an in-depth survey based on a representative sample of 122 Sardinian firms active in

[33] F. Manca, C. Murroni, C. Persico," Le Industrie delle Tecnologie dell'Informazione e della Comunicazione in Sardegna", Osservatorio Industriale della Sardegna, June 2004. Wholesale and retail distribution were not included in the sample. The study recorded no significant difference between Cagliari and other production locations on the island.

ICT manufacturing and services. According to the survey, software houses (22% of the sample) offer a range of services:

- personalised software solutions for their clients (74%),
- training (63%),
- off-the shelf software packages (52%) technical assistance (52%),
- consulting on system design and installation (44%).

Web services are offered as a secondary activity by over 25% of the firms contacted, but only a minority (five companies in the survey) make this their principal activity. In the Cagliari area, however, companies registered as providers of web services such as web hosting, housing, e-commerce, portals and websites have increased six fold between 1991 and 2001 – a double digit annual growth of 17.9 - and have exhibited the highest yearly increase in the number of workers of the ICT sector (14.7%). In the same period, their weight in the Cagliari ICT sector rose from 3% to 11%. The fastest growing IT area is '*robotics, eidomatics etc*' (mainly creation and processing of electronic images), where the number of companies has increased 10-fold in the period considered.

After IT-related activities, telecommunication services make up the most important ICT activity in the Cagliari area. In the survey mentioned above, as well as having the largest firm size, telecommunications services operators were found to be predominantly *limited companies* (hence with a more sophisticated set up than normal), belonging to the upper income group (€ 1-25 million a year). Even though the number of local production units offering telecommunication services has decreased between 1991-2001, the overall number of employees in the sector has shown a modest increase.

The survey also investigated the relations between the ICT sector and the local market, asking companies to report on their backward and forward links as well as their chosen methods for researching and contacting suppliers, clients and personnel.

By and large, Sardinian ICT companies show a greater inclination to expand their markets than firms in other industrial sectors, but they are nevertheless much less "connected" with the outside world than their Italian and European counterparts. While the majority of surveyed companies have email (84%), only 44% have a website. Both values are low, especially considering that the firms contacted are supposed to be the *high tech* sector on the island!

The survey found that 28% of respondent firms only use Sardinian suppliers, while 42% use both local and mainland suppliers. A minority of firms (13%) also access EU and other international markets for their supplies.

Table 11: Sardinian ICT firms by location of suppliers

Sample = 122 firms	number	%

Only use Sardinian suppliers	34	27.9%
Only use Italian suppliers	21	17.2%
Use both Sardinian and other Italian suppliers	51	41.8%
Use suppliers from anywhere	10	8.2%
Use suppliers from anywhere but none local	6	4.9%

Source: Osservatorio Industriale della Sardegna 2004

The survey proceeded to investigate on the preferred ways of searching for suppliers, focussing on supplies of ICT goods or services. Respondents were asked to rate the relevance of different methods.

For 70% of the companies contacted, personal contacts or word of mouth are the main mechanisms for finding suppliers. Internet is a distant second: while 47% of respondents consider the net "very important" for finding new suppliers, more than half gave it little or no importance. A disquieting 30% rated it absolutely "unimportant". Trade fairs proved to be the most unpopular searching method.

Internet appears to be more relevant as a communications tool to keep in touch with existing relations, for which purpose it is rated just below telephone and fax. While the phone is important for 93% of respondents, the net is for so for 70%. The relevance of personal meetings for on-going communication with suppliers is modest: 38% of respondents found face to face meetings to be important for keeping in touch with suppliers.

These findings suggest that in the case of Sardinian ICT producers, the majority of local entrepreneurs prefer to deal with the environment they know rather than venturing into the unfamiliar. Cultural barriers can be an obstacle to the efficient use of the new technologies. The face-to-face interviews we conducted also suggested a certain cultural resistance to networking and sharing resources, which could be important ways of overcoming some of the problems stemming from small size. The main cultural obstacle is a generalised diffidence; together with the belief that the local market is so small that sharing equals losing a precious slice of it.
When it comes to their downstream markets, Sardinian ICT firms are even more locally orientated: word of mouth and personal contacts are overwhelmingly more popular than the establishment of an independent sales force or even traditional advertising. Novel methods of advertising, such as web banners, search engine marketing and web promotion in general are used more often than traditional broadcast and press advertising, probably because of their lower costs. In both cases, however, the percentage of companies who advertise regularly is extremely low.

Just under a quarter of the sample sells both in Sardinia and in mainland Italy, while two thirds of the companies contacted only sell on the island. The

percentage of Sardinian ICT firms that export their product to Europe and the rest of the world is just over 12%. This is a higher proportion of export-oriented firms than found in overall manufacturing.

Table 12: Sardinian ICT firms by location of final market

Sample = 122 firms	**%**
Only sell in Sardinia	65.5
Sell in Sardinia and rest of Italy	24.6
Sell anywhere	6.5
Do not sell locally	2.4

Source: Osservatorio Industriale della Sardegna 2004

Companies were also asked to report on their average number of clients in the year to date. The majority of contacted firms (47%) declared to have more than 100 clients. This appears to be a positive factor, as a large number of clients usually translates into higher and steadier volumes of sales. However, this finding also seems to confirm the results of research from Assinform[34], which pointed out that ICT companies in the Mezzogiorno regions of Italy need to invoice many more clients than their northern counterparts in order to obtain the same level of sales, because their lower specialisation results in lower earnings per client.

Call centres. Our analysis so far has not considered call centres. Even though they are not part of the ICT definition, and are classified differently in official statistics, call centres deserve a special mention. Call centres use telecommunications and software solutions to offer data intensive services, usually customer service or reservations for third parties. As technological progress and liberalization contributed to drastically reduce the cost of communications, many back office activities of large multinational companies have been outsourced to call centres conveniently located in low salary areas/countries. Call centres do not require specialised workforce, but only pleasant manners and use of the required language(s). Given its vast pool of workers in search of employment, it is little surprise that Sardinia has a significant presence of call centres. In the Cagliari area, nearly a thousand people work in call centres, which is more than the employees of agriculture and fisheries put together.

[34] Assinform, Federcomin, Anasin. Occupazione e formazione nell'ICT – rapporto 2002

Table 13: Call centres in Cagliari LWS

Local production units		workers	
1991	**2001**	**1991**	**2001**
67	343	186	949

Source: ISTAT 2004

All in all, the ICT industry in Sardinia is a sector of growing importance, considering that in less than 15 years it has earned relevance comparable to that of the well-established sectors of restaurants and hotels, for both production units and workers. ICT now employs six times as many workers as petrol and chemicals – for many years the most important economic activity on the island. Relative to the other sectors of production, it is also a moderately sophisticated and international division. When compared to ICT productions of northern Italy and Europe, however, the Sardinian clusters look small and lack specialisation. There is no evidence of a growing division of labour among the local outfits, which could result into a local integration of production along the lines of the Italian industrial districts. There the small size of the individual firms is overcome by the overall size of the district, where companies are integrated vertically and engage in cooperative competition. Here, as we will argue later, companies are small and seem unwilling to grow.

4. Tiscali

The origins of Tiscali, the European ISP created in Cagliari in 1998, can be linked back to a series of events that unfolded in the preceding decade.

In the late '80s, Cagliari, and Sardinia as a whole, were confronted with the decline of the island's traditional industries: mining, chemicals and agriculture. The prevailing industrial model in manufacturing - direct involvement of the Italian state in productive activities – was also in decline. The Sardinian administration in power at the time was therefore charged with the task of creating a new model of sustainable development for the island. The administration identified a new and promising development path in the field of knowledge-intensive industries in general, and advanced mathematical calculation in particular. It thus resolved to invest heavily in the creation of local knowledge through a series of complementary measures, ranging from post graduate scholarships for Sardinian students to direct investment in research structures. Within this context, as discussed in the General Description, Consorzio 21 was created in 1985 to develop and manage the Science and Technology Park. By the end of 1990, the digital research centre CRS4 was up and running, and it rapidly established itself as an international centre of excellence for innovative digital technologies. Cross fertilizations between the centre and the main media outfit in Sardinia (L'Unione Sarda) produced a chain of events that gave life to a few remarkable start-ups:

- The first web page in Italy; www.crs4.it (1993)
- The first newspaper on line in Italy: *l'Unione Sarda on line* (1994);
- A pioneering national Internet Provider, Video on Line (1994-96), from the same local newsprint company
- The first national provider of free internet services: Tiscali (1998)

The idea behind Video on Line (VoL) was to create a community of users that could access content and services on the web in many different languages; a model that added an international and exquisitely Mediterranean dimension by offering services in many minor local languages. Though visionary and innovative, these experiments did not last. Video on Line became a casualty, as the incumbent Telecom Italia bought the new outfit and put an end to its development in 1996. On one hand, the state of competition in the Italian telecommunications sector was still embryonic and as a result Video on Line was heavily indebted with Telecom Italia. On the other hand, Internet was a little known platform and the popularisation of Internet services required either very deep pockets or risk capital – neither of which was at hand.

After acquiring the local ISP, Telecom Italia developed its own internet company and transferred most related competences from Cagliari to the mainland, leaving only the customer service unit on the island.

Still, the net result of these events was the creation of a pool of advanced local skills in a new area of telecommunications where even the national incumbent had little or no experience: at the time, most of the (few) Italian people who knew something about Internet were based in Cagliari.

The start of Tiscali in 1998[35] was undoubtedly the most significant circumstance of the decade for the Cagliari area. Many of the human resources that had acquired new competences through CRS4 and Video on Line contributed to the shaping of Tiscali in its early years. Tiscali's founder, Renato Soru, had made his first mark in the ISP business as a manager of the Video on Line's Czech division. As Telecom Italia moved its network division out of Sardinia, Tiscali's growth fed off it, proceeding in parallel with the gradual reduction of the incumbent's local presence. Because of the legacy of Video on Line and Telecom Italia, local human resources were capable of developing and managing an innovative new business like Tiscali.

The first business model adopted by the company was based on three main lines of revenue: voice, internet and business services.

Tiscali sought and obtained a full telecommunications licence from the Italian Ministry of Communications, in order to tap immediately on the more mature voice telephony market, where Telecom Italia had seen relatively little challenge.

[35] The company was formed in 1997 but began operations in 1998

Initially licensed to work as a regional operator in Sardinia, Tiscali obtained a national licence in early 1999. The voice segment was crucial for short term success and the establishment of Tiscali in Italy, a country still relatively unexposed to competition[36]. Firstly, voice had a much higher earning potential at the time, while Internet had a modest penetration in Italy. Voice revenues dominated the company's turnover in 1998 and 1999: figure 3 shows that they accounted for nearly ¾ of sales in 1998 and over 60% in the following year.

Secondly, and perhaps more importantly, voice was a strategic asset for running an internet business with high margins. EU telecom regulation is in fact based on the principle of "network competition[37]", that is competition between telephone companies operating their own networks. This implies that regulation is engineered to provide incentives for companies to build alternative telecommunications network, as opposed to renting the incumbents' network and supplying services over it. Although mere service providers are also protected by regulation, they are given 'lesser' interconnection rights, so to speak, compared to alternative network operators, who therefore can operate services on higher margins and thus repay their (larger) investments. The full telecommunications licence thus meant that Tiscali could negotiate interconnection charges for its Internet business with the incumbent rather than buy wholesale connectivity which was more expensive and less flexible. In fact, Tiscali pioneered the *Reverse Access Charges*, a payment system whereby the incumbent pays for traffic to the new entrant's dial-up access number. Rather than exposing itself to Telecom Italia, as Video on Line had done, Tiscali earned income from the incumbent as its business expanded. Voice was therefore a short term, albeit strategic, business. Once competition drove down the high margin of the voice business, voice services would remain a strategic complement to B2B and web based services.

From the onset, however, Tiscali operated an IP based network, which offered crucial economies of scope with the growing data and internet markets. The company expected these markets to rapidly overtake voice services and was eager to create a vast community of users, a critical mass around the company's portal. Revenue would flow not only from the minutes of internet traffic, but especially from advertising and distribution services based around the portal. Confident that on line advertising and ecommerce would be the major earners in the future, Tiscali began looking for strategic content. In early 1999 it acquired Infomedia srl, a company that had developed important software for e-commerce and e-payments, and thus commenced its drive to own valuable content.

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[36] The first telecom licences for alternative operators were issued only in 1998.

[37] For a discussion of the principles underpinning European telecom regulation, see Collins R. and Murroni C. New Media New Policy, Polity Press ,1996.

Also, analysts and financial markets were extremely enthusiastic about internet businesses internationally and internet companies were rewarded awesomely by the stock markets, even though there were few established internet operators and it was still unclear which internet business model would survive in the medium term.

After a year of successfully retailing voice services in *carrier selection* and *prepaid telephone cards* mode, in March 1999 the company launched "Tiscali FreeNet", the first free internet access service in Italy: a move that shook the market and established Tiscali as a national innovator. In its first three months, with coverage limited to Sardinia, Rome and Milan, FreeNet earned 216,000 customers. Six months later it was attracting as many as 4,000 customers a day[38]. Other national operators slowly followed.

In October 1999 the company launched an Initial Public Offering in the Italian New Market and began raising financing for its European expansion. Fuelled by the market euphoria for New Economy listings, Tiscali's debut on the financial markets was so successful that at one point the Sardinian company had greater capitalisation than Italian car maker Fiat[39].

A European company. Following its debut on the Nuovo Mercato, Tiscali began focussing on its internet strategy, aiming at a top position in Europe. It had three strategic objectives:

- building a critical mass of users throughout Europe to exploit economies of scale and scope
- developing a range of web-based services and content to attract visitors to its portals
- gaining a foothold in the emerging mobile and fixed broadband technologies[40]

To realise such objectives, Tiscali went on an acquisition spree that saw the company rapidly move to the top league of European ISPs. The acquisitions, described in Table 4, were made to gain market share in other European countries as well as to obtain strategic network and content assets. Chief among

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[38] From Tiscali's IPO, 22 October 1999

[39] Financial Times, 2001: "Before the correction in high-tech stocks provoked by the falls in the US Nasdaq exchange, Tiscali, Italy's free Internet pioneer floated on the Milan new market for high growth stocks last October, had seen its market capitalisation overtake that of Fiat. The vehicle group is now back ahead although Tiscali's capitalisation has still grown from US$6.3bn at the beginning of the year to nearly US$11bn in April."

[40] While the vast majority of internet connections at this point were dial-up, broadband technologies were already at the horizon. The EU was preparing the first round of frequency auctions for UMTS technology and the Union's telecommunications policy was actively promoting broadband through a diverse mix of technology.

them was the merger with the Dutch company World on Line, which represented the quantum leap that made Tiscali a major international company. With this acquisition, Tiscali graduated from being a fast growing independent telecom operator in Italy, to being one of Europe's chief Internet Communication Company.

Table 14: Tiscali Acquisitions, 1999 - 2000

1999	INFOMEDIA SRL (Italy)
	ENERGY BYTE (joint venture – Marton srl 45%)
	NETs SA (France)
2000	GILLA spa (joint venture – Sonera 50%)
	DATACOMM AG (Switzerland)
	TELEKOMUNIKACE (Czech Republic)
	LINK LINE (Belgium)
	NIKOMA BETEILIGUNGS GmbH (Germany)
	INTERWEB SPRL (Belgium)
	WORLD ON LINE (Netherlands)
	A TELECOM SA (France)
	IDEARE spa (Italy)
	STS (Italy – 50%)
	FREETRAVEL (Italy – 50%)
	MOTORCITY (Italy – 60%)
	BEST ENGINEERING spa (Italy)
	QUINARY spa (Italy)
	ANNUNCI GRATUITI (Italy)

Source: http://investors.tiscali.com

The Dutch company World on Line had a market capitalisation of € 4.5 billion and 4 million subscribers[41]. It also had peering agreements with TIER1 operators in both US and EU networks, a key strategic asset which allowed it to swap bandwidth freely with other international carriers. Its merger with Tiscali (who had 2.3 million subscribers at the time) created a new company with initial market capitalisation of €12.5 billion[42] and

- The largest pan-European footprint covering 15 countries
- The top 3 positions in 5 countries (by subscribers)

[41] From 2000 archives at www.ispreview.co.uk

[42] pro forma figures from Tiscali's company literature on the merger, www.tiscali.com/investors

- The largest pan-European internet community with 6.1m registered subscribers (3.5m active)
- The second largest subscriber base in Europe

The management of the newly formed group, which was headed by Tiscali's founder Renato Soru, comprised managers from both companies, including Ruud Huisman, who would eventually became Tiscali's CEO in May 2004, as Soru began his political campaign to become Sardinia's first elected governor[43].

In the year 2000 most EU countries set up their first auction for UMTS frequencies. The European Union had put great emphasis on the development of this broadband mobile technology, as cellular phones (and the European GSM standard) had proven a great success throughout the continent, and reached significantly higher penetration than in the USA. If a similar success story could be replicated with UMTS, then Europe would enjoy the widespread broadband penetration it needed for full development of interactive digital services. Tiscali, too, considered UMTS to be a strategic technology in which it should be involved, particularly since it would provide a channel to supply broadband without depending on Telecom Italia. Fixed broadband services were proving too expensive to market if supplied through the incumbent's network, and regulation did not yet allow competitive provision at the last mile. Tiscali's controlled subsidiary *Andala UMTS* bid for one of five licences auctioned by the Italian government in early 2000, as part of the H3G consortium based in Cagliari. The consortium, in which Hutchison Whampoa had nearly 80% of the capital, was granted a licence in October. However, during these months, technological listings began to fall and eventually crashed in most international markets: the speculative bubble that had magnified them for the last few years finally burst, and operators world wide had to deal with huge debts as well as needing new ways to finance their investments.

Fortunately, Tiscali had engineered many of its acquisitions as a share-swap and therefore was not impaired by the market crash. However, the huge investments required to buy the UMTS licence (which were auctioned at very high, pre-crash prices) and to roll out the network, caused Tiscali to re-think its strategy and reduce its participation in the H3G consortium to 0.3%[44]. The consortium's headquarters moved to Milan from Cagliari, where H3G maintains a call centre. Tiscali's acquisition drive also ebbed noticeably.

[43] Since June 2004, Mr. Soru is the head of the Autonomous Region of Sardinia

[44] Tiscali press release 12.07.01

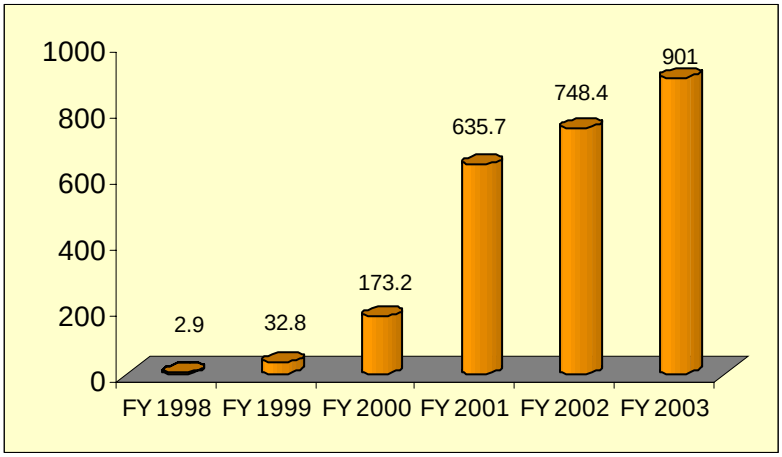
Table 15: Tiscali Acquisitions 2000-2003

2001	EXCITE ITALIA
	PLANET INTERKOM GERMAN
	SURF EU
	SPRING BOARD Internet Services Limited
2003	AIRTELNET (Spain)
	WANADOO BELGIUM N.V. (Belgium)
	TISCALI INTERNET LTD (UK)
	HOME.SE.AB (Sweden)
	NEXTRA SPA (Italy)
	EUNET EDV (Austria)
	CABLE & WIRELESS Domestic Internet Business (France)
	NPOWER (UK)

Source: http://investors.tiscali.com

With the vast expansion of the company, Tiscali group's revenues have grown enormously: average annual growth from 1998 to 2003 was 96%. The group's performance is summarised in figure 2 below.

figure 2: turnover of the Tiscali group (€ mln)

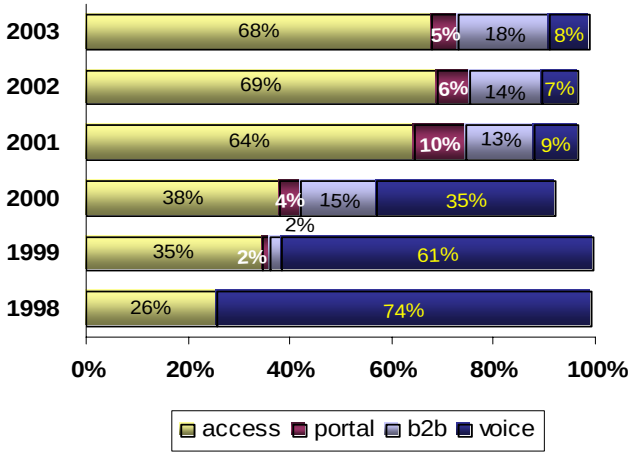


source: www.tiscali.com

Tiscali's IP based network also enlarged with each acquisition. At the time of writing, Tiscalis's network has a 12,000 km fibre backbone that crosses all of Europe and a series of Metropolitan Area Networks, covering over 30 major European cities and reaching a total of 60 points of presence. The backbone is interconnected with the national Tiscali network and enables the company to reduce costs drastically. Considering all the aggregate network properties of Tiscali, the network covers over 50,000 km. Tiscali has over 300 peering partners all over the world. This way, users can connect to the Tiscali backbone, known as '*Autonomous System 3257*', and have immediate access to more than 60% of all the routes on the global Internet Routing Table. Tiscali's International Network Operation Centre monitors proactively the backbone and services, so that this single contact point can manage and follow up any problem on the entire international network from the Cagliari headquarters.

The international economic slowdown and ensuing reduction in advertising revenue during the last few years have affected the business model initially forecast by the European ISP. As figure 3 indicates, e-commerce and portal revenue did not overtake access revenue after all. Access has remained the main source of income, responsible for nearly 70% of the company's turnover in the last two years. However the new trend was for broadband rather than dial-up access, that is, access with much greater speed and capacity. Broadband access, therefore, became the key focus for Tiscali, and its founder began campaigning in front of the EU commission in July 2002 for deregulation of the local loop.

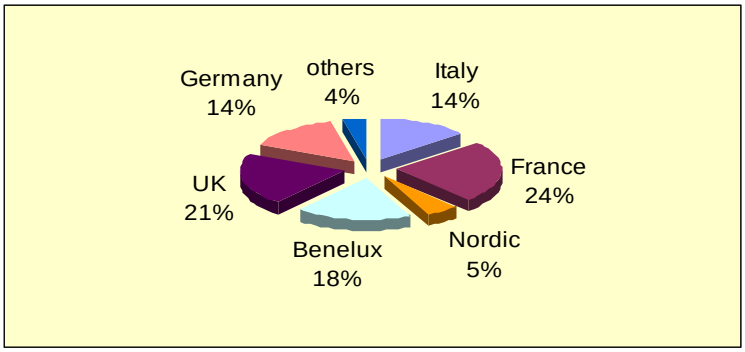
figure 3: incidence of different lines of revenue over company turnover, 1998-2003



source: www.tiscali.com/investors

Indeed, the importance of broadband access has grown throughout Europe the last few years, and Tiscali is betting heavily on broadband development. ADSL is now responsible of 41% of the group's access revenues and nearly a quarter 24% of overall revenues. The company connected 1.542 million customers throughout Europe by 30 September 2004 and expects to have 1.7 million by year end.

figure 4: broadband customers of the Tiscali group at 31.03.2004



source: www.tiscali.com/investors

Tiscali's current business model can be summarised as follows:

1. Access services

Narrowband and broadband access to internet through a portfolio of platforms (from dial-up to x-DSL and satellite broadband) constitutes the chief line of business for Tiscali. The two types of access underline, however, two very different types of business for the supplier. In the dial-up narrowband environment, most customers enjoy free Internet access, and revenue comes from reverse access charges. In order to increase profits, companies keep the free packages very basic and try to get customers to upgrade to premium services (greater mail-box capacity, antivirus, anti spam) for a small fee. However, to get customers to pay for something that they enjoyed for free is notoriously a difficult task, and therefore other advanced services, such as voice over IP, unified messaging and voice portal services complement the access package.

Broadband access is on subscription, and has therefore a potentially more stable revenue model. The vast majority of Tiscali's ADSL customers, particularly in Italy and France, are serviced through wholesale re-selling of the incumbent network's functionality, rather than unbundling of the local loop (LLU), at the time of writing. Broadband profitability depends on the operating margin

available after paying the incumbent for its services. According to Tiscali's literature, while broadband based on wholesaling has lower profit margins than dial-up, unbundling would raise the provider's margins to nearly 70%[45]. But this option requires investments in the local loop. As we will discuss with greater detail later, Tiscali's ability to undertake the necessary investments for unbundling ADSL in Italy (as announced in August 2004) is heavily conditional on the company's cash position. Many analysts are casting doubts on the company's ability raise enough cash through asset sales in the current year to finance its future growth[46]. Despite this surrounding pessimism, Tiscali announced in late 2004[47] the launch of new fast ADSL subscription packages, based on local unbundling, following investments in Italy France and the Netherlands[48]. In the near future, Tiscali's unbundled ADSL subscribers will be offered "triple play": broadband access, voice and content services. The voice package entails a flat rate fee for unlimited IP calls through the telephone, which would allow Tiscali's LLU ADSL clients to cease renting the line from the incumbent.

2. Content distribution

Tiscali offers a wide range of content, e-commerce and advertising opportunities through its portal. Revenues come from advertising, which depends on the number of users/hits, and from distribution, which pays a fee per transaction. These lines of business grow with the number of users who access the portal, but unlike access fees, which are non-cyclical, they tend to follow the ups and downs of the economy. During bad times companies advertise less, and the volume and value of most transactions fall. Broadband access impacts positively on content revenues, since its superior speed makes it easier to download content or buy products on line. Attractive content, which draws customers to the portal and makes them stay on line as long as possible, is therefore a crucial ingredient of a successful broadband business. Tiscali's 2004 portals, renovated in their graphics and content, offer many dedicated channels such as Music, Finance, Games, Motoring and Sports. The majority of channels offer free downloads, news, surveys and specialist information; a few also offer pay services. With broadband access, ISPs are (or strive to be) in direct competition with other digital content providers, such as broadcasters and cable TV operators. The history of pay-TV and subscription content has shown that sports, films and music – in that order - are the three crucial revenue drivers. Tiscali has been a first mover in the music arena, offering legal downloads of digital music as early as February 2003 – a service called Super

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[45] Tiscali results from 2nd quarter 2004, from www.tiscali.com

[46] see for example Carlo Castelli of Actinvest (London) in www.ispreview.co.uk or Hugo Dixon's "Breaking Views" feature on La Repubblica (7.8.04) www.repubblica.it

[47] Tiscali Press Release 14.10.2004

[48] Tiscali Press Release 12.11.2004

Sonic Selector[49]. A platform for movie downloads was launched in Italy, Denmark and the UK in 2004: *Cinema Now* offers digital movies for €2.99. By way of comparison, satellite pay per view movies retail between €5.00 and €6.00, but they offer a much wider selection, more novelties and can be easily obtained even by "low tech" customers. In Italy, Tiscali's sport offers appear to be lacking: no pay content is available to complement the photo-gallery, survey, games and news sections. Alice, Telecom Italia's ADSL division, offers live Serie A (top division) football on their site, both pay-per-view (€2.5) and on monthly subscription (€5), as well as movies and other premium content from the group's generalist TV channel La7. RossoAlice is now one of the most visited websites in the country. Fibre operator Fastweb retails the Sky TV football matches at €12-€15 per match, as well as offering a virtual movie archive at €5.90 per month plus PPV fee. In the area of premium content, Tiscali laments their difficult negotiating position with rights owners compared with the incumbent and the main broadcasters in each country.

3. Business services

Tiscali is able to offer telephony, Internet connection and data transmission services along a single network connection, which can include direct circuits for connecting branches, disaster recovery procedure circuits and mainframe interconnections. The company has pledged to dedicate more resources in the near future to this line of business, which currently provides 18% of the group revenue (FY 2003) but only 5% of the parent company's income.

The company's results for the first nine months of 2004 were presented in mid-November. Compared with the first nine months of 2003, Tiscali's revenues were up by 24%, to € 808.7 million and gross profit increased by 11%. However, the gross margin narrowed from 50% to 45% this time, because of the lower profitability of ADSL services sold on a wholesale basis.

Table 16: Tiscali latest results, 3Q 2004

2004 *(9 MONTHS)*	
REVENUES	€ 808. 671 m
ACCESS	€ 549.3 m
PORTAL	€ 33.1 m
B2B	€ 154.9 m
VOICE	€ 66.1 m
EBTIDA	€ 74.9 m
TOTAL cash and cash equivalents	€ 133.3 m

Source: www.tiscali.com

[49] see www.tiscali.it/musica

As Table 6 indicates, access was the major earner, responsible for 68% of total revenues, which is the same percentage as FY 20003, totalling € 549.3 million. Portal revenues fell by 5% to €33.1 million compared to the first nine months of last year, while business service revenues gained 40% and reached € 154.9 million. Finally, voice services brought in € 66.1 million, or 9% of total revenues.
Earnings before interest, tax, depreciation and amortisation (EBITDA), which is an indicator of profitability used to make comparisons across industries, in the first nine months of 2004 was € 74 million, a 57% increase on the level recorded in the same period of 2003. Pre-tax loss was also smaller than last year (€33.3m versus €73.6m) or even last quarter (€65.5).

However, Tiscali's cash flow has been a source of concern for most analysts, especially considering the 250 million bond repayment due in 2005, which casts a great shadow over Tiscali's future. With cash flow reduced by two previous years of economic stagnation, uneasy stock markets and the need to invest in LLU in key countries, Tiscali opted for a strategic downsizing, announcing in mid-2004 the sale of non-strategic assets (in Norway, Sweden, Switzerland, Belgium and South Africa) acquired during its expansion years. The first asset disposal was the sale of Tiscali Österreich GmbH, the Austrian outfit, ceded to Nextra for €12 million, in August 2004. Sale of the Norwegian assets (to Telenor for approximately €6 million), the South African ISP and the cell phone company (subject to regulatory approval, for €40 and €5.3 million, respectively), the Swedish and the Swiss company (for 13 million and 5.1 million, respectively) was announced a few weeks later. The Belgian company was sold in December. Rumours of a possible takeover, however, continued to spread in 2004.

At the end of September 2004, the group had liquid financial resources of €133m, while the net debt was €382.4 million.

In Italy, commercial ADSL offers have began in 1999[50], and have accelerated in the last quarter of 2003. The National Regulatory Authority, who sets the price and conditions for wholesale access to and for unbundling of the local network, indicated in early 2004[51] that LLU provision of broadband services had been minimal and that the alternative option of a shared permanent virtual channel had seen no take up at all. It reported also operators' complaints of the incumbent's delay tactics and other examples of behaviour aimed at frustrating competition, which were specifically addressed in the NRA 2004 determination on pricing and conditions of broadband services.

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[50] Ref. OECD Working Party on Telecommunication and information services policies; '*The Development Of Broadband Access In Rural And Remote Areas*', 10.05.2004

[51] see Delibera 3/04/CIR published on 28.05.04

The needed impetus for broadband take up came in 2003 in the form of government incentives for broadband operators (a €75 refund per new ADSL customer). The incentives and the heavy marketing campaigns that followed produced the highest acceleration of broadband take up in Europe in 2003, driving ADSL penetration to 5.5 million households in January 2004. All the main telecommunications operators now offer competitive ADSL packages, mostly reselling wholesale ADSL functionality from the Telecom Italia network. The incumbent had upgraded its network making ADSL services available on 80% of the national network since the end of 2003. Wind and Fastweb are the only operators connecting residential customers through LLU at the present time, and only the former is active in the Cagliari area. Its ADSL customers in Italy represent 14% of the group's total, which is, nearly 185,000 users[52].

Tiscali has pledged to offer LLU connections in the near future. However, at the time of writing, there was no evidence of local investments in the Cagliari area. In its early days, the company had regarded Cagliari as a priority for investment (it was awarded a local licence before the national one), but in broadband the national competitor Wind has began marketing direct connections to both business and residential customers in 2003, and Tiscali is lagging behind.

Table 17: Tiscali broadband products, Italy 2004

	TECHNOLOGY	COST	SUBSCRIBERS
SATELLITE	Satellite fast connections and LANs	€80 - €199 per month	business
TISCALI ADSL	ADSL 2M, 6M, 12M	Flat:€29.95 – €99.99 free:€1.8 per hour	residential
TISCALI HDSL	HDSL 12 Mbps	Ad hoc	business

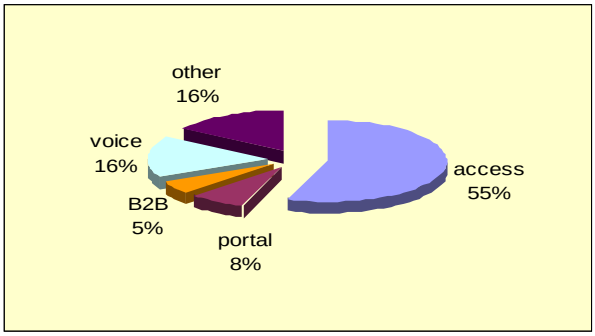
Source: www.tiscali.it

In addition to xDSL broadband, Tiscali offers fast satellite connections through Eutelsat, up to 2 Mbps. This type of connection, which uses the POTS telephone network for upstream traffic and the satellite bandwidth for downstream, is available everywhere, and is particularly suitable for rural and low density areas. The only competitor in Italy for this technology is the incumbent Telecom Italia, which uses the Astra family of satellites.

The figure 5 describes the contribution of the different business segments to the turnover of the parent company Tiscali s.p.a. in the FY 2003.

[52] Telecom Italia boasts over 2.5 million ADSL customers by the 2nd quarter 2004.

figure 5: composition of revenue, Tiscali Italia 2003



source: 2003 Annual Report, in www.tiscali.com

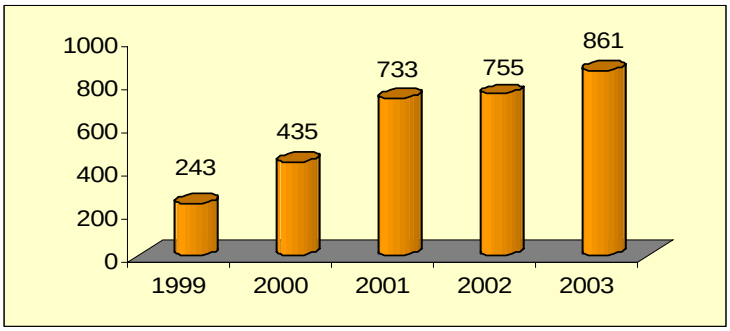
It confirms that Tiscali addresses mainly (or more successfully) the residential market: access is the main revenue line, with over half of the total income, while B2B services are a mere 5%. Compared to the revenue split of the previous year, portal revenues decreased (from 20 to 14 million and from 14% to 8% of the total) while access takings have increased 10% - from 67 to 99 million. While a decrease in portal income can be attributed to the general economic slowdown, the boost of access revenues is mainly due to the improved penetration of broadband. The partial reports for 2004 confirm the growing trend for broadband customers.

From the initial core group of 45 employees in 1998, the parent company headquartered in Cagliari has grown to employ 861 people in 2003, while the Tiscali group had 3,226 employees. Tiscali is the largest employer in the ICT sector in Cagliari, possibly matched by the incumbent Telecom Italia, if all companies of the TI group are taken into consideration[53]. The company Tiscali S.p.a. has just restructured its assets, grouping all Italian activities into Tiscali s.r.l and all services supplied by italy to the group business into Tiscali Service S.r.l.. Both new companies are wholly owned and controlled by Tiscali S.p.a. and the restructuring was performed to improve transparency and accountability within the group[54].

[53] Unfortunately employment figures for Telecom Italia and Telecom Italia Mobile are available only on a national basis, not disaggregated by production unit.

[54] Tiscali Press Release of 3.01.2005

figure 6: Employees of Tiscali s.p.a.



source: Annual Reports in www.tiscali.com

As well as being part of the CRS4 consortium, Tiscali has actively promoted the concept of distance learning, particularly attractive for a sparsely populated land such as Sardinia. In 2000, Tiscali teamed up with Credito Industriale Sardo, a local development bank, and the University of Cagliari to offer remote university degree courses in Ilbono and Sorgono, two small villages in the mountainous centre of the island. The project was very successful and two more villages in the province of Cagliari were added by 2003. Currently, 120 students can earn a short IT degree through e-learning – even though they must attend classes in Cagliari during their third and final year. Also in 2003, the company began a sponsor program for PhD students of the University's Electronic Engineering department: Tiscali offers a three-year scholarship to four graduate students, who conduct their research at Tiscali's headquarters. There is, however, no formal commitment to future relationships between the students and the company.

Tiscali's new headquarters at *Sa Illetta* (officially opened in summer 2003), are the site of Cagliari's own Telecommunication Pole, according to a three-party agreement signed in 2001 between Tiscali, the Municipality of Cagliari and the Autonomous Region of Sardinia. The Telecommunication Pole is composed by the new Tiscali headquarters and a number of infrastructure and research facilities, in the same compound, for high-tech companies in the ICT or biotechnology business (both technical and support facilities, such as nursery, school, catering…). The Sardinian region earmarked €15 million for the development of the Pole's advanced infrastructure, but so far no other company has officially located there.

Tiscali is the only newly-formed company in the Cagliari area which can boast the numbers of a company of international calibre. It is among the largest companies in Sardinia for turnover and number of employees; it is one of the most European orientated as well as the only publicly quoted company on the island.

5. In depth and up to date: other ICT firms in Cagliari

While the chain of events and local innovations that led to Tiscali's creation is relatively well documented[55], very little has been written on the relationship between Tiscali and its local peers. Can we identify a cluster of high tech companies in Cagliari? Is there evidence that points to the development of an ICT district? The present section elaborates on the results of several interviews with leading ICT companies in the Cagliari area. As well as talking to those who work with ICT companies within Consorzio 21, we selected a panel of companies, which are described in

Table below, based on the following criteria:

- Size – the largest in terms of turnover and/or employees
- Age – the companies that have been active for the longest time
- Core product – a cross section of different ICT activities
- Referral – interviewees were asked for suggestions on the most innovative or interesting companies to question

The overall objective of the interviews was that of gaining a deeper understanding of the local sector, by investigating its research activity, the upstream and downstream links within the industry, and the wider relations within the Sardinian market.

[55] as well as numerous articles in the local and international press, see in particular L. Ferrucci e D. Porcheddu 2004 op. cit., Del Monte 2001 op. cit.

Table 18 : overview of surveyed ICT companies in Cagliari

COMPANY	CORE PRODUCT	2002 TURNOVER (€ '000)	2004 EMPLOYEES	2004 LOCAL SALES
ABBEYNET	Audio video streaming	1,560.	50	0% -1%
AKHELA*	Software House	1,486	53	n.a.
ATLANTIS	Digital territorial management	1,092	110	n.a.
AXIS	Web communication and software	n.a.	15	60%
DATAREX	Manufacturing of diskettes and CD-R	2,876	24	1% - 1.5%
ENERGIT	Networked utilities (energy, telecom)	17,428	36	15%
PRODINSAR	Software House	n.a.	1	100%
SCELTA	Software House, web services	n.a.	5	50% - 75%
SOLEJA	Web advertising	1,500	15	35%

	agency			
STELNET	Web information agency	n.a.	10	20%
SYS INFORMATICA	Software House	n.a.	6	100%

Source: our interviews and Bureau Van Dyke' s AIDA data base
***** The turnover reported is that of SarasLab - now operating under the new name Akhela

Even though our conversations highlighted a number of drawbacks and limitations of the local market, the general outlook obtained from the panel of ICT companies is positive.

The first positive trend is the consolidation of a number of small successful companies into larger competitive outfits. The absence of large companies and a "critical mass" in the local cluster is one of the main weaknesses of the Cagliari economy, and consolidation is therefore a refreshing development.

The merger of SarasLab, FST, Techne and Vox, into the new company Akhela is the most high profile example of this trend. The newly formed company Akhela is now one of the largest local ICT company (180 employees), and has highly specialist skills: embedded software and system-on-chip, focussing on IT security, IT consolidation and IT services based on Linux/Open Source software. Most of the companies now consolidated in Akhela were nurtured by the largest local industrial group, Saras. After developing IT solutions for the group's internal needs, which led to the creation of an advanced data centre (in Macchiareddu, Cagliari), these companies were able to offer competitive services to other affiliate (and outside) companies on the national market.

The three IT companies Shelter, Scelta and Zonanet, which are part of a family of web projects and successful ventures spun off by the same partners, will also be consolidated into one single company in the near future. In this case, the merger is motivated mainly by a need to pool resources in the face of weak demand. While Scelta is a veteran of the Sardinian ICT sector (it was set up in 1987), Zonanet was created in 1997 and has only just left the ICT incubator of the Polaris Internet Farm.

Another positive trend is the development of formal links between companies and the local research community. Several companies in our panel are actively engaged in joint research with various departments of the University of Cagliari and with other centres of research.

Tiscali and the Saras group, for example, are partners of the research centre CRS4, and therefore contribute to setting its lines of research as well as sharing its results.

Several companies established important links with the Polaris Technology Park. Atlantis, active in the field of local development and territorial management, employs a team of 20 researchers who work at Polaris[56]. Atlantis also cooperates with universities and research centres internationally: the Robotiker foundation, the University of Central London, the Italian national research centre CNR, and the University of Cagliari.

The web communication company Axis is involved in two start-up companies at Polaris, in the field of genomics. The company owns 15,38% of the consortium *Parco Genos*, which undertakes genetic research on the population of north-eastern Sardinia, and for whom Axis processes data into useable information, and 10% of *Pharma-Gen*, supplying them with services of intelligent representation. Through the venture *Sardegna Innovazione*, of which it owns 65%, Axis has an on-going joint project with the universities of Cagliari and Indianapolis. The project aims to create a technological platform for server-client data transfers on UMTS cellular phones.

The company Abbeynet, which patented a new audio streaming protocol (Voice over Internet) in 2000, has very strong links with the local University Department of Electronic Engineering and Physics. The relations with the university are kept not only because some of Abbeynet's founding members were academics, but also because the company's emphasis on R&D motivates them to search for new staff primarily at the local university. They signed a research agreement and develop innovative projects with the cooperation of the university.

Energit, the multi-utility telecom and energy company who also patented their key energy product, awarded two scholarships to 2004 university graduates who presented original dissertations on the theme of renewable energy.

Some companies, however, question the usefulness of forging ties with the university. Stelnet, the first database business in Sardinia, considers itself a spin-off of the University of Cagliari's engineering department, with whom it has excellent relationships, but has given up joint research with them. While there are a lot of interesting projects and ideas - the company complains - financing is always difficult and the long delays between approval and actual financing usually kill the projects. By the time a new project can get underway it is already obsolete. This happened with projects undertaken with the University as well as the research centre CRS4, even with those earmarked as 'innovative applied research', for which three years passed by between planning and approval. The same problem applies to all public financing, so that often brilliant ideas, even at pre-competitive stage, are lost because of the ridiculously long time lags before the funds are actually available.

[56] in addition to over 100 employed in sales and production

The local degree in IT was, however, widely criticised (in fact, no positive opinion was recorded) for being of little relevance to the needs of the companies. The software houses, who train all their staff internally, prefer to use non-technical graduates, because in their experience they tend to be more motivated and turn into better IT professionals than the local IT graduates.

Turning to the negative trends, the firms interviewed confirmed the general tendency of Sardinian companies to operate in isolation. The absence of formal or informal links between companies in this industry, to be fair, is not a peculiarity of the Cagliari Work System. The high-tech cluster around Genoa, which employs around 9,000 people, is also characterised by a distinct lack of productive links. However, the companies in the Genoa district – even in the absence of such links - realised the need to get together to pursue many common objectives. A number of them (130 out of some 200 operating in the area) teamed up and created the association *Dixet* to enhance the competences of the high-tech district[57]. Among the stated common goals are: the growth of human resources, development of advanced ICT networks and systems, establishment of joint laboratories between firms, university and research companies, and promotion of the district and its firms nationally and internationally. As a result of this agreement, many local actors worked together to officially form the Genoa Technology District[58], set up by Dixet, the Regional Administration, the University of Genoa, the Genoese Chamber of Commerce and the Liguria Technology Park.

Unfortunately, in the Cagliari area there are no signs of spontaneous cooperation among companies. Not only the firms surveyed have no permanent or structured links with other ICT companies in the area, but also no "systematic preference" for the services of the Sardinian ISP has emerged from our findings.

In its role as facilitator of technology transfer, Consorzio 21 carries out many activities aimed at local SMEs, often with the objective of strengthening cooperation among firms. Companies hosted in the Polaris Internet farm, for example, are invited to share their projects among them and tap on the expertise of researchers from the CRS4 centre. However, their success is mixed. Some employees within Consorzio 21 point out that in order to win over well-known cultural barriers, companies were attracted to the Internet Farm with the promise of superior facilities and advanced telecommunication infrastructure. However delays and inefficiencies meant that this objective was only partially

[57] From RUR, Censis Federcomin: Distretti Produttivi Digitali. Rapporto 2003. www.censis.it

[58] In September 2004 the Italian Ministry for University Education and Research signed a Memorandum of Understanding which earmarks €30 million for the creation of a public-private venture to manage all projects of the Genoa High Tech district. The district specialisation is the development of Integrated Intelligent Systems for marine and port logistics.

achieved - and with it went a great incentive to locate in the remote Technology Park.

The issue of special competences and skilled labour was discussed with every company interviewed, with a view to establishing whether this perceived advantage of the Cagliari area in the early nineties was still significant. Given the extremely quick pace of technology in the computer and telecommunications industries, these skills can rapidly become obsolete, and unsurprisingly opinion on this issue was rather divided.

While Cagliari was a leader in internet technology in the past, today most of the companies who engage in research and development complain about lack of good technical skills. Abbeynet and Axis complained that they were unable to fill all their vacancies in 2003 because of the poor level of the applications they received. The former only filled 10 out of 40 positions available. Scelta and Prodinsar observed that high skilled labour at a relatively low price was available in the early days (the '90s) but now the price differential has evaporated and the level of competence seems to have decreased.

Others point out that technical competences (which they find adequate to their needs) are not the main local bottleneck: according to Tiscali's head of new business development, for example, there is no shortage of technical skills, but it is difficult to find (or even to import) good managers. Energit laments the absence of sophisticated financial and commercial skills. In order to fill the local skill void, ad agency Soleja has invested massively in the creation of professional skills in the Cagliari area. They trained their workforce not only in their specific discipline (camera, audio, video), but also in use of advanced ICTs and general communications and management techniques. The agency built a network of professional competences, many of which are free lance and therefore are available on the market for everybody.

At the same time, most entrepreneurs were ready to point to other benefits of the local workforce. First of all, its stability: companies believe that they would face a much higher workforce turnover if they were based in more dynamic markets like Milan. Secondly, its attachment to the territory: most workers accept to earn less than they could elsewhere in Italy, because they want to stay on the island. It appears therefore that the local market is an excellent source of middle and low-end, rather than high technical skills. There is a vast pool of labour looking for employment, and companies can therefore pick the very best. For the manufacturer Datarex, in fact, the availability of good workers is the only advantage of operating in Sardinia. The growth of call centres in the area, which tripled between 1991 and 200, seems to confirm the existence of such advantage.

In different ways, most of the firms contacted had tales of difficulty with the local market. Nearly half the companies contacted prefer to look out to other markets. For the Scelta group, who derive 50% to 75% of sales from the

Sardinian market, the small size of Sardinian firms and the local business market is the main disadvantage of operating a software house in Sardinia. Furthermore, the private sector felt the effects of the 2003 economic slowdown, and only IT projects financed with public money actually went ahead. The group, which had 20 employees and around 5 consultants in 2003, was forced to make redundancies and switch those numbers around. It now employs five people and uses around 20 consultants. Prodinsar complained that as national distribution took over the retail sector in Sardinia in the late 90s, many IT functions of the sector were centralised and brought outside the island, thus forcing the software house to target new sectors and develop new products. The company, however, also points to a positive side of operating in small markets: clients become extremely loyal and can positively assist and inspire the development of new product. Soleja adds that it is impossible for a company to form and adopt a business plan if it is to rely on the Sardinian B2B market. Local demand is uncertain and can oscillate between significant ups and downs. Firms have to maximise the efficiency of their management lay out, so that they can remain small but also be able to implement rapid response time to new and bigger opportunities. The upside of such fickle markets is that companies are compelled to create flexible business structures with competitive costs. Once such a flexible business is in place, however, it must be put to service a sizeable market outside the island: no company can realistically grow on the local market.

Another serious deficiency of the local market is the inadequacy of its local telecommunications infrastructure. Saraslab/Akhela and Datarex, two companies located in the Macchiareddu industrial zone, complained that the topmost industrial area near Cagliari was never endowed with advanced telecommunications infrastructure, like a fibre ring to which companies could connect at their own expenses. Saras proceeded to purchase their own fibre network, while Datarex had no option but to wait for the incumbent phone company to provide them with ASDL, only available in that area since late 2003[59]. The same area hosts Cagliari's own Telecommunication Pole, the new Tiscali headquarters, but so far no advanced telecommunications infrastructure has been offered to other resident companies in the industrial area.

Finally, even though we heard from Scelta that public sector financing was crucial to keep the IT market moving in 2003, most of the interviewees expressed little satisfaction with public incentives, and the activities of the public sector in general. The principle of public incentives for start ups is not questioned: it is the modes and times of delivery that come under attack. Datarex was a direct victim of these inefficiencies and was extremely critical about the local financing and credit system. The company was created by a

[59] The MD recalls that, to add insult to injury, for several months Datarex was bombarded by calls from Telecom Italia's sales agents who tried to sell ADSL even though it was not technically available.

small group of middle managers made redundant by Olivetti[60] in the late eighties, who had money and competences to start up new businesses. They set up shop in Cagliari because of the generous financial incentives and other forms of production support they were offered. However, the reality check was brutal: the promised support took so long to materialise (years!) that the company nearly bankrupted, as it had to service high interest loans to cover expenses in the meanwhile. A similar fate occurred to their only local supplier, a producer of plastic shells for diskettes, who became a victim of the expensive local credit system and closed within months.

Conclusions

1. Better infrastructure needed

The island of Sardinia is one of the lesser developed areas of Italy. Its infrastructural endowment is significantly inferior to that prevailing on the mainland. Internal transport is particularly poor: Sardinia is the only region without a motorway and its rail infrastructure is the worst in the country. Only when it comes to ports and airports, Sardinia is above national average.

The island's low levels of population density and per capita income make it a low priority for private investments in telecommunications infrastructure: broadband is mainly available through the incumbent's network. At the time of writing, the only alternative operator supplying broadband through local loop unbundling is the company Wind - and only in the Cagliari metropolitan area. Fibre operator Fastweb is not present on the island.

E-government projects spearheaded by the Autonomous Region of Sardinia are expected to link all municipalities to a fast public network (the EGOS and RUPAR projects) within the next year. Unfortunately, technology appears to move faster than public sector decision making!

2. Education must improve but research is encouraging

On the whole, the population of Sardinia has extremely low levels of education: nearly 40% of the resident population only completed primary school. Even though the general level of education in Sardinia is below the national average, which in turn is lower than EU average, there are numerous active research centres, particularly around Cagliari. The city hosts many research departments that belong to the local University, as well as CRS4, the research outfit of the regional Science and Technology Park Polaris, specialised in digital technology. In the nineties, CRS4 was instrumental in building advanced local competences in the (then) innovative fields of digital technology. These were a crucial ingredient of the experimentations which led to the creation of Tiscali. Today

[60] Olivetti was a world class maker of typewriters based in Ivrea, northern Italy. In the 80s it undertook several major restructuring processes as it failed to make the transition to the PC market and eventually moved to telecommunications. Since 2003 it controls Telecom Italia and adopted its name.

the work of CRS4 is no longer mentioned by local ICT companies as the main source of local innovation, probably the consequence – among other things - of a few years of difficulties in sourcing long-term funding for the centre. The recent re-appointment of Nobel laureate Rubbia at the helm of CRS4 is expected to restore the centre's authority to its original level. A few local entrepreneurs, really niche innovators, have established valuable links with the department of Electronic Engineering at the local University, for original research as well as headhunting. The same department is in charge of one of the largest e-government projects on the island.

3. Cagliari: high unemployment, small firms, a growing ICT sector

The local work system of Cagliari, capital city of Sardinia and focus of our analysis, is the largest on the island and one of the largest in Italy. It includes 32 municipalities and accounts for 38% of the production units of the island. Unemployment is a severe problem in the area: the local rate of 20.37 is more than double the national average. Cagliari shows a degree of relative specialisation in the fields of oil and chemicals, due to significant past investments in these sectors, and a mild specialisation in services, especially IT and financial. The local ICT sector is also dominated by the service component. Computer related services employ locally nearly 2500 people, who work in many small outfits: average firm size in this area is only 3.27. Conversely, telecommunications services are offered by much larger firms, each employing on average 49.19 workers. Tiscali and the incumbent Telecom Italia are the largest telecommunications providers locally. Call centres, which are not included in the OECD definition of ICT adopted here, are also a growing reality that employed just under 1000 people in 2001. Within the IT industry, software houses are the main type of business. Here, a few large players share the market with a plethora of very small businesses.

4. Local entrepreneurs wanted

Local ICT companies appear to make little use of the network potential for broadening their client base, and prefer to do business using personal contacts and word of mouth. With a few significant exceptions, businesses in Sardinia generally tend to be risk-averse rather than enterprising, and inward looking rather than international. As a consequence, the service sector faces a very small and uncertain business demand, which reinforces the local trend towards small, generalist ICT businesses. The few entrepreneurs who want to grow their niche markets operate successfully outside the island.

5. Tiscali, Cagliari's greatest corporate success story of all times

In many ways, Tiscali represented the climax of a sequence of events and experiments that took place in the early nineties. Through CRS4 and the short lived ISP video on line, Cagliari was accumulating innovative competences and novel business skills in the new field of Internet. In 1998, Renato Soru, a former partner of VoL, set up Tiscali to compete with the national incumbent

Telecom Italia. Initially geared for competition in long distance and international voice services, Tiscali operated an IP network from the start, as the emerging markets for Internet and data services presented good potential economies of scope. By the end of 1999, Tiscali had made a mark in the fledgling Italian internet market with its free internet offer and stunned the Nuovo Mercato with an extremely successful IPO. At this point in time, Tiscali was positioning itself to become a key European player in the internet market. Voice telephony became a minor line of revenue, while the company planned to make its success with internet, e-commerce and portal revenues, and began acquiring any company that could make a significant contribution to this new business plan. When Tiscali and World on Line agreed to merge, in September 2000, the Sardinian company entered the European top five. Tiscali's management, until then totally Sardinian, began to internationalise too.

6. A missed opportunity with UMTS

In the same year Tiscali set up its venture into broadband mobile communications with the subsidiary Andala UMTS, also based in Cagliari, which bid for the Italian UMTS auction. Tiscali had joined forces with Hutchison Whampoa, which put in the majority of the capital (over 80%). After the market crash and economic slowdown of 2001, however, UMTS appeared overpriced and its development prospects slow, so Tiscali abandoned the plan and reduced its participation to 0.3%. The bid was successful and the newly licensed consortium, renamed H3G, moved to Milan leaving only a call centre in Sardinia.

7. Tiscali bets on broadband – will it weather the storm?

After a slow 2002, the company repositioned itself to bet on fixed broadband as the main revenue line. ADSL numbers accelerated throughout Europe in 2003, and Tiscali has now 1.5 million broadband subscribers. The new emphasis on broadband, however, raises important issues for the ISP. Firstly, unless it is offered through the operators' own network, ADSL has lower profit margins than dial up. Secondly, in order to take advantage of ULL, operators must make investments on the local network. These are critical issues for a company like Tiscali, which is heavily indebted and needs additional funds to finance its growth. Thirdly, in the broadband environment Internet operators compete with other digital content distributors for sport and other rights: Tiscali is in a weak negotiating position compared to broadcasters and telecom incumbents in each market. Analysts are on balance sceptical about Tiscali's capability to raise enough cash to pay its debt and finance its growth, and rumours of possible takeovers abounded in 2004.

In June of this year, Tiscali's founder (and majority shareholder) put the business aside to pursue public office: he became the first elected governor of Sardinia.

8. Promising examples of niche competences and new companies

Our interviews with leading players of the local ICT scene have described a local sector which, though unable to replicate the glittering success of Tiscali, shows a few encouraging examples of innovative and outward looking enterprises. Interestingly, while the majority of firms in our panel were set up by local entrepreneurs, the two largest outfits, which employ twice as many workers as the next largest firm in this set, are part of large national groups. Akhela, the largest local software house, belongs to the oil group Saras, while Atlantis, which specialises in digital territorial management, was ceded by the same group to the Grozzini family (former IBM managers) in 2001. Among the firms born and bred locally, Abbeynet and Energit appear the most dynamic realities. The former has patented its own protocol for audio and video streaming on internet (VoI) and is harvesting increasing success both in Italy and abroad. The latter is a multi-utility company that applies the synergies of web technology to all networked utilities and developed its own Virtual Network Plant. Energit has grown in three years into a business with 56 employees and €26m in turnover.

9. An advantage that should not be lost

While Cagliari could boast the abundance of unique specialist skills in the early 90s, today the advantage appears to have shifted to low end and middle range skills, which are plentiful and competitively priced. There are several instances of very advanced niche skills, both technical and commercial, within Tiscali and the other companies we contacted. However, these appear to be sporadic examples rather than the tell tale of an emerging paradigm.

Attempts to consolidate the sector or pool together resources have produced mixed results. On one hand, cultural barriers make it difficult to convince firms about the advantages of this type of behaviour. On the other hand, there is evidence that good initiatives of the public sector got lost in the long corridors of bureaucracy and/or were carried out to a lower standard than expected. Most initiatives appear to have been initiated with a top-down approach. The recent Telecom Pole project did not meet much enthusiasm among the firms we contacted. Abbeynet is the only company to date that has moved some resources into its server farm, while most others questioned the value of the entire project. Certainly knowledge building was not a political priority in the new millennium: in Cagliari, as in the rest of Italy, funding for research is getting harder to obtain.

10. And the future?

Tiscali has undoubtedly benefited from some unique circumstances: advanced local competences built before the company, buoyant stock markets, and a lucrative sector newly open to competition. None of these ingredients is now available for the new entrepreneurs on the Cagliari scene, or at least not to the same degree. From this perspective, the existence of a few success stories, a mild degree of ICT specialisation in the Cagliari area, should be viewed as the symptom of a great potential that could unfold further. Despite the lacking

infrastructure, the abysmal performance of the school system and the inefficiencies of the public sector, the distance from the central markets, there are examples of success. Local resources are eager to be employed and learn. A lot more could be done, with better transport and telecommunications, strategic alliances and more education and research.

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