

Digital Cities and the Opportunities for Mobilizing the Information Society: case studies from Portugal

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Abstract. The development of case studies in selected Portuguese cities and regions which have been engaged in “digital city” projects is considered in this paper in a way to discuss main challenges and opportunities for mobilizing the information society in Europe, with emphasis for the conditions affecting less favourable zones. It is argued that value-based networks have the potential to make both public administration and markets more effective, which helps promoting learning trajectories for the inclusive development of society, but require effective infrastructures, incentives and adequate institutional frameworks.

1 Introduction

In view of the current socio-economic context, in which innovation is a key driving force for the sustainable development, which challenges are facing the diffusion and adoption of information and communication technologies at regional level, in a way to contribute for regional policies that could mobilize the information society in less favoured regions in Europe?

This broad question has motivated the work behind the present paper, which considers the development of case studies in selected Portuguese cities and regions, which have been engaged in building digital networks. It is argued that value-based digital networks have the potential to make both public administration and markets more effective, which helps promoting learning trajectories for the inclusive development of society, but require effective infrastructures, incentives and adequate institutional frameworks promoted over time and across space [1]. Early-stage developments are shown to be particularly dependent on public funding and the necessary institutional framework, including the development of knowledge-integrated communities. The analysis builds on the need to continually adapt trajectories and foster the necessary learning capacity of increasingly diversified communities, which refers to social capital as a relational infrastructure for collective action [2], in a context much influenced by a dynamic of change and a necessary balance between the creation and diffusion of knowledge.

In this context, the paper discusses a *knowledge-based view of the territory* to foster institutionally organized metropolitan *systems of innovation* [3] and *competence building* [2], which derives from observations in different Portuguese metropolitan areas with the ultimate goal of increasing regional competitiveness, by promoting public awareness and participation in decision-making processes. It is argued that the territory is a basic infrastructure that justifies and invites for the construction of several layers of information about cities and regions where people live, visit or do business. Digital city schemes should also encourage the global legibility of the information architecture of the territory and promote broad and informed participation in the decision-making process of the future of its entire influence area and not only within city limits [4].

Although we are still in a very early and limited stage of what Mitchell [5] called 'cities of bits', it is clear that it has become a "commonplace" to discuss the diffusion of knowledge, and the "knowledge-driven economy" in general, in close association with the introduction and use of information and communication technologies [6,7]. In this context, several national initiatives for the Information Society aim to achieve four broad objectives: to create a more open state, to link and make available to all the available knowledge, to promote Internet usage in education, and to support and develop digital technologies usage by firms [8]. The evidence calls for our attention for the critical role of public funding and the dynamic adaptation and development of the context necessary to facilitate digital cities.

The work follows current discussion in Europe aiming to: (a) ensure widespread broadband access and a secure information infrastructure; and (b) services, applications and content, covering online public services and e-business [9], but argues for the need to plan systematic actions of competence building with the ultimate goal of attracting new communities of users and to build the necessary capacity for connectivity. Community building and demand creation for digital services became the critical factor for implementing digital cities, requiring proper incentives and institutional settings.

The remainder of this paper attempts to frame these aspects from the perspective of the challenges facing *digital cities* in Portugal. We begin by bringing empirical evidence on the Portuguese situation, as a specific case study within EU. Clearly, Portugal has significant quantitative shortcomings, but, at the same time, the country has been making good progress, in a catching-up dynamics that is well known. This combination of rapid catch up but persistent shortcomings make the Portuguese case useful to illustrate the main point of the paper: network societies occur across time and space and require the dynamic adaptation of infrastructures, incentives and institutions, in a way that calls our attention for the need to foster learning societies. The third section, informed by the empirical evidence associated with the analysis of the Portuguese situation, discusses current evidence from specific case studies, based on specific digital city projects. Finally, we conclude by briefly presenting policy implications, the necessary conditions for the establishment of knowledge driven activities and a summary of our most important conclusions.

2 Building the network society across diversity: Portugal in Europe

Focusing our attention to information and communication technologies (ICT), Figure 1 presents the intensity of ICT expenditure in 1997 against the growth rate of this intensity from 1992 to 1997. Following recent analysis for knowledge-based industries [10], the results show that Portugal was the leading OECD country in the growth rate of ICT expenditure from 1992 to 1997, with a growth rate of more than 10%, and mainly accounted for by increases in expenditures in telecommunications (about 9%). Expenditures in IT services and software are particularly low, below 1%, and only Turkey, Greece and Poland have shares of expenditure on IT software and services below the Portuguese value. The growth in this category has been equally dismal, below 2% a year.

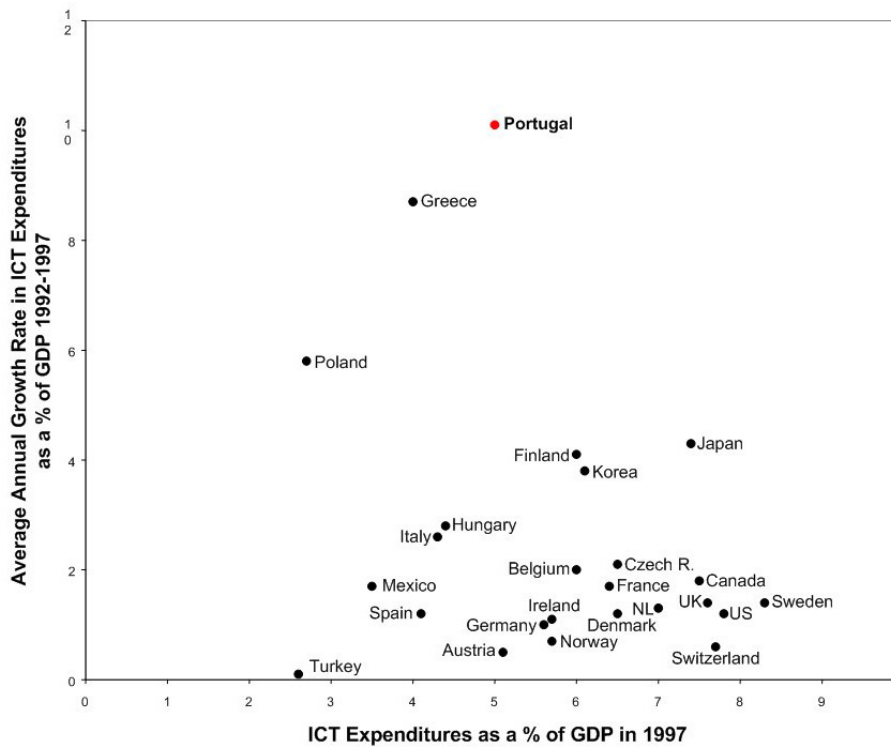


Figure 1. Information and Communication Technology (ICT) Intensity and Growth (1992-97); Source. [13]

In terms of our analysis, we would like to argue that the figure shows large variations associated with countries characterized by small absolute values, exhibiting patterns typical of latecomer industrialization for Portugal. In addition, the results may represent indications of the process through which latecomer countries become

engaged in the new techno economic paradigm [11]. Most countries are clustered in the bottom of the figure, with growth rates below 4%. The levels, as indicated by the horizontal distribution of countries, confirm the perception that the US is a leading country. The expenditures on ICT as a percentage of GDP in the US are about 2% above the European average. Individual countries, such as Sweden, outperform the US, but most countries lag behind.

The evidence of still low absolute investments on ICT in Portugal is clearly illustrated in Table 1, which shows values per capita for sample European regions in the census whose programming documents indicate information society actions and that provide the necessary financial information [8]. It is clear that the table refers, above all, to regions that have attracted European structural funds and, on this basis, it is important to mention the wide diversity of situations and framework conditions for attracting these funds, which clearly influence any analysis to be considered. But for the purposes of our analysis, it is interesting to attempt defining the extent to which the performance of digital networks and cities would depend exclusively on the limitations of funds, as well as from the capacity to attract them.

Border Midland and Western Region	357.8 €
La Rioja	357.8 €
South Aegean	269.4 €
Ionian Islands	241.4 €
Baleares Islands	238.2 €
Western Greece	151.1 €
Açores	117.9 €
Highlands & Islands	98.4 €
Epirus	83.4 €
Alentejo	44.5 €
Peloponese	43.1 €
Continental Greece	42.8 €
Algarve	42.5 €
Centro	29.9 €
Norte	13.3 €
Southern Scotland	9.2 €
Lisboa e Vale do Tejo	6.8 €
Liguria	2.2 €

Table 1. Expected ICT Expenditure per capita for selected European Regions, 2000-06; Source: [8]

Besides large growth rates in ICT investments, the extent to which the Portuguese society is engaged in the knowledge economy comparatively to other nations can be analysed making use of the recently established systematic assessment by the World Economic Forum in collaboration with INSEAD and the World Bank's *infoDev* programme through the "networked readiness", as represented in Figure 2 for 2002

[12]. This indicator offers an aggregated idea of “the degree of preparation of a nation to participate in and benefit from ICT developments” and illustrates the still weak position of Portugal in the European context, only above Greece. The main point to note is that the results for Portugal and for most of the OECD countries appears to be dependent from other than the country’s overall wealth (as measured in terms of GDP per capita). Considering the partial log regression plot included in the figure, Portugal is in fact entering the cluster of countries where the effect of increasing GDP on network readiness is less pronounced and other factors, namely at institutional and contextual level, have been shown to particularly influence country’s competitiveness [10].

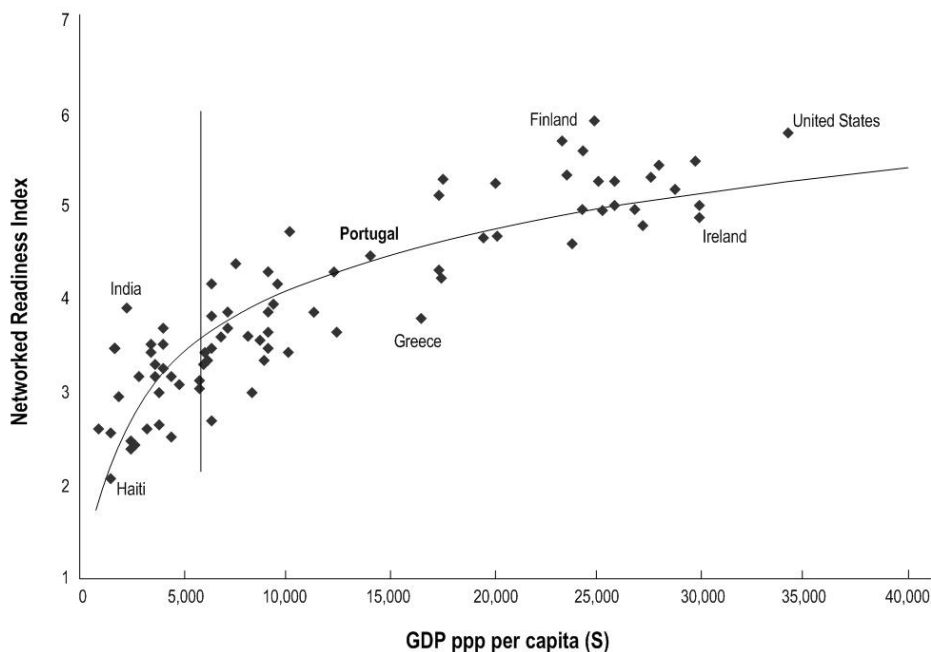


Figure 2. Network Readiness Index versus GDP (PPP) per capita, for 2002, with partial Log regression. *Source:* [11]

The challenges associated with latecomer industrialization, as mentioned before, and the relative positioning of Portugal in the international scenario at the outset of the 21st century can be further analysed from the sample results of Table 2: it shows Portugal ranking among the first 25-30 positions but the least performing country in Europe.

The pattern of small absolute values regarding the mobilization of information society, but large variations, can be further analysed making use of a number of typical indicators to characterize the penetration of ICTs in a country. For example, Portugal had the highest Internet penetration rates in southern Europe for 2002 (Portugal 42%, Spain 42%, Italy 40%, Greece 18%, with an EU average of 51%), although far away from typical north European penetration rates [14]. A similar

pattern can be observed in the use of Internet access in the household, with Portuguese rates of 31%, as compared with 29% for Spain and 9% for Greece, while 40% for the EU average and 74% for the USA, although Portugal exhibits growth rates between 2000 and 2002 considerably larger than the European average (namely 72% for Portugal, with 81% for Spain and 89% for France, as compared with 43% for EU average) [15]. Turning to the type of telecom infrastructure, the country follows typical average EU trends, with standard telephone lines as the most frequent connection to the Internet access at home (Portugal 74%, EU average 72%), followed by cable modem (Portugal 12%, EU average 7%). ISDN, ADSL and Wireless connections are still relatively low.

Ranking	Networked Readiness Index (a)	Information Society Index (b)	e-Government Benchmarking (c)	FT / OCDE ranking (d)
Finland	1	8	13	10
United States	2	4	1	3
Sweden	4	1	11	2
United Kingdom	7	7	7	9
Denmark	8	5	9	18
Germany	10	15	10	12
Netherlands	11	6	8	5
Austria	16	16	25	16 =
France	19	20	14	16 =
Japan	20	12	27	13
Ireland	21	21	23	4
Belgium	22	19	12	7
Spain	25	24	16	Not included
Italy	26	23	19	20
Luxembourg	27	Not included	20	15
Portugal	31	26	24	25
Greece	42	25	49	Not included

Table 2. Sample results from recent international rankings. Sources: (a) World Economic Forum, Global Information Technology Report 2002–2003; [12]; (b) IDC, Information Society Index 2003, [16]; (c) United Nations, Benchmarking E-government: A Global Perspective 2001, [17]; (d) Financial Times, 25 Countries Most Likely to Succeed in Knowledge Industries (2001), based on data from the 2001 edition of the OECD's Science, Technology and Industry Scoreboard, [18].

For this brief analysis of main figures characterizing the Portuguese context for the use and application of ICTs in an international perspective, it should also be mentioned that the country has one of the lowest European usage rates of Internet for on-line purchases of products or services (9%, but only 1% frequently) and the third lowest percentage of Internet users that have already contacted the public administration [14]. These facts are important to set the context of information networks and clearly call our attention for the need to consider contextual levels

beyond pure infrastructural issues, when considering measures to foster information networks.

But the values presented above should be further explored in terms of the main point of this paper, in that we are aimed to improve our understating of the conditions necessary for digital networks to succeed. Learning from the conceptualization of knowledge-based economies [6], it can be said that, fundamentally, the performance in knowledge-rich competitive environments in terms of innovative performance depend on the quality of human resources (their skills, competencies, education level, learning capability) and on the activities and incentives that are oriented towards the generation and diffusion of knowledge. But beyond human capital, which corresponds to the aggregation of an individual capacity for knowledge accumulation, developing a collective capacity for learning—as suggested by Wright [19] in the context of the US—is as, if not more important, than individual learning. Instead of individual or even aggregated human capital, a further important concept for learning seems to be social capital, as analysed by Conceição et al. [20], among others.

Before further exploring social capabilities and related issues associated with the development of digital networks, we present below further evidence on the penetration of ICTs in Portugal through the analysis of specific projects aimed to build digital cities, namely making use of European structural funds.

3 Institutionalizing “digital cities”: evidence from Portugal

The evidence presented in this section is built on the analysis of sample projects for digital cities and regions in Portugal, which have been structured around the electronic provisioning of local government administrative services complemented by some pilot projects in areas such as e-business and telemedicine.

The first experiences in Portugal with digital cities started in 1998 through a program jointly funded by the Portuguese Government (who contributed with 25% of the total investment through the national Science and Technology Foundation) and the European Union (75% of the total investments through the European Regional Development Fund). Private investments were insignificant. The program involved 5 small and mid-sized cities (Aveiro, Bragança, Guarda, Marinha Grande, Castelo Branco) and 2 rural regions (Trás-os-montes and Alentejo), as identified in Figure 3. The main objectives of the program were to (a) improve the quality of life in cities; (b) contribute to development of peripheral areas; (c) improve local economy and employment; and (d) fight info-exclusion and help citizens with special needs [21].

The project sites were chosen for reasons which are out of the scope of this paper and we concentrate our analysis on issues associated with their effective implementation.

Alentejo and Trás-os-montes are remote agricultural regions, among the least developed in Portugal and Europe, sparsely inhabited by an aging population. Both projects were designed to create new opportunities for the local population, mitigate social and economic disparities, promote regional networking and provide public administration electronic services to peripheral local parishes.

Aveiro is developing a true innovative and entrepreneurial image, in particular connection with the local university and the local branch of Portugal Telecom, which includes important research and development activities. On the other hand, Marinha Grande is particularly engaged in traditional, labour-intensive industries and the digital city project has been particularly promoted through the industrial network associated with the local moulds industry. Both these two projects invested mainly on local competitiveness and competence building.



Figure 3. Identification of main projects for the specific development of digital cities and regions, established over the period 1998-2001, making use of European structural funds. Adapted from [21]

Bragança, Guarda and Castelo Branco are peripheral cities with relative regional significance. Their approach was to support the adoption of information and communication technologies by individuals, firms, associations and local government and other public organizations.

3.1 The overall picture

In terms of regional penetration, Table 3 shows that the projects listed above covered about 11.30 % of the total Portuguese population (10.44% of the population under 15 years of age) and about 42% of the total surface of Portugal. All projects involved a

broad range of relevant actors and change agents within each one of the territories being nonetheless always led by local municipalities. Local higher education institutions were particularly involved only in a limited number of projects (Aveiro, Bragança, Trás-os-Montes).

It should be noted that, at least for the initial projects analysed here, the institutional framework established by the central government was quite flexible and fostering local voluntary initiatives. It was based on the simple provision of guidelines focused on providing content and services related to local public administration and to specific activities with social implications (e.g., healthcare), economic impact (e.g. business-driven corporate networks for regional competitiveness), and aimed to promote cultural contents [22-25]. Initiatives to mobilize and promote the adoption of the Information Society were part of various applications, although not always considered at the required level, at least beyond that given to the implementation of infrastructures [24].

Municipality	Pop.	(%) Total	Pop under 15	(%) Total	Area (Km²)	(%) Total
Aveiro	69,560	0.67	12,160	0.73	208	0.23
Bragança	32,440	0.31	4,760	0.29	1,138	1.23
Castelo Branco	54,260	0.52	7,440	0.45	1,440	1.56
Guarda	38,560	0.37	6,230	0.38	709	0.77
Marinha Grande	33,370	0.32	5,050	0.30	186	0.20
Alentejo	510,690	4.93	71,930	4.34	27,227	29.55
Trás-os-Montes	431,540	4.17	65,450	3.95	11,122	12.07
Total	1,170,420	11.30	173,020	10.44	42,030	45.61

Table 3. Characterization of digital city projects, in terms of population and area considered in each city/region Source: INE, 2001

Table 4 show sample data in terms of public funds made available to the seven projects mentioned above, illustrating diversified situations, with levels of funds per capita ranging from low to moderate when compared with those considered within the overall usage of European structural funds [8].

Within the broad range of digital city projects considered at international level [4], *Aveiro Digital* represents an interesting case study in that it has comprised diversified initiatives promoted and coordinated by an autonomous organization formed among the local government, the local University and the incumbent Telecommunication operator, PT Telecom. It represented the result of a long preparation effort and provided the opportunity to evaluate concepts and dynamically testing ideas, involving a limited but well informed group of people [24].

Bragança Digital focused on creating basic ICT infrastructures and wireless networking environment for local government buildings, health institutions, educational institutions, and local employment agency to provide information and services to local citizens. Other initiatives included the provision of local products (www.rural.net), health, educational and e-business activities [25].

Project	Pop. (a)	Total investment	Investment p.c.
Aveiro	69,560	5,590,000 €(b)	80.39 €
Marinha Grande	33,370	1,200,000 €(c)	35.96 €
Bragança	32,440	1,044,000 €(d)	32.18 €
Castelo Branco	54,260	1,082,000 €(e)	19.94 €
Guarda	38,560	350,000 €(f)	9.08 €
Trás-os-Montes	431,540	1,735,000 €(g)	4.02 €
Alentejo	510,690	1,500,000 €(h)	2.94 €

Table 4. Public Funds Expenditure Per Capita in the first phase of the Digital Cities Program, 1998-2000.

Sources: (a) INE, 2001; (b) PACD, Final Evaluation Report, 2001; (c) ; (d) Associação para o Desenvolvimento de Bragança, Final Evaluation Report, February 2001; (e) <http://www.dpp.pt/pdf/info52.pdf>; (f) <http://www.freipedro.pt/tb/110698/guarda3.htm>; (g) Final Evaluation Report, 2001; (h) http://home.telepac.pt/telepac/net/13/regionalismo_2.html.

Guarda Digital was promoted by and organization formed by the municipality, local educational institutes, associations” and the incumbent telecommunication operator. It included pilot projects in healthcare e-business, tele-working and educational initiatives [26].

Castelo Branco Digital aimed to connect all public institutions (municipality, social security and health institutions) and local associations (sports, culture and business) to provide an integrated information network to citizens and tourists. For example, it has included the provision in rich media of old Portuguese theatre contents [27].

Marinha Grande Digital, as managed by the local municipality and the Technological Centre associated with the moulds and plastic injection industries, focused on creating an Extranet to provide business-related (mould, plastics and glass) content and services and on facilitating communication among companies and clients. Other initiatives included a centre of advanced telecommunications to promote the use of the Internet [28].

Trás-os-Montes Digital included regionally-based web contents (i.e., www.espigueiro.pt), managed by the local University, that aggregates content and services of 31 municipalities. The portal is still managed by the local university and includes business and employment opportunities, geo-referenced information, healthcare facilities and technologies to coordinate medical services in rural areas [29]. An important feature of this project is the support network constituted by 84 service centers scattered throughout the region that provide public Internet access, as well as human support to help citizens’ interactions with new technologies.

Alentejo Digital brought together 47 municipalities and 3 regional agencies to create a regional information network to provide services and territory-related content to citizens and local firms through regional web-based contents. The main objective was to enable local government teams to learn, use and promote new technologies, namely computer network management and digital content production and publishing. An Intranet was set up linking all municipalities and regional agencies to enable the necessary collaborative work environment. About 50 people were

recruited, mostly from local unemployment lists, to work on the project that lasted until July 2001 [30].

Most of those people worked as local agents, based on each one of the town hall facilities of all the 47 municipalities involved, who proactively produced, collected or published relevant local content in the portal. Although they did not work directly with the general public, they were a very important factor of Internet diffusion in the territory covered by the project.

3.2 Building competencies for mobilizing the information society: the experience of Aveiro

Aveiro is a seaport, located at the Vouga estuary, with a population of approximately 69,560. The city's innovative and active character, although recent, draws from the singular institutional framework established in close collaboration between the local university and the local business environment, mainly driven by the national telecommunication operator. Following the launch of the first Digital Cities public funding program in Portugal (1998-2000), the municipality, the university and the incumbent operator set up a public-private partnership to develop the idea of Aveiro Digital City focusing on (a) quality of life in the city; (b) democratic participation; (c) extensive access to public and private digital information and services; (d) local public administration modernization; (e) inclusive development and sustainable growth; and (f) job creation and lifelong learning [22-24]. The complete funding life cycle was expected to be 8 years, with the first phase of the project starting in February 1998 and lasting until December 2000, totalling an investment of 5,590,000 Euros. The second phase, originally planned to start in January 2001, has only begun on June 2003 and is planned to last until December 2006. The new round of public funding is expected to be some four times larger than the previous investment.

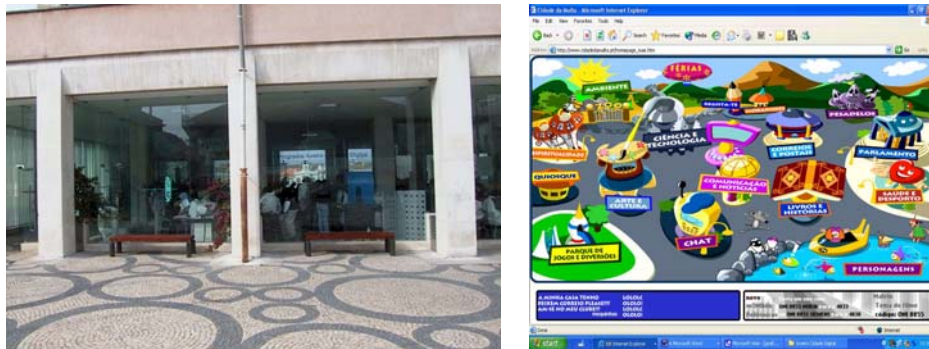
After a troubling start – budget allocation negotiations and bureaucracy caused lengthy delays, mostly for over than one year, in both the formal approval procedures and the technical implementation schedule – the first phase included 37 projects covering several different aspects of the use of information and communication technologies, as illustrated in Figure 4. Emphasis was given to infrastructures and digital contents, including local e-government, e-health, e-business and entertainment, as listed in Table 5¹.

E-business and education related activities accounted for 35.1% of the total number of approved projects and 40.7% of the budget allocated. E-government used up to 20.4% of the available funds. University-based and e-health projects included only two projects and utilized less than 9% of the total budget. On the other hand, entertainment, culture and arts accounted for about 30% of the total number of approved projects, but only received about 8% of the total budget available. In general, ICT infrastructure – computers, applications, Internet access and basic ICT

¹ The projects in Table 5 were chosen among 70 applications in a call for ideas competition held in June 1998. 42 were approved, predominantly from public institutions or not-for-profit organizations and 37 projects were actually implemented.

training – was the most important component of all projects, while investments in activities oriented towards the mobilization of the population for the information society were practically inexistent. Consequently, the evaluation of many activities claims for reduced levels of public participation, with some of the initiatives falling short from their original objectives [24]. E-government and other projects involving basic and secondary schools had more permanent effects, while e-commerce and e-health performed poorly. Budget cuts and uneven financing flows during the implementation phase posed extra difficulties and increased risk unnecessarily.

Nonetheless, Aveiro is considered a paradigm to be followed in the development of digital cities in Portugal. The relative success of the project is argued to be dependent on three conditions: (a) ICT skills locally available or capacity to learn; (b) existing ability to work within multidisciplinary teams; and (c) social responsibility [31].



a) Aveiro Digital City Centre (source: <http://digipraca.aveiro-digital.net/>) b) Interactive learning website for kids (<http://www.cidadedamalta.pt/>)

Figure 4. Sample infrastructures and contents provided through *Aveiro Digital*.

Nonetheless, during 1999-2000, Aveiro Digital City made available 446 personal computers to diverse public and private organizations, published 8 CD ROMs and 32 websites, supplied 73 interactive services, and trained 529 people, as listed in Table 6. The number of Intranets and Extranets users exceeded 3,000 people in different public and private organizations and the Aveiro Digital City Website (www.aveiro-digital.pt) accounted for a monthly average of 4,700 visitors in 2000.

The main question raised by local people involved in the project has been consistently associated with the structure of public financing and the conditions for long term sustainability, mainly due to the fact that when the limited public funds dried up some of the projects came to a close, while others kept their presence in the Internet although rarely updated. Moreover, the funding concentrated mostly on the inputs of a long change process, namely infrastructures, information systems and ephemeral content, giving little consideration to the improved understanding of forms of mobilizing the population at large.

Intervention Areas	Main Activities	Main Related Websites
Community Building (5 activities totalling 1,040,000 €)	Internet access points in 13 public buildings and 5 cultural organizations	digipraca.aveiro-digital.net
		digibairros.aveiro-digital.net
e-Government (4 activities totalling 1,139,000 €)	Municipality geographical and administrative information systems	n.a
	Water and sewage municipal services one-stop shop	www.smaveiro.pt
	Water quality sensing and monitoring system	www.simoqua.pt
	Justice Court Intranet	n.a
Education (7 activities totalling 904,000 €)	Computers, Internet access and ICT training in local basic and secondary schools for teachers, parents and students	veraria.aveiro-digital.net
		cspveracruz.aveiro-digital.net
		membros.aveiro-digital.net/esvir
	Cybergames and interactive learning applications	tictac.aveiro-digital.net www.cpj.ua.pt www.cidadedamalta.pt
Environment (1 activity totalling 201,000 €)	Biology knowledge network	www.biorede.pt
Health (1 activity totalling 267,550 €)	Computers, Internet access and ICT training for health professionals	saudenet.aveiro-digital.net
Social Cohesion (4 activities totalling 216,618 €)	Computers, Internet access and ICT training for low income families and people with special needs.	Resea.aveiro-digital.net
		portal.ua.pt/projectos/meu bancoalimentar.aveiro-digital.net
eBusiness (6 activities totalling 1,372,088 €)	Teleworking	portal.ua.pt/projectos/ist
	Computers, Internet access, services and ICT training for 20 SMEs.	n.a.
	Port authority telecommunication and management infrastructure.	n.a.
	eCommerce service centre	n.a.
	On-line shopping mall	http://www.aveiromegastore.com
	Livestock information network	n.a.
Entertainment, Culture and Arts (10 activities totalling 450,125 €)	eLearning and interactive training	www.ibjc.pt
	Interactive TV pilot project	n.a.
	On-line news	www.netpaginas.pt
	Digital arts workshops	oadgv.aveiro-digital.net
	Interactive listening music CD Rom	www.orquital.ua.pt
	12 public access information Kiosks	n.a.
	History, culture, art and nature from Aveiro	aveirana.doc.ua.pt camarinha.aveiro-digital.net www.net-moliceiro.inovanet.pt ciadanca.aveiro-digital.net

Table 5. Main digital contents included in the first phase of the Aveiro Digital City Project. (source: <http://www.aveiro-digital.pt/>)

The time frame of the project and the extent to which public funds were continuously available at the early stage appear to be critical conditions, namely to guarantee the evolution of a process of gradual competence building. This is a major issue learnt from the Aveiro project and here we refer to competence as skills and capacities, both individual and collective. It is important to stress that new skills are part of the competence foundation, but we are not necessarily arguing that technological change is skill-biased. It often may be, but there are also cases in which it is not. When we consider competence we focus on generic skills, including higher levels of education (who can ever be against more education?) but also capacities that are more generic, such as creativity, risk-taking, and initiative [2].

Trainees	Technical	28
	Teachers	108
	Students	47
	IS promoters	51
	Project Managers	38
	Public servants	257
	Total	529
Users	Internal	3,020
	External	4,700 unique visitors/month (year 2000)

Table 6. Number of trained people and users in the first phase of the Aveiro Digital City Project. Adapted from [14]

3.3. Fostering the provision of local contents from peripheral zones, but looking for communities of practices: the case of Bragança

Bragança Digital City project, led by the local government and the local Technical Institute, promoted several initiatives that included basic ICT infrastructure, local e-government one-stop shop, Internet access in public schools, telemedicine and a very successful e-commerce website for local products (i.e., “*RuralNet*”). Several public service buildings were connected (local government, health institutions, schools and local employment agency) through a Wireless MAN [32], as partially shown in Figure 5. The municipality implemented a management information system and a geographical information system that supported the provisioning of digital services by the Internet. Other projects included an agricultural information network for the local irrigation perimeter and activities to attempt mobilizing young people.

RuralNet was aimed to improve the competitiveness of rural SMEs by providing local firms with (a) innovative marketing ideas supported by digital technologies; (b) knowledge sharing environments and (c) new opportunities and new markets for their products and services. It mobilized several local manufacturers of high quality traditional goods – wine, olive oil, sausages, cheese and handcraft among others (total of 46 firms) – to sell their products and services through the Internet (www.ruralnet.pt). The digital contents were developed at the local Polytechnic Institute in 1998 and were integrated in the *Bragança Digital City* project in 2000.

The period of incubation of the project can be derived from the statistical information of Figure 6, which shows a lengthy, but significant process of market penetration although very low in comparison with traditional sales and orders. Although it involved about 40 providers of local products, 5 firms of smoked sausages, cutlery and cheese, had more than 50% of the total 1999 sales. Local clients accounted for only 25.6% of total number of orders, while orders from Lisbon (25.7%) and Porto (9.0%) together summed up almost the same number of orders as those from the rest of Portugal (34.4%). International sales totalled 5.3%.

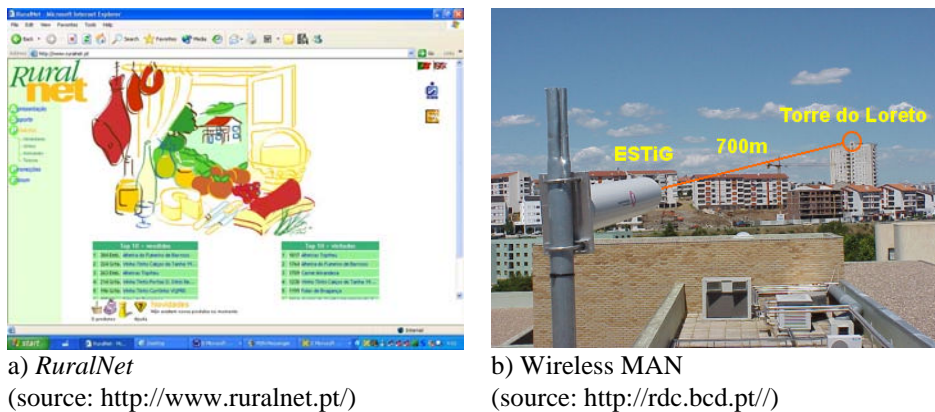


Figure 5. Sample digital contents and infrastructures provided through *Bragança Digital*

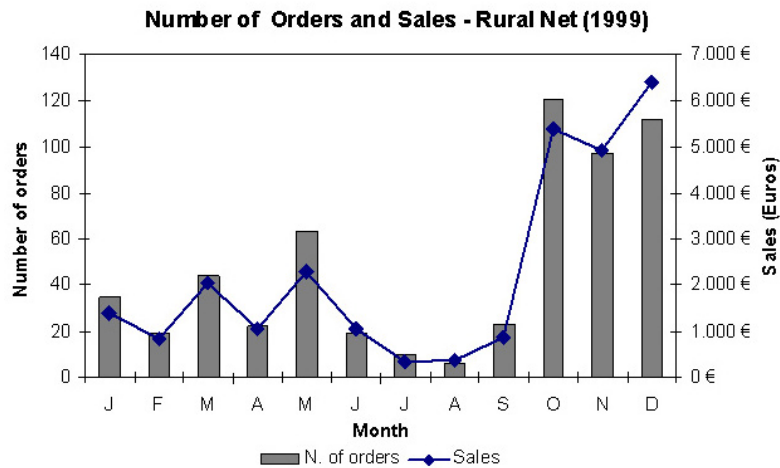


Figure 6. Monthly evolution of orders and sales during the first year of operation of “*RuralNet*” (adapted from: www.ruralnet.pt).

Usually, local traditional manufacturers are very focused on production and lack the necessary competences and resources to address the needs of a global market. *RuralNet* makes available to local firms a new sales channel and a new marketing tool

to expand local markets. It also provides training for all the partners and follows-up closely the information and communication technologies adoption process. Although net sales weren't very high, the mobilization effect among local firms was very strong and not only all of the companies that have participated in the first phase of the project continue to use and sell through the Internet.

4 Discussion and Conclusions

The evidence provided shows that mobilizing the information society at regional level may provide the necessary form of knowledge for the inclusive development of society at large, but it requires effective infrastructures, incentives and adequate institutional frameworks promoted over time and across space. Our discussion is framed within three main levels of analysis, namely infrastructures, contents and context, which are comparable with those schemes that consider five main aspects, namely: infrastructure, access, applications and services, digital content development, and ICT skills development. In fact, the evidence provided by Lena Tsipouri throughout Europe [8] leaves us to jointly considered the first two levels under infrastructure, as well as to join application and services and digital content developments into a single level of analysis. In addition, we broaden the scope of the so-called ICT skills development to include other contextual issues and local characteristics of communities of practice.

Levels of Analysis		Projects	
		Aveiro	Bragança
Physical Infrastructures	Networking and Connectivity (a)	Local health institutions communication network; Internet access in public schools; People with special needs	Municipality communication network; Internet access in public schools
	Information Systems (b)	Local public administration management information systems; Justice court Intranet; GIS	Municipality management information systems; GIS
Content (non-physical infrastructures)	Information Services (c)	City guide; Entertainment, Arts & culture initiatives; Local government website	City guide; Local government website
	Interactive Services (d)	e-business, Agriculture; Job opportunities; Environment; Teleworking	e-business; Telemedicine; Agriculture
Context (e)		Community building based on city metaphores	

Table 7. Main initiatives developed within Aveiro and Bragança Digital Cities Programmes in Portugal (1998-2000); (a) Networking and connectivity includes communication networks and Internet access; (b) Information Systems includes technological components that store and process data like data bases, electronic mail, ERPs, management information systems, content management, application servers and business intelligence software; (c) On-line presence or downloadable forms; (d) Electronic form submission or interaction through the web; (e) Mobilization and context building initiatives

Turning to incentives, current understanding of knowledge-driven activities based on endogenous growth theories are based on the existence of dynamic externalities and imperfect markets, and require a careful understanding of the structure of competition. On the one hand, because of the nature of knowledge, investment of private agents often fails to acknowledge spillover effects, or may not be able to anticipate the full extent to which there is further learning potential in a new technology. On the other hand, incentives to invest in new knowledge depend on the existence of some degree of monopolistic rents. These rents may not exist in latecomer countries exposed to international competition, if they are solely adopting foreign technology.

As a result, Conceição et al [1] call our attention that private investment levels (which result from the incentive structure provided by the market to economic agents) in activities with learning or spillover potential tend to be lower than the social optimum, and may even generate what is known in the literature as “low-level equilibrium traps” [33, 34]. In principle, these shortcomings of the market mechanism call for some sort of government intervention. Governments are concerned with making sure that societal costs and benefits are endogenized in the decisions of private firms. In a learning environment this may mean subsidizing specific activities, investing in education, or protecting infant industries [35, 36]. But government intervention must balance the potential distortions on competition that may come from intervention with the needs to “correct market failures”.

Against the background of the conditions described above, it is clear that digital cities cannot be promoted independently of an innovation policy fostering capacity and connectivity and that in turn innovation determines and is determined by the market. However, it is also clear that it will require an effective mix of public support mechanisms that take a relatively long-term perspective, taking into consideration specific regional and thematic aspects, thus promoting a diversified environment.

But still focusing on the issues of incentives and looking at their relation with the operational effectiveness of digital infrastructures, applications and services, figure 7 shows that the most important web contents associated with the digital city projects discussed before were available to the public domain only for the time public support was also available. Besides the notable exception of the Aveiro Digital Project, this result may be obvious for the local promoters of those projects, but should be acknowledged as a major issue for public policies fostering the information society. We will argue that early stage developments, as those we are considering throughout this paper, do require continuous support, together with adequate monitoring and evaluation procedures, in order to acquire the necessary strength for their sustainable development. The evidence is that market mechanisms do not necessarily work at the

level of the issues associated with digital cities, namely in less favourable zones, where incentives structures should be effectively designed and adapt over time.

Although incentives and infrastructure greatly inform our understanding of economic development, they do not tell the whole story about the differences across the various projects discussed in section 3, or even across the countries briefly discussed in section 2 above. This is because both incentives and infrastructure do not operate in a vacuum, being shaped by and shaping the particular context where they operate. In the scope of our analysis, the city or region must have embedded a set of social capabilities that define the context under which digital cities evolve. Consideration of contextual issues in building-up network societies have not always been considered in many different situation throughout the world, as acknowledge by Castells [7], among others, and evidence shows that specific measures to promote adequate contexts in the projects considered in this paper have also been scarce.

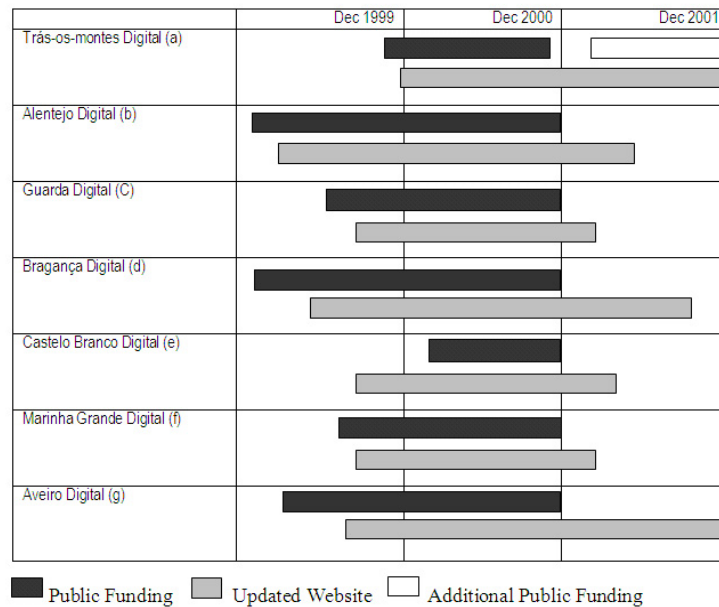


Figure 7. Timeline of public funding to the projects, versus the availability of updated web-contents. Notes: (a) 10 Municipalities; 20 “Juntas de Freguesia”; Regional Agricultural Agency; Hospitals of Vila Real, Chaves e Macedo de Cavaleiros; 80 basic and secondary schools; Trás-os-Montes and Alto Douro University (UTAD). The second phase started in January 2001 and it will end on October 2003 (source: SCETAD, Trás-os-Montes Digital Presentaion, Vidago, November 20-21, .2002); (b) Only 8 out 47 municipalities were connected during the first half of 1999 (source: <http://www.alentejodigital.pt>); (c) A very limited pilot project of Telemedicine started in April 1999 (source: <http://www.ipg.pt/adsi/>); (d) Most of the projects started in February 1999. RuralNet Started on January 2000 (source: Associação para o Desenvolvimento de Bragança, Final Evaluation Report, February 2001); (e) Website still available but there is no updated information since April 2001; (f) Website still available but there is no updated information since March 2001; (g) Projects submission and evaluation started in July 1998, but only started implementation in May 1999 (source: PACD, Final Evaluation Report, 2001).

If one considers the broad social and economic context under which digital cities may be facilitated, we must consider the conditions for integrated learning processes. This has led Conceição, Heitor and Lundvall [2] to build on Lundvall and Johnson's learning economy [37] and to discuss the learning society in terms of innovation and competence building with social cohesion. They view innovation as the key process that characterizes a knowledge economy understood from a dynamic perspective, while competence is the foundation from which innovation emerges, and which allows many innovations to be enjoyed. In other words, it contributes both to the "generation" of innovations (on the supply side of the knowledge economy) and to the "utilization" of innovations (on the consumptions side of the knowledge economy). Conceptually, the foundations for the relationship between learning and economic growth have been addressed in the recent literature [38], with learning being reflected in improved skills in people and in the generation, diffusion, and usage of new ideas [39].

Learning can occur in many shapes and forms, some of which are informal, some formal. As described before, the institutional framework that comprise the national and regional systems of innovation formalize the technological infrastructure critical to generate the learning processes for individuals, firms, and nations, that ultimately lead to long-term development. Thus, looking at a particular set of organizations, their capabilities and related institutions, provides important lessons for development. This is the reason we argue for the need to combine adequate infrastructures and incentives with institutions, to foster the necessary context for digital cities to succeed.

The analysis above is broad in scope and considers network societies as wide social and economic processes, which we argue occur across time and space and require the dynamic adaptation of infrastructures, incentives and institutions, in a way that calls our attention for the need to foster learning societies. However, the evidence of the projects discussed in this paper show that we must extend our analysis to other aspects of the learning society. This is because the experience of projects such as those developed in the cities of *Marinha Grande* and *Aveiro* clearly shows the important mutual relationships that specific project-based communities have on the facilitation of network societies, but also the fact that the implementation of digital cities may significantly improve the efficiency of those communities. In the following paragraphs, we extend this evidence and argue that the success of digital cities rely on the specific development of knowledge-integrated communities, KICs.

We refer to project-based communities, oriented to specific social and economic goals, that will benefit, and gain from, digital networks if particularly challenges by knowledge-based activities. In the case of *Marinha Grande* the evidence is that economically-oriented networks based on mould-forming companies has particularly launch business networks, which still require long-term processes and continuous funding, as well an adequate institutional setting. In this case, it should be noted the role of the related industrial association and technology centre in promoting the necessary links and networking facilities, which again support our previous analysis of the need to consider basic framework conditions.

In a different scale, but also using relatively reduced level of incentives, namely at an international scale, the evidence provided by the *RuralNet Project* developed in

the city of *Bragança* also shows the critical importance of project-based mechanism to support and sustain digital cities. But of specific interest in our context, are some of the activities developed in *Aveiro*, in that knowledge-based activities could promote and sustain digital networks well beyond the period under which public incentives were made available.

The reason why knowledge-based activities are particularly prone to foster and sustain digital networks is because they will increasingly rely on “distributed knowledge bases”, as a systematically coherent set of knowledge, maintained across an economically and/or socially integrated set of agents and institutions, as discussed by Smith [40] and Conceição et al [1], among others. The relevance of considering distributed knowledge bases across economically and/or socially integrated set of agents and institutions leads us to the concept of social capital. In the broadest sense, social capital is associated with the “social capabilities” [41] that allow a country or region to move forward in the process of development. In a more sophisticated treatment, Coleman [42] states that social capital is “a variety of different entities, with two elements in common: they all consist of some aspect of social infrastructure, and they facilitate certain actions of actors—whether personal or corporate actors—within the structure.” The relationship of social capital for the economic performance of nations was recognized by Olson [43] and North [44], in broad descriptions of the process of development.

In Portugal, most of the complex social, economic and political advances towards the Information Society are governed by public decisions. The evidence provided in this paper shows that investments in ICT infrastructures, although very necessary, haven’t been sufficient to create a sustainable knowledge-based living and working environment. Consistent public policies, innovative regulatory frameworks and strong incentives are thus needed to create over time the conditions to catch up with more developed societies and mitigate the uncertainty associated with the adjustment process [6].

Within this perspective, our analysis calls for policies that consider long term approaches of dynamic environments, which require to be continuously monitored and evaluated. Specific incentives for infrastructures should continue, but articulated with the need to foster knowledge integrated communities as drivers of larger communities of users. This requires a continuous public effort, but also a better understanding of the effectiveness of the mix of public support mechanisms and private incentives for the development of digital cities.

The analysis is based on observations in different Portuguese metropolitan areas and regions with the ultimate goal of increasing regional competitiveness, by promoting public awareness and participation in decision-making processes. It is argued that the territory is a basic infrastructure that justifies and invites for the construction of several layers of information, but above all for communication infrastructures and digital contents, but well arranged with local contexts. It is suggested that knowledge driven communities, KICs, are important drivers of larger communities of users and different types of KICs are identified. Particular attention is suggested for those established among basic and secondary schools with university and research groups and evidence is provided from sample case studies in Portugal.

Our analysis led us to suggest that while the role of institutions needs to be re-examined, the variety of demands and the continuously changing social and economic environment is calling for diversified systems able to cope with the need to produce policies that nurture and enhance the learning society. We refer to the need for individuals, firms and organizations to operate in dynamic environments, where markets and technology are changing fast and in unpredictable ways. This calls for the need to combine adequate infrastructures and incentives with institutions, to foster the necessary context for digital cities to succeed. The institutional framework should be dynamically considered in order to foster local conditions over time, and this does not necessarily mean less government, but rather continuous public support and monitoring.

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