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From Technological Determinism to Regional Development: Lessons Learned from the Portuguese Digital Cities Program (1998-2006)

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Abstract: This paper discusses the development of the Portuguese Digital Cities Program (1998-2006) within the context of the current national public policy framework for the development of the Information Society in Portugal. It explores the case of the Aveiro Digital City and discusses how Portuguese cities and regions are building information and communication networks in both urban and rural environments, with the ultimate goal of promoting regional development. It is argued that such networks have the potential to attract and mobilize people into a "culture of knowledge" and make public administration and free markets more effective, but require adequate infrastructures, incentives and institutions. The analysis builds on the co-evolution of human and social contexts at a territorial level and the endogenous process of technological change, namely in terms of local and regional adoption of information and communication technologies.

1. Introduction

Society and technologies co-evolve shaping, and being shaped by the places and spaces where we live. The variety and intricacy of these recombination processes contribute profoundly to the current diversity of spatial structures and meanings of cities and countryside. Information and communication technologies (ICT) can afford new scenarios for territorial development and provide a new kind of networked infrastructure that will have a profound and lasting effect on patterns and shapes of urban areas. One of these scenarios is the concept of "digital cities and regions".

The term "digital city" was coined in 1993 after the Amsterdam Digital City (DDS – De Digitale Stad), a very well studied experiment based on the FreeNets and Community Networks in the USA and in Canada. Its goal was to provide an electronic space for political discussion and participation in the ten weeks that preceded the local elections, but its success made it last until 2001 [1]. Other early experiments followed shortly after, being the most well known Kyoto Digital City, Bristol Digital City and Helsinki Arena 2000. The original concept of "Digital Cities" has since then expanded and, currently, five basic design patterns can be identified: (a) highly wired territory; (b) community network; (c) 3D or 2D representation of physical cities; (d) local government portal; and (e) commercial city guides [2]. While the first pattern concentrates on digital infrastructure, the other four are manifestations of different aspects of urban everyday life. Recombinations as well as whole new patterns that emulate the vast diversity of real cities are also emerging, for example, digital cities as "augmented public spaces", where virtual worlds expand the living and imagining of the physical city [3].

In Portugal, the development of digital cities and regions became one of the centrepieces of national policies for the development of the Information Society, playing a critical role for the appropriation of information and communication technologies at a regional and local level. This ambitious program, led by the central government and implemented by the local government, must be understood within the context of increasing focus on national technological competitiveness, global productivity growth and modernization of public administration. Such context set the stage for a top-down, technologically deterministic approach that has been constantly challenged by the increasing territorial complexity and heterogeneity of uses, attitudes and skills at local level.

As pointed out by MacKenzie and Wajcman, "The history of technology is a path-dependent history, one in which past events exercise continuing influences. […] Path-dependence means that local, short-term contingencies can exercise lasting effects" [4]. This paper briefly compares the case of the Aveiro Digital City within the institutional and technological framework of the Portuguese Digital Cities Program and discusses the challenges and opportunities for the development of the Information Society in Portugal.

2. The Portuguese Digital City Program

The Portuguese Digital Cities Program can be divided into three noticeably different phases. The early experimental phase, from 1998 to 2000, focused on building basic technological infrastructures to support information exchange and service provisioning. In the second phase, between 2001 and 2003, 2 out of the 7 projects from the previous phase, Trás-os-montes Digital and Aveiro Digital, were prolonged for another three years. Together with 7 new digital city projects, they lagged for long periods due to national political instability, funding bureaucracy and lack of clear goals and metrics at a local level.

The third phase of the digital cities and regions program started with the publication "Digital Cities and Regions Operating Guide" by the Central Government in September 2003, and coincided with the complex spatial rearrangement of Portuguese regions – voluntarily association of contiguous municipalities – in metropolitan areas (at least 9 municipalities and over 350,000 inhabitants), urban communities (at least 3 municipalities and over 150,000 inhabitants) and intermunicipal communities (project oriented grouping). The program has grown to cover three quarters of the territory and about two thirds of the Portuguese population (circa 10.3 million). Currently, there are 26 different projects afoot to be completed by December 2007, totaling more than 220 million Euros in public incentives under the 3rd European Framework Program (see Figure 1). Four more projects are under negotiation.

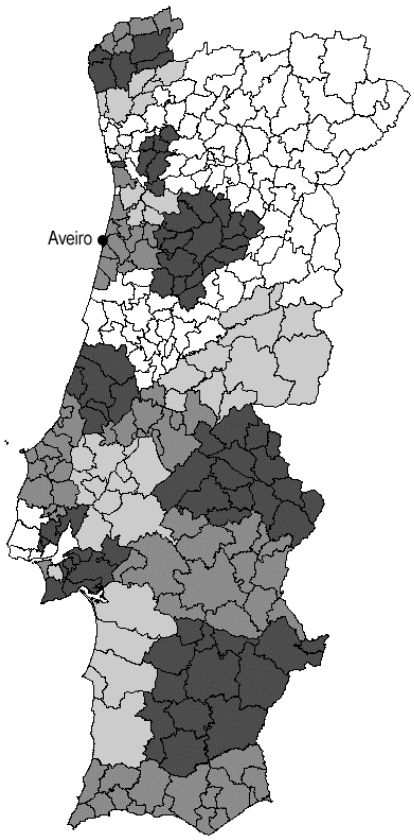

Figure 1- Territorial coverage of current digital cities and regions projects (excluding 2 autonomous regions, Madeira and Azores Archipelagos)

The projects developed in the third phase have basically the same architecture (see Figure 2). The idea behind such standardization was both the synchronization of project lifecycles and better control and/or optimization of expenditures. Besides the basic architecture, each city or region could also submit up to two or three pilot projects that would address specific sectorial or regional needs and mobilize local actors

The typical project has a layered architecture encompassing 5 main components: infrastructure (broadband municipal networks and Internet data center), regional portal (content management platform and digital contents – local life, tourism, business directories, education, health, etc.), pilot projects, modernization of local administration (online services, Intranets and process reengineering), and mobilization (free public access points, wi-fi hotspots, mobile Internet units and marketing initiatives).

Despite the original intentions, the basic architecture was soon revealed to be too complex. Also, the rigid framework was applied with poor adaptation to local context or lacked significant contributions from local actors, except for the pilot projects. In fact, the framework clearly hampered local creativity and project managers, in time, started to concentrate on one or another component to overcome the technical, institutional and political barriers to implementation.

The most successful initiatives, in terms of speed of implementation, were the pilot projects (e.g Algarve Tourism Portal, http://www.visitportugal.pt). The modernization of local administration, considered the cornerstone of most of the projects, proved to be an immense challenge, above all due to the need of long-term change programs to accommodate process reengineering of administrative procedures.

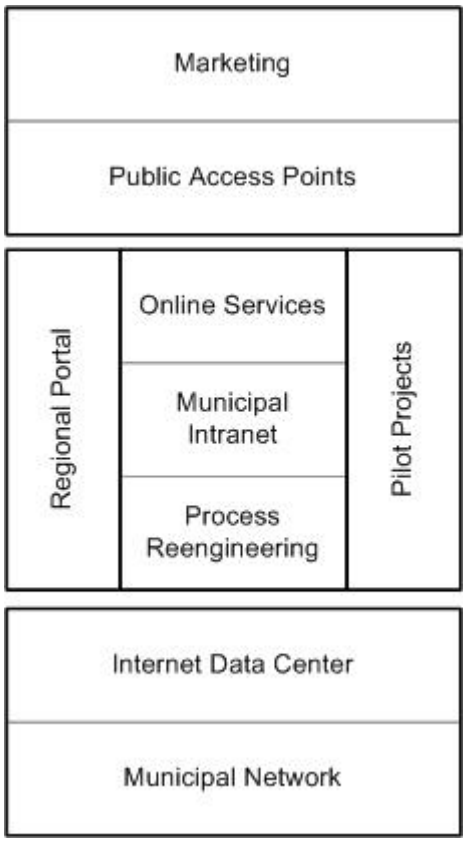

Figure 2 –Basic Architecture of the 3rd phase of the Digital Cities Program

Most of the projects of the second phase, Gaia Global (http://www.gaiaglobal.pt/), Maia Digital (http://www.maiadigital.pt/), Ribatejo Digital (http://www.ribatejodigital.pt/) and Almada Digital (http://www.almadadigital.pt/), all focusing only on the provisioning of local administration services, already draw to a close, but few results are available. The projects of the third phase are taking much longer to be implemented and 5 main reasons could be identified: (a) administrative, managerial and technological capacities, both local and central, are scarce and inelastic; (b) high transaction and opportunity costs due to weak institutional arrangements - territorial, political and procedural; (c) hard technology determinism is deeply embedded in the larger social structure and culture; (d) discretionary funding does not reward execution capabilities nor promotes competition; (e) the 26 projects function as separated silos that don't collaborate nor share accumulated knowledge.

Aveiro Digital City is an exception.

2.1 Aveiro Digital City: a Brief Case Study

The Aveiro Digital City project represents an interesting case study in so far as it is promoted and coordinated by an autonomous organization formed by the municipal association, local governments, the local university and the incumbent telecommunication operator, Portugal Telecom. Aveiro Digital City represents the result of a long preparation effort and it provided the opportunity to evaluate concepts and then to roll-out a much more comprehensive initiative.

Aveiro is a seaport in the north of Portugal, located at the Vouga estuary, with a population of approximately 65,000. The city's innovative and active character, although recent, draws from the singular institutional framework established in close collaboration

between the local university (Aveiro Universtiy) and the local business community, mainly driven by incumbent telecommunications operator, Portugal Telecom.

Following the launch of the first phase of a 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 [5, 6].

Actually, the Aveiro Digital City, since its inception, cannot be considered a project but a regional program for the development of the information society at a regional level. Instead of a tightly integrated project led by a limited group of actors, the Aveiro Digital City is a loosely coupled set of initiatives (most of the initiatives were drawn from open idea contests) coordinated by a non-profit organization that provides very clear and objective guidelines and monitors and evaluates very closely every aspect of the implementation, particularly financial and administrative aspects, through a very sophisticated and comprehensive extranet. Other aspects that contribute decisively for its success are the technical, administrative and political capacities of the coordination team, led by a very skilled and networked general manager.

The complete funding life cycle was expected to be 8 years, with the first phase of the project from February 1998 to 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 reaches 20 MEuros and expands the territorial coverage to 10 other municipalities (Ovar, Estarreja, Albergaria-a-velha, Sever do Vouga, Murtosa, Águeda, Ílhavo, Oliveira do Bairro, Vagos and Mira), totalling about 350,000 inhabitants.

Both phases had a troubling start – budget allocation negotiations and bureaucracy caused lengthy delays, mostly for more than one year, in 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. Emphasis was given to infrastructures and digital contents, including local e-government, e-health, e-business and entertainment.

E-business and education related activities accounted for 35.1% of the total number of approved projects and 40.7% of the budget allocated. eGovernment 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 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 [7]. eGovernment 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.

The second phase includes 77 projects with emphasis on training, public Internet access areas, mobilization, local e-government, education, e-health, social services, regional competitiveness, tourism, culture and daily life. By the end of 2005, the Aveiro Digital has already certified 10,487 people in basic computer skills. The expected number of certifications will exceed 45,000, or more than 13% of the population. Furthermore, 91 Internet public spaces will be installed (see Figure 2), including one for every parish of all

participating municipalities. During 2005, 68,007 users, about half of then between 10 and 18 years old, expend 234,877 hours navigating on the Internet [8].

Figure 3- Sample Projects from Aveiro Digital City. Mobility Portal (http://www.cm-aveiro.pt/mobiria) and Aveiro Digital City Internet Public Spaces (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 form the Aveiro project and here we refer to competence as skills and capacities, both individual and collective [9].

3. Discussion

3.1 The Importance of Communities of Practice, Interest or Proximity.

The evidence shows the need to extend the design of digital cities and regions from a technocratic paradigm of technical change and look at broader system design fostering societal developments. Complex technology-enabled infrastructures typical of digital cities calls for the integration of social and cultural aspects in early design phases to mitigate uncertainties, such as usability, sustainability, flexibility and scalability. The five main barriers mentioned in section 2 may compound with other contingencies, like the permanent financial constraints of municipalities or development agencies and, even more frequently, very low participation of the civil society in the decision making processes.

Moreover, digital cities may develop other unexpected properties, or emergent properties, developed by users of a system and frequently unbeknown to the project managers. Being so, the stakeholders involved in the co-evolution of urban areas and ICT would be better off if the current technology deterministic paradigm would be substituted by human-centred systems that would attract broader range of users.

Expanding this conceptual framework to the entire city or even whole regions in order to consider the way millions of people interact with information and communication technologies in their daily life, it is clear that the initial approach to design and implement digital cities and regions in Portugal needs to be reconsidered. In particular, the experience of projects such as the Aveiro Digital City clearly shows the important mutual relationships that specific project-based communities related to each and every one of the initiatives 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 of practice, interest or proximity, meaning a collective learning process [10].

These considerations are based on the need to consider uncertainty in the mobilization of ICT, which requires 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 flexible infrastructures, adequate incentives and

appropriate institutional settings to build competence and foster the necessary social context for digital cities and regions to succeed in Portugal.

3.2 Funding Pathologies

An important aspect to be taken into consideration regards the functioning of the funding agency. Several pathologies can be identified during the long process of negotiation, approval and implementation of the projects. The most important is the lack of standard operating procedures and decision-making models in the lengthy submission and money transfer processes. Although most of the projects had to follow the basic digital city or region architecture, the total amount approved for each project differed markedly (see Table 1) and it was essentially dependent upon on ad-hoc negotiation capabilities of each city or region. It was not related to the specific needs of each city or region, resident population or absorption capacity, resulting on situations were some regions, e.g. Braga Digital, received large amount of funds, only used a very small fraction of it. As a result, in May 2006, only 22% of the available funds were used.

Project	Investment (€)	€ p.c.	Project	Investment (€)	€ p.c.
Madeira Digital	23,780,423	98.57	Beja Digital	4,774,000	36.27
Braga Digital	14,696,167	88.10	Porto Digital	9.327.000	35.45
Litoral Alentejano	7,031,466	71.74	Gaia Global	8,441,500	28.78
Maia Digital	8,350,000	67.08	Leiria Digital	7,960,560	26.24
Aveiro Digital	20,000,000	57.38	Algarve Digital	10,086,739	25.32
Medio Tejo.Digital	8,724,541	45.41	Viseu Digital	7,369,439	24.63
Almada Digital	6,911,687	42.92	Açores Digital	5,000,000	20.94
Portalegre Digital	5,282,880	42.84	Vale do Sousa Digital	6,805,237	20.60
Évora Digital	6,530,072	38.21	Oeste Digital	6,281,290	18.20
Beira Baixa Digital	7,764,197	37.90	Setúbal Digital	7,283,434	17.97
Ribatejo Digital	8,919,492	36.53	Seixal Digital	1,318,307	8.65

Table 1- Investments Per Capita in Selected Portuguese Digital Cities and Regions

Another important aspect, the funding agency never set up an integrated evaluation framework or a monitoring programme to collect data centrally and eventually help project managers in their decision-making processes. Moreover, networking, knowledge sharing, and benchmarking were not stimulated by the funding agency. As a result, on the one hand, some distrust sprung up between the funding agency and the project managers causing more bureaucracy and delays, on the other hand, there is no data available to assess either ROI or impacts on regional growth or territorial competitiveness.

4. Conclusions

The most obvious finding to emerge from this study is that consistent public policies, evaluation frameworks, innovative regulatory systems, openness to the civil society and large investments are needed to create the conditions for Portugal to catch up over time with more developed societies and mitigate the uncertainty associated with the adjustment process. The second major finding was that specific incentives for infrastructures should continue, but articulated with the need to foster knowledge networks – communities of practice, interest or proximity – to mobilize individuals, communities and organizations for the information society. This requires a continuous long-term pubic effort, but also a better understanding of the effectiveness of the mix public support mechanisms and private incentives necessary for the development of digital cities. Market mechanisms do not necessarily work at the level of the issues associated with digital cities, namely in less favorable zones.

In early stage developments, digital cities have demonstrated that they also call for specific initiatives, together with monitoring and evaluation procedures, for the mobilization of individuals, communities and organizations. This is one of the most critical factors to be considered in the design, implementation and exploitation of digital cities. They cannot be promoted independently of an innovation policy fostering competence building and connectivity to knowledge networks.

Layer of Analysis	**From**	**To**	**Implications and requirements**
Infrastructure/access	Conspicuous objects	Invisible infrastructure	Embedding ICT infrastructures in urban daily life, fostering **human-centered systems**
	Fixed access	Roaming	Ubiquitous and competitive **mobile services** and improved regulatory framework for **increased individual participation and expression**
Content/ services	One-way distribution of information	On-line collaboration and participation	Specific knowledge of institutional and local contexts in order to help developing **interactive contents**
	Web functionalities	Networked Activities	New competences in content and services development, **enhancing user activities and networks**
Human and social Context	Technology supply	Mobilization of users	Mobilizing **change agents** to foster communities of practice and **user involvement**
	Standards	Interoperability	Building **individual and social competences** through knowledge-based adaptive human centred environments

Table 2 - Emerging Trends in the Mobilization of the Information society, towards a new generation of "Digital Cities" Adapted from [11].

The Aveiro Digital City, supported by the local universities, could build a large base of competences for the development of contents and applications. Other cities or regions could not secure the necessary endogenous competences and had to shut down their portals as soon as public funds were discontinued.

Bridging the digital divide to promote social cohesion – both national and European – was the main rationale to support the Program. Knowledge networks have the potential to make both public administration and markets more effective, which helps promoting learning trajectories for the inclusive development of society and bridging the digital divide, but they require effective infrastructures, incentives and adequate institutional frameworks. In particular, incentives for Portuguese digital cities should be mainly concentrated in providing context, connectivity and content for local knowledge networks. When embedded in daily life routines, knowledge networks can be simultaneously mobilizers for the information society and drivers for change. Other trends (see Table 2) can be observed that may help the design of a new generation of digital cities or regions.

The 10 main recommendations for the development of a new generation of digital cities and regions are:

1. New financial mechanisms and simpler administrative procedures must be created at central level to decrease transaction costs and cope with accelerated technological change and emergent properties of complex systems;
2. Digital city programmes must be decentralized and focused on fostering public-private partnerships at local or regional level;
3. The provisioning of competitive telecommunication services and improved regulatory framework is a critical success factor for the deployment of public networks;
4. ICT infrastructures must be embedded in urban daily life, fostering human-centred systems that respond to specific needs and wants;
5. Projects managers must develop an ongoing dialog with local civil society and accommodate their needs and wants;
6. Projects managers should also evaluate and eventually accommodate or mitigate emergent properties of digital cities;
7. Inclusion of specific knowledge of local contexts in order to help the development of relevant and useful contents and strengthening of social networks;
8. Identification and mobilization of local change agents to foster communities of practice, interest or proximity;
9. The evolution from one-way distribution of information or two-way transaction (e-government) to real time collaboration and participation in local governance (e-democracy);
10. Promotion of diversity and inclusiveness.

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