

# A Quantitative Survey of the Transformation of the Málaga Area Due to Information Technology

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## Abstract

*This is a quantitative analysis of economic indicators of the Malaga area. The examination is specifically directed to the technological Málaga. In particular, the relation between its principal actors (Science Park and Telecommunications Faculty) is considered in detail, and framed within a general model.*

## 1. Introduction

### 1.1. Motivation

This paper constitutes the natural continuation of a former one [1], in which it was recognized the role information technology is currently playing in the transformation of the Málaga area. That change is seen by the authors principally as the outcome of the activities within the Science Park of Andalusia (Parque Tecnológico de Andalucía, PTA); these, on their side, rely to an important extent on a strong interaction with the Telecommunications Engineering Faculty (Escuela Técnica Superior de Ingenieros de Telecomunicación, ETSIT) of the University of Málaga.

The following is therefore an attempt to validate this hypothesis by quantifying facts. The paper outline follows: an analysis of PTA evolution comes first; emphasis has been put on understanding results concerning research and development (R&D), to which end an inquiry was conducted. Settings for this survey are next provided in a hierarchical fashion, that is, sequentially in local, regional and national contexts. Since we attribute to ETSIT at least part of the success of PTA, the most relevant data of ETSIT's evolution are also presented; we delve shortly into the dependence relations set up between ETSIT and PTA, both at institutional and individual levels. Indicators

confirm that PTA is gradually becoming a telecommunications park; to conclude we have also tried to fit this in a theoretical model. But before carrying on, some observations about the working methodology are pertinent.

### 1.2. Procedural remarks

Since the purpose of this paper is to quantify facts, it is expedient now to comment on the limitations we had to face in order to elaborate the analysis below. These limitations were caused by the nature of the statistical sources, and can be classified into:

- Limitations related to the **disaggregation of activities**, where disaggregation stands here for the resolution achieved at describing the different types of activities. We have been able to determine the activity disaggregation within PTA with a considerable precision; in fact, this accuracy surpassed any usually provided by local or national economical statistics [2], and as a consequence it was sometimes difficult to make sensible comparisons. From this first limitation, two more emanate:

- **Periodicity limitations**, that is, time disaggregation. More precisely, PTA growth has intensified in the last two years, but no sources at a local [3] or national level [4] reflect yet this period of time, impeding thus a sound comparison.

- **Territorial disaggregation**. Complementary to the former, the spatial resolution of good statistical surveys stops at a larger scale (national or regional, but rarely provincial).

To overcome these limitations a combination of approaches has been used; in what PTA is concerned, an *ad hoc* inquiry was realized in order to determine the

characteristics of R&D projects run by PTA-sited companies. Our premise was to suppose that R&D activities are the most significant, and therefore represent a good approximation to the actual enterprise economic figures. In a regional context (Andalusia) we counted on a rather updated source (till 1998), which permitted us to place PTA, save for the fact that it ignores the latest (and most interesting) PTA progress, that is, the time from 1998. Finally, in the national frame, and given the lack of an updated source, bibliographic information was used [5], where PTA is compared to the remaining Spanish Science Parks.

## 2. Evolution of PTA

### 2.1. General information

The Science Park of Andalusia (PTA) was founded in 1988 as a result of the co-operation of several administrations, i.e., the Junta de Andalucía (regional government of Andalusia), Instituto de Fomento de Andalucía (Development Agency of Andalusia), the Empresa Pública del Suelo de Andalucía (Public Soil Company of Andalusia) and the Ayuntamiento de Málaga (Málaga Council). It was inaugurated in 1992, and since September 1995 is the seat of the International Association of Science Parks (IASP). A detailed description of PTA can be obtained at [6]. Physically, PTA is located at the west boundary of the Málaga township, some 20 km away from the city centre. More information on both Málaga and Andalusia is provided later.

### 2.2. PTA historical record

The figures below summarize the evolution of PTA in the last eight years. The parameters depicted (number of companies, employees and global turnover) are considered as most relevant. PTA's progression is quite remarkable, and the prognosis for 2001 still very optimistic. Nevertheless, a slowing down could be expected due to the present crisis in the telecommunications arena (besides, an ever-expanding growth is not sustainable, and some type of permanent regime will eventually settle).

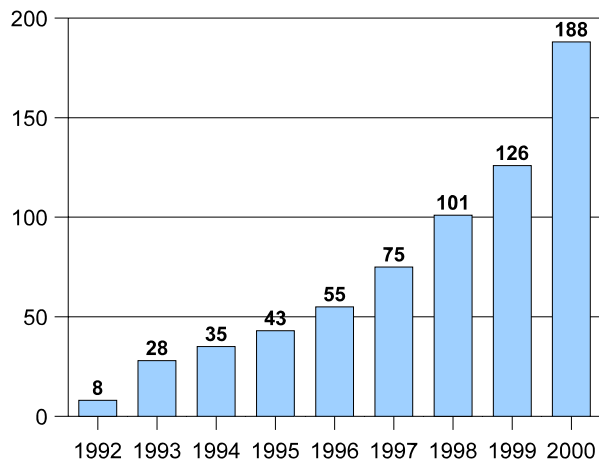


Figure 1. Number of PTA-sited companies

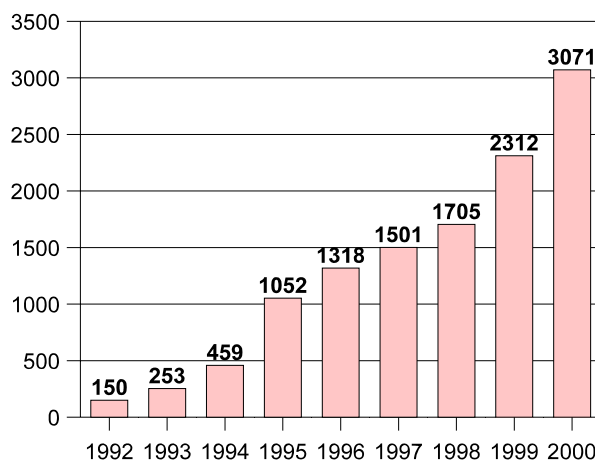


Figure 2. Progression of number of employees

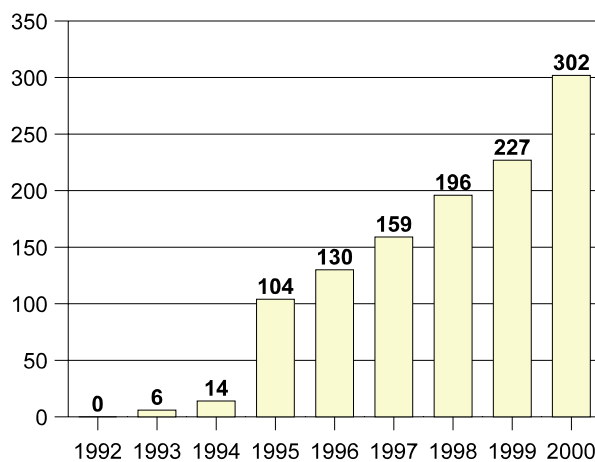


Figure 3. PTA-sited companies turnover (Mi)

## 3. Research and Development within PTA

### 3.1. Inquiry

An extensive inquiry was conducted by one of the authors (F. Romera) at the beginning of the year in order to find out the most relevant ciphers concerning the PTA research and development (R&D) activities. The figures to determine were:

- Number of enterprises involved in R&D
- Number of R&D projects run by each company
- Main research lines of these projects
- Number of people working on R&D
- R&D investment figures

The poll was submitted to the entirety of the PTA firms; 143 answered the questionnaire, what amounts 76% of the total. Considering that 11% of the companies (belonging to those that did not respond ) are still at their setting up, it follows that the outcome of the inquiry is really meaningful.

### 3.2. Poll results

**3.2.1. Activities.** From the total of companies, 57 undertake R&D activities, which adds 40%. An inspection of the research lines reveals that these are principally focussed on the information technologies, namely:

- Mobile telephony
- Platform development
- E-commerce
- Online marketing
- Automation systems
- Software development
- Multimedia applications
- Microelectronics
- Telecommunications in general

There are also some alternative research lines (mainly related to molecular biology), but these can only be regarded as subsidiary. The total number of R&D projects currently managed by PTA companies amounts 363, with 622 people involved (mostly academics). The average for PTA companies is therefore two R&D projects a year.

**3.2.2. R&D expenditures.** The estimated turnover of PTA companies reached 302 million € in year 2000. On the other hand, the R&D expenses of both firms and institutions was of 42 million € in the same year, some 13.9 % of the above figure .

**3.2.3. R&D Employment.** The number of employees in PTA companies reached 3071 people, from which 622 (20.3%) are directly devoted to R&D.

**Table 1. Summary of R&D PTA figures**

Distribution of R&D within PTA			
	Companies	Institutions	Total
No. of R&D projects	351	12	363
People working on R&D	563	59	622
R&D Investments	29.12 Mi	12.92 Mi	42.04 Mi

### 3.3. A finer examination

The inquiry results permit us to delimit what is being currently done (research lines) as well as the target in the frame of the productive tissue of Málaga. We comment shortly on both (see table 2).

Regarding the R&D conducted, up to 86% of investments are dedicated to the manufacturing of electronic equipments, infographics and informatics, confirming the orientation of research towards the information technology in its various forms.

With respect to the target economical sector, we observe that:

- Telecommunications represent the majority of projects, personnel and investments.
  - Non-specified means all the R&D related to software and the internet susceptible of being used for various purposes.
  - Services to enterprises retain a significant proportion of the number of projects (22%), lesser in personnel (17%) and investments (10%).
  - Services to administration represent 11% of investments.
  - Media (audiovisual, press and documentation) are also relevant (13%).
- In conclusion, telecommunications appear to be very compact, uniting both the activities developed and the destination of it, while informatics has a wider applications spectrum, and is probably the link between PTA and its productive environment. Online marketing and e-commerce, advisory, formation and distance work count among the main targets; it is remarkable the relative absence of tourism, given its importance in Málaga's economy.

## 4. Regional and national settings

Málaga is a port city and capital of the province Málaga, in the Comunidad Autónoma (region) of Andalusia, southern Spain. It lies along a wide bay of the Mediterranean Sea at the mouth of the Guadalmedina River in the centre of the Costa del Sol. The estimated population of Málaga is some 600,000, and the metropolitan area can probably reach 1,000,000. Further information on Málaga can be obtained at [7].

Andalusia, on its side, is the federal region to which Málaga belongs. This historic territory encompasses the eight southernmost provinces of Spain, corresponding roughly to the ancient Roman province of Baetica. The government of the Comunidad Autónoma established in 1981 consists of an executive council (headed by a president) and a unicameral parliament. Andalusia faces both the Atlantic Ocean and the Mediterranean Sea to the southeast. Its topography is divided by mountain ranges into several distinct zones, each running southwest to northeast. A Mediterranean climate prevails in most of Andalusia, with mild temperatures all the year through, except for hot summers; colder climate marks only the Baetic Mountains,

where heavy snows and low temperatures occasionally leave the upper reaches snowbound in winter. Annual precipitation ranges from 2,000 mm in the Sierra of Ronda

to as little as 100 mm in the desertic Andalusian steppes. The estimated population is some 8,000,000. More on Andalusia can be read at [8].

**Table 2. Economical activities to which PTA R&D projects are devoted**

Purpose -Group of activities	Number of projects		Number of people		Investments (MPta)	
	T	%	T	%	T	%
<b>Telecommunications</b>	157	42,66	283	45,57	2502	35,77
<b>Non-specified</b>	59	16,03	76	12,24	816	11,67
<b>Services to Enterprises</b>	82	22,28	105	16,91	716	10,24
<b>Media</b>	5	1,36	21	3,38	471	6,73
<b>Regional Administration</b>	2	0,54	9	1,45	405	5,79
<b>Justice Administration</b>	1	0,27	4	0,64	400	5,72
<b>Press</b>	1	0,27	4	0,64	400	5,72
<b>Biotechnology</b>	2	0,54	3	0,48	252	3,60
<b>Construction</b>	11	2,99	16	2,58	246	3,52
<b>Fishing</b>	4	1,09	14	2,25	164	2,34
<b>Sanitary Industry</b>	8	2,17	19	3,06	130	1,86
<b>Informatics</b>	5	1,36	10	1,61	125	1,79
<b>Education</b>	7	1,90	9	1,45	63	0,90
<b>Graphics Industry</b>	2	0,54	13	2,09	59	0,84
<b>Personal Advisory Services</b>	1	0,27	3	0,48	50	0,71
<b>Electronics Industry</b>	1	0,27	5	0,81	40	0,57
<b>Equipment Industry</b>	4	1,09	3	0,48	40	0,57
<b>R&amp;D</b>	1	0,27	6	0,97	25	0,36
<b>Electric Material</b>	1	0,27	4	0,64	20	0,29
<b>Environmental Industry</b>	3	0,82	4	0,64	20	0,29
<b>Textile and Food</b>	2	0,54	3	0,48	15	0,21
<b>Textile Industry</b>	2	0,54	1	0,16	11	0,16
<b>Chemical Industry</b>	3	0,82	2	0,32	10	0,14
<b>Pharmaceutical Industry</b>	3	0,82	3	0,48	10	0,14
<b>Others</b>	1	0,27	1	0,16	5	0,07
<b>TOTAL</b>	<b>368</b>		<b>621</b>		<b>6995</b>	

(1i =166.386 Pta)

#### 4.1. The Málaga area in figures

Málaga's economy rests principally on services, which absorb up to 76.64% of its gross product and 72% of employment. Among these services, commerce and hotel business (both related to tourism) represent nearly one third of the above ciphers. This specialization can be traced at the Spanish national statistics: with only 3.11% of Spanish national population and 1.44% of its area, Málaga reaches 6% of tourism gross product. In this framework, industry represents a mere 8.7% of Málaga province GP, contributing less than 2% to the Spanish GNP and

employment. Thus, the importance of PTA activities is not quantitative, but rather strategic (innovation). Still, and except for the more traditional and implanted industries in the area (food transformation, breweries and drinks, and tobacco), the telecommunications sector is comparatively appreciable.

#### 4.2. R&D comparison at an Andalusian level

The data for Andalusia indicate the importance of innovative activities in Málaga. As observed from statistics, up to 38 % of Andalusian companies related to electronics

are sited in Málaga, and in the group of companies with over 100 employees, a 44% is attained.

**4.2.1. R&D expenditures.** According to the data provided by the National Institute of Statistics (Instituto Nacional de Estadística, INE), the estimated R&D disbursements were 126.2 million € for Andalusia (the autonomous region to which Málaga belongs) in year 2000; in the same period, PTA companies expenses reached 29.12 million €, that is, a 23% of the whole Andalusia figure.

**4.2.2. R&D Employment.** INE estimates some 2000 people working on R&D in Andalusia; that means that roughly 30% of these people work for a PTA-sited company.

**4.3. A national review**

As already indicated, our national comparison could only be based on bibliographic material [5]. It can be observed that PTA has experienced the largest growth rate in the number of companies (131%). Nevertheless, the increase of employment (68%) is more limited. Growth has been accompanied by a reduction in the average number of employees per firm (from 23 to 17). Ondátegui [4] relates this to the following factors:

- The absence of an industrial environment provoked PTA promoters to develop a strategy of “exterior” projection, with some specific actions, like the attraction of companies by an active image policy, and also the cooperation of the Park in networks, like T2A, AMBAR (Andalusia, Montpellier, Bari), COPAINS (Málaga-Sevilla-Oporto-Sheffield-la Vienne), attracting the seat of IASP.

- In contrast to the other Andalusian Science Park (Cartuja, located in Seville), where public investments predominate, private initiative is the engine of PTA, with an increasing importance of small and medium size firms. According to PTA board, 50 % of PTA growth is originated by PTA companies, and the rest comes from the establishing of foreign companies, with some prevalence of nordic telecommunications enterprises.

- While the table indicates a growth of the figure of employees per corporation, Ondátegui [5] points out the importance of small and medium size companies in relation to a greater flexibility in space arrangements, enabling an economic startup of small companies that can tailor their space needs as they grow. In the case of PTA, and facing a greater demand on physically reduced spaces, the offer ranges from 15 to 20 m<sup>2</sup> a company (“pre-incubator”), from 25 to 200-300 m<sup>2</sup> (“incubator”); “nests” (a minimum of 40 m<sup>2</sup>) and finally “containers” (a minimum of 500 m<sup>2</sup>).

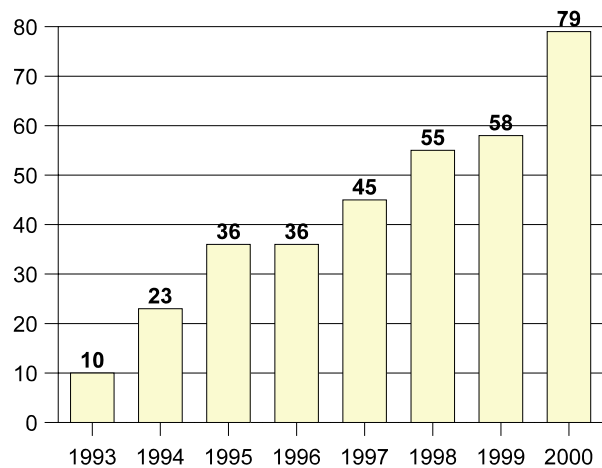
**5. Interplay between PTA and ETSIT**

ETSIT began its activity by implementing the curriculum of a five-year telecommunication engineering degree (Ingeniería de Telecomunicación) in October 1988. In October 1995, and coinciding with the move to the modern Teatinos campus premises, three new three-year degrees started to be lectured; they were devoted respectively to electronic systems, telecommunication systems and image and sound. More on ETSIT can be found at [9].

**5.1. ETSIT statistics**

An inquiry amongst received students has recently been conducted by the board of ETSIT, from which a number of conclusions can be drawn; the most relevant is perhaps a situation of full employment, with a virtually immediate incorporation of students to the labour market (89% found their first job within a few months after graduation). Another remarkable trait is the high job mobility (56% of engineers moved at least once to another company within a three year professional activity lapse). This is a consequence of a very dynamic job market in the past few years, although it must admitted that this market is now showing signs of saturation, if not of recession.

Most of received students (61%) remained in Andalusia, principally concentrated in Málaga (46%). From the rest, 31% found a job in Madrid (which represents by far the principal telecommunications industrial centre of Spain), 5% in Europe and 3% in other Spanish provinces. From this data it can be concluded that ETSIT has acted as the principal supply of qualified personnel to PTA; once PTA’s needs were fulfilled, people oriented themselves to elsewhere (basically Madrid and Europe). On the other hand, and given the acceptance ETSIT engineers enjoy in such competitive markets, the satisfactory formation level achieved at ETSIT can be concluded.



**Figure 4. Number of people received from ETSIT**

## 5.2. Evidence of PTA-ETSIT interplay

Interaction between PTA and ETSIT came about in a natural way from the very foundation of both, since a significant number of engineers in PTA were simultaneously teaching part-time at ETSIT. As commented above, on the other hand, a large proportion of received students are now working for PTA companies. We see this joint PTA-ETSIT growth, characterized by an extensive sharing of manpower, as one of the keys to PTA's success. Furthermore, the process resembles a kind of "crossover": on the one hand, the majority of PTA sited companies have or had R&D contracts together with ETSIT, which can be viewed as a technological partner. On the other, and as an outcome of years of collaboration, some of these contracts have given birth to permanent joint PTA-ETSIT research lines, bringing in the end public and private research together. Over 50% of current R&D undertaken at ETSIT is linked to PTA. This vinculum enables innovative businesses to take place, for these rest on the existence of qualified engineers. A paradigm of this PTA-ETSIT interplay is the System Competence Centre established by Nokia in the premises of the University of Málaga in PTA. Started in year 2000, this brings together Nokia staff, teachers from the department of Communications Engineering (IC) of ETSIT and personnel specifically hired for this project (chiefly received from ETSIT) in order to work on third generation mobile telecommunications R&D. The experience, as far as we know, is pioneering in Spain. It is also a good example of a theoretical model [1], in which multinational companies can be attracted by the combination of quality infrastructure (PTA) and an offer of capable engineers (ETSIT) competing in a global market. For low cost manufacturing cannot be achieved in Europe, knowledge becomes a key factor. With this setting, it is evident that the future of PTA is strongly reliant on ETSIT keep on providing qualified engineers.

## 6. Conclusions

Méndez [10] distinguishes between four types of innovation, namely, process, product, management and social and institutional innovation. In accordance, the PTA case would fit into the latter class, i.e., a social and institutional innovation.

- PTA goal would be the promotion of innovating actions, led fundamentally by telecommunications
- Some of its acting means would consist of the application of some technological policy (from the Andalusian government, see [1]), and the financing by means of joint ventures between public and private partners (PTA-ETSIT).

With respect to PTA-sited companies, we could also speak of management innovation: there is a greater orientation to processes (vs. functions) and clients (vs. production), as well as some fostering of creativity. Acting means would be in this case the access to information

networks and the qualification of human resources.

Regarding the products elaborated in PTA, they represent themselves innovation. At any rate, we see both dimensions (managerial and technological) of innovation originating from a former of a political initiative. Finally, it is still to determine whether the considerable research taking place will diffuse and provoke a change in the productive framework of Málaga. If this occurred, we could regard PTA not only as a technopolis, but Malaga itself as an innovating metropolitan area.

## 7. Acknowledgements

We want to express our gratitude to the Cámara de Comercio de Málaga (Chamber of Commerce of Málaga) and the ETSIT board for the data supplied.

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