Information Society, Work and the Generation of New Forms of Social Exclusion (SOWING): National Report (Portugal)

Moniz, António and Gomes, Cláudia and Machado, Tiago and Urze, Paula

UNL-FCT, IET

January 2001

Fundação da Faculdade de Ciências e Tecnologia

da Universidade Nova de Lisboa

Information Society, Work and the Generation of New Forms of Social Exclusion (SOWING)

National Report (Portugal)

António Brandão Moniz

Cláudia Teixeira Gomes

Tiago Machado

Paula Urze

Monte de Caparica, January 2001

TABLE OF CONTENTS

SOWING - National Case Study Report (version 2.0)

1. Introduction

1.1. Portugal as a Region

Portugal has about 10 million citizens. It is not institutionally divided into "regions" (referenda was held in 1998 on the subject of regionalisation), although we can identify five territorial units in the Continent (North, Centre, Lisbon and Tagus Valley, Alentejo and Algarve), plus Azores and Madeira archipelagos. There are no political, ethnic or religious divisions worth of notice. The Socialist party is in government (since 1995), while the President was also a SP leader, a situation which in principle ensures institutional stability. Portugal have some immigration flow, specially, from Cape Verde and, more recently, from Brazil. In the last few years is increasing an immigration flow from Moldavia, Romania and Ukrania, mostly to the construction sectors. The large majority of the Portuguese citizens is Catholic (there is a minority of Muslim).

The construction of a new Information Society has, in Portugal, mainly a national orientation: it is based on national public policies and programs (as are the Mission for the Information Society or the National Initiative for the Information Society). Firms were not directly involved or interested in the stages of this technology policy.

There are, of course, certain regions - those with higher levels of education or higher average incomes, for instance - which are more able to absorb, in the short-term, some of the features of this change process (Lisbon and Porto). Also, there are differences concerning technological practices within the national territory. Finally, we find some programs (promoted by public organisations) as "Digital Cities" (Portuguese Mission of Information Society) that are pointed to specific regions. This program involved several projects as for Aveiro, Bragança, Alentejo, Azores, Guarda, and in Amadora (for the ethnic minorities). Anyway, we can not talk about specific/regional ways of implementing the Information Society features.

In what concerns the data on demographic variables, we verify that Portugal is a small country, with a surface of 91 906 Km^2, and 9 955,4 (10^3) inhabitants. It was estimated that, in 1997[1], the population density was about 108,1 inh/Km^2.

[1] Preliminary estimation of resident population in 31.12.1997. Source: INE-Statistical National Institute.

TABLE 1 Portuguese resident population at 1991 (NUT's II) x 1000

	Resident Population
Total Population	9 866,0
Portugal Continental	9 362,1
North	3 434,5
Centre	1 709,0
Lisbon and Tagus Valley	3 310,3
Alentejo	540,6
Algarve	367,8
Azores	240,5
Madeira	263,4

Source: PORTUGUESE CENSUS OF 1991 (INE)

The Portuguese territory (Continental) is devised in five territorial units and it has two autonomous regions (Azores and Madeira). The population distribution shows that the North and Lisbon an Tagus Valley areas are those with higher population concentration/active population. In fact, those two territorial units concentrate the flux of the (even if in a low level) dynamics of industrial production and national/international investments in the industry sector. Also relevant the role of the services sector in these units, comparing with the remaining areas.

According to the existent data concerning population, we observe some interesting evolutionary scenarios. According to several studies,[2] the Portuguese population tends to stagnation in the next 25 years, corresponding to an annual growth average under 0,1%. Another aspect noticed is an general ageing trend for the next two decades: the decreasing of young people (0-14 years) will continue, and the older people group (65 years and +) will increase from 14,7%, in 1995, to 18,1%, in 2020.

It is also estimated a decreasing of the population at working age (15-64 years), which will pass from 67,6%, in 1995, to 65,8%, in 2020. This population at working age will go through an ageing process:

- young adults (15-24 years) will accuse a strong decrease (eitheir in relative or absolute values);
- adults with 25-49 years will slightly decrease until 2020;
- older adults (50-64 years) will register a significant increase: from 16,5% to 20,4% of total population.

According to the estimations regarding the total population:

- the total labour force will register a continuous growth, with the increment of 368 thousand active people in the labour market. This increase, which contradicts the demographic evolution, will be the expected increased of the total activity rate.
- by gender, it's estimated that the rate of active man will register a continuos growth, with a variation of +0,5% between 1995 and 2020. The rate of women activity will notice a significant growth and estimations show a variation of +4,1% until the period of 2010.

[2] Cenários Demográficos 1995-2020, Instituto Nacional de Estatística, Lisboa, 1995.

- the number of the total labour force among young people (15-24 years) reveals a tendency to decrease in result of increasing incorporation in the formal schooling (secondary and University), articulated with the expected process of extension of the compulsory schooling.
- the activity rates of both genders will tend to approach: 37,3% in women and 39,2% in man, in 2010.
- in what concerns the adults with 25-49 years old (the population segment with the highest total value), it's estimated an increment of man until 2005, followed by a decrease after this period. For women, a continuous growth is excepted in the labour force, as a consequence of its incorporation in the labour market.

Following this analysis of the short/medium term scenarios for the Portuguese demographic evolution, we can except some structural implications as well major impacts at the economic and social levels. These impacts, with could be more evident in the social systems (Social Security, Health and Education), they have implications on several dimensions of Portuguese society.

After the 1992-93 recession, the evolution of the Portuguese economy has been characterised by a continuous recovery, although with moderate growth rates. Despite that, the average level of the national incomes is still one of the lowest in the EU, as well as the average work productivity.

The recovery of the economic activity has been followed by considerable progresses concerning the nominal convergence. The inflation rate was strongly reduced, and its now very closes to the remaining EU national rates. At the same time, Portugal has developed, in the last years, a notable effort regarding the consolidation of its public finances, decreasing the public deficit and the public debt in percentage of the general national product in a very considerable degree. The behaviour of the Portuguese labour market reveals a straight dependence on the economic conjuncture, since the decade of the 80s, with a very intense product/employment relation and a high adjustment speed.

Despite the fact that the economic activity has started to show some symptoms of recovering after 1994, the labour market's behaviour remained unfavourable until 1995, and only in 1996 presented some signs of recovering, which have become stronger in 1997. The employment raised, with more intensity for women and young workers. For the first time in the last years, the unemployment rate decreased in 1997, with greater intensity for women and young workers, reaching values that were similar to those in 1994.

The innovation in the employment behaviour is particularly clear in what concerns the sectoral composition of the employment changes: the persistent decrease of the industrial employment (even if within a framework of some recovery of the industrial product), a slight expansion in the employment on the tertiary sector, and an important growth of the employment in the construction and public works activities.

In a qualitative perspective, the employment system is still characterised for the persistence of its structural features. Among them, the education and schooling structure with a high weight of low level, specially comparing with the other countries of the EU, as a result of long-term deficits concerning the education of the population. Although the educational level of the young citizens is higher than that of the remaining groups, the portion of those who have a level non-superior to the 9th year of schooling remains high. In consonance with this structural feature, Portugal has a non-favourable qualifications structure, with a low potential of adaptability.

These characteristics of the employment structure are associated with the fact that several sectors are dealing with cheap/intensive labour force. Plus, in lots of enterprises the recruitment is made on the basis of low qualified workers and few training opportunities. On the other hand, there seems to be emerging some structural transformations of great importance. We can identify a considerable sector mutation concerning the industrial and the services sectors as well as growth of the atypical forms of employment.

As mentioned before, the framework of the macro-economic evolution and the changing processes in the Portuguese economic structure have influenced the recent employment evolution. In short, the qualitative features of the employment in Portugal are, in the present, characterised by the following aspects:

- decrease of the weight of the youth unemployment (although remaining very relevant in relative terms), but it is worth of notice that the mechanisms of transition from school to the working life still are insufficient,
- decrease of the relative weight of the women unemployment, even if it still represents the largest portion,
- continuous increase of the relative importance of de long-term unemployment and of the unemployment concerning the elderly groups,
- continuance of higher unemployment rates for the groups with intermediate education levels (2nd and 3rd cycles) concerning the population aged between 25-64 years; those rates in the lower education levels reflect the minor development of the Portuguese economy comparing with most EU countries.

In this sense, the goals of the national employment policy must focus on the following domains:

- to promote an adequate transition of the youngsters to the working life,
- to promote the socio-professional insertion, avoiding the long-term unemployment and exclusion,
- to improve the basic and professional qualifications of the active population,
- to manage in a preventive way and to escort the sector restructuring processes.

In order too guarantee a coherent and integrated development of the employment policies, it should be privileged a global and transversal actuation in this matter, favouring an economic growth that is rich in employment, and contributing for the sustentability and promotion of the levels/quality of the employment. Of course, this program (the National Employment Plan) must be aware of the new challenges that are brought up by the Information Society in what concerns the new forms of production, work and learning.

TABLE 3 Synthesis table of the labour market in Portugal (1985, '90, '95, '97, in 1000's and %)

PORTUGAL	1985	%	1990	%	1995	%	1997	%
1. Total Population (3+6)	10 014	100,0	9 873	100,0	9 918	100,0	9 950	100,0
2. Pop. at working age (15 - 64 year)	6 472	64,6	6 556	66,4	6 707	67,6	6 762	68,0
3. Total labour force	4 514 (100)	45,1	4 948 (100)	50,1	4 802 (100)	48,4	4 967 (100)	49,9
4. Employed people	4 057	90,0	4 658	94,1	4 417	92,0	4 589	93,4
5. Unemployed people*	385	8,5	225	4,5	342	7,1	334	6,7
6. Non-active population (1-3)	5 500	54,9	4 925	49,9	5 116	51,6	4 983	50,1

Source: ANUÁRIO DEMOGRÁFICO (INE), INQUÉRITO AO EMPREGO (INE)

* Actively seeking work and immediately available for work

In what concerns the *labour market* in Portugal, between 1985 and 1997, we verify that, within an environment of continuous growth of the population at working age – reaching in 1997, 68,0% of the total population (67,0% in the EU15) -, there was an increase (5%) of the total labour force between 1985 and 1990, followed by slight variations during the other periods. In 1997, the total labour force included 4 967 000 people, 49,9% of the "total pop." (45,7% in the EU15).

The category *employed people*, between 1985 and 1997, was never inferior to 90 % of the total labour force. But, nevertheless, it shows a decrease of 2,1% between 1990 and 1995 (following the trend of the EU15, where the decrease was of 1,6%), being, in 1997, 93,4% of the total labour force. When compared to the countries participating in the EU15, considered as a group, we verify that in the same reference periods, the national percentile values of employed people are always superior to those of the EU15. It is important to underline that between 1995 and 1997, the number of employed people grew in Portugal (1,4%) while, on the contrary, it decreased slightly in the EU15 (0,1%).

Naturally the scenario is the inverse in the category of *unemployed people*, in other words, the national percentile values are, in this case, and for the four periods in study, inferior to the European average. In 1997, Portugal had 6,7% of unemployed people and the EU15 10,7%.

1.2. Sector/Activity

Analysing the labour market in Portugal, between 1990 and 1997, according to sectors, we verify that there was a high decrease, between 90 and 95, of the number of employees included in the primary sector (-6,6%), followed by a small recuperation, between 95 and 97 (+2,3%). For the secondary sector, the numbers, between 90 and 97, point at a continuous decrease in terms of percentage of the employees (-3,0%). In the tertiary sector, there is a significant increase in the number of employees, between 90 and 95 (+8,8%), after which we can notice a certain decrease, between the last two periods (-1,5%). In the EU15, between 1990 and 1997, there was a negative variation, in absolute and percentile values, in what concerns the number of employees in the primary sector (-1,5%) and in the secondary sector (-3,1%), together with an increase of the number of employees included in the tertiary sector (+4,5%).

TABLE 4 Employed people in Portugal according to sectors (1990, '95, '97, in 1000's and %)

PORTUGAL	1990	%	1995	%	1997	%
All activities	4 658	100	4 403	100	4 579	100
Agriculture, hunting, forestry and fishing	833	17,9	497	11,3	623	13,6
Manufacturing industries	1 607	34,5	1 422	32,3	1 443	31,5
Services	2 216	47,6	2 484	56,4	2 512	54,9

Source: ANUÁRIO DEMOGRÁFICO (INE), INQUÉRITO AO EMPREGO (INE)

In 1997, in Portugal, the primary sector included 623.000 employees (13,6%), the secondary sector 1.443.000 (31,5%) and the tertiary sector 2.512.000 (54,9%). During the same period, in the EU15, the primary sector included 7.578.000 employees (5,0%), the secondary sector 44.713.000 (29,8) and the tertiary sector 97 873 000 (65,2%).

In what concerns the relation service/manufacturing industry in the Portuguese employment structure, it was developed in the following way: 1,37/1 in 90, 1,74/1 in 95 and 97. Worth of notice is that in the

EU15, this indicator is higher in 90 than the national correspondent in 97. Therefore we have for the EU15: 1,84/1 in 90, 2,13/1 in 95 and 2,18/1 in 97. In other words, from 95 on, for each European worker employed in the industry sector, there are more than two workers employed in the services sector.

TABLE 5 Employed people in Portugal according to activities (1990, '95, '97, in 1000's and %)

PORTUGAL	1990	%	1995	%	1997	%
All activities	4 658	100	4 403	100	4 579	100
Agriculture, hunting, forestry and fishing	833	17,9	497	11,3	623	13,6
Mining and quarrying	36	0,8	18	0,4	16	0,3
Manufacturing	1 148	24,6	1 013	23,0	982	21,4
Electricity, gas and water	42	0,9	36	0,8	37	0,8
Construction	381	8,2	355	8,1	408	8,9
Wholesale and retail trade, restaurants and hotels	723	15,5	854	19,4	861	18,8
Transports, storage and communications	212	4,6	191	4,3	179	3,9
Financing, insurance, real estate and business services	208	4,5	334	7,6	350	7,6
Community, social and personnel services	1 073	23,0	1 105	25,1	1 122	24,5

Source: ANUÁRIO DEMOGRÁFICO (INE), INQUÉRITO AO EMPREGO (INE)

Table 5 complements the previous one, allowing us to identify which are the activities that have more weight in the evolution of the respective sectors. Nevertheless, for the primary sector, this table also presents the activities in an integrated manner, therefore it does not bring anything new to the previous one. At the level of the secondary sector, we can understand that "manufacturing" in itself (-3,2% of employees, between 90 and 97) has been determining the global decrease of employees in the sector (-3%, between 90 and 97). "Construction", between 95 and 97, shows an increase in the number of employees (+0,8%), mainly due to the event EXPO98 and to the infrastructures related to it. In the tertiary sector, between 90 and 95, the increase of the number of employees in the activities of "Wholesale and retail trade, restaurants and hotels" (+3,9%) and of "Financing, insurance, real estate and business services" (+3,1%) is very significant.

The transport services can be divided in
1. air traffic control
2. road transport
3. urban passangers transport

This sector spent almost 1000 million PTE in 1997 for intramural expenditure on R&D (4,4% of all business enterprises)

In what concerns the textile industry, was considered as one of the most important sectors with strong economical specialisation during the '70s, and acknowledged a maintenance of this situation during the '80 in spite the strong changes that all industry knew in this period. In the late period of this decade, the secific sector of the textile (home-textile) had an increased static competitivity. Thus, the main pole of industrial specialisation with cost competitive strategy is still the textile-garment-shoe (cf. Lança, 2000), that has in 1996 31% of total exports (13% for the textile), 32% of employment (12% for the textile) and 21% of GAV (14% for the textile, which is the highest for all manufacturing). This sector spent 535 million PTE in 1997 for intramural expenditure on R&D (2,5% of all business enterprises).

The metal manufacturing sector included the following subsectors:
1. mould engineering
2. train wagon assembly.
3. light transport manufacturing
4. shipbuilding and repair services

This last one was one of the most competitive sectors in Portugal until the beginning of the '80s, but lost its competitive advantage since then. All the three others (together with the automotive sector) are

incresingly competitive in international terms. These sub-sectors spent almost 2610 million PTE in 1997 for intramural expenditure on R&D (12,1% of all business enterprises).

2. Methodology and description of the sample

The choice over the Portuguese case studies was based on the sample constructed for the application of the firm questionnaires, during the second year of the SOWING project, 1999. This sample was fulfilled of firms among several activity sectors: textile, manufacturing, electronics, transports and software industry, based on NACE – codes (2 – digit level). Due to some problems concerning the data gathering, the Portuguese team have received more questionnaires than the number agreed at the SOWING project, 100 questionnaires (there was two phases of data collection). Thus, we agreed to include in a new database the remaining questionnaires and construct a sample with 113 observations.

Knowing the characteristics of the universe of firms (economic activities) we are able to reproduce those characteristics by a reassessment of the sample. With this procedure of stratification by economic activities our sample is supposed to have more precision and statistical pertinence: *"... the variance of sample estimations can be reduced (...) those statistical estimations can be more precise"*. (Osuna; 1993: 27). By this procedure the sampling process is more flexible and allows making use of other sampling methods simultaneously.

Facing the reality of the 113 observations and knowing the characteristics of the universe of firms by economic activities, it was possible to treat those strata or quotas (NACE codes at 2 digit level) by pondering them in the sample and weighting each case in each statistical estimation. This methodological sampling (by quotas) translates the same principles of a stratified sample trying to *"obtain sufficient representativeness, reproducing in the sample, the distributions of certain important variables"* (Ghiglione; 1993: 45). Now our sample loses the character of random and probability but its still available and rigorous.

With 113 observations, our sample has 91% of confidence when estimations are made (see Table 1 in annex). Given the characteristics of the universe of firms as well as characteristics in the sample, we could increase proportionality (in the sample) by the calculus of a ponderation coefficient for each strata or quota. With this procedure we still are working with a not probabilistic sample, in a way not all firms had have the same probability to become part of it, however the sample is proportional in a way we are weighting collected data with a ponderation coefficient.[3]

2.1. Sample characterisation

Based on the sample and weighting collected data in a SPSS tool we are going to proceed to a brief characterisation of the Portuguese companies concerning the information society diffusion. Data that will be characterised and analysed join together a ponderation coefficient as well as 91% of confidence when estimations are making.

[3] The calculus for the ponderation coefficient was the method used by Osuna: dividing the percentage of each strata or quota in the universe by the percentage of each one in the sample. With this calculus we obtain the weight that each firm from each activity sector has in the sample. The 'rule of simple proportion' could also be pointed out.

A deep and meaningful analysis shows a set of characteristics that can lead us to assume how diversified is the application and diffusion of information and communication technologies in Portuguese companies. This assumption is independent of the activity sector where companies belong and it's specially related within organisational and managerial concepts than technological or financial concerns. Considering the geographical localisation of the companies in the sample, we can observe that they belong to areas where the industrial activity is more dynamic and intensive, namely the region of Lisbon and Tagus Valley (45,6%) and the North region (19,6%). We've also collected a significant number of answers from companies located in the autonomous regions of Azores and Madeira, more than we expected initially. On the contrary companies located in the Centre region showed a low rank of answers to the SOWING questionnaire.

Table 1 – Dimension of companies at the sample

(Weighted data by the pondered variable NACE 2 digits)

	% (Ponder)
Until 9 workers	5,0%
10 – 49 workers	35,7%
50 – 99 workers	3,8%
> 100 workers	55,6%
TOTAL	100,0%

Concerning the dimension of companies we can observe that those with *'more than 100 workers'* assume a relevant position in the sample collected, representing 55,6% of the answers. Small and medium sized companies appear in second place with 35,7% of the total. With this data we can consider that SME's and rather big companies are more predisposed for answering to this kind of questionnaire or, in other way, they integrate in their organization structure specifics departments or sections that reply to this kind of demands and studies.

When we consider the *'kind of area'* where the companies are located (table 2) we concluded that the urban area, including suburbs, is the most frequent with, 71,3% of the answers. Mixed areas, including small towns in the country, represent 25,1% of the companies presented in our sample. This statement seems to be coincident with the fact that the regions most represented in our sample came from areas with a high urbanism level, as Lisbon and Porto areas.

Table 2 – Kind of area

(Weighted data by the pondered variable NACE 2 digits)

	% (Ponder)
Urban area	71,3%
Rural area	3,6%
Mixed area	25,1%
TOTAL	100,0%

About the operation period of companies we can observe that the majority of the cases, 43,7%, has been operating at the given address at *'more than 20 years'*. However, we can't neglect the significance

of youngest companies, namely those who have less than 5 years of seniority, which are 24%. Indeed, we are in presence of a sample of companies operating during long periods of time as we can observe by table 3.

Table 3 – Seniority of companies

(Weighted data by the pondered variable NACE 2 digits)

	% (Ponder)
Less 5 years	23,9%
5 – 10 years	22,0%
10 – 20 years	10,3%
More than 20 years	43,8%
TOTAL	100,0%

Concerning other aspects of the general information and environment of the companies we can verify that the most frequent type of company (juridical nature) are fully independent (quota society) with 55,5% followed by the anonymous society with 43,1% of the companies in the sample. Brief, Portuguese companies presented in the sample are quite big and old (with more than 20 years) and they are mostly fully independent.

2.2. Data analysis

As regards specific environment of companies, like market opening or relationship and potential fidelity within customers, we can notice some kind of important relations in terms of the number or kind of client and even other variables. To verify the independence of sample conjuncts relatively to some attributes and qualities we applied independence tests of Chi-Square. By this, results showed that there are important relations between the number or the kind of clients and, for instance, the duration of relationship within customers (fidelity criteria), the geographical localization (rural, mixed, urban), or even the market criteria considered relevant and strategic by companies for their functioning.

There are a direct relation between the *'number of clients'* and the interaction within customers, in a long or short term. Thus, companies that have a large set of customers (> 20 clients), 99% keep a long-term relationship with them. In that case, customer fidelity can be a characteristic of companies that referred a large set of clients. However, we should point out that even for companies with a short set of clients (< 20), the long term relationship represent about 67%.

The companies that have a large set of customers, declared that 63,5% of those clients are other companies, 32,7% are isolated or individual clients and, only 3,8% of their clients belong to any public administration organization. We used the test (chi-square) and it was found a relation between these two variables: a large set of clients, most of them with based fidelity relationships, can be connected with the fact that those customers are other companies.[4]

Concerning the geographical localization of clients we verify that the region where the company is

[4] See in Annex Test 1, page XX.

operating it's the one that concentrates the majority of their customers (48%). Other regions in the country concentrate 42% of customers. Finally, only 10% of customers from the companies in our sample are from other countries in EU or in the rest of the world. It's possible to extrapolate this observation: we are in presence of a sample that maintain privileged dynamics with other companies in the national market, inducing us to assume that Portugal is a country with a low level of exportation. It's need a more dynamic expansion and enlargement of economic relationship within companies, namely international relations and exportations (based on a more developed marketing policy).

When companies were confronted with the market criteria that could be more relevant to their business and activities, we found that quality was the most important criterion in the competitive market dynamics. It's followed by the innovation (17,1%) as the market criteria more referred. Productivity and flexibility were draw both with 16,2%, and finally, the delivery periods were referred in the last position (5,4%).

Table 4 – Market and competitive criteria

(Weighted data by the pondered variable NACE 2 digits)

	% (Ponder)
Quality	45,0%
Innovation	17,1%
Productivity	16,2%
Flexibility	16,2%
Delivery period	5,4%
TOTAL	100,0%

In what concerns the kind of services or products offered by the companies we could observe that the product flexibility (specified by the customer or with standardized variants) is a constant variable and from which the most important market criterion depends. Due this we can detect that the majority of companies (38,7%) affirmed the existence of products or services with standard variants: different variants of products or services can be offered, but they have fixed specifications. We also cannot forget companies that referred their products or services were tailored to the customer specifications, indeed, 36% affirmed that clients specified their products or services. Finally, about 25% of companies assumed their products or services were standardized: they have fixed specifications and without variants.

Table 5 – Kind of products or services

(Weighted data by the pondered variable NACE 2 digits)

	% (Ponder)
Standardized	25,2%
Standard variants	38,7%
Specified by customer	36,0%
TOTAL	100,0%

Independency tests demonstrated that there's an association between the kind of products or services

of the companies and the most important market criteria to their business.[5] Like this, companies that considered quality as the most important criteria of market dynamics, 50% have products or services with standard variants.

For companies with services or products with standard variants the most important market criteria and strategy is related with quality (58,1% of them) and innovation (34,9%). Considering the companies which products or services are specified by their customers, focused their market criteria in quality (42,5%), flexibility (40%) and innovation appears as a relevant concern only for 4,5% of them. Finally, for companies which products or services are standardized, the most relevant market criterion to them is productivity (53,5%). So, the productivity criterion is more relevant to companies with standardized products or services than companies that have standardized variants or products and services. For this companies customers' quality is the most mentioned criterion. In other words, quality can also be considered as the most strategic criterion in a more and more competitive market.

By the special distribution of companies we can detect that the urban areas concentrate the majority of the companies, 72,3%. It is followed by 25% of mixed areas, which includes small towns in the country. With a residual weight, 3% in the pondered sample, the rural areas can be considered as a remaining area and a place where Portuguese companies haven't had the tendency to be put into practice their services or production processes (because of interiority barriers, difficulties on infrastructures, etc). Thus, industrial/services companies and urban areas seem to be a reality and a quite common practice considering the geographic distribution of firms in Portugal.

In what concerns the cross tabs of the variables *'kind of geographic localisation'* and *'most important market criterion'*, we can observe that for the most firms located in urban areas, quality is assumed as a relevant market criteria (45,7%), followed by the flexibility and innovation (each one with 21%). For these *'urban companies'* productivity presume a lower weight (4,9%). As regards companies located in mixed areas (i.e. small towns), productivity is considered the most important market criterion (53,6%) followed by the quality of their products and services (with 35,7%).

The analysis also confirms the fact that companies from urban areas prefer a strategic managerial philosophy based on quality criterion, in a way to face exigencies arise from a product or a service based on flexibility (be it specified by customers) and by exigencies inherent of proposed demands from other companies (as it happens in the case of the firm networks).

It's a fact that communication networks and the integration of technologies in work contexts tend to be the axis of a structure transformation or renovation and even their diffusion and application produce an intensive change of the companies and activity sectors socioeconomic relations. Analyzing table 6 we can verify that 89,5% of the inquired companies affirmed the existence of a *local area network* (LAN). This can be a data that induces the increase importance of the technological field in the Portuguese companies. However, we must consider that 75,2% of them still have stand alone PC's even if they apply simultaneously any kind of computer infrastructure. The usage of mainframe and terminals was referred by 53,4% of the companies and the electronic data interchange (EDI) was maintained by 27,4% of them. Concerning the programmable machines they have an inferior weight in the pondered sample due the fact that activity sectors based on industry have a lower representation both in the sample and in the universe. Thus, programmable machines, quite emblematic of the industrial sectors were referred by 20,5% of the companies (proportionally they are also less significant than other sectors presented in the sample).

[5] See in Annex Test 2, page XX.

Table 6 – Kind of computer infrastructure

(Weighted data by the pondered variable NACE 2 digits)

	% (Ponder)
Local Area Network - LAN	89,5%
Stand Alone PC	75,2%
Mainframe + Terminals	53,4%
Electronic Data Interchange - EDI	27,4%
Programmable Machines	20,5%

The given data wont allow us to confirm that we are in presence of a hi-tech group of companies as well as an aggregation of firms presenting a technological positive trend in a short term. This occurs in a way that the weight of stand alone PC's is quite considerable in the collected sample. As well, the technical integration between the different stages of the production or services processes doesn't seem to be a typical practice among inquired firms. Indeed, only about 25% of them stressed the existence of a computer support or infrastructure between tasks or stages of productive processes.[6]

An important fact emerges when we consider the data collected: it's a fact that nowadays almost all companies, wherever the activity sector is, make use of information and communication technologies even if this application focus on word processing activities or accounting with stand alone computers. As we can verify by Table 7 tasks that are done by mean of specific software are: invoicing (97,1%); accounting (95,6%); personnel and salary administration (79,9%); purchasing (76,6%); sales and marketing (68,4%) and, finally, customer service (50,8%).

Table 7 – Tasks done with specific software

(Weighted data by the pondered variable NACE 2 digits)

	% (Ponder)
Invoicing	97,1%
Accounting	95,6%
Personnel & salary administration	79,9%
Purchasing	76,6%
Sales & marketing	68,4%
Customer service	50,8%

The approach to the contexts surrounding information society or the application and diffusion of information and communication technologies at the core processes of the inquired companies cannot be assumed only as a purely quantitative dimension: we should meet the actors that *'define'* the success of technical-organisational structures and that edify those technological representations all together. Success doesn't occur only by the technical integration among activity stages, but it depends fundamentally on a human-machine relation integrated in several work contexts.

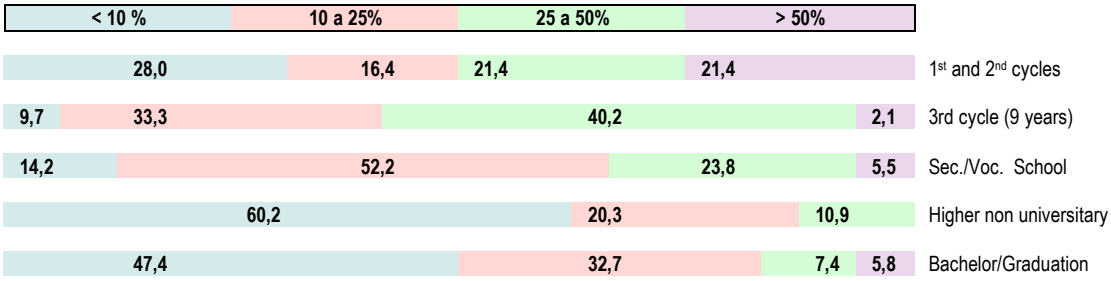
About the workforce profile the graph 1 can illustrate that companies at the sample have a tendency to

[6] Technical integration can be described as, for example, data from the apparatus for the treatment of products are transmitted electronically to computer controlled planning systems or any other data transmission between different stages (design of products, planning and preparation of the production process, computer-controlled systems for the treatment of products, process control, transport of products, warehouse management, maintenance planning or, finally, quality management).

increase schooling levels of their workers. So, we can observe that 21,4% of them affirmed to have more than 50% of workers with 4 and 5 years of schooling (1st and 2nd cycles of basic education). On the other hand we can also detect 28% of firms that stressed less than 10% of workers with lower schooling levels. This tendency also seems to have repercussions in the influence assumed by workers with 9 schooling years (compulsory level in Portugal), secondary school or vocational school. Indeed, 40,2% of the inquired companies affirmed to have between 25% and 50% of workers with 9 years schooling and 52,2% of them held that 10% to 25% of their workforce have the secondary school or a grade from a vocational school.

Graph 1 – Workforce profile of companies inquired: schooling levels

(Weighted data by the pondered variable NACE 2 digits)



Note: in each dimension the sum isn't 100% in a way we don't presented missing values.

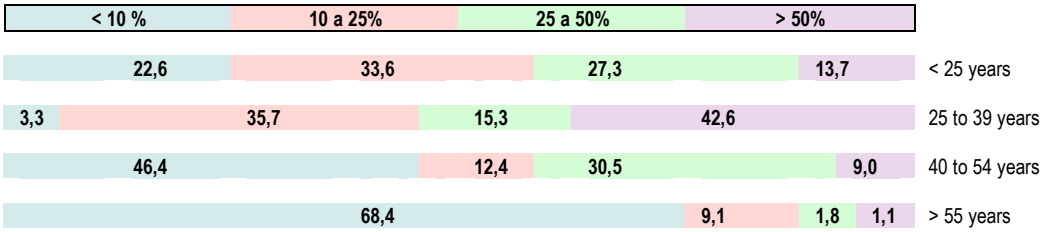
In what concerns average or higher education levels it still exists a profound gap between the revealed needs of companies and school levels of their workforce. In fact, an *'acceptable'* percentage of workers with an average and higher schooling levels it's still a characteristic of a reduce number of inquired companies. Thus, from the inquired companies, 60,2% has less than 10% of workers with an average school (higher non-universitary schooling). Similar trend, however less emphasized, is seen in terms of the higher education: 47,4% of the companies has less than 10% of bachelor or graduate workers. We can perceive that organisational design of companies assume a larger proportion of workers with higher education (bachelor or graduate) than workers with a higher but non-universitary schooling. This fact can be an evidence of a certain underestimating from companies to average levels of education or even vocational schooling.

About the age structure we can verify that workers with between 25 and 39 years old constitute the most frequent category within the inquired companies. However, younger workers tend to an increase of their representativeness when compared with the weight of workers with over 40 years old in national industry. In fact, 42,6% of companies affirmed the existence of more than 50% of workers with between 25 and 39 years old and, 13,7% of companies referred that more than 50% of their workforce was quite young (less than 25 years old). The decrease of the relative weight of older workers at organisational configurations its quite perceptible.

Given the workforce tendencies concerning the age structure we could easily extrapolate from the majority of inquired companies the desire of younger effectives. This strategy, not always conciliatory, passes by the *'refuse'* of the considered older workers and by the inclusion of young people in a *'flexible'* contract situation, or a precarious work circumstance. The insecure inclusion of some people conduce to the precocious exclusion of other from the labour market under different causes, sometimes disguised with discourses associated with the introduction of information and communication new technologies.

Graph 2 – Workforce profile of companies inquired: age structure

(Weighted data by the pondered variable NACE 2 digits)

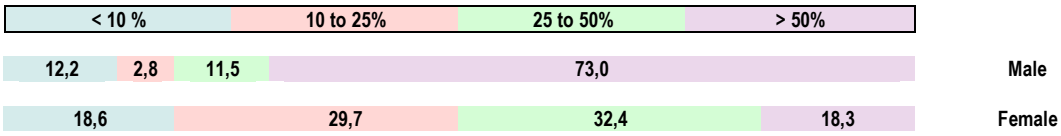


Note: in each dimension the sum isn't 100% in a way we don't presented non-answers.

The presence of a masculine group in their workforce it's revealed by 73% of inquired companies. Indeed, over 50% of their effective is male. The reference of female in the organizational design of companies is quite dispersing in a way 32,4% of companies referred the existence of female between 25 to 50% of their workforce and, 29,7% of inquired companies stressed the presence of female between 10% to 25% of their workforce. In spite of a great men representation it's a fact that female incidence it's revealing a growing tendency in those inquired companies.

Graph 3 – Workforce profile of companies inquired: gender

(Weighted data by the pondered variable NACE 2 digits)



Note: in each dimension the sum isn't 100% in a way we don't presented non-answers.

Besides being slow the changing process seems to produce effects as the regenerating desire that is felt at the *'heart'* of companies. This is interpreted as the inclusion of young workers and also the increasing of schooling levels. Female segregation at labour market seems to confirm some of the trends (i.e. when we are referring wages), however, the raising of their presence at the active life it's a fact. Effectively, gender seems to give place to other characteristics more related with the qualification levels (social skills, technical skills or even experience), schooling and other immaterial factors inherent to the worker himself.

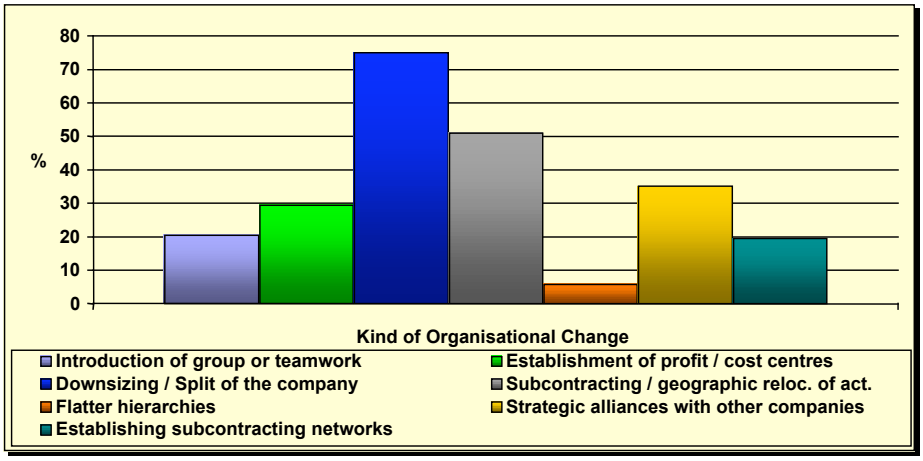
2.3. ICT introduction and organisational changing processes

When confronted with organisational changing aspects the majority of inquired companies (77,1%) referred at least one kind of changing. By the Graph 4 we can observe that organisational changes stressed by the inquired companies are fundamentally related within numerical formulas that confer more flexibility workforce. In fact, declared changes occur essentially in terms of downsizing, enlargement or splitting of the companies. The effects so far conferred to the globalisation processes

assume, in the present case, a pertinent role namely the nearly 50% of companies that were a target of geographic (re)localisation of activities or even the nearly 35% of inquired companies that established strategic alliances with other companies.

Graph 4 – Kind of organisational changing

(Weighted data by the pondered variable NACE 2 digits)



We can verify that organisational changes related with anthropocentric models or work labour relations humanization take less weight in the majority of inquired firms. Indeed, only 6% of the companies referred flatter hierarchies, which could represent a beginning towards work horizontality still in a small scale. However, the introduction of groups or teamwork and the establishment of networks with other companies seem to be growing. By this, companies privilege a kind of differentiated organisation in a way to apprehend their workers abilities, skills and experience. The growth towards the establishment of profit or cost centres it's also an element to consider and that reinforces the previous statement.

About changing contexts we can verify they tend to generalise quantitative and numeric flexibility through the establishment of profit or cost centres aiming the control and costs saving. These strategies can cover, in the most part of the cases, a reduction or a precarious enlargement of workforce. As it is verified, the linkage to new work organisation logics, namely the flattering hierarchies, the establishment of networks or even the teamwork introduction, assume a relative weight with less importance when considered organisational changes occurred during the last 5 years among inquired companies.

Companies under a quite deterministic paradigm assume technology introduction at work context. In a way, to verify the existent relation between the technical integration of different stages of production process (supported by a computer infrastructure or automated) and the importance to the ICT implementation towards personnel cost reduction, we carried out independence Kolmogorov-Smirnov (K-S) test.[7] Results of the test allow us to infer that information and communication technologies application and diffusion in work contexts can be an important path for managers to reduce costs with personnel. Thus, potentially they recognize unemployment situations or even other human resources policies related with technological determinism.

[7] See in Annex Test 4, page XX.

It's quite relevant to know the importance degree recognized by companies to ICT in the different dimensions of the entrepreneurial reality. Indeed, it could be determinant to identify company perceptions concerning their own strategies with a particular socio-economic context. With a factor analysis, by the extraction method of a principal component analysis, we intended to compact groups formed by correlated variables, or in this case, firm categories (factors) classified by the degree of importance that they confer to ICT in different dimensions of organisational reality.[8] The output from the rotated component matrix helped to confirm which original variables form each one of the four factors. Thus, groups of companies were made in relation to the kind of response they answered.

Table 8 – Firm categories (factors) by ICT importance degree

FACTOR 1	Dynamic companies through organisational changing	42,0%	Q14.8 – To achieve greater decentralisation in the organisation Q14.15 – To better control the output of workers Q14.12 – To accelerate the innovation process Q14.11 – To improve flexible forms of work organisation Q14. 10 – To give workers more autonomy Q14.4 – To improve co-operation and information exchange
FACTOR 2	Technological deterministic companies (post-fordist based)	16,7%	Q14.1 – To reduce personnel costs Q14.9 – To speed up decision-making Q14.13 – To improve working conditions
FACTOR 3	Companies based on the co-operation and quality intensification	9,2%	Q14.3 – To improve co-operation with suppliers Q14.5 – To improve or standardise the quality of products/services Q14.2 – To improve co-operation with customers
FACTOR 4	Companies that react actively to external exigencies	7,5%	Q14.14 – To reduce environmental damages Q14.6 – To improve the ability to react quickly to market demands Q14.7 – To control production process more adequately

The *dynamic companies through organisational changing* (Factor 1) considering the presented importance degree to ICT in work contexts explain the main variance of original data (42%). We can observe that organisational changing it's a constant reality at our sample independently of the organisational design point of reference. Companies that orient ICT diffusion based on a technological determinism (Factor 2) explain about 17% of the original data variance. Explaining 9,2% and 7,5% of the original data variance we have respectively a group of companies that point out the ICT importance towards the *co-operation and quality intensification* and those companies that *react actively to external exigencies*.

Independently of the type of orientation or organizational design, ICT diffusion and application towards companies go side by side with changing strategy (most of them as a market reactions and demands). Part of the inquired companies wants this changing aiming the enrichment (empowerment) of their workforce (decentralizing hierarchies or even work organisation flexible forms). However, a large majority of them tend to adopt 'lean' strategies in terms of personnel or internal immaterial investments (among other: training, workers social benefits and the contractual situation).

In what concerns the main factors that hinder the introduction of ICT in inquired companies we also intended to identify groups with reference to their own obstacle perception. With a factor analysis, by the extraction method of a principal component analysis, we intended to compact sets of variables in a way to form firm categories (factors) classified in terms of their perception towards the main barriers and

[8] The statistic factor analysis (principal component) assumed by the KMO (0,76) that we are in presence of a good sample. By the significance level (=0,000) we decided to prosecute the analysis.

obstacles of ICT diffusion or application.[9] Output from the rotated component matrix helped to confirm what are the original variables from each factor created. Therefore, we found three new categories (factors) of companies.

Table 9 – Firm categories (factors) by ICT application barriers (factors that hinder ICT introduction)

FACTOR 1	Technical, personnel, information and connected costs barriers	68,1%	Q15.1 – Lack of strategic relevance of ICT's for the establishment Q15.2 – Resistance within management Q15.3 – Lack of co-operation from suppliers or customers Q15.4 – Difficulties to acquire adequate software Q15.8 – Too costly. Costs are difficult to control in the implementation, use or support of ICT's Q15.9 – Incompatibility with existing technical systems Q15.10 – Lack of information about ICT's Q15.13 – Lack of required qualifications in the workforce to handle ICT's
FACTOR 2	Workers resistance and consultancy deficit	13,3%	Q15.5 – Resistance from workers Q15.11 – Deficit in the availability of IT-consultancy (internal or external) Q15.12 – Fear of a too large dependency on information service functions (internal or external)
FACTOR 3	Participation and organisational design barriers	7,5%	Q15.6 – Resistance from union representatives Q15.7 – Rigid organisation structure

The barriers that explain the main variance of original data (68,1%) are deeply connected with *technical, personnel, information and connected costs* towards ICT application among inquired companies. Indeed this category of firms can have a direct link with the fact that the integration of technologies in work contexts tends to be one of the main axes of a structure transformation or renovation. However, this is a gradual process and it's happening with some blockages namely the lack of information concerning the alternative technological structure pertinent to companies, inherent costs towards ICT's, lack of qualifications and a fundamental barrier it's the incompatibility between systems in a way to support technical integration.

Companies that enounced ICT barriers connected with *workers resistance and consultancy deficit* explain 13,3% of the main variance from original data. In fact, workers motivation towards ICT implementation can be a quite relevant variable through the success of technology performing. In parallel, probably due to a lack of information about ICT, companies often recur to external units for the handling of customer queries with the support of computer technology. This situation leads companies to a deep dependency towards outsourcing activities and IT consultancy. Also the lack of *participation and a planned organisational design* form a category of obstacles to ICT introduction (explaining 7,5% of the main variance of original data). This category shows how relevant the participation (of workers and unions) can influence ICT choices and also how outsourcing dependence have inherent fears among inquired companies.

Organisational restructuring appears as a common practice within companies. As a central point of this transformation modern ICT's are seen as playing an important role either as driving factors or as facilitating factor. For instance, at almost of the Portuguese case studies, companies stressed the importance of ICT as a masterpiece or a key at the organisational level, allowing certain types of

[9] The statistic factor analysis (principal component) assumed by the KMO (0,869) that we are in presence of a quite good sample. By the significance level (=0,000) we decided to prosecute our analysis.

organisational structure or design.

Companies were also confronted by their own ICT evaluation. In fact, based on their experiences they were confronted with a range of statements where they should express an opinion between each declaration and ICT application at the organisational context. First, we noticed that a lot of inquired companies affirmed 'no opinion' in presence of ICT statements concerning their own experiences. This could reveal a lack of knowledge, unfamiliarity with certain technological situations and, in a way, some fear that hinds some uncertainties by the side of companies. To form groups shaped by their experiences and opinions about ICT we did a factor analysis statistic, by the extraction method of a principal component analysis.[10] The output from the rotated component matrix selected 3 factors, or firm categories in relation to their own evaluation on ICT. Those factors explain 69% of original variables.

Table 10 – Firm categories (factors) by the evaluation of ICT's

FACTOR 1	ICT as a tool of power and control	48,7%	Q25.17 – ICT give more power to large organisations higher up the supply chain Q25.12 – ICT's threaten the jobs of older workers Q25.10 – Due to ICT employees get more responsibilities Q25.15 – ICT creates new routine jobs for low-skilled workers Q25.18 – In information society the unions lose power Q25.9 – Employees are monitored more precisely and continuously through ICT's
FACTOR 2	ICT as a tool of change and new organisational practices	12,2%	Q25.6 – Benefits of ICT do not come so much from the technology itself but from how the organisation is restructured to implement them Q25.5 – ICT's make jobs safer and cleaner Q25.1 – Until now the implementation of ICT's has had few repercussions on the organisation of the company Q25.3 – ICT's increase the need for continuous learning of the employees Q25.8 – ICT's increase the need for flexible working practices and labour contracts Q25.4 – ICT's create more jobs than they destroy Q25.14 – Due to the use of ICT's work becomes more family friendly
FACTOR 3	ICT as a 'friendly' and co-operation tool	8,4%	Q25.11 – ICT's increase the accessibility of employment for disabled people Q25.16 – Due to ICT's the relationship between management and workers becomes more trust-based Q25.7 – The use of ICT's increases externalisation and/or delocalisation of activities Q25.2 – I expect in the near future major organisational changes in the company due to ICT's Q25.13 – ICT's offer more job opportunities for women

ICT is still viewed as a *tool of power and control* among companies (Factor 1). Indeed, it can lead us to observe a majority of firms that assume technology as a mean to reach an end and not a tool with choice alternatives. Other category of companies interprets ICT as a *tool of change and new organisational practices* possibilities (Factor 2, that explains 12,2% of main variance of the original data). Finally, companies also evaluate *ICT as a 'friendly' and co-operation tool* even if it's perceived in a small scale (Factor 3 explains 8,4% of main variance of the original data). Definitely ICT starts to become perceived as a masterpiece in terms of work organisation, but its still need a lot of efforts to do.

[10] The statistic factor analysis (principal component) assumed by the KMO (0,816) that we are in presence of a good sample. Due the significance level (=0,000) we decided to prosecute our analysis.

3. General selection criteria

The selection process of firms that made part of the 10 case studies proposed by the Portuguese team was based on the sample of the *'firm questionnaire'* data collection with 113 observations. In what concerns the selection of companies that were chosen to conduct the 10 case studies, there is one first issue that should be highlighted. There is, in Portugal, little tradition regarding the (desirable) co-operation among Universities and companies in order to develop research activities, in particular, social sciences related research. So, our initial sample was strongly conditioned by the companies' willingness to embrace the Sowing Project. We understood this would be a problem ever since the first group of questionnaires was sent. At that time, the feedback was not encouraging at all actually, it was quite difficult to get all the required answers. Plus, we looked forward to conduct the case studies in those companies that have answered to the questionnaire.

Portugal, despite all the measures that have been taken by the public authorities on the last few years, still has a much significant number of companies, particularly small and medium enterprises, that are not yet getting involved within the Information Society. Nevertheless, the 10 case studies were developed on companies that were, somehow, seeking to get involved within this emergent society. This was one of the characteristics of our first database. In this sense, we are not dealing where with a representative sample of the national entrepreneurial structure.

Theoretically speaking, it was expected that we would not get to study those so-called "bad cases". Nevertheless, bad practices (and also good practices) were found in every case (these will be described forward). Actually, we feel this kind of approach – identifying good and bad practices instead of good and bad cases – is the most reliable one for us to apprehend the complex nature of the organisations. There is no such thing as a, one hundred percent, good or bad case.

On the other hand, there was a great concern in selecting companies belonging to different sectors of activity, both manufacturing and services companies, as a way to understand the variety of the different modes of production, always following the Project requirements. So, we pointed our research to both traditional sectors of activity (e.g. textile manufacturing) and to newer ones (e.g. software services). Naturally, some traditional sectors of activity that are still very important for the national economy (like footwear manufacturing) were not focused. As far as size is concerned, our smaller company had 68 employees (PT6 software services) and the larger one more than 1400 employees (PT10 – industrial services).

3.1. The companies

Companies of the 10 case studies were chosen from the firm questionnaire sample, which was collected during the first semester of 1999. These companies aren't a random sample representing the average of the Portuguese companies in terms of information and communication infrastructure. By this fact, all inferences cannot be extrapolated to the activity sectors where those companies selected belong. Indeed, they were chosen in a basis of theoretical and empirical considerations and not with the intention to be representative of the universe of Portuguese firms. Like other partners of the SOWING project, these 10 case studies have been selected in a way to illustrate some of the topics and concepts

present in the main issues concerning the information society. Results presented give us a *diverse and wide perspective of possible emerging organisational and social trends in the Information Society*.

Table 1 Sample of the companies from case studies

Sectors	Case	Description of Activities	Activity	Orientation - Market	Size	Employment evolution
Transports	PT1	Urban Transport: bus	Services	National/Regional	487	Rather constant
	PT3	Air Traffic Control	Services	Global	977	Rather constant
	PT5	Road Transport	Services	National/Iberian/International	675	Small increase
Metal Industry	PT4	Light Transport	Industry	National	133	Small increase
	PT8	Heavy Eng.: rail transp.	Industry	National/International/Global	768	Rather constant
	PT9	Metal Eng.: mould making	Industry	International	100	Small decrease
	PT10	Ship Repair Business	Industry	National	1412	Small decrease
Textile	PT2	Textile	Industry	International	1016	Rather constant
Chemical	PT7	Synthetic Fibres	Industry	International	241	Large decrease
Software	PT6	Software	Services	National/International	68	Large increase

Five activity sectors are represented in the sample. Description of companies at transport services shows that there are three mainly subsections or activities, which are urban transport (PT1), air traffic control (PT3) and road transport (PT5). Metal industry is represented by light transport industry (PT4), heavy engineering of rail transport systems (PT8), metal engineering of mould making (PT9) and ship repair business (PT10). Other important branches represented are the textile industry (PT2), chemical by the production of synthetic fibres (PT7) and the software industry (PT9).

Except for the case of PT1 which is owned at a regional level (provides urban transportation services to the population of Funchal), the most part of the companies are owned at a national level (PT2, PT3, PT4, PT5, PT6, PT9, PT10). Only two companies are owned at an international level, which are PT7 and PT8. Only PT6 and PT9 have less 100 workers, respectively 68 and 100. Otherwise we are in presence of a sample presenting rather big companies than SME's. It also contains a variety in terms of their *'position'* towards Information Society even because managers have a wide range of attitudes concerning organisational change and the introduction of ICT in workplace.

With exception to PT6 (Software company), all companies are ICT users. Some of them (ICT-users) stressed that with the improvement of ICT systems have ameliorate the ways and solutions within their clients and suppliers, namely in terms of communication (PT2, PT4, PT5, PT8, PT9).

Market orientation for the majority of cases is characterised to be hold at a national level. However, it's a fact that we can observe a certain evolution towards other markets at an international level, fact that demonstrates changes in terms of their competitive factors.

Companies showing an employment evolution rather constant are from both activity sectors: services and industry. Nevertheless their market orientation is fundamentally turn to global and international markets with exception to PT1 which is mainly regional. In the case of small increase of employment we can observe the same trend, but market orientation is focused on national level (PT5 is turning faster than PT4 to conquest international markets).

Large increase of employment is verified at the software company (PT6) and in terms of market orientation they are following the same trends of the sector, enlarging their capabilities and opening their market orientation through an international level.

Decrease of employment, be it in a large or in a small scale is observed fundamentally in industry. Market orientation or size doesn't seem to be quite relevant to these companies concerning their employment evolution in a way there are companies with 100 workers and other with more than 1000. Also market orientation doesn't seem to be a variable to explain employment evolution in a way they can be orientated towards national and international markets.

4. Organisational aspects

Concerning the organisational change we make a distinction of three categories of change. First we'll analyse changes taking place at the **inter-firm level** (outsourcing, subcontracting, geographic relocation), followed by changes at the **organisational level** (deconcentration/decentralisation, reduction of hierarchical levels, introduction of cost and profit centres). The third kind of changes analysed will be those taking place at the **workplace level** (job enlargement/enrichment, changing character of work, work load).

4.1. Changes taking place at the inter-firm level

4.1.1. Outsourcing

The majority of the case study companies didn't outsource any significant activities in a recent period (at least 5 to 7 years). However, there exits some punctual activities outsourced like at PT9 where there is a possibility to access outsourcing to implement an advanced technological infrastructure (intranet/Internet), or at PT7 where part of the maintenance area outsourced activities. In the case of the textile company (PT2) in surplus periods of demands they can outsource activities, specially at the making-up unit.

We also can observe that outsourcing activities also depends on the character of the business and the kind of the ownership structure. For example, in the case of PT5, that belongs to a group of companies, outsourcing activities are not relevant in the main sense of the term, unless when we consider outsourcing activities within firms of the same group of this road transport group. However, this is a strategical way of organise their activities and business development and we can't consider it as an outsourcing activity in the main sense of the term.

At PT8 the main philosophy attitude towards outsourcing activities has changed since 1998 (period when the company was sold to a German group). In fact, until then outsourcing activities were a common practice in the company in different areas, now they are inverting this situation by the adjustment of workers in some of the outsourced activities. *Insourcing* activities are being seen at this company in a way the strategy of the group is to reduce the main external budget and activities.

In other case companies (PT1, PT3, PT4, PT6, PT10), no significant parts of the core processes or other units were subject to outsourcing activities. Some of these cases are on the contrary considered as a player of the role of outsourcer to other companies, like the case of PT6, a software service provider.

At PT6 the relation with customers continues beyond the solution deployment with management services, based on outsourcing model or other. The PT6 suppliers are mainly foreign companies, some from Europe but the majority from the United States. There are two types of products, those corresponding to a basic infrastructure grounding added components developed by the main supplier, by third parties or by the PT6 company and also end-user applications (solutions) integrating such infrastructure and the added components. Their strategy is guided by the end-user requirements. Depending on the specific end-user problem their job is to glue those heterogeneous technologies toward integrated solutions to solve complex

document flow management and information management needs. In some projects they integrate different technologies to automate some processes when there are different solutions offering different ratio price quality.

Considering the main issues connected with outsourcing IT-related activities, we can observe a large number of companies that makes appeal to IT-subcontractors, freelancers or external consultants detached for specific projects or technological strategies of the companies. It's considered as a specific action and not an entire IT-occurrence. We can interpret this situation more as an economic, strategic and technical consideration than an*'outsource activity'* as it is known.

II. The impact of ICT

ICT don't seem to play a major role considering the decision making at the outsourcing level. In fact, whether outsourcing is taking place it depends not on technology itself, but on economic considerations or company traditions (focussing on core activities, emergence of economies of scale).

Even if most part of the outsourced activities is based on technological applications and activities among companies (by IT-subcontractors) those occurrences are preceded by economic and strategic considerations, like organisational changes or production readjustments. But it's an important fact that ICT will obviously facilitate the communication and information exchange with the company of destination, however their role is quite limited in a way it's a question of organisation strategy.

At PT5, the road transport company belonging to a group of companies, outsourcing activities are not relevant in the main sense of the term, unless if we consider outsourcing activities within firms of the same group of this road transport group. This is a strategical way of organise their activities, business development and global competitiveness so, we can't consider it as an outsourcing activity in the main sense of the term. For this kind of organisation ICT plays a major role for connecting people between firms of the group and their main clients. All existent organisational forms are available due the existence of ICT that make possible this complex interaction process between actors involved.
Outsourcing activities can occur at the textile company (PT2) when there is a surplus of demands, especially at the making-up unit. It's a quite seasonal phenomenon and when it takes place they subcontract other independent companies or freelancers (mainly women). Again, it's not related with ICT but with production demands or capacity.

In conclusion, ICT don't play a dominant role in connection with companies outsourcing activities (when they exist or are, in part, applicable). When outsourcing takes place it depends not directly on technology, but on economic, organisational and strategic considerations of companies.

The ten cases studied don't show any direct case of outsourcing victims or any function at risk due this kind of organisational strategy. It seemed to be an organisational form, which make possible some of the strategies of the companies. They need to outsource activities in a way to have a computer infrastructure or a desired technological system, with some concrete characteristics. The presence of external people doesn't seem to conduct to exclusion processes in the companies studied and never led to dismissals. However, it's a fact that outsourcing is a complex and a delicate question containing inherent risks of exclusion and instability.

At PT8 (heavy engineering – rail transport) the human resource strategy has consequences at the outsourcing activities. Due to organisational change and restructuring they had to adjust their personnel criteria to face the surplus of human capacities installed. Cost reduction and group profits are the main objectives towards this strategy. The Portuguese rail transport sector is characterised by a loss of added value, trend that was the main factor to the financial and organisational strategies of this global group. So, by this strategy they intend to reduce personnel costs, the improvement of productive processes and the

restructuring of co-operation between clients and suppliers. Outsourced personnel reduction happened, especially when considered the *core business* of the group activity in the Portuguese unit: they tried to diminish the outsourced persons at the maximum, replacing them with effective workforce from PT8, even if they should be moved to other sectors or departments of the company. They adjust people from the core business, specially their *'best professionals'*. As the human resource manager said: *'our human resource actions and strategies intent to diminish the 'rented personnel' (outsourced or freelances) and substitute them by our own personnel, even if they should transferred from other areas of the company. Then, of course, those persons are a target of an intensive training in a way to be adapted to these new functions and activities'*.

4.1.2. Conclusions and assessment of hypotheses

The Portuguese companies under study did not make any significant conclusions concerning outsourcing. In general, ICT don't play a dominant role in connection with companies outsourcing activities (when they exist or are, in part, applicable). Otherwise, when outsourcing takes place it depends not directly on technology, but on economic, organisational and strategical considerations of companies.

4.2. Other changes taking place at the inter-firm level

4.2.1. Some observations

It's a fact that organisational restructuring leads us to a new type of corporation, operating together in a network with other companies by the ways that ICT can promote and facilitate. This new shape of relationship inter-firm can define different kinds of organisation adapted and adjusted, for example, the establishment of strategic alliances, subcontracting, geographical relocation of activities or long-term relationships of co-operation, concentrates a spread of new functions and interconnections between actors. Our sample show some of these changes, but each case has is own characteristics.

Some of the companies studied didn't reveal any other changes taking place at the inter-firm level or external restructuring (PT1, PT4, PT7, and PT10). Subcontracting is a common practice at the textile company when they have surplus of demands or specific ones (which requires determined services) and also at the road transport company (they subcontract occasionally drivers and other similar firms to face surplus of demands). The same happens in the case of the air transport (where other firms have done some supporting activities like cleaning, cafeterias, carwash and security). As well, in the case of the software industry (PT6) some project tasks are subcontracted to other companies and they intent to pursuit this strategy of organisation. On the contrary, PT8 have had a organisational policy of subcontracting, but in the last 3 years this fact known an inversion in a way to diminish the excess of personnel capacity of the company. Activities closer to the core process of companies, seems to be subject to subcontracting:

PT8 don't use temporary-workers, but they subcontract people, fact that knows an inversion. Concerning the expansion of employment we can verify considering the last 5 years new jobs on specific areas: electricity area (in a way this company traditionally is attached to mechanical areas they are now trying to develop an area that they subcontracted to Siemens until recently, the electricity area), assistance and maintenance area, quality, informatics. New jobs are mainly concentrated on

those areas enounced. It's also a fact that the majority of those skills are based on machinery/technological application and in most part of the cases we can identify more readjustments in terms of layouts and personnel organisation than the emergence of new jobs (in the sense of career). In general TP had an important role.

Subcontracting strategies as the main goal of organisation has their maximum expression in the case of PT9 (metal engineering – mould industry). In fact they subcontract mould manufacturing to smaller companies located in the same region which, as been a common practice in this sector. For example, at the moment of the case study they had 4 moulds in production on a subcontracting basis. It's almost as a network of subcontracting in a way some of the subcontracted companies subcontract by their hand the moulds to other even smaller companies. Subcontracting is definitely embedded in the mould industry at the Marinha Grande region.

In the case of PT9 www and e-mail infrastructures are not used to support other processes than the mould business with special emphasis to the co-operation with customers and subcontractors.
Some workers that left the company and have created their own small enterprises and most the times they continue to work to the company where they used to work not as employees anymore but as subcontracted enterprise.
The enterprises are asked to get an added flexibility in order to maintain customers answering to their wide mould construction requirements. In some extent this flexibility is obtained by the establishment of subcontracting networks where each company is specialised in a kind of mould, a size of mould or mould projects. These subcontracting networks are the unstructured way of companies like PT9 (inclusive) to distribute workload according to responsibility, production capacity from other factors.

The main factors responsible for geographic relocation of activity are business strategies and organisational requests. The main examples that can illustrate this are PT5 and PT8. In the first one the constitution of a new road transport company in Spain has been an added value to business at the company and also to the whole group, in a way it's important to the interaction with PT5. By other hand, the case of PT8 has more global characteristics in terms of business and organisational change in a way the group is globally located. When there's a need, some activities are relocated to other companies of the group most of them are especially at design and engineering level. One of the reasons for this strategy is the different level of qualifications required and those that exist. In general when there is geographic relocation of activities, in the cases studied it's always a strategic process connected with business and organisation exigencies. It seems to be a pacific process and doesn't seem to have any direct obstacle in introducing it.

Since 1948 PT5 transformed itself from a family owned business into a public limited company (holding). Nowadays it belongs to a group of companies, issued from a central road transport company that in 1995 and 1996 have suffered an organisational restructuring. This transformation gave place to many firms that together form one of the most important Portuguese road transport group, also very active in Spain due the strategic constitution of a road transport company. Business has improved.

Strategical alliances or networking as well as the relocation of activities consist in strategic processes connected with business and organisation exigencies. It has been observed in some of the Portuguese cases (PT2, PT5, PT6, PT8 and PT9). Sometimes strategical alliances emerge from the need of being networked to improve business and expand in a more and more competitive market, of course that this kind of change brings always-organisational adjustments and adaptation of workers and departments.

Under a quality and product development philosophy the PT2 group of companies established in 1994, proves the growth that the company has made since the 40's. To facilitate the greater penetration into existing markets PT2 Group expanded with the setting up of PT2 New Zealand Ltd.. A further step was the purchase of 25% equity of Unique Accessories Ltd., a company with vast experience in distributing throughout the UK. In 1995 the group was further expanded with the setting up of Luso

Trading GmbH in Germany.

Strategical alliances are also conceived as a way to face external environments, namely economic fluctuations or market pressures and exigencies. This was the main factor that pushed PT5 to make some strategical alliances and networks with other firms. They belong to a big firm that, to face the Portuguese road transport crisis in the middle of the 90's, split the firm in a group with a structure based on a holding integrating four business areas: transportation in Portugal and Spain, logistic operation and complementary businesses. With the same philosophy all over the group they interact their services and activities towards a commonplace and objective, not only between the firms that constitute the group but also with other strategical firms to their business. They have an important network of clients, which are mainly maintained and supported by ICT's all over the group.

Also stressing economic and competitiveness as the main reasons, the software company (PT6) did strategical alliances with some important development tools and system developers (Oracle, FileNet, Microsoft and others).

Companies seemed to do strategical alliances also in the same perspective (be at a global or at a regional level): competitiveness and market pressure are factors that push them to get the *'strong'* of other companies. In the case of PT8 (a global company of rail transportation systems) those more and more global markets introduce new forms of organisation, fact that can produce instability over the workforce. It has a strong link with demanding and the production capacities of the group. In the case of a regional company, PT9, they have been involved in a network with other enterprises from the same region also due to external factors:

The purpose of the network was to join competencies in order to answer the competitive market of the former Soviet Union. Some of the enterprises were able to construct small moulds while others specialised their activities in large moulds. Thus, the network aimed to construct the production of the moulds according to the different specifications of the former Soviet Union customers.

4.2.2. The impact of ICT

Findings on subcontracting, strategical alliances or geographic relocation of companies are quite similar to those on outsourcing. ICT have a direct influence at the orientation level of those organisational changes enounced and clearly are a channel that facilitate communication between companies and subcontractors, outsourced or relocated units.

For the majority of firms that stressed changes at inter-firm level (geographic relocation, subcontracting, strategic alliances or networking), ICT seems to be a masterpiece in terms of relationships, organisational parameters or at business levels. However, we can't support the thesis that organisational changes at inter-firm level are determined by ICT, in fact it can't be interpreted in terms of causality in a way they're an important support for the organisational designs defined (facilitate communication between units, software development). For the companies studied, ICT where not the fundamental reason for change, but other strategical reasons (economic, demands, productivity, business).

Geographically PT5 are located in strategic locations within the country (north to south and also in Spain): they are based near

Lisbon (Loures and Carregado), but they have territorial operations centres in both north and south. This is part of a strategy from the group to control the respective regional markets aiming to improve responses to their customers. Also the strategy of internationalisation is a priority of the group and this may be proved by the setting up of an autonomous mercantile company based in Madrid in 1990, with full autonomy in the Spanish market (also with territorial operations centres in Barcelona, Seville and Lugo). All firms that constitute this group are located at the same places in a way to concentrate efforts of their activities in a mutual objective. We can also find an attempt from the Administration to the de-bureaucratisation of labour by the use of ICT's when they started to exchange information between departments, other firms of the group and between clients by an internal electronic mail. However, we can remark a relative importance of face-to-face interaction between workers (on leisure moments, internal newspaper, interaction with other firms including in Spain, etc).

Considering the PT6 core business the ICT it's embedded into their nature. Communication among enterprise members be them at the company or at client sites they are permanently connected and most of the problems are solved recurring to such communication infrastructure. In some cases a special communication lines are installed to give specialised support mainly for large customers and depending on assistant signed contracts.

At PT8 in the moment of the case study the atmosphere was dense and people were in general de-motivated because they we're waiting for a group decision, be it the enclosure of the Portuguese unit of railway transportation systems production. Besides all organizational barriers we presume that ICTs could result in a more decentralized co-ordination and closer co-operation between the units. The process of automation at PT8 depends on each project units production requests and not of ICT implementation in the main sense of the term. However, it's a fact that a better diffusion could facilitate some existent gaps of communication between these units. Specific technologies are important for the processes and production control (quality of products, avoiding errors, reduction of time lags, etc).

Finally, in the case of PT9 ICT is a mean and not an end for this company. Therefore, all the training efforts are more oriented to improve the worker's knowledge about the processes and when ICT tools are used to implement them, in those circumstances the train is focused on the utilization of such ICT tools and also on their concepts and underlying processes. Even if some flexibility can be detected with the introduction of ICT the enterprise is guided more by the mould construction process that by the technologies itself.

4.2.3. Social consequences

Subcontracting, networking or strategic alliances don't seem to have negative influences concerning employment in our sample. In some of the cases workers adaptation to new organisational situations can lead to 'indirect exclusion' of those, for instances, that don't fell available enough to work with ICT or adapted to a new organisational context (older workers, some unadapted professions or skills). However, information collected don't let us to conclude that social consequences emerged when there was subcontracting, networking or strategic alliances. Eventually they could induce to consequent processes of exclusion related to some of the organisational strategies (relocation of the company, for example), but it's a fact that the subcontracted services are not a factor of endangering any job internally.

For PT6 is essential to validate the technologies considering its core business. Nevertheless, there are some flaws when considering the utilisation of ICT's for PT6's own internal process management. In any case, as they have a large knowledge in ICT domains they are able to implement simple mechanism or integrate others to cope with different aspects of their internal processes. As an example the project director has implemented a simple tool to help the management of the running projects. As owners of the technology, they are able to apply according to the enterprise needs.

At PT8 there exists what we could call a *'surplus'* of personnel if we consider subcontracted people. Indeed they are trying to reduce the number of subcontracted people replacing them with people from PT8, moving them from other units or by reconverting them to the new function. As the Human Resources Manager stressed, the aim *"is to diminish the subcontracted (…) last year they were 260 and at this moment they are about 60"*. Age is not taken as an indicator for social exclusion, but it's a fact that older people offers resistance and gives more examples on the technological and organisational changing.

4.2.4. Conclusion and assessment of hypothesis

Those cases, which are more dependent of ICT, are those that tend to have strategical alliances and networks with other firms, usually in core activities of their businesses like, for example development of tools and information systems. Market demands and the competitiveness pressure are also relevant and a reason to make strategic alliances and networks between companies be them located in a global, national or even at a regional level.

Organisational changes at inter-firm level are not determined by ICT, it can't be interpreted as causality due the fact that they're a support for the definition of organisational designs: they can facilitate communication between units or be an instrument for software development, etc. For the companies studied ICT where not the fundamental reason for change, but other strategical reasons where as economic factors, demands, productivity levels or business strategies.

4.3. Changes taking place at the organisational level

Within this section we intent to present a spread of possible changes that have a direct relationship with the basic organising principles of the companies studied. In fact, a range of changes made possible different shapes and organisational configurations in the most part of the cases. Response to competitive requests or market pressures and the improvement of the position in the market are some of the reasons that impel companies to change and adapt their organisational configurations.

Those organisational readjustments are quite obvious among the majority of the firms studied and even inside them we can found departments or units presenting very different characteristics concerning organisational changes. ICT are interpreted as an important tool that facilitate those changes or can make easier to manage readjustments. However, technologies are not that relevant and rarely are the main causes of organisational change.

4.3.1. Centralisation and decentralisation

Within the concepts of centralisation and decentralisation we are attempting to discuss about the implications of ICT in terms of decision-making or even in terms of the autonomy of workers towards their working-place and jobs. The hypothesis #3 stresses that ICT is a relevant rule for decentralisation *by way of making communication, co-ordination and control easier and less costly*. However, for the

most part of the cases studied ICT doesn't seem to be a main factor for organisational decentralisation. Indeed, even if companies are very active concerning diffusion and application of technologies at working contexts they define organisational designs quite centralised.

> At PT1 within the (functional) organisational chart we find several levels of responsibility – administrators, managers, division leaders, sector leaders and section chiefs. Decision-making is highly centralised in the chairman. Even managers don't have much discretion to vary regulations. Strict formal rules. No room for creativity, for innovation. Orthodox organisation.
>
> At PT2 we can't talk about a dominant culture were the decision-making is totally centralised, but different segments some of them related with technology, work processes and organisation (the way the work is oriented by the foreman and team-leaders).
>
> PT3 shouldn't be worried about the market share, since it withholds the monopoly of the Air Traffic Services. This situation that would allow the continuity of a traditional structure is supported by a centralised organisation, the bureaucratisation of the internal communication and by the emergent development of a bigger margin of manoeuvre for some professions, which finally introduce power structures (collated internally) parallel to that legitimated by the organisational chart. Between the traditional structure and the requests of the coming third millennium society, PT3 represents the apparent contradiction of not being possible "to rest" on the tranquillity that represents that exclusiveness, which, in turn, functions as a constant coherent adaptation commitment, to the different technological innovation requirements of the civil aviation. That is why at PT3, there is an increasing importance of technical supporting staff whose mission is to establish the connection between a (still) too much "taylorized" organisational project at the strict operational level, and the necessary aperture to the information society.

ICT can be an easy way to decentralise some of the activities and can be also a tool to support organisational change towards new production or services conception. Even if in companies a centralised structure still persists in terms of hierarchical levels, using ICT can relatively facilitate core process activities. It happens at PT6 where activity is mainly centred on projects:

> They have a well-structured management of the running projects using beyond project management tools a centralised and shared information repository with the project status. Project directors are asked to update on a daily basis such information in order to offer the team members, department director and other workers the opportunities to follow up the project execution. The Intranet is also used to share information among PT6 members. The Internet and e-mail are used to support the project deployment. Some component installation and maintenance is done through the Internet infrastructure.

Besides all organisational barriers we presume that ICTs could result in a more decentralised co-ordination and closer co-operation between the units. In some of the companies the process of automation depends on each project units production requests and not of ICT implementation. However, it's a fact that a better diffusion could facilitate some existent gaps of communication between units, target of organisational restructuring (e.g. at PT8).

Concluding, ICT can result into more decentralisation but it is not necessarily to have these results. Among all cases there are a significant degree of organisational choices or alternatives dealing with technologies and work organisation, leading companies to be more centralised or decentralised. For instance culture, tradition and business orientation can also be determinant to the degree of centralisation, more than the introduction of a concrete technology. All over studied companies this evidence can be verified by the case of PT9 and PT10:

> At PT9 Formally the structure is grounded on traditional principles while a parallel informal system maintained by the production director, a share older that is contributing to introduce a more participating culture in the company. The production director acts towards an incremental autonomy of the workers (responsibility) contributing this way to the decision making

decentralisation which has the opposition of the remaining shareholder partners owning an organisation ideal closer to process characteristics from a machine bureaucracy. In some extend the enterprise presents some characteristics that makes it member of the J model considering that many times the formal hierarchy works more as a integrated driving process than as a control mechanism. The mould industry tasks tend to be very qualified requiring a high expertise to deal with the mould conception and manufacturing. The qualification of the workers gives to them some autonomy to decide about different phases of the manufacturing process.

Concerning the case of PT10 and differing from naval manufacturing, naval repairing activities assume less standard features: minor mechanisation, more discontinuous activities, more malleable work organisation and greater levels of polyvalence. This is true at PT10. In particular, if we consider the work on board, which engages quite particular attributes like larger autonomy, frequent readjustments, decentralisation of decision-making and relevance of teamwork.

The eventual link existent between ICT and organisational change can't be interpreted by way of causality, but ICT can be a factor that facilitates changing at the organisational level.

4.3.2. More changes at the organisational level

Concerning other concrete changing taking place at the organisational level like teamwork, introduction of cost, profit centres, reduction of hierarchical levels and downsizing when they happen they have a strong connection within economic and consequently, organisational factors and not directly within ICT diffusion. In fact, ICT can be seen as a mean or a tool to prosecute those changes.

The introduction of groups or teamwork is verified at PT2 in a specific unit of the company. It's still an experience and we can't support that it can be diffused all over departments, which can be difficult in a way workers are not prepared to that change as managers (this new generation).

ICT's tends to be a medium of communication and an important tool at the workplace and for co-operation between other firms. 1994 and the assistance of grants from PEDIP II conducted PT2 to an important investment (54 million USD) not only at the technological level but also organisational, in a way that teams were put together in an autonomous and auto-managed way within production (experience at the new spinning mill). This was a relevant step towards a systemic solution (implementation of an EDI support) concerning both ICT and workplace, however the degree of isolated technologies is still high.

In the case of PT5, PT8 and PT9 working groups can be considered as an organisational strategy and internal restructuring towards productivity or management concepts of these companies. Specific concerns can be taken as a target of organisational process as it happens in the case of PT5 where teamwork of the whole group does the quality co-ordination of all companies. At the PT8 the strategy follows a guideline in terms of process organisation. In fact, in this (global) company all project units work under a group/teamwork policy of organisation. Indirectly it could have a link with ICT in a way this was a mean that facilitated the integration of those teams in terms of organisation and definition of workers tasks, functions and skills. Fundamentally, they supported a better communication between other teams located inside the group be them in Germany or Sweden (at least in the Project Unit studied). We can also consider PT9 as working by project but in a different kind in a way they don't operate in a global format. In fact, there is a team composed by the commercial (who discusses the project with the client), the project leader and the production director that make a proposal including the

first draft of the design. This multidisciplinary team is the responsible of the revision of the project and its tracking until it is delivered to the customer.

Reduction of the amount of hierarchical levels is mainly connected with companies that have restructured both externally and internally (PT2, PT5, and PT8). For instance, internal restructuring has lead to flatter hierarchies in a way to promote and facilitate teamwork or group. ICT is a parallel process, which has direct liaisons with this kind of organisation in a way it makes possible certain requests demanded in this internal restructuring. The reduction of the amount of hierarchical levels is also connected with the emergence of new jobs or skills on specific areas, namely R&D, marketing, design, quality and IT.

Some of the companies are the result of downsizing or splitting up. More than a direct objective towards organisational improvement, these strategies followed strong economic reasons. One relevant example was PT3, which emerged from a governmental decision (because of the high public debt):

> The previous company responsible for the provision of airport and air navigation services, has been splitted into two different companies, each one responsible for each of those services. PT3 resulted from this decision and is responsible for the provision of Air Navigation services.

ICT makes possible better understanding and feasible the internal restructuring, be it the introduction of group or teamwork, the reduction of the amount of hierarchical levels or even the downsizing and splitting up of companies. Communication can be improved by way of technologies, which can be adapted to workplace and organisational context. ICT is an important tool to sustain new organisation concept.

The level of market orientation (if it operates at a global, international or national level) can be a factor that stimulates a certain kind of internal restructuring, namely in terms of the constitution of groups and teamwork. For instance, companies operating in a global level can lead their projects better oriented if they organise their work by groups or by project. However, companies operating nationally or internationally can perceive that they could have better results if they organise themselves in group, specially some units or departments (commercial or quality, for e.g.). Perhaps in the moment of selecting workers for the integration in those groups or teamwork there are some criteria that could exclude some of them, like age or gender or even objective criteria as formal skills and qualifications. However, there seems to exist the possibility of choice for workers that are reached in terms of organisational change for the majority of the companies studied.

> At PT8 the internal restructuring conduced to flatter hierarchies. In the case of the Project Unit studied (PUMetros) there has been a possible situation of social exclusion in a way old foreman were replaced by 2 engineers with the same functions of co-ordination. We can verify new jobs on specific areas: R&D, quality, human resources and informatics. Those change processes have a connection with ICT application but aren't determined or induced by them.

4.3.3. Teleworking

Concerning the spatial dimension of work of the companies studied we can observe that telework doesn't seem to be a generalised practice. In fact, only two companies (PT6 and PT7) have stressed the existence of this kind of work organisation and even existing any form of telework it can be considered quite incipient (in the main sense of the term).

At PT6 when a team is implementing a project at a customer site there is some ICT based co-operation with the company office (solve questions, download software, get advice). Nevertheless, this is not a structure methodology followed by the PT6 company.

In the case of PT7 there are two teleworkers (working at home) in the marketing area (in Oporto), but their telematic equipment are not that sophisticated in a way communication is usually established using a mobile phone.

There is another company, the PT2 that even if declaring that doesn't have tele-workers considering a strict definition of this concept, that has some working situation where workers stay for long periods at customer places presenting similarities with teleworking. The workers do their tasks cooperating remotely with the enterprise using ICT.

Telework in the main sense of the concept don't exist in the company. However in the Marketing and R&D areas sometimes we can identify punctually some workers that can be considered as that working at different locations when they're looking for new markets and discussing with customers about products characteristics. In those punctual cases, communication is established using a cellular phone or internet. In production units it is irrelevant this king of work organization (PT2).

Even if it's not a disseminated practice, this kind of spatial dimension of work has a strong relation with ICT in a way they make it possible, be people working at different locations or working in regional offices. Again, it's not a general practice and even in the medium term we don't reach a tendency towards this kind of work organisation. It seems to be also a question of management mentality and organisational tradition.

In the PT9 case some specific technical factors are conditioning restrictions to the emergence of teleworking. In fact, most of the activities require special equipments difficult, if not impossible, to make available in other spaces that the enterprise facilities. This conditioning aspect can be also extended to most of the studied companies. Nevertheless there is a consciousness that the last evolution of ICT might contribute to change this scenario. As an example, systems until now requiring special computational resources are now available/accessible through a simple web browser be it in the enterprise facilities, at an enterprise branch, at a customer place, at home or in any other location with Internet access. On the other hand this evolving facilities are conditioned by traditional management practices that consider the need for a physical presence of the workers at the work places.

The work is exclusively done at the enterprise space. The mould industry is very competitive and exists always a great concern about information security, this might be considered as a justification for such a resistance to cooperate remotely unless security conditions are completely guaranteed.

The PT9 from a formal viewpoint presents a bureaucratic structure not completely opened to innovative changes. Nevertheless, there is an internal movement represented by the interviewed owner and by the production director that wants to change the organization toward a more opened and participate company where workers might have the opportunity to be involved. This is not easy because the other main owner with a more "conservative mind" puts some obstacles to such changing movements. The organization culture can be considered as a consensus between these two forces.

We can't stress that teleworking is a threat to any weak group on the companies studied. The risk of

social exclusion is null in a way the majority of companies don't make use of this kind of work organisation. When it occurs it's more in an informal than a formal way.

For the PT6 the existence of some working situations pointing to teleworking doesn't transport situations of social exclusion risks for the workers. Even if they stay for long periods at customer places installing and customizing the systems, they maintain a strong contractual relation with their company. The PT6's workers that can be considered more closed to telework situations are mainly young, highly qualified and with a permanent contract with the enterprise. This kind of work practice does not mean any type of risk to the workers in this company.

Almost all the workers have a high schooling level what is directly related to the PT6 core business (IT). Beyond the high schooling level, the company invests a lot in complementary training not only in basic technologies but also to learn how to deal (integrate, customization, installation and maintenance) with the products/components they integrate to build their offered solutions.
The PT6 is very young (1988) what contributes to the young workforce. Around 50% of the workers are above 30 years old and only three workers are more than 39 years old. The great mobility presented by this area (IT) is contributing to the need to continually hire new workers. Some of them are directly hired from the technical schools mainly for the less skilled tasks like the technical support and systems installation and administration. For more qualified tasks they are recruiting workers when they finish their studies at polytechnic institutes and/or universities.

4.3.4. Changes taking place at the organisational level & ICT: concluding remarks

As far as changes at the organisational level & ICT is concerned it is possible to raise some conclusions in spite of so different examples from the studied companies. In fact, in most of the cases the technology itself cannot be considered as the major factor influencing the changes at the organisational level. However, in many cases the use of ICT is a strong facilitator to implement old organizational behaviour patterns changes.

The mould sector is very competitive and most of the companies in the region are investing in innovation strongly supported by industrial associations. The introduction of new, machines, new processes based on the utilization of computer-aided systems (CAD, CAM and others) is forcing the company to change internal organization in order to cope with the new technologies and methodologies. The crescent utilization of electronic based cooperation systems like the mentioned e-mail, FTP and others is contributing to the establishment of a new interrelationship among internal teams and also in the relation with customers and suppliers.
ICTs are not the main cause of the internal restructuring. We can say that, in the last five years, ICT´s have not forced any organizational change, although it is sure that there is a important ICT contribution on the implementation of certain politically decided organizational modifications.
ICTs facilitate and have been a factor of acceleration of the changes processes at PT5. The majority of new skills are based on new information technologies and in most part of the cases we can identify more readjustments in terms of personnel and tasks organisation than the emergence of new jobs. Training plays a major role at all hierarchical levels concerning the application and diffusion of ICT's.

The case studies shows in some extend that the political and management choices are the main factors that conduct changes within the organisations. In some cases the presence of technological innovation might generate smooth organisational changes, it is considered as a catalytic factor to change old processes.

Indeed, the tendency of the case studies demonstrates that the technology has not a deterministic relation with organisational changes. In some companies it is more evident the technological impact considering organisational choices, but in other cases, the organisational direction doesn't show a clear link with ICT. In PT1 and PT4, for example, the use of ICT follows a centralized communication/ information pattern, which demonstrates the technological weakness when facing the management values that support the organisational choices.
Nevertheless, there is also a trend to consider the first adoption of the new technologies under the as-is organizational structure and, later on, when further technological improvements are realized, then, some organizational changes are considered. In fact, as the enterprise understands better the technology the organizational changes are accepted considering that they facilitate the adoption of ICT.
In average we can say that our case studies point to the hypothesis which stats that *"ICT is implemented within existing organisational structures and therefore, organisation influences the design of technology. Once ICT is implemented, technology driven phenomena influences the organisation".*

Yes: ICT is implemented within existing organisational structures. And no: once implemented, technology driven phenomena does not really influence the organisation (PT1).
The influence of technology (ICTs) over the organisation tends to increase but, at the moment, it is not that important (PT7).
The PPC (Production Planning and Control) system was adapted to the reality of the PT4's reality. In some extent the enterprise has been influencing deployed ICTs to fulfil PT4' specific requirements.
Informatisation has no direct connection with job losses, but with skill changes in terms of contents and characteristics. However, ICT introduction influenced the organization (PT5).
ICTs are implemented within the existing organisational structures. Technology driven phenomena is not (strongly) influencing the organisation (PT10)

There is another important perspective detected in a significant number of companies (even if not directly expressed) pointing to some disillusion about the adoption of technology designed to some organizational/functional model other that the target enterprise. In some expressed cases in a first approach the technology is implemented after a customisation effort in order to fulfil the as-is organization. However soon the enterprise is involved in a complex adaptation process, most of the times without a well ahead planning, leading to a too long and cost effective technology implementations.

The enterprise does not have any influence on the technology design. Nevertheless, some processes are being tuned considering the changes on key processes resulting from the technology adoption. The utilisation of CNC machines directly connected to the project department has introduced some changes on strategic activities; new programs are downloaded managed remotely (PT9).

There is a generalized feeling about the need of more flexible and standard technological solutions able to fit well the enterprise organization. The standardized aspect is related to the costs reduction of generalized applied technological solutions. In most cases they require a shorter implementation time with less operational risks. Nevertheless, the available approaches that can be considered with a wide acceptation (toward a de facto standard) are not flexible enough to accept smooth organizational changes, a key strategy required for a successful ICT implementation, as mentioned below by PT9 about social exclusion.

The changes resulting from innovation must be smooth in order to reduce the risk of exclusion. In general the workers integrate well into the new processes that result from the introduction of new machines (CNC, measure, others) and tools (CAD, CAM, CAE, others)… (PT9).

4.3.5. Changes taking place at the workplace level

From the group of studied companies it is possible to find the following tendencies when considering the introduction of ICT systems at different enterprise sectors: the elimination of some functions, changes on the way some activities are done and the emergence of new tasks as a consequence of the adoption of new methodologies/technologies.

At different levels almost all the studied companies are performing some ICT introduction what contributes for changes at work level. Depending on the performed activities the changes range from new work places resulting from the unification of former ones like it happened in PT7 where the spinning mills machines were grouped to work together to simple reformulation of the techniques and tools used to perform tasks.

> Due to the growing automation of processes physical activities tend to decrease. Even so, in same cases work is becoming harder. If we give a closer look to the spinning area, we can see, in a certain spot, four spinning mills working together (initially, spinning mills were all individual). This has lead to an overload of work for who's in charge of these. In this sense, automation, increasing the production levels, may turn the work harder for those who keep their jobs. This situation can bring new problems to workers (experimenting exhaustion, not being able to cope with the pace, etc) (PT7).

In fact there is a general trend to stress the new skills (all companies) required to deal with the new generation of enterprise resources with a crescent incorporation of ICT facilities be them automation of tasks, new available information and in some cases the possibility to make some programming/configuration tasks for flexible systems.

> The acquisition of new machines (CNC and robots) has been contributing to change the training needs namely the ability to operate such sophisticated new machines. There exists however the conviction that the age and the background training of the workers are not determinant to establish a success patterns. The detected difficulties are more related with punctual resistance of a few workers that have some difficult to adopt the change. "*They are persons who when we say that some operation is performed like this, they reply that we always perform this way and why have we to change it*?"*(Forman)*
> The changes that are happening in the company are related with the introduction of new equipment, the substitution of the milling and other machining tools by CNC machines. New robotic welding cells, new cutting machines, and the implementation of a system to plan and control the production, the PPC (Production Planning and Control), are only some examples of the extended changes the company is crossing. The technological changes mean important changes on the work processes, however was not always a synonymous of skilled activities (PT4)
>
> The problems of the PT6 company are not specific to work and tasks changing but rather the evolution of the technology and the adoption of new technologies and tools. The enterprise workers are required to be updated and for that the company as a well structured training program.
>
> At PT8 changing work concerning tasks, tools and skill requirements has been a consequence of the *'permanent'* technological integration in workplaces. The majority of new skills are based on new information technologies and in most part of the cases we can identify more readjustments in terms of personnel and tasks organisation than the emergence of new jobs.
>
> There are a set of new processes that result from the introduction of new machines (CNC, measure, others) and tools (CAD, CAM, CAE, others). This requires a long training period and depending on the worker's qualification it conditions the required

adaptation period (PT9).

There is another aspect related to this added skill requirements, in some cases the companies have several difficulties to find qualified workers (PT4, PT9) given the competition among local industries and a lack of trained people in the workforce market.

The required skills for new employees are very flexible considering the difficulties to find people in the PT4 region. This situation lead to the adoption of more flexible selection criteria. The lack of candidate workers has created some difficulties to the company on the establishment of a well-defined profile, according to the real requirement of the enterprise.

The PT9 region has several problems to find the required workforce. This situation contributes to the reduction of exclusion when considering the use of ICT. The enterprise makes an extra effort to integrate all the workers even those consider the ICT based tools difficult to manage. As a consequence of this and as far as their jobs are concerned the workers have a strong security feeling. Besides, the enterprise workers training policy is guided according to the technology funcionalities. There were a few cases where the workers were no able to lead with the new technologies, like CNC machines instead of conventional ones. In these cases they kept working in the conventional processes (they are still using) or they are displaced to other functions more adjusted to their skills.

This is particularly pertinent in regions where the lack or work force is a generalized problem while involves also other regions where the people exists but without the minimal scholarship required to be able to succeed on the specialized training to deal with the new ICT resources. The reduction of the handmade activates contributes to a crescent requirement of “white collar” work places most of them involving personal computers even at the shop floor level. Most of the new production equipments present operating interfaces (management, configuration, control) requiring a PC usually interconnected to a local network. The work contents tend to require higher abstraction levels, they move from physical force centred work places to more knowledge/expertise centred work places.

The ICT processes involves in most of the cases structural changes conducting to work place redefinition requiring from workers some flexibility to adopt the new processes and tools. At PT7 an industry from the continuous process the integration of four spinning mills working together when initially they were independent, introduced an overload while an increased production level was achieved. In fact the innovation at shop floor tend to contribute on the one hand to production flexibility and on the other hand to higher production. In these situations workers are faced with faster processes, they have to decide and act faster and an increased number of solicitations what contributes to an added stress considering that brake periods are shorter.

Due to the growing automation of processes physical activities tend to decrease. Even so, in same cases work is becoming harder. If we give a closer look to the spinning area, we can see, in a certain spot, four spinning mills working together (initially, spinning mills were all individual). This has lead to an overload of work for who's in charge of these. In this sense, automation, increasing the production levels, may turn the work harder for those who keep their jobs. This situation can bring new problems to workers (experimenting exhaustion, not being able to cope with the pace, etc) (PT7).

Another aspect that can be considered as a stress to workers is the requirement for a continuous update about the underlying supporting technologies. In fact, the ICT as a business requires from the workers high qualification levels leading to a continuous training process associated to high-pressure certification requirements. When they fail on the certification examinations the employer might do a special pressure. This is related to the marketing requirements when it asks for certified workers in specialized products or technologies, some of them proprietary from some well-known ICT company

(Microsoft, FileNet from many others).

> There are some technicians that are not able to move to systems administrators. This situation is creating some integration difficulties because it is a key skill a systemic perspective for all the workers and some of them are not able to comply with this objective. The characteristic of the performed tasks is multi skilled (if some problem happens the worker is supposed to manage the situation) which involves a wide knowledge about interrelated technologies. This is not only related with the education level (twelve years of secondary studies) but more with the ability to deal with such diversity/complexities (PT6).

While clearly applied to ICT service companies (software houses) like PT6, this aspect might be also detected in other companies when involved in complex and global ICT innovation processes. The workers are required to understand new tools, processes, technologies and methodologies in most of the cases requiring intensive training periods also under rigorous evaluation processes. The fear to fail on understands the new tools and to be replaced by new workers with an added facility to embed the changes is a detected situation.
Another aspect common to almost all the enterprises, mainly those with significant ICT innovation processes is the difficulties for workers to deal with the new resources (tools, applications, systems) considering that they are different from the former ones, are more complex considering that they usually present a more systemic approach to the enterprise processes and above all introduce new concepts that requires time to be incorporated. Associated to these more structural aspects people often comply about the low quality presented by the available interfaces. In most of cases they fail too much, there is not a sufficient integration among different subsystems and as a consequence of the continuous technological evolution; they do not achieve a reasonable stable situation for a reasonable time period.

The PT3 company represents another reference case where ICT is intensively used to control air traffic where reliable systems are required considering its characteristic of a life dependent system (critical system). The work contents tend to be rigid, with repetitive operations where worker's creativity is not accepted considering the underlying risks of any added flexibility. As stated in the case this risky aspect conditions the work organization transforming it in a rigid and hierarchical structure where the hierarchy conditions decision-making.

> Opposing the complexity of air traffic control functions and despite the evolution of ICT, it is visible an increase of a certain taylorization of the strictly operational work organization, resulting in a mechanization of the processes, which makes possible an upgrade of the rhythms, compelling, in turn, to a greater severity in the work organization (PT3).

The workers do they tasks under a great pressure, they repeat rigid procedures and changes are very much conditioned by a complex hierarchical structure.

5. Technological Aspects

5.1. ICT Infrastructure and Applications

5.1.1. ICT Infrastructure

For the SOWING survey sample, as explained initially, it was chosen firms that were not acquaintance with ICT. They could have at least some PCs for administrative tasks. But most of them use microelectronic devices at the manufacturing level, or in direct tasks. So, the case studies used had some experience with ICT. Most of them use local area networks (LAN) and EDI. In the metal sector, the firms are more skilled with numeric control devices and other automation systems (robotics, automatic conveyors, CAD/CAM, PLC).
Most of these information systems are not integrated and some of the components have no link with former resident systems. But the tendency is clearly on the way of establishment of network applications.

In almost all of the studied companies a generalized path has been following from the mainframe (central computer AS/400 at PT4) "era" to the distributed systems based exclusively on a local network (PC and servers network) and more recently integrating also the Internet world.

> This new infrastructure based on a client server model replaced an old system running on an AS/400 from IBM. The innovation has introduced into the enterprise a local network with personal computers replacing the old text terminals (main frame model). Beyond an increased set of facilities, the new application interfaces are considered easier to operate and offers also an added set of facilities considering that each new workstation is able to perform other activities like text editing, spreadsheet operation, easier file access and sharing from others. (PT4).

This trend continues with improvements on application software in several cases old systems are being substituted by new ones in order to cope with the new installed infrastructure.

5.1.2. ICT Applications

It is assumed a distinction between (a) ICT for the administrative and office tasks, (b) ICT support in production/manufacturing environments and core business processes, and (c) communication applications.

(a) ICT for the administrative and office tasks

Most of the cases, either they are in the manufacturing industry, or in the services, transport, communication or logistics, they use *appropriate ICT-support* for the most office tasks (as, accounting, invoicing, personnel and salary management). In some cases, the ICT support is organised in a LAN

infrastructure. They use standard software packages, but most use adapted and/or configured packages, and the larger companies are getting involved with SAP system.

(b) ICT support in production/manufacturing environments and core business processes

One could find important differences among the cases studied. Nevertheless, most of firms use advanced information systems in the shop floor, specially the SMEs. This can mean CAD/CAM packages, EDI for the subcontracting activities and production within networks, and automation devices and systems (robotics, automatic conveyors, PLCs). In the PT3 case, although is not in the manufacturing sector, is one of the firms with most advanced ICT systems applied to the direct operations level, namely some of the most critical ICT activities use AFTN-Aeronautical Fixed Telecommunication Network, satellite communications, air and ground radars (collecting information), flight plan and radar information processing (information handling), and for the release and interchange are used the CCTV-close circuit TV, the VCS-voice communication systems and the WPP-working position processors. They are using also specific communication application, but these are in the core business process.
In some of the cases, there is a strong link among the administrative tasks, and the production ones, all support by significative ICT infrastructures. This is important in the cases PT5-logistics and road transport, PT8-train wagons assembly, and PT9-metal engineering.

At this moment, PT5 is making actively usage of ICTs and it tends to an augmentation for the purpose of information supply and uses a computer infrastructure with several systems in support. Specific technologies are: ICTs on board, mobile phones (by a virtual private network), dedicated circuits (PPCA/Multiplex), ethernet, internet and especially the company's detailed information system (SMART, GEODE, SID), allows almost everybody to be informed much better on the clients specifications (demands) and the ongoing of the deliveries.
They are now preparing microwave circuits and the extension of their networks for some (fundamental) clients, as the Informatics manager said, *"the group it's a network and the rest are interconnection points"*. They are also expanding the technology on-board by the implementation of a scanner that will identify each delivery and inform immediately the 'central' of the delivery conditions and PT5 will be able to invoice the client on the hour.
All departments at PT5 use technology and there are no computer standing alone. In administrative and supporting units, ICTs are used more frequently, especially when we refer internet. The degree of isolated technologies is very low and it tends to a continuos improvement of the ICT access all over workers as well as suppliers and customers (the Informatic team at PT5 are preparing a network structure all over the most important clients, in a way they will be able to accede directly to information).

The PT9 computational infrastructure is grounded on a local network with windows workstations where some 3D modeling tools are running, surface design and analysis tools, CAD systems, CAM from other applications used in different phased of the mould construction.
Beyond the administrative tools the PT9 company has a group of specialized applications to support different phases of a mould cycle. At the design level a solid modeler is an important tool to cope with complex moulds for the automotive industry and also to the consumer products like TV set, refrigerators and other appliances. For his products, even if the new design requirement point to complex pieces, they are much simpler than the works made to the automotive industry. The results of the designs made with the solid modeler are automatically sent to the CNC machines. There is a high level of integration between design tools and the machines at the mould production cells.

(c) Communication applications

Most communication applications in the cases studied use *electronic mail systems*. Others are using for external communication purposes the FTP (file transfer protocol) and data transfer (EDI). These changes are recent, occurring since the beginning of the '90s, especially in the SMEs. Larger firms are still in a changing process, and few have already communication applications used by the most sectors in the firms.
But in general the *email users* are very few in all companies. Just specialised sectors are able (or allowed) to use Internet and email. And most of those are located in the administrative departments. Few cases are using it in the planning or design sectors.

> The major part of them is connected in Ethernet. Even so, network applications were not developed. Plus, within personal computers, every task is done in isolation. Each disc is divided in two parts. In one of them applications are installed and the user administrates the other. There is a share folder with general access and one other that is confined to the area. Presently, there is only one PC connected to the Internet. It is previewed that the Internet will be accessible to *all*, that is, as the Information Systems manager told us: "managers". Each one will have a personal e-mail address. Very soon, PT1 will have a Website (PT1).

There is a special concerns detected more in SME (PT4, PT6, PT9), pointing to a smooth (step by step) adoption of ICT considering their limited investment capacity on the one hand and the lack of an IT department the opposite situation from what happens in the large companies. The exception goes to PT6 a software house that cannot be compared based on the same assumptions. In the PT6 case they are producers of ICT and so, it doesn't make sense to consider a lack of knowledge in this area to improve their internal processes. As an example, for PT4, a metalomecanic SME industry they don't have IT department, they get IT knowledge support from external consulting individuals (or companies) and in most of the cases the supplier companies play in some extent a consulting role contributing with advise about strategies to follow.

> The investment in information and technology has been made by phases. The first phase was initiated three years ago and involved the management of acquisitions and stocks. The second phase involved the salaries and accounting and now some investment is planned to be done in the design department with new and advanced tools. The experience acquired from each technological innovation step has created crescent expectations for new areas not planned at the beginning. These results from the crescent knowledge and experience increased with the successful experience from the implemented phases.
> The enterprise owns an e-mail address managed by the financial department director. By now the workers do not have access to e-mail facilities from their work places. However there is a great flexibility to use indirectly the e-mail or even to access the Internet facilities also installed and with a centralize access. Every body can ask the financial director or someone delegated by her to deliver or receive an e-mail or to do some information search in the Internet (PT4).

For the large companies the situation is contradictory considering that on the one hand there exists a declared capacity to implement e-mail and web services but on the other hand the utilization level of this technologies seams to be above its real potentialities (for internal and external information flow and relation with customers and suppliers). In several cases the e-mail is used quasi exclusively for personal message exchange and the web infrastructure is used to establish a simple presence of the company in the Web.

> Electronic mail and Internet is only used by 10% of the total workforce and mainly the users are from administrative units, top management, middle management and some team-leaders. PT2 is an Internet user as well as an offer of a website especially

for marketing, customer orders and after-sales service (http://www.lameirinho.pt). As a Internet user the purposes are fundamentally for surfing on the world-wide web, use of paid databases and e-mail. However, e-mail is still centralised by the Informatics Department (it's a specialised and internal unit/ functions for the handling of queries with the support of computer technology) (PT2).

This can be related to the early stages of this technology and the flaws they present to really contribute with a structured added value for the enterprise business processes. In fact in most of the cases the enterprises are planning to adopt Internet based technologies.
A more intensive utilization of Internet/Web as a resource to the enterprise business, and not restricted to marketing purpose (TP5), requires a higher integration level among the enterprise applications/systems. Nevertheless, the real utilization of technologies like workflow, e-mail and web is not a priority (PT5) but shows a significant presence in the studied companies. In the PT5 company the Web site is used to make recruitment beyond its main purpose as an advertising/marketing tool.

Concerning workflow management systems we found about 50% of regular users (in 1998), and it tends to an improvement in the short term. Internet it's not a priority at PT5 and only the administration will accede. Other workers could accede only if their work justifies the access, but "if the administration agree all workers at PT5 could have access to internet, the structure is done". The same occurs with the electronic mail. However there are more workers (about 59%) using this tool as a communication mean and if they intent to extend the access at any moment the informatic department is able to do it. They have the applications developed in lotus notes, where they have a fundamental quality tool, the help desk. Only few drivers accede it and the users are mainly from administrative units, top management and middle management.
PT5 is an internet user and also supplies a website especially designed for marketing, customer ordering and information about job vacancies (one of the forms of selection and recruitment, in a way people can candidate to the job by an electronic application) which are updated on a regular basis.

5.1.3. ICT typologies

In the SOWING project it was used two ICT typologies. One is dealing with the kind of *computer infrastructure*, i.e. stand alone, telecommunication or telematic computer system. The other one is based on the degree of *ICT usage*.
Although in the survey we could find several companies with isolated computers, in the case studies we could find only firms with at least a LAN on the administrative activities. Thus, the cases that are integrated in subcontracting networks are the ones that use some *telematic* computer system. They are using EDI systems in approximately 1/3 of the cases studied. The *telecommunication system* is being used in the software industry, air traffic control and logistics company. They include several devices and technologies specific to the sector.
According to the degree of *ICT usage*, the SOWING typology accepted three levels: no/low usage of ICTs, traditional usage and advanced usage. In most cases was observed a traditional usage of ICT, with PCs and LAN at the services sector (information systems department), or even with the use of CNC, CAD/CAM systems, CAE, and 3D modelling. An advanced usage can be found in specific sectors, in those that use also telecommunication systems: software industry, air traffic control and logistics company and also in some other automation systems (metal engineering, chemical sector).

5.2. The character of ICT usage

5.2.1. Communication tool and information provider

One important conclusion from the Portuguese cases studied is that the communication function of ICT is considered to be *very important* (or even central, for some firms). It was inquired the importance related to the different kinds of communication and information exchanges (internal and external).
For the *external communication*, most firms use mostly EDI, and at the administrative level, the email. Nevertheless, the companies continue to use the more "traditional" communication tools, as the fax, phone or regular (snail) mail. The telex is a tool that is no longer used.
For *internal communication* the cases studied use local area networks, or even intranets. The internal information exchange is used to share databases and to communicate directly. This is more common in larger firms. But in some companies, mostly on logistics and transport, is largely used the GSM and other voice communication tools, once the working units are displaced in different geographical areas. The most sophisticated usage of communication tools was found at the air traffic control company, but that situation was not a surprise once the specific activity requires the usage of state of the art communication tools.

5.2.2. Automation

Automation as an ICT usage type could be found in some companies where a strong rationalisation process was introduced for production purposes. Most of them are exporting their products, and are facing an increasing pressure from their clients located on high technology sectors (metal engineering, chemical, software, transport).
Although process automation meant an *increasing of ICT usage*, especially at the shop floor, that didn't mean that occurred an increasing of labour casualization. On the contrary firms that introduced automated machinery, with incorporated ICT, were firms that were able to increase their market relations, and respond positively to more sophisticated demands. They could find new market niches, and increase their business activity, and most had to increase their employment volume.
Of course, it was now an employment with more scholarised young workers that could adapt themselves easily to the job requirements with more complex tasks. This created also a side effect in the firms of the same sector, and also of the region.

5.2.3. Organisational technology

Very few cases were found with applied *standard information systems and software packages*. Most of the cases are using systems in a incremental basis development. Only the PT7 case referred the need to use a SAP system. The PT8 case is also in a changing situation, because of its dependency from the mother-companies that determine their ICT information system, in spite the fact that in the last 15 years, this firm was investing huge amounts for the development of their system (mostly adopting a strategy of simultaneous engineering process). Other firms are using departmental MRPs in a non-integrated perspective.

5.2.4. Control

For the SOWING case studies was accepted to distinguish between three different kinds of control related to ICT:

a) control over the general production/business process;
b) control and/or surveillance over individual employees and their concrete work;
c) control over the usage of ICTs.

Most of companies mention the greater importance of the control over the general production and business process that were possible with ICTs. It can be confirmed this assertion when the systems introduced were applied to solve specific and located production process problems. This permitted the start-up of an evolution to further information system platforms. But the main preoccupation was control over the process, and not over the employees.
Thus, in the cases from the transport sector (passengers, merchandise and air traffic), the ICTs reveal a critical importance to make a control and/or surveillance on employees and their work. In all other sectors is possible to make that control, but it is not specifically done (due to the characteristics of PT3 sector, it can be mentioned as the only exception). The situation where it can occur are in the quality control process, where is possible to control the work done, and ultimately, to control the employee.
Problems that could reveal a need for control over the usage of ICTs were not mentioned. The only problem where it could occur is with the mis-usage of ICT due to deficient planning procedures. The examples issued with the simultaneous engineering strategy and integrated manufacturing is very clear about that (PT8, PT9).

5.2.5. Character of ICT usage: conclusion

The Portuguese case studies for the SOWING project don't confirm the assumption that the character of ICT usage is clearly shifting from automation and control technology towards communication and network technology. These functions (communication and networking) didn't replace the dominant use of ICT for automating processes and to control production and people.
The differentiation of ICT usage is very often similar in terms of sector (metal, transport or services). But it depends mostly on the types of organisational strategies. If is possible to stress some specificity for the case of air traffic control (PT3), is not possible to say that all cases in the metal sector are similar. And they don't differ on their size effect (to conclude that could be an erroneous assumption!). The rationalisation strategy adopted (sometimes influenced by external factors, groups or companies) is a key factor that models the character of ICT usage.
The modelisation processes is developed in one way and not in the other, also because of cultural aspects are related with local/regional traditions (specially, sectoral defined) or with educational backgrounds.

These reasons are crucial to understand why Taylorism, as a rationalisation model is still attractive, even with an increasing use of ICT. We can mention this model, once an increasing division of labour, mostly manual and intellectual division, is yet considered as a competitive factor. The worlds of shop floor and administration or design don't "mix" each other. And this segmentation is leading to an "autist" behaviour of the social actors at the industrial level.

5.2.6. Resume of ICT usage in PT cases

5.2.6.1. PT1

In general PT1 presents a low level of integration of its diversified processes. In fact there is no communication between buses and the central office, there is no communication system installed at the transport units/buses (wireless communication infrastructure – cell phone/radio or other technology with central coordination site).
The computational infrastructure is based on a central system with terminals and some PC based workstation distributed by administrative/services sectors (including the information systems department) interconnected to by a LAN. The enterprise uses an old system mainly for administrative processes (finance, maintenance and human resources) and less to the management of the operative processes like an on-line tracking system to manage the buses during their operation (buses network coordination and supervision (wireless communication. and a positioning system like GPS).
The company started with some internal developments but later, they realized the advantage to find standard products in order to get more processes automated in less time and at reasonable costs. The company's ICT implementation level is quite low. The emergent technologies like Internet, web and e-mail have a limited utilization.

5.2.6.2. PT2

The PT2 company presents a significant level of ICT adoption not only considering computational infrastructure but also the shop floor **automation.** The utilization of CAD systems for design and CAM systems for CNC machines programming shows an effort to improve the production using new ICT tools. Nevertheless there is a lack of integration among the installed subsystems leading to the stand-alone operation of some areas. In any case the company has been making an effort to improve integration and workflow flexibleness investing in a local network interconnecting workstations (PC) to access Internet based facilities in addition to their operation as terminals of a central computer system. In the administrative sector the PCs run stand-alone administrative applications. There is some level of electronic communication with business partners (EDI).

5.2.6.3. PT3

The ICT initiatives are grounded on two mail functional areas. The systems and information technologies area is responsible for the local network, connected PCs and other operational equipment which presents a high level of integration. Considering the characteristics of the company, airport facilities/resources management, the technical studies area is responsible for a continuous innovation in order to maintain the services with the required quality and using the most updated technological solutions. As a service company, it has adopted several systems to automate from air traffic processes to the most administrative ones. The strategy is directed to a good training of the employees for each

adopted systems (AFTN – Aeronautic Fixed Telecommunications Network, CCTV – Closed circuit TV, VCS – Voice Communication Systems, WPP – Working Position Processors, from others). Even if some technological solutions are developed internally, most of them involve large projects with the participation of manufacturers and other service companies.
Along all the enterprise sectors the ICT are intensively used. The Internet, e-mail, FTP, EDI are example of technologies with a generalized utilization by a large number of workers.

5.2.6.4. PT4

PT4 has been following a step-by-step approach to the introduction of new technologies at all the enterprise levels. The production area received a robotic welding cell and new CNC machines. The planning/design department is now using CAD systems to product design. The planning department is using a new PPC – production and control planning system. A local network interconnects a number of PCs used by workers to access the installed applications/tools.
From the involvement of PT4 in an Esprit (DG III) project addressing the development of an infrastructure for virtual enterprises, the company has installed Internet facilities involving e-mail, web presence and the utilization of searching and communication tools (FTP and others) to find and cooperate with business partners.
This company participates on local subcontracting networks, with some participated companies and with other independent ones. The strategy of the company doesn't involve the outsourcing of ICT functions; they are investing on a skilled team to manage ICT in the all company.

5.2.6.5. PT5

As a logistic/transportation company PT5 presents a competitive strategy deeply centred on ICT facilities mainly those helping to manage the large distributed and dynamic network of trucks (GSM, Smart, SID, Geode). There is an investment of new systems namely a scanner to read barcode information in order to easily identify delivery packs transmitting the data to a central processing unit in order to invoice the customer on an EDI basis. The PT5 company as a group it has a distributed set of sites and companies interconnected in a extranet configuration (connecting different branches) involving dedicated communication circuits at a group level.

5.2.6.6. PT6

As a software house with a core business centred on document managing and imaging has a group of skilled and young workers, most of them computer science engineers and computer technicians. Their organization is directed to manage a group of projects involving different expertise from different departments. Beyond services and the role of valued added reseller of known global software producers, they have their own product targeted to smaller companies and requiring a reduced budget.
With a crescent trend to win subcontracted activities involved in large integration projects a significant number of their workers stay at customer site from long periods. Another aspect mainly related with maintenance contracts is the remote assistance where the communication infrastructure plays a major

role.

5.2.6.7. PT7

The PT7 company centres its ICT competence on a IS department managing an infrastructure involving mainframes and servers (with NT, UNIX and Novell operating systems) interconnected by a token ring network involving also around 1000 PCs and an Ethernet network confined to the IS department. The continuous processes from the production area are controlled/supervised by the Corus system while the management processes like the production planning and administrative ones are being moved to the SAP framework.

5.2.6.8. PT8

The PT8 company is a large company integrated in a large global group with a core activity on train project, design and production. They are intensive users of ICT mainly to support design/project activities and production control and supervision processes. They cooperate among enterprises of the group and with other partners exchanging electronically working drawings and other cooperation information. Their computational infrastructure involves some stand-alone and dedicated workstations but the main computational resource are interconnected in a local network (intranet), with connection to Internet and integrating also a WAN (extranet) involving other companies from the group. The Internet/web presence follows a group strategy being the PT8 site a contribution for such a global presence. Beyond at production level, ICT is intensively used to manage administrative processes with its core competencies grouped around the IS department team.

5.2.6.9. PT9

As a SME from the mould industry the PT9 company has a technological infrastructure based on a local network with PC workstations and NT servers. A group of the important ICT resources are located in the mould project and design department where CAD/CAM systems, CAE, and other 3D modelling specialized tools are used along the mould project/design process. This company has a presence in the Web and the e-mail and FTP file exchange protocol are used to exchange data files with customers. At shop floor level the measurement and the mould production areas are integrated to the design department providing these areas with drawing and other product information to be used during mould production.

5.2.6.10. PT10

The PT10 case refers to a very new large company (only three years old) created from an old shipbuilding and repair company. Its core business is ship repair based on the work force that comes from the original company. Even if there is a project department with a CAD system the main work force is based on qualified workers most of them metalomechanics or qualified on complementary activities

like painting, washing, pickling, welding, electricity from others. The ICT infrastructure is confined to the project and administrative departments. It is organized around a large number of PC interconnected on a local network with e-mail and other Internet/Intranet facilities. There are plans to invest on technological innovation not only on repairing and construction processes but also on administrative and management ones with technologies like SAP (a candidate under study) from others.

6. Personnel related aspects

6.1. Skills and qualifications

The Portuguese studied companies presents a relative uniform pattern considering the variables social competencies, practical knowledge, responsibility and specialized professional qualifications. In fact almost all of the companies, independently of the core business, present a high rate for all of these variables. There is however the PT7 company from the chemical sector that presents a significant shift from the reference pattern. To this company the social competencies and the responsibility are not so important. This can be associated to the high automation of this industry where the continuous processes requires a few human intervention and in most of the cases the number of workers are being reduced and trends to isolated workplaces, workers do not interact very often and based on a rigid hierarchical structure any doubt or proposal to a change needs to be reported first to the above level.

In PT7 technological, organisational, cultural and personnel related dimensions seem to be coherent. PT7 is characterised as Machine Bureaucracy with extensive division of labour, centralised decision-making and routinised tasks. Technological practices are a natural reflex of this structure. E.g. if a worker identifies a damage he must call for his leader for him to check the situation and to introduce the data in the information system, which will be enabled in the Maintenance area in order to call for an electrician or mechanician (or both).

Another relevant aspect is the importance almost all the companies give to the social competencies. Even for those that gave a relative low score to this variable consider continuity when asked to comment the last five years. In fact, more than technical skills, enterprises give a significant importance to the personal interactions either among workers or with customers and suppliers.
The specialized professional qualifications are another variable considered on the set of answers. In most of the cases the companies are expecting / requiring more skilled workers not only with technical ground competencies but also with social knowledge.
As far as information processing is concerned only three companies (PT1, PT7 and PT10) attribute a less importance to this aspect into their companies. The contradiction presented when comparing PT1 with PT5 both from transport sector, is more attributed to the low profile of PT1, a public transportation company when compare to a multinational large private transport/logistics company (PT5). The fact that the first company is located in an island (Madeira) with a less competitive market than the Continental/European one might contribute to a so disparate position. The overall trend points to a de facto importance of the information processing competencies considering that more and more worker are using a diversified ICT tools to realize their activities.

6.1.1. The impact of ICT

In most cases we can totally agree with the hypothesis that *'social skills are appreciated more than ICT related skills'*. In fact, ICT related skills form a surplus of workforce and not selection criteria. Social skills can be considered relevant in a way they can't be learned or changed that easily as ICT related skills. Technical functions and administrative have more ICT related skills as a selection criteria than

core process related functions. The social and integration moments are crucial at work dimension, even if there is an ICT intensive support.

'A need to learn the efficient and conflict-free utilisation of communication media such as e-mail' can be accepted in a concrete area of the company in a way Administration decides who should accede to e-mail. In the present case, only white-collar workers and those who Administration specifies have an e-mail address. The access to e-mail is centralised at the Informatics Department.

Sometimes we can found a connection between age and organisational change resistance. However, in general learning potential or willingness is more important than age or gender. So, by this evidence we can't totally agree with the hypothesis that stresses the *'little difference between younger and older workers in their capacity to cope with ICT'* because it's a fact that *'mentality and learning potential are more important'*.

The company has a low level of schooling and they're seeking for an inversion of it (especially when the weaving unit is considered). Also youngest age levels are loosing weight within employed people, fact that is taken into account at the recruitment. Technological skills are also important. With this we cannot conclude that people lacking ICT skills are excluded, however they can be redirect to specific functions at the production units.

Concerning the expansion of employment we can verify considering the last 5 years new jobs on specific areas: R&D, marketing, design, quality, human resources, informatics and on *core process* new jobs are mainly concentrated on specialised activities (eg. spinning and weaving mill, CNC milling and turning machines, CAD systems). It's also a fact that the majority of those skills are based on machinery/technological application and in most part of the cases we can identify more readjustments in terms of layouts and personnel organisation than the emergence of new jobs (in the sense of career).

For the air traffic operational functions (PT3), ICT skills are not determinant in the selection process, as specific ones must be acquired, during the *ab-initio* course. For other departments like maintenance or administrative and project support departments, general ICT skills start to play a growing role in the selection process. Some firms are also developing efforts to maintain a human related culture for a broader visibility of it's objectives and needs, by all employees. Social skills play then a major role in the relations with customers and/or other national and international organisations, with which information interchange programs are normally maintained.

While being well spread throughout the company, electronic communication still needs to find out its real value as a facilitator. Still a significant percentage of all electronic messages traffic, outside operational environment, does not relate to professional matters, or are used in a fashion like way. At operational level also other electronic means of communication like EDI-Electronic Data Interchange are familiar and correctly used.

Capacity to cope with ICT has been about the same among all employees. At operational level, all employees, independently of the age followed up the recent implementation of a CBT (Computer Based Training) system for the future Air Traffic Control Centre, without major problems.

Clerical workers (PT1) seem to be the ones facing more difficulties to cope with ICT. Nevertheless, not only they don't have to work with complex tools (basically, they are using the OFFICE tools), as spontaneous social networks of mutual support were developed.

In some extent the IT manager plays such a role. There is also a similar behaviour from other managers. There is an innovation culture, looking for enhancements of the production system be it oriented by ICT improvements or the integration of new machines, the new welding robotic cells are an example of such trend. In all this efforts the executive manager and production and IT directors are always pushing their working teams discussing problems in their work places. However this kind of support is not formal, it cannot be considered as a formal cultural pattern of PT4 company. This depends more on the personality of the executive manager that seams to have the company in his 'heart' and reproduces his feelings in his management team.

6.1.2. Social consequences

There is a clear trend to an increased automation of the enterprise processes be them production, management, planning or administrative processes from others. In this respect the enterprises require more and more skilled workers considering that they present an added flexibility to deal with complex tools and also a greater flexibility to deal with the crescent integration among the existing different enterprise processes (convergence among different subsystems). In fact the companies and associated to the state of the art in ICT are acquiring systems more integrated offering convergence from different subsystems toward integrated views of disparate processes (workflow, document management systems, call centre, Customer Relationship Management – CRM, from others). This changing process are creating a greater pressure over almost all of the workers considering that the new candidates present an added advantage to cope with the new emergent ICT while some old workers with less education level have more difficulties. Nevertheless it is a result from the evaluated companies when considering the practical knowledge and responsibility the importance the companies give to the seniority. This apparent contradiction is in fact the stability factor that contributes to equilibrate the new generation of more skilled workers and the experienced ones. Even if the young workers have a higher schooling level they do not have life experience and so companies ground their experimental training at the workplace from the more experienced workers. Nevertheless the reality presents in several cases some differences for instance in cases (PT7) where downsizing is implemented based on the automation of processes and when there is no allocation to other functions.

Since the late eighties, PT7 has been continuously reducing the number of employees. In 1990, there were about 400 employees; now, less than 250. The starting point was the Maintenance area (mechanicians passed from twenty to four), when the company decided to externalise part of these services, and, in a minor extent, the Information Systems department (when SAP was adopted five employees were dismissed).

Presently, and as far as production is concerned, there are 8 individuals per shift in the polymers and about 30 individuals per shift in the staple-fibres. In the first case, even if there was a significant increase in the production levels, automation has permitted to keep the same 8 individuals per shift. With the former equipment many more workers would be needed to cope with these levels. In the staple-fibres, the goal is similar – "To automate all the spinning operations and process areas and, as far as possible, to replace the human labour", as told us the Electrotechnics and Automation engineer. Older workers were/are the main *victims* of this policy, even if within a framework of a "peaceful revolution", based on mutual agreements. But, again, this has not to do with ICTs themselves but with generic technocentric choices. ICTs are only part of this strategy.

There is a particular case for ICT company (PT6) where almost the workers are high skilled engineers or at least high-qualified technicians. Considering their competencies they do not have difficulties on the labour market while internally they are continuously under pressure to acquire added expertise, to deal with more complex systems and above all, their career evolution is deeply based on their capacity to acquire a systemic perspective of the technological solutions the company offer.

On the one hand, the recruitment is very selective considering that a maximum schooling is required (most of them with university level). On the other hand, there is a few groups, the system administrators without university schooling, they came from technical schools and even if they are specialized in systems administration they do not own a systemic perspective of the systems they manage. This situation creates some problems when technicians present a great efficiency to solve sporadic questions while engineers fail in these situations. The engineers while having a systemic perspective of the systems do not know how to solve specific problems which requires an accumulated experience from the utilization of the systems.

The experienced knowledge of the technicians has a relative importance for the company. For those that are not able to evolve in the direction of a systemic perspective, the PT6 company do not have space for them. However, this is a relative problem considering that the market has a lack of experienced workers to administer computer systems. The technicians that cannot continue integrated in PT6, don't have problems to be integrated in other enterprise more oriented to systems administration. Nevertheless most of the technicians are studying in universities and most of them are being integrated in functions with more responsibility and when they finish the courses them can get project coordination or department director positions. The actual director of the development department crossed such professional path.

6.2. Training issues

On the one hand the enterprises give a significant importance to the training of workers. On the other hand in the large companies training is more structured and addressing a wider group of workers. Only in the case of PT6 an SME software company the training presents an approach similar to that shown by the large companies. In fact PT6 needs to maintain a continuous training plan in order to cope with the ICT evolution and from the large diversity/complexity of the underlying technologies used to implement their products and services.

As already mentioned PT6 has a well-structured training program, but more directed to the technology itself (train development teams) and in processes and management. In fact there is a consciousness at all levels (administration and workers) that technological knowledge is of primordial importance to comply with the enterprise business goals.

However the general situation presented by the studied SME points to a not well structured/planned train of the workers. In most of the cases the companies organize the training courses according to the daily needs what presents some flaws mainly those related to a dissatisfaction of the workers when dealing with new ICTs. The introduction of new office tools at administrative level without enough training is a common situation commented by the workers.

6.2.1. The impact of ICT

ICT-related training is not really structured: not everyone that is dealing with new technologies, in a way or another, has received the required training. So, we do not observe continuous training on ICT issues but only occasional support. Naturally, certain difficulties remain in using some applications – "Some times, there are opportunities for us to do more but we are afraid to move forward", told us a clerical worker in PT1 case.

Experience, tacit knowledge and direct contact with production process are fundamental. With this we can agree with the hypothesis that support the idea *'to master technology, a learning process is required in which spatially and culturally close persons give information and help during work'*, specially if we consider the high age average level and low levels of schooling among workers (PT2). A continuous learning process and a direct contact with technology is required even if they have long training over it. Training is considered an important mean of integration in the company, however experience plays a major role (especially for workers in the core process).

In terms of *'specific programmes to promote the workers employability over time'* the company doesn't seem to have anyone specifically. However, we can consider some training actions as a mean to promote learning and employability of workers.
Some enterprises (PT3) dedicate a significant budget percentage to training and programs dedicated to maintain or improve the workers qualifications, resulting in a promotion of work stability and workers employability.
The acquisition of new machines (CNC and robots) has been contributing to change the training needs namely the ability to operate such sophisticated new equipment. Some detected difficulties are more related with punctual resistance of a few workers that have some difficult to adopt the change. They are persons that, when we say that some operation is performed like this, they reply "we always perform this way and why have we to change it?"
International skills (especially languages), social competencies, multi-skills and responsibility emerge as fundamental skills and qualifications when we consider the principles and objectives at PT5: desire of internationalisation; provide a competitive service for clients and seek to continually improve their performance as the main objectives. Information processing qualifications, youngest age levels and higher levels of schooling (minimum 9 years of schooling) are asked for in the selection process. (They form closed selection criteria because of legal reasons - to have C class-driving license there's a need of compulsory level of schooling). Besides this, drivers' candidates have to do psychological, aptitude and clinical tests (drugs and alcohol control). Lacks in qualified and technical personnel were not found, and a reason for this can be the intensive training actions provided by the 'training office' of the group that assure a staff well prepared *'to deal responsibly and efficiently with the challenges of change and competition'*. So, there are no categories on road transport sector outdated, but the sector needs to readjust and extend new skills (especially IT) to old functions (PT5).
As keeping unemployed workers gets very costly, sometimes PT10 provides medium-term internal training (that is almost always funded), attenuating the costs of the technical unemployment when there is no work to be done in the naval repairing business.

6.2.2. Social consequences

The Portuguese case studies support the hypothesis "There is little difference between younger and older workers in their capacity to cope with ICT. Mentality and learning potential/willingness are more important than age" considering that in most of the answers only a few companies shown to detect more difficulties on older workers to cope with ICT. In general companies report a successful introduction ICT be it PC based or even specialized equipment of the production area.
However, more than the age difference, the motivation and the learning attitude is considered as a key factor to succeed start-using ICT.

> The attitude is a key element concerning the predisposition to lead with the new technologies. The background knowledge owned by the younger workers is important to break barriers related to the fear to not be able to work in a new environment. However, there are many older workers with a learning attitude fundamental in the process of matching the existing tacit knowledge with the potentialities of the new tools (machines) (PT9).

Another aspect that greatly contributes to the evidence of some differences about worker's age is related to their background knowledge. Workers with higher background knowledge have fewer problems to accept new challenges and, in most of the cases, independently of their age, new ICT is not a constraint at all.

According to the production director *'there are no cases of disintegration consequence of the difficulties results from the introduction of new technologies, namely CNC machines*'. Those that demonstrate more difficulty to deal with the new machines are still working in the traditional process (conventional machines).
However, there were some workers that left the company and have created their own small enterprises and most the times they continue to work to the company where they used to work not as employees anymore but as subcontracted enterprise (PT9).

While the age is not considered as a determinant factor under the analysis of exclusion, some special situations exist where people working for long time with interiorised processes present some resistance to change them according to the new ICT requirements.

According to the Human Resources Manager there exists what we could call a *'surplus'* of personnel if we consider subcontracted people. Indeed they are trying to reduce the number of subcontracted people replacing them with people from PT8, moving them from other units or by reconverting them to the new function. As the Human Resources Manager stressed, the aim *"is to diminish the subcontracted (…) last year they were 260 and at this moment they are about 60"*. Age is not taken as an indicator for social exclusion, but it's a fact that older people offers resistance and gives more examples on the technological and organisational changing (PT8).

The hypothesis "*The introduction of ICT (and related organizational changes) have made older and/or less educated workers more exposed to greater occupational fragility*" does not get a consensus among all the studied companies. However, the trend points to a rejection of this hypothesis considering that most of the companies do not consider the older and less educated workers a "hard weight". Most of the enterprises consider their experience and willing to compete being an important part of the changes.
In some extent we can say that younger and skilled workers balanced with older and experienced, only in a few cases this synergy doesn't work and measures like moving to other service or in minor cases unemployment (box above) were mentioned.

In fact the hypothesis "*Directly ICT-related skill changes can be met relatively easily. If employment security is affect by a lack of skills, this usually relates to other factors than ICT*" is confirmed by some of the above sentences. As already stated the introduction of ICT is always considered as a good benefit not only for the company itself but also to enrich workers work contents. None of the companies have mentioned any relation between worker's training/skills flaws and any plan to lay-off in any phase of their ICT innovation processes.

6.3. Flexibility, contracts and labour casualization

6.3.1. Impact of ICT

The introduction of ICT (and related organisational changes) is not bringing new risks for older and/or less educated workers.

The lack of ICT skills is not weakening the employment security. Actually, individuals with great difficulties in writing collision participation or a simple damage report are still being recruited. So ICT (lack of) knowledge, as far as drivers are concerned, is not determinant when considering employment security.
From the contractual point of view the worker's situation is very stable, not only by the performance of the company (competitiveness) but also because there is a lack of workforce (workers) in the region. The workers that by some reason want to change to another employer do not have difficult to find another company in the region requiring their services.
By recruitment we can observe that the average age tends to a stabilisation that can result in employed people characterised by being very young.

6.3.2. Social consequences

PT2 is making usage of temporary-workers fact that can be related with the seasonal fluctuations of work production, customer demands and also with the market pressures in terms of quick delivery, and not with social exclusion due ICT implementation.
During the case studies we didn't observed any case of inadequacy to ICT even if the changing work concerning tasks, tools and skill requirements has been a consequence of the permanent technological integration in workplace. In terms of employment expansion we can verify in the last 5 years new jobs concerning specific areas of R&D, marketing, design, quality, human resources, informatics and on core process new jobs are concentrated on the process automation. There exists a surplus of less qualified personnel and with low levels of schooling, trend that the HR policy is trying to invert (by training and by selection processes). Age is not considered as an indicator for social exclusion, but it's a fact that older people offers resistance in many cases of technological and organisational changes. Thus, concerning the hypothesis of *'the introduction of ICT have made older or less educated workers more exposed to occupational fragility'* it's a fact that employment risks with those strata of workforce are more related with fluctuations and variations occurred in terms of market demands, than directly with ICT. There's no tradition in recruiting individuals belonging to ill-favoured groups on the labour market.
Concerning concrete actions to *'avoid exclusion'* or to *'promote inclusion'* the company isn't totally active, but they co-operate with local employment agencies and with the Textile Sector Association.
Because of it's main activity (air traffic services) PT3 has always been, and not only at strictly operational level, a great user of ICT. May be that is why an exclusion situation related to the ICT new technologies cannot be identified at PT3; whenever some (few) cases were identified, they were solved by means of transition rules, always defending the workers socio-economic rights.
Outsourcing is only used for supporting activities, like security, cleaning and simple maintenance tasks. Thus employees are not in risk of becoming outsourcing victims. Also, as already stated older employees have an occupation as secure (and sometimes more secure) as younger ones.
The hypothesis that *'The introduction of ICT (and related organisational changes) have created greater employment opportunities for woman and, in general, for subjects with greater flexibility requirements'* is departing from a gender exclusion perspective that does not exist at PT3. There are no specific jobs for woman or for man, and women are not seen as having more flexible needs than man. An example of this reality is that a woman, which secretariat includes a man, is assuming the operational directorate.
To avoid exclusion and promote inclusion is also a major concern. However there are not specific programs for that, as changes occur in a fluid and smooth manner. In this context it is always possible

to foresee the necessary organisational changes to cope with international required process standards, without implying an exclusion risk for certain occupations.
As stated above PT6 requires workers with an increased schooling level. In fact the selection of persons to join PT6 during the periods of exceeding workload, are those with advanced competencies on ICT. The more skilled are positioned in the top of the list to be involved more often in temporary collaboration
Concerning the kind of contract we can observe that there is almost a draw in a way that full-time permanent represents more than half of labour force (in some cases full-time with periodic contracts). Men are most frequent than women (in both kinds of contracts). This fact can lead us to think that there is a link with social exclusion because of signs of precarious situations or risks of unemployment. However we couldn't confirm that objectively, but only being a firm strategy in the field of human resources. We can't affirm that there is a direct link with social exclusion.

6.3.3. Labour casualization

Most of firms made no significant resource to labour casualization policies. And there are no victims of labour casualization and, consequently, no related risks for older and/or less educated workers.
In PT6 was verified that there is however a trend on the software industry to use different kinds of teleworking. The ICT facilities leaded by e-mail and Web are opening a space to distribute some specific development tasks among remote collaborators without a physical presence in the company.
Two singular cases only: on the Maintenance area (in which mechanicals passed from twenty to four), when the PT7 company decided to externalise part of these services, and, in a minor extent, on the Information Systems department (when SAP was adopted five employees were dismissed).
Human resources strategies provided by PT8 are directly connected with the global group main objectives. Depending on it they suppress in some cases local particularities. Main example of it is the excess of productive capacity and the group decision to close one of the Portuguese units. These global decisions can be considered means of social exclusion at a general level, independently of the school levels or qualifications.
At the moment of the case study, they were trying to diminish the excess of personnel capacity by reducing the subcontracted people. In the case of older people, mutual accords on the contract rescission. Concerning younger people we founded two situations: possibilities of (re) qualification, on one hand and the cumulating of personnel in a specific unit by other. It's a fact that the improvement of production is taken as the main objective at PT8, and to get it they focalise their attention at training and quality/production level.
PT10 was born in order to respond to two major challenges: to guarantee the viability of the naval repairing business, to turn it competitive, and to solve an emergent social problem, receiving all the employees that another company could not handle anymore. So, at the age of 55, workers can get anticipated retirements, with complete salary and all the social benefits until they are 60 years old, entering then in the social security regular retirement scheme. On the PT10 case, one can say that it was born to die, within a framework of retirement schemes. After all, the decreasing number of employees is the natural consequence of the initial purpose that was established for this company.

7. Conclusions

- ICT is implemented within existing organisational structures and therefore, organisation influences the design of technology. Once ICT is implemented, technology driven phenomena influence the organisation

It is not true that these technologies are implemented within existing organisational structures and therefore, organisation influences the design of technology. Although ICT is very important at all levels in firms, it is not possible to state that is already implemented. But when ICT is being introduced, the organisational processes became more clear and sensitive. In one case (PT9), the utilisation of CNC machines, directly connected to the design department, has introduced significant changes on strategic activities. New machine programs are downloaded and managed remotely.

- Organisational changes are supported by ICT, but not determined/induced

It was verified for the Portuguese case that the organisational changes were supported by ICT, but not determined/induced by it. In most of changes there were recently developed, ICT had an important role. In the cases where ICT is already implemented (PT3, PT9), the new organisational options will take into account ICT support possibilities. Can even induce new working procedures. There are experiences (PT9) where new techniques are being developed based on working teams with concurrent engineering methodology.

- ICT supports decentralisation by way making of making communication, co-ordination and control easier and less costly

The hypothesis that "ICT supports decentralisation by way making of making communication, co-ordination and control easier and less costly" is strongly supported. In some cases, due to their sectoral specificities (chemical products-PT7), this decentralisation is very difficult to achieve.

- The introduction of ICT affects organisational rules, culture, relationships, etc.

Contrary to the last mentioned hypothesis, the one that referred that "the introduction of ICT affects organisational rules, culture, relationships, etc." was not strongly supported. The organisational rules, culture, relationships depend more evidently on traditions in the sector or region, and on the market relations, rather then due to ICT. The professionalisation and growth of the company can be more influential over some culture and work relations changes (PT5, PT9).

- Social skills are appreciated more than ICT-related skills

After analysing the case studies, one can totally agree with the fact that "social skills are appreciated more than ICT-related skills". In some cases even, ICT-related skills are looked as normal professional

requirements (PT3). Nevertheless, in case PT9, technical competencies are still at the top of the concerns and are considered as the key-skill most suitable to the mould for plastic injection industry.

- In coping with new technology, ICT-users rely on social networks of mutual support. To master technology, a learning process is required in which spatially and culturally close persons give information and help during work

It is a truth for the Portuguese case that, in coping with new technology, the ICT-users rely on social networks of mutual support. In fact, to master technology, a learning process is normally required in which spatially and culturally close persons give information and help during work. It happens especially with older and less scholar workers. And is facilitated with the existence of working groups strategy. With case PT9 it is believed that intranet can play an important role to promote an internal co-operation among workers. But it pre-exists a collaborative environment at shop floor, and among departments.

- There is a need to learn the efficient and conflict-free utilization of communication media such as email

Is contradictory the conclusion that states that "there is a need to learn the efficient and conflict-free utilization of communication media such as email". In some cases there is a wide possibility to use email. But, in general, is very restrictive the possibility to that use: only information systems managers are able/allowed. Some consider even that email can disturb the execution of normal working procedures. In most cases, email is not an important tool to be used by all workers, but only by some (few) occupations.

- There is little difference between younger and older workers in their capacity to cope with ICT. Mentality and learning potential/willingness are more important than age

One can almost agree on "There is little difference between younger and older workers in their capacity to cope with ICT. Mentality and learning potential/willingness are more important than age". In some firms, the age average is very low to make any conclusion (PT5, PT6). When the age average is higher, it seems to happen some relation between age and organisational change resistance (PT8). In general, we can consider that the background knowledge owned by the younger workers is important to break down barriers related to fear of incapacity of working in a new ICT environment. However, many elder workers (with less scholarship) have a positive learning attitude that match the existing tacit knowledge with the potentialities of the new tools (PCs, CNC machines, CAD, etc).

- 9a. The company has made significant recourse to outsourcing

In most cases, the companies had not made significant recourse to outsourcing. On PT7 occurred only on the "maintenance" area. On the PT8 because of several MBO by other TNCs, it is becoming an outsourced firm...

- 9b. Since the victims of outsourcing are "recycled" internally (assigned another job), they are not at risk of become unemployed

Even for the above-mentioned cases, the victims of outsourcing were not "recycled". Neither internally (for example, assigned to another jobs), nor they were not at risk of become unemployed.

- 9c. ICT support outsourcing through its communication medium and control function. Whether outsourcing is actually taking place depends not on technology, but on economic considerations and company traditions

Generally, ICT supports outsourcing through its communication medium and control function. But these functions depend clearly on economic considerations. Not on ICT. So it can be confirmed "whether outsourcing is actually taking place depends not on technology, but on economic considerations and company traditions".

- 10a. The company has made a significant resource to labour casualization policies

There are no labour casualization policies in the studied cases in Portugal, except in a single case (PT10). In this case there is a strong dependency on other firms of the sector and on the market. Due to the specific conditions of the market, this case planned a specific casualization policy with the support from the state in order to reduce the negative effects.

- 10b. Labour casualization makes older and/or less educated workers more exposed to greater occupational fragility

It is only true that "labour casualization makes older and/or less educated workers more exposed to greater occupational fragility" on the case where it occurred (PT10).

- 10c. Labour casualization has been facilitated by ICT

Not at all, for the Portuguese case, labour casualization has been facilitated by ICT. When it exists has nothing to do with ICT. We could not find any relation between these variables.

- 11a. The introduction of ICT (and related organizational changes) have made older and/or less educated workers more exposed to greater occupational fragility

In most cases was verified that more important than the introduction of ICT, has been the changes at the market level. On the PT7 case, it can be verified for older workers, when ICT are optimising the automation of production processes. But in most cases there is a shortage of labour.

- 11b. The introduction of ICT (and related organizational changes) have created greater employment opportunities for women and, in general, for subjects with greater flexibility requirements

It was verified that the introduction of ICT (and related organizational changes) have not created greater employment opportunities for women and, in general, for subjects with greater flexibility requirements.

- 11c. If employment security is affected by a lack of skills, this usually relates to other factors than ICT

It was verifiable, for almost all the Portuguese cases, that "if employment security is affected by a lack of skills, this usually relates to other factors than ICT".

- The enterprise applies social protection programmes to safeguard the workers' job

There are no social protection programmes at the firm level on the cases studied. PT10 as a firm is an attempt to safeguard workers' job in a re-structuring process.

- The enterprise applies active programmes to promote the workers' employability over time

The enterprise doesn't apply directly active programmes to promote the workers' employability over time. In some cases (PT5, PT10), systematic training action, that involve all firm members, can be considered as promotion of employability over time.

- The enterprise applies internal/external means to cope with occupational changes and avoid exposure to exclusion

There are only means to cope with occupational changes and avoid exposure to exclusion at the level of employment agencies (IEFP, MTS-Ministry of Labour and Solidarity) and the INOFOR of MTS. We could not find internal enterprise means.

- The enterprise applies internal/external means to cope with occupational changes and promote inclusion

As for the previous hypothesis, there are only means to cope with occupational changes and promote inclusion at the level of employment agencies (IEFP, MTS-Ministry of Labour and Solidarity) and the INOFOR of MTS. Because there is a large mobility of skilled labour between firms in the same region and sector, the PT9 case tries to promote inclusion with internal means (promotions, wages)

So, as in other countries and regions, independently of the economical development level, we didn't found explicit technological determinism in the relation between ICT and social exclusion. But, if the *direct* risk of exclusion are not present in any of the cases studied, the *indirect* one can be more implicit whether organisational processes can take place decreasing the levels of employment security, or even precarising the industrial relations. Some outsourcing, or mostly, rationalisation processes can in the near future endanger some workplaces in some firms.
There is a National awareness about the weakness of the worker's skills. During the last years the situation is being changing considering the extra investment is being done in this direction mainly at government level, pushed by European Commission global policies. Other environmental conditions in terms of economy and technology developments, as well as social and political features, can influence the direction of the trend. In other words, some internationalisation processes and competitive strategies can more directly influence issues related to social exclusion and/or precarisation of living conditions.

ANNEX

Table 1 – (Re)sampling of Portuguese firm questionnaires, by strata and ponderation coefficient[11]

NACE	N (Universe)	N (%)	n (sample)	n (%)	Ponderation Coefficient *
17 +18 Textile industry	12 501	5,51	6	5,3	1,037
21 + 22 Pulp, paper products and publishing industry	3 394	1,5	1	0,9	1,691
23 + 24 Coke, petroleum products and chemicals industry	998	0,44	5	4,4	0,099
25 Manufacture of rubber and plastic products	1 321	0,6	1	0,9	0,678
27 + 28 Manufacture of basic metals and metal products*	10 177	4,48	5	4,4	1,012
29 Manufacture of machinery and equipment, n.e.c.	2 879	1,3	22	19,5	0,066
30 + 31 + 32 + 33 Manufacture of office and electrical machinery and optical instruments	1 730	0,76	15	13,3	0,057
34 Manufacture of motor vehicles, trailers and semi-trailers	406	0,18	4	3,5	0,051
35 Manufacture of other transport equipment	470	0,21	1	0,9	0,237
45 Construction	32 160	14,2	1	0,9	16,06
50 Sale, maintenance and repair of motor vehicles and motorcycles	16 645	7,3	5	4,4	1,65
51 Wholesale trade and commission trade	30 734	13,5	8	7,1	1,907
52 Retail trade	82 819	36,5	3	2,7	13,752
60 Land transport and transport via pipelines	8 786	3,9	7	6,2	0,629
61 Water transport	38	0,016	1	0,9	0,018
62 Air transport	11	0,005	1	0,9	0,006
63 Supporting and auxiliary transport activities	1 226	0,98	4	3,5	0,277
64 Post and telecommunications	193	0,09	2	1,8	0,05
72 Computer and related activities	1 522	0,67	16	14,2	0,0473
74 Other business activities	17 954	7,91	5	4,4	1,7879
	226 964	**100,0**	**113**	**100,0**	

Source: *Painel de Empresas 1995 – 1996*, Lisboa, Instituto Nacional de Estatística, 1998.

[11] Procedure also used at Gomes, C.T., *Globalisation and the emergence of the information society: reflex at the metallomechanics organisational change*, Master Thesis (Final Draft), October 2000, Lisbon, ISEG.

* Except machinery and equipment.

Test 1 – Independence Chi-Square Test: Number of clients * Relationship within clients

		Relationship within clients		Total
		Long Term	Short Term	
Number of clients	**Some Clients (2-20)**	4	2	6
	% within nb clients	66,7%	33,3%	100,0%
	% within relationship	3,7%	66,7%	5,5%
	% of total	3,6%	1,8%	5,5%
	A lot of Clients (> 20)	103	1	104
	% within nb clients	99,0%	1,0%	100,0%
	% within relationship	96,3%	33,3%	94,5%
	% of total	93,6%	,9%	94,5%
Total		107	3	110
% within nb clients		97,3%	2,7%	100,0%
% within relationship		100,0%	100,0%	100,0%
% of total		97,3%	2,7%	100,0%

Postulation: two random samples and two qualitative variables in a nominal scale. We intent to prove the independence of the samples concerning some attributes, be it, verify if there is a relation between the number of clients of the company and the existing relationship maintained within customers (or clients).

Ho: There's no relation between variables. The variables are independent.
Ha: There's relation between variables. The variables aren't independent.

Decision: With α = 0.000 (significance) we reject Ho in a way the associated probabilities to the test are < to the significance level. By this way, we accept the fact of existing relation between the number of clients and the relationship that is maintained within those clients (thus, the variables are independent). Concerning the symmetric measures (the intensity degree between variables both in the sample and in the universe), Cramer's V shows that it is 0.451. Thus, the intensity degree between variables is average.

Test 2 – Independence Chi-Square Test: Kind of services or products * Market criteria considered as more important

		Most important market criteria to the companies					Total
		Quality	Productivity	Delivery	Flexibility	Innovation	
Kind of services or products	**Standardized**	8	15	4		1	28
	% kind service or	28,6%	53,6%	14,3%		3,6%	100,0%
	% criterion most imp	16,0%	83,3%	66,7%		5,3%	25,2%
	% of total	7,2%	13,5%	3,6%		,9%	25,2%
	Standardized variants	25	1		2	15	43
	% kind service or	58,1%	2,3%		4,7%	34,9%	100,0%
	% criterion most imp	50,0%	5,6%		11,1%	78,9%	38,7%
	% of total	22,5%	,9%		1,8%	13,5%	38,7%
	Specified by customers	17	2	2	16	3	40
	% kind service or	42,5%	5,0%	5,0%	40,0%	7,5%	100,0%
	% criterion most imp	34,0%	11,1%	33,3%	88,9%	15,8%	36,0%
	% of total	15,3%	1,8%	1,8%	14,4%	2,7%	36,0%
Total		50	18	6	18	19	111
% kind service or		45,0%	16,2%	5,4%	16,2%	17,1%	100,0%
% criterion most imp		100,0%	100,0%	100,0%	100,0%	100,0%	100,0%
% of total		45,0%	16,2%	5,4%	16,2%	17,1%	100,0%

Postulation: two random samples and two qualitative variables in a nominal scale. We intent to prove the independence of the samples concerning some attributes, be it, verify if there is a relation between the kind of products or services and the market criteria considered as the most important to the companies.

Ho: There's no relation between variables. The variables are independent.
Ha: There's relation between variables. The variables aren't independent.

Decision: With α = 0.000 (significance) we reject Ho in a way the associated probabilities to the test are < to the significance level. By this way, we accept the fact of existing relation between the kind of products or services and the market criteria considered as the most important to the companies (so, the variables are independent). Concerning the symmetric measures (the intensity degree between variables both in the sample and in the universe), Cramer's V point out that it is 0.59. Thus, the intensity degree between variables is average.

Test 3 – Independence Chi-Square Test: Kind of geographic localisation * Market criteria considered as more important

		Most important market criteria to the companies					Total
		Quality	Productivity	Delivery	Flexibility	Innovation	
Kind of geographic localisation	**Urban**	37	4	6	17	17	81
	% kind geographic	45,7%	4,9%	7,4%	21,0%	21,0%	100,0%
	% criterion most imp	75,5%	21,1%	100,0%	89,5%	89,5%	72,3%
	% of total	33,0%	3,6%	5,4%	15,2%	15,2%	72,3%
	Rural	2				1	3
	% kind geographic	66,7%				33,3%	100,0%
	% criterion most imp	4,1%				5,3%	2,7%
	% of total	1,8%				,9%	2,7%
	Mixed	10	15		2	1	28
	% kind geographic	35,7%	53,6%		7,1%	3,6%	100,0%
	% criterion most imp	20,4%	78,9%		10,5%	5,3%	25,0%
	% of total	8,9%	13,4%		1,8%	,9%	25,0%
Total		49	19	6	19	19	112
% kind geographic		43,8%	17,0%	5,4%	17,0%	17,0%	100,0%
% criterion most imp		100,0%	100,0%	100,0%	100,0%	100,0%	100,0%
% of total		43,8%	17,0%	5,4%	17,0%	17,0%	100,0%

Postulation: two random samples and two qualitative variables in a nominal scale. We intent to prove the independence of the samples concerning some attributes, be it, verify if there is a relation between the kind of geographic localisation and the market criteria considered as the most important to the companies.

Ho: There's no relation between variables. The variables are independent.
Ha: There's relation between variables. The variables aren't independent.

Decision: With α = 0.000 (significance) we reject Ho in a way the associated probabilities to the test are < to the significance level. By this way, we accept the fact of existing relation between the kind of geographic localisation and the market criteria considered as the most important to the companies (so, the variables are independent). Concerning the symmetric measures (the intensity degree between variables both in the sample and in the universe), Cramer's V point out that it is 0.421. Thus, the intensity degree between variables is average.

Test 4 – Independence Kolmogorov-Smirnov Test: Technical integration of different stages of production process * Importance to the ICT implementation towards personnel cost reduction

Postulation: two random independent samples (Q11 – Is there any technical integration between two or more of the stages in the production process? and Q14.1 - Importance of ICT for the reduction of personnel costs). We have a qualitative variable in a nominal dichotomised scale and a qualitative variable in an ordinal scale. We intent to verify if there's relation between the variables *'technical integration between two or more stages in the production process'* and the *'given importance of ICT for the personnel cost reduction'*.

Ho: There's no relation between variables. The variables are independent and the two samples came from populations with equal distribution.
Ha: There's relation between variables. The variables aren't independent and the two samples don't come from populations with equal distribution.

Decision: With 2-tailed P = 0,001 < 0,09 we reject Ho. So we can conclude that there's a relation between technical integration of two or more stages of production process and the fact that companies stressed the importance of ICT towards the reduction of personnel costs.