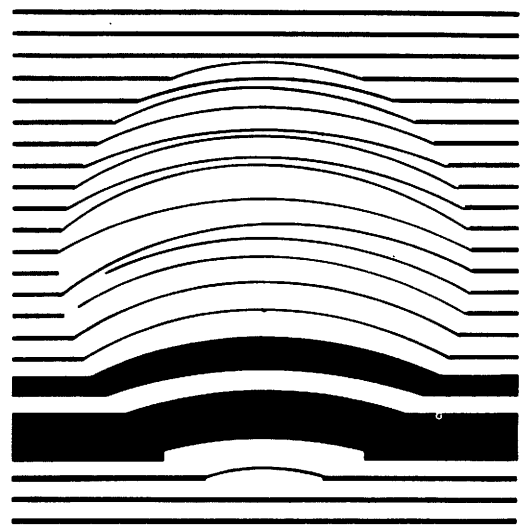
Report
to the Commission
of the European Communities

ISDN/PABX

FINAL REPORT

Volume 1 / Executive Summary
Main report



ETCO

FINAL REPORT

August 1988

" *A l'heure où l'onde par la lune est attirée,*
Je me suis mis sur le sable -après un bain de mer-
Et la tête partant la première, mon cher,
-Car les cheveux, surtout, gardent l'eau dans leur frange !-
Je m'enlevai dans l'air, droit, tout droit, comme un ange."

Edmond ROSTAND, "Cyrano de Bergerac", Acte III, scène XIII

The Commission of the European Communities (DG XIII) has instructed the European Telecommunication Consultancy Organization (ETCO) to perform a study entitled:

ISDN/PABX

INVESTIGATIONS ON WIRING CHARACTERISTICS AND TERMINAL EQUIPMENT TYPES OF PRIVATE TELECOMMUNICATION NETWORKS IN EUROPE

ETCO thanks European PTT Administrations and Recognized Private Operating Companies for their assistance:

France: France Telecom

Germany, F.R.: Deutsche Bundespost

Italy: SIP

Netherlands: Nepostel

United Kingdom: British Telecom

ETCO thanks European PABX manufacturers for their collaboration:

France: Alcatel, IBM France, Jeumont-Schneider, Matra, Northern Telecom, SAT

Germany, F.R.: Nixdorf, Siemens, Telenorma

Italy: Dial Telecomunicazioni, Face standard, Fatme, IBM Italia, Italtel, Siemens, Telettra

Netherlands: Philips

Sweden: Ericsson

United Kingdom: GPT, Mitel

The work was carried out by a multinational expert team :

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S U M M A R Y

GENERAL INTRODUCTION

1 PURPOSE OF THE STUDY

In anticipation of the onset of ISDN, Ad Hoc Groups on layer 3 and 1 met in Brussels on September 22-23, 1987 to identify the broad areas of standardization work required for the ISDN/PABX - known as ISPABX - extension line interface.

There was no agreement on the type of layer 1 configuration to be standardized.

A reason for this lack of consensus was the insufficient information available on wiring practices of private business networks in Europe.

The Commission of European Communities decided to carry out a field survey and awarded a contract to the European Telecommunication Consultancy Organization (ETCO).

The subject of this contract was to determine the main features of PABX installations relating to extension lines and extension terminal equipments.

The study was carried out from February to July 1988. It involved the five ETCO partners (British Telconsult, Consultel, Detecon, Nepostel, Sofrecom) and four market research companies (Institut français de Démoscopie - France, Institut Prof. Dr Strothmann Gmbh - Germany, Demoskopea SRI - Italy, Research Service Ltd - UK).

The final report is divided into two sections :

Section A : Executive summary (Main results and Recommendations)

Section B : Quantitative results (Technical and field survey)

2 METHODOLOGY

The study was carried out in three phases :

- Phase 1 consisted of a technical survey among the PTT's or national operating companies, main PABX manufacturers and wiring contractors. The objectives of this survey were to collect information on existing private telecommunication systems and their evolution and to collect comments on the field questionnaire of phase 2. Statistics were compiled when available.

- Phase 2 consisted of a field survey performed in France, Germany, Italy and United Kingdom among 800 establishments with more than 50 employees.The scope of the survey was to determine the main features of private installations relating to PABX,wiring,networking and terminals.

- Phase 3 consisted of data analysis resulting in recommendations.Existing national statistics concerning establisments with less than 50 employees were taken into account.

During the "European Market Research on demand for new broadband services for business use" carried out by ETCO in 1987 following a DG XIII's contract ,a representative sample of establishments in the four countries had been created.The surveyed establishments belong to this sample.

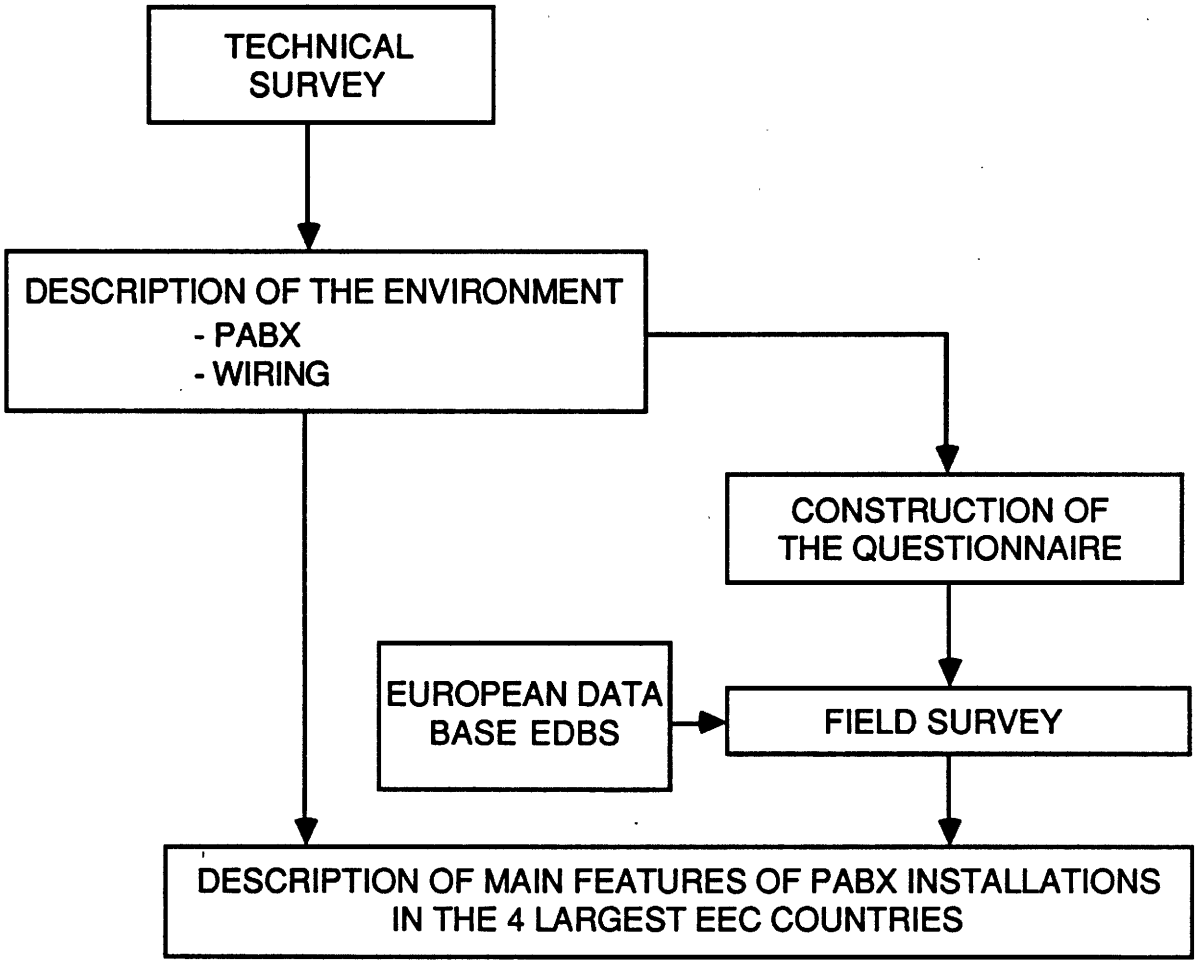

FIG. 1 : METHODOLOGY

SECTION A

EXECUTIVE SUMMARY

One of the main issues concerning ISDN terminals is whether the public and private ISDN terminals should be interchangeable. It is in fact expected that the public ISDN terminals will be cost effective due to the potential high volume ordered by PTT or operating companies.

The total number of telephone sets connected to public networks in the EEC was 165 million in 1986 out of which 48 million were connected to PABX.

The number of telephone sets connected to PABX represents about 25 % of the total number of telephone sets connected to public networks in the four largest countries that we surveyed (France,Germany,Italy,United Kingdom).

Given the fact that ISDN is primarly aimed at business applications, the issue of ISDN terminals connected to PABXs is clearly of prime importance.

During this study, we gathered information on wiring practices and characteristics of business private networks.

We concentrated our investigations on establishments with 50 employees or more for several reasons :

- the medium and large establishments are expected to be among the first users of ISDN

- these establishments account for more than 65 % of the total number of extension lines in the four countries which have been surveyed.

The main findings of the survey are :

1 Extension line length

The distribution of loop length of the lines connected to PABXs in the four countries is :

DISTANCE	0-150 m	150-500 m	500-1000 m	more than 1000 m	DK
% of telephone sets	66 %	21 %	6 %	4 %	3 %

Table 1 : Distribution of telephone sets according to loop length

We considered only establishments with 50 employees or more during the survey. For small estalishments, we expect practically all telephone sets to be located within 150 meters from the PABX. The following Table shows the close correlation between the employee size class of an establishment and the loop length of the extension lines.

DISTANCE	0-150 m	150-500 m	500-1000 m	more than 1000 m
50-199 empl.	85 %	13 %	1,3 %	0,7 %
200-499 empl.	65 %	29 %	3 %	3 %
500 or more employees	42 %	32 %	15 %	11 %

Table 2 : Distribution of telephone sets according to size class of establishments.

2 Wiring capacity

We considered separately two parts of the wiring installation :

- the wiring from the telephone socket to the first distribution box
- the main cable distribution arteries.

. Although existing wiring installations are based on a two wire connection of analog telephone sets to the PABX, we found that **in almost 50 % of establishments of more than 50 employees, the majority of telephone sockets are connected by 4 wires or more.**

This is either due to national recommendations, or because one pair installation cable is no longer used by installers since two pair cable has a similar price and offers ease of extension.

We noted a correlation between the percentage of establishments with 4 wire connections and employee size class. In large establishments, wiring issues are more carefully addressed

Size Class	50-199	200-499	500 or more
% of establishments with 4 wire connection	47 %	55 %	56 %

. In the main distribution cables, we found that in 45 % of establishments a spare capacity of 25 % or more exists. However, one third of the installations are saturated.

Overall we estimate an average of 10-20 % spare pairs in this part of the wiring.

3 PABX and Wiring installations

. Extensive replacements have taken place over the past 5 years.

12 % of wiring installations and 11 % of PABX have been installed over the last 12 months. Over the last 5 years,60 % of wiring installations and 65 % of PABX have been renewed.

32 % of the installed base of PABX in the four countries are digital.

. The renewal of the cabling is often performed when a new PABX is installed. This aspect is important as the transmission quality provided by existing cables could be unsuitable for ISDN transmission especially when the wiring installation was made without special care (e.g. telephone cables close to electrical cables, electromagnetic sources...)

60 % of the cabling renewed during the last 12 months were installed as the PABX was changed.

. The unwillingness to adopt ISDN is often connected to the cost of equipment transition.

A quick economic analysis shows that the amortization of investment required for a PABX installation is of the same order of magnitude as the average annual telecommunication bill.

Let us consider the average installation (120 telephone sets) identified in the survey ; if we assume the PABX has a 200 port capacity to cope with future demand, then the following prices reflect the European market :

cost of	an analog port	:	2000 FF
	a digital port	:	5000 FF
	an analog set	:	500 FF
	a digital set	:	2500 FF
	wiring (2 pairs) per set	:	1000 FF

We assume than 20 % of the extensions are digital. For the 200 port PABX, the total cost will be 900.000 FF. On an average life time of 9 years , it represents 100.000 FF per year.

Over 82 % of the surveyed establishments have an annual telecom bill higher than 100.000 FF.

However this comparison can be interpreted differently according to the point of view which is selected : user, PABX manufacturers or PTT.

4 Terminals

In this study we identified the types and quantities of all terminals in use by establishments which could be connected to ISDN in the future and therefore could be connected behind an ISPABX. In the four countries surveyed for establishments of more than 50 employees, we found that :

- the number of telematic terminals is 1.4 million.
- the number of data processing terminals is 4.6 million
- telephone sets with extra functions (e.g. with visual display such as lamps, diods...) usually used by managers represents slightly more than 5 % of the number of telephone sets (1.3 million out of a total of 24 million telephone sets).

The most numerous categories which could benefit from ISDN capabilities are data terminals and micro computers which represents 65 % of terminals besides telephone sets.

5 Awareness of ISDN among users

A minority of users is presently aware of the possibilities that ISDN will bring. Only 22 % of interviewed persons already knew of the basic services provided by ISDN. 51 % had never heard of ISDN before. This percentage varies according to the economic sector, employee size class of the establishment or the country : only 24 % of establishments with 500 employees or more did not know ISDN for example. But this issue remains a real challenge for suppliers and administration.

Because of this lack of awareness, it is evident that many users are replacing their PABX and wiring installations without taking account of the future requirements of ISDN.

It should be highlighted that among all the wiring installations made over the last 12 months :

- one third are based on 2 wires per socket
- one quarter have less than 10 % spare pairs.

Among PABXs installed last year, 45 % are not of the time division type.

Conclusions and recommendations :

1 The various S-bus configurations provide sufficient range possibilities to accomodate 93 % of present day PABX extensions.

The short passive S-bus can connect almost 2/3 of telephone sets although its maximum range stands only between 100 and 200 meters (according to the cable impedance).

Furthermore the increasing tendancy for decentralised architecture in PABX design implies that the long extensions can be accomodated in the future.

2 . The way ISDN terminals will be introduced in estalishments willl have an impact on the need for additional cabling. It is very dubious that inside large establishments which are expected to be the first customers of ISDN all the existing telephone sets will be replaced by ISDN terminals. Cost constraints will limit this replacement to offices where the number of installed terminals besides telephone sets justify installation of a S-bus, and to managers and executives using telephone and telematic services extensively.

Furthermore the connection of a S-bus with 4 wires will allow to connect 3 terminals or more which were previously connected by one pair each.

Considering the possible increase of connections as it is estimated by the users (45 % of them declare that they can increase the number of connected terminals by 25 % whilst using existing wiring installation), **the use of a S-bus will involve the need for additional wiring only in those installations or parts of installations which are near saturation** and which are willing to go for ISDN very quickly.

3 Common specifications on wiring characteristics or at least minimum requirements on cable specifications and installation ensuring good ISDN transmission should be issued in the EEC.

This is of prime importance as we noted that some very large establishments well aware of the benefits of ISDN are waiting to replace their existing PABX and to renew their cabling.

Test equipments and measurement methods should guarantee that existing cables are suitable for S type transmission.

Special care should also be given to Main Distribution Frame (MDF) and intermediate distribution frames where the discontinuity of cables can bring transmission impairment.

4 The predominance of the micro computer as a terminal which could benefit from ISDN confirms that low volume applications will be the first to make use of integrated services.

It should encourage the approach of manufacturers to provide an in-slot ISDN terminal adapter for PC.

5 Information on ISDN is needed by business users and,in particular, by small and medium sized establishments.

This problem will be addressed by the PTTs in launching their ISDN service.The possible actions taken by manufacturers associations will also be important.

During ISDN pilot phases and before full commercial launch,intermediate actions to provide information to the user should be considered.In deciding how best to provide such information,the possible role of organisations such as the PTTs,Government Agencies, standards promotion bodies, user groups, manufacturers associations and the European Commission itself should be examined.

We can conclude that there is no major impediment originating from wiring considerations to the use of public ISDN terminals behind ISPABX. It should be stressed that an important aspect, from the user point of view, is the terminal functionality. Although it was outside the scope of this study, the point was made during the survey about the problems raised by differences of services provided by public ISDN exchanges and ISPABX. As long as the services provided by an ISPABX have not been specified, it is difficult to know whether a public ISDN telephone set could provide extra services specific to the PABX in a user friendly way. This implies that there still will be a market for proprietary terminal equipment meeting new or specialised applications.

SECTION B

QUANTITATIVE RESULTS

INTRODUCTION - SURVEY OVERVIEW

1 THE UNIVERSE OF ESTABLISHMENTS

The necessary limitation of the number of interviews led us to limit the field survey to the establishments likely to be concerned with ISPABX installation and use in the coming years.

Such establishments which already operate a PABX today should express communication needs in voice but also data fields in order to find some interest in integrated services.

Some small enterprises have a requirement for integration of voice and data. This is specially true in the service economic sector. However these will represent a very small demand compared to the one expressed by medium and large enterprises. For PABX manufacturers and PTT, the marketing policy today is a top-down approach aimed at the large size enterprises which are expected to be the users of ISDN during the first years.

For the small enterprises, private telephone installations have an average of 8 extension lines. This will mean a demand for a few ISDN basic accesses most probably connected directly to the public telephone network. There will be a coexistence of a small PABX or key telephone system and one or two S-buses.

Consequently we concentrated our investigations on establishments having more than 50 employees in France, Italy, Germany and United Kingdom.

We added another constraint which is the existence of a PABX on the estalishments. Most of the required information applies to the existing equipment or wiring installation : the survey of establishments without PABX would have been useless. The percentage of establishments of 50 or more employees but not equipped with a PABX is about 10 % in the four countries.

These considerations led us to consider a universe of 193255 establishments in the four surveyed countries.

This choice has several advantages:

- The European data base EDBS already contains a representative sample of establishments having more than 50 employees belonging to 17 countries in Western Europe.

  It provided a sample guaranteeing geographical and economical representativity in the four largest countries. The sample is structured according to the country and inside each country according to sector and size of establishments.

- The task of extending the main results to the 17 countries could be performed by reference to EDBS.

Small establishments (less than 50 employees) have a low contribution to the main results of this study.

For example there is a strong correlation between the size of an establishment and the number of telephone sets located at more than 1000 m. The establishment of the size class 50-199 employees represent 9% only of the number of long loop lengths compared with 78% for the size class 500 employees or more.

Except for very specific cases (in the Industry Sector mainly), all the telephone sets in small establishments will be within the 1000 m range.

Main detailled statistics on the installed base of PABX and key telephone system are found in paragraph 3.

2 LIMITS OF ANALYSIS

It is important to stress that all the figures quoted in part 2 of section B have been calculated on the basis of the establishment sample representing the total universe of establishments. In consequence, it is necessary to keep in mind that a confidence interval is attached to each result according to the statistical laws.

Obviously, the precision is better when the sample is larger. If we consider the total universe of establishments in the four countries, the initial sample guarantees a high representativity and reliable results. If we consider a specific universe -for example the establishments of one country belonging to one sector and one employee size class-, the corresponding establishments in the initial sample constitute a too small representation to give reliable information.

We consider that a practical limit is to cross a maximum of two among the following establishment characteristics : country, size and economic sector.

3 STATISTICS

3.1 TELEPHONE SETS

Statistics were collected from various sources: PTT, manufacturers, international organizations and market research institutes.

It was complicated by the fact that extension line classes are not homogeneous in Europe and that statistics were not always available for the same reference year. Also, detailed statistics were considered confidential in some countries. This explains why the information is sometimes partial.

Table 3 gives the total number of telephone sets connected to the public networks. The total number for the four countries is around 127 500 000 representing 77% of the telephone installed base in EEC (165 365 000) in 1986.

The growth rates are not homogeneous among the four countries : Italy has the highest increase in the installation whereas UK has the lowest. One can note also a decrease of the growth rates in 1986 compared to 1985. This is the result of the high maturity of the telecommunication market.

The ratio of the number of telephone sets per main line is almost similar in the four countries and varies around an average value of 1.4.

	1984	% 85/84	1985	% 86/85	1986	
Number of telephone sets connected to the public network	22992 35137 31483 29062 118674	5,8 4,1 4,8 1,6 4,0	24331 36582 33002 29518 123433	5,3 3,6 4,1 3,3	25615 37899 34347 NA 127500 *	ITALY GERMANY FRANCE UK TOTAL
Number of main lines	16521 24921 22086 20921 84449	5,3 4,0 4,3 NA 4,1	17396 25912 23023 NA 87931*	4,9 3,1 3,8 NA 3,6	18253 26726 23904 NA 91133*	ITALY GERMANY FRANCE UK TOTAL
Number of main lines connected to PABX	NA 1775 1755 1691	 3,9 13,5 	NA 1844 1992 NA	 4,0 5,6 	1362 1918 2103 	ITALY GERMANY FRANCE UK

* Estimation
Source : ITU/CEPT

Table 3 : Number of telephone sets and main lines (in thousands)

3.2 INSTALLED BASE OF PABX

The number of PABXs including key telephone systems and the number of extensions are given in Table 4. It must be stressed that some figures are only estimates due to the lack of available statistics.

We can note the low penetration of PABX in Italy according to our estimations.

	France (31/12/87)	Germany (31/12/86)	Italy (end of 87)	U.K. (31/12/87)
Number of PABX	641	1 229	550*	444
Number of extensions	9 884	12 285	4 300*	7 450*
Average number of extensions	15	10	8	17
estimated ratio of the number of extensions to the number of telephone sets connected to the public network	27 %	32 %	15 %	24 %

* estimated

Table 4 : Number of PABX and extensions lines (in thousands).

We can estimate that in the four countries the number of telephone sets connected to PABXs is close to 34 million in 1987. It represents 71 % of the total number of PABX extension lines in Europe estimated to be 48 million.

Compared to the total number of telephone sets connected to public networks as estimated in 1987 from Table 2, it represents 25 %.

Given the fact that ISDN is primarly aimed at business applications, the issue of ISDN terminals connected to PABXs is clearly of prime importance.

France and UK provided statistics on the distribution of private installations according to size.

A large proportion of the total number of private installations is composed of key telephone systems (KTS).

In France,70% of private facilities are KTS.In Germany, we find that 78% of the total number of installations with a capacity between 2 and 9 ports are KTS.A very high percentage of installation in the 2 to 10 port range are KTS (80 to 90%) but PABX outnumber KTS in the other ranges. The upper limit for KTS is around 25 ports.

Although KTS are the most widely used sophisticated facilities, they represent a small percentage of the extension lines.In France,only 25% of the extension lines are connected to KTS.The average number of connected telephone sets on KTS is less than 6.

If we consider the KTS and PABX with a capacity of less than 50 ports, the average number of connected telephone sets is 8 ; they represent slightly less than 50% of the total number of extension lines.

In this report by limiting the survey to establishments of more than 50 employees we take into account not only large PABX but also some small PABX with a capacity less than 50 ports. **We deal exactly with 23.9 millions extensions representing almost 65% of private installation extension lines found in the four European countries.**

The following Figures show the distribution of the number of PABX and KTS according to their capacity in France and UK .

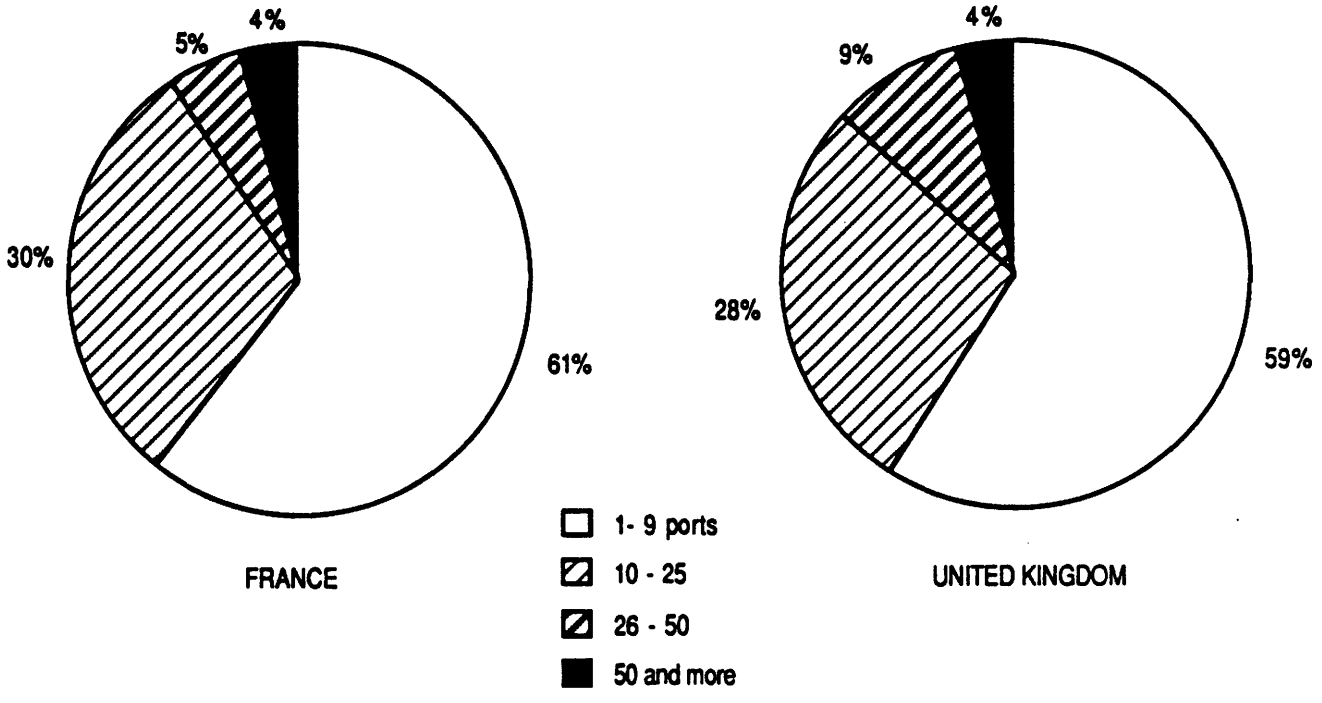

Fig.2 *Fig.3*

DISTRIBUTION OF PABX AND KTS ACCORDING TO THEIR CAPACITY

3.3 ANNUAL MARKET

Growth rate of the PABX market is low.A high percentage of the systems installed during the last years were replacements for existing obsolete systems.

It should be noted that due to the modularity and distributed architecture of most new systems, it is very easy to cope with expansion without replacement.

As we saw previously, the KTS dominate the 1-25 port market but beginning to impact the 25-50 port market. A majority of installed key systems are still analog and will need replacement. However new KTS, being digital do not require heavy internal wiring and provides attractive services.

We will probably see KTS penetrate market segments where they were previously absent.They will compete directly with small size ISPABX offered in these segments (see Part 1, paragraph 2).

Statistics on the annual market were provided by France and UK. Last year shipments of PABX are shown below as a percentage of the installed base of each capacity.

Capacity	2-30 ports	31-99 ports	100-499 ports	+ 500 ports
UK	12%	7%	5%	4%
France	12%	15%	13%	14%

Table 5 : Annual PABX market in UK and France

If the annual overall market represents 11% of the installed base in UK and 13% in France, all the capacity segments are not equally involved.

PART 1

RESULTS OF THE TECHNICAL SURVEY

1 ADMINISTRATIONS AND NATIONAL OPERATING COMPANIES

The Table below summarizes the situation concerning the provision of PABX to day.

	France	Germany	Italy	UK	The Netherlands (1)
SUPPLY	(2)				
INSTALLATION					
MAINTENANCE			(3)		

(1) Deregulation after 1.1.1989
(2) Open for KTS
(3) Since March 1987

LEGEND

PTT and private suppliers compete

Private suppliers only

PTT only

TABLE 6: PABX SUPPLY CONDITIONS

91C8608/30/G.LE/T17

The PTT's are clearly in a phase of elaboration of their own position on ISPABX.It is evident for them that it will be advantageous for the users to achieve interchangeability of terminals between public and private networks.

FRANCE TELECOM has never issued recommendations on wiring so far.However a working group has been set up with the installers to specify subscriber premise installation in the ISDN environment.

In parallel a measuring tool which could test the quality of cable transmission is under specification.

The position on agreement of ISPABX is under discussion.It is however generally assumed that an ISPABX will have to provide the analog and the S interfaces on the private side.A proprietary interface will be accepted as an option.For long loop length,a transmission on 2 wires will be possible if it is terminating on a NT providing a S interface.

The **GERMAN PTT** impose specifications issued by FTZ and VDE (Association of German Electrical Engineers) on cables and wires

However the interface on the private side of the PABX is not imposed.

SIP carries out acceptance tests before connection of a PABX to the public network on the basis of technical recommendations issued by CEI (Comitato Electrotecnico Italiano).These recommendations are rewieved and,if necessary, up dated by a working group composed of CEI,SIP and manufacturers.

The PABX shall only guarantee that any connected terminal shall be able to access any ISDN service.

BRITISH TELECOM issue recommendations for in house wiring.
However BT has no position on the private interface provided by PABX.

Available information is presented below in Tables dealing successively with :

- recommendations on wiring (Table 7)
- ISDN introduction (Table 8)

Besides the spread of characteristics of cables used in building wiring, it is interesting to note that two countries at least (Germany and The Netherlands) are making a wide use of solderless main distribution frames (MDF). Soldering or wrapping can generate impairments in transmission of digital signals whereas on the other hand modern type MDF can handle high frequency signals.

Transmission at very high frequency requires of course special care such as screened jumpers and connection of the screens to the same earth reference. For ISDN bit rates, this will not be required. However, such a type of MDF will provide dependable circuit separation.

	France (1)	Germany	Italy	UK	The Netherlands (2)
Gauge (mm)	0,5, 0,6 or 0,9	0,6	0,6	0,5, 0,6 or 0,9	0,5
Insulation	PVC	PVC	PVC	PVC	PVC
Loop resistance (Ohm/Km)	0,5 192 0,6 133 0,9 59	130	150	196 136 59	
Conductor resistance (ohm/Km)	0,5 0,6 0,9			98 68 30	93
Insulation resistance M Ohm.Km/20°C	500	150	10	50	5000
Mutual capacitance nF/Km (Khz)	160	52		100	40
Capacity unbalance for 500m (Pf)	400			300	250
MDF type		Solderless since 1970			Solderless
Number of pairs of cables		Star quad cable		1 pair cable available	2 pairs + 1 earth wire
Specification	Cable type SYT1	VDE 0815 I-2Y	Issued by CEI	CW 1293 (3)	Norm 88

Table 7 : National recommendations or typical characteristics of building wiring

(1) France Telecom does not issue recommendations. Specifications of a widely used cable (SYT 1) are given as an example.

(2) Information available on the Netherlands is included to give an example outside the four largest countries.

(3) The cable BT Spec CW 1308 used widely by private installers has specifications similar to 0,5 gauge CW 1293 cable.

	FRANCE	GERMANY	ITALY	UK
Pilot test	1987 (Renan)	1986 Stuttgart-Manheim 400 subscribers each	1989 (pre pilot) 1990-91	IDA service (80 Kbps) since 1985 basic access test : oct 1988
Commercial Opening	since dec 87 Connection of PABX in 1989	1988 (services phase 1) (Munich-Stuttgart- Berlin-Hanover Hamburg-Frankfort Nuremberg Dusseldorf)	1992	
Number of subscribers (basic access)	1988 :600 1992 : 150000 1995 : 700000	1995 : 1 000 000	1990 : 5000	

Table 8 : ISDN Introduction

2 - MANUFACTURERS

The information provided by the manufacturers is summarized in the following Tables. We considered digital PABX only. Most of them use pulse code modulation of the speech and data signals. Not all of them will be upgraded for ISDN purposes. The marketing policy of a manufacturer may be to replace an existing model by a new advance feature model.

The following characteristics,structure and design are common to almost all the systems.

Digital PABXs are made of the following functionnal components :

- switching matrix
- peripheral interfaces
- control system
- servers for specific applications.

Control is usually performed by a decentralized, hierarchically structured microprocessor architecture.

The switching matrix can be expanded by the addition of cards or modules and is often non blocking.

Peripheral interfaces can be either dedicated to trunk lines or terminal equipments. The capacity of a PABX is therefore dependent on traffic and the number of extensions given in the following tables is given for information only.

Distributed systems can be configured in the majority of the cases by utilising remote extension units connected via 2 Mbps PCM links. This distributed architecture can connect remote terminals and telephone sets on distant modules : in this way,the average line length of connection cables can but decrease.

Integrated or separated servers and adapters give access to additional functions such as protocol conversions, access to LAN. PABX provide interfaces for analog or digital connections of telephone sets. Non ISDN data terminals can be connected through a Terminal Adaptor (TA) or via a digital telephone set with an integrated TA. Data rate adoption is usually performed according to ECMA 102/V110.

The description of the various interfaces is given in the following Tables.

We dealt mainly with large PABXs having a capacity larger than 2000 ports. These PABXs are supposed to be the first to fully support all the interfaces of ISDN.

However PTT are expecting that in very small sites a specific demand will appear for low capacity PABX. This type of system will be in competition with direct basic accesses on the public network. Its success will be linked to its price level and service features. Such systems are provided in France following a call for tender by France Telecom and in Germany for the ISDN pilot tests. The characteristics of the first generation equipments in France appear below :

Interfaces	T Interfaces	S Interfaces	Analog Interfaces	V24/V28
Star NT	2 to 8	6 to 24	0 to 24	
Hybrid NT	4	16	32	16

TABLE 9 : FRANCE

	ALCATEL	JEUMONT-SCHNEIDER	IBM	MATRA	SAT	NORTHERN TELECOM
PABX RANGE	TELIC 1600 2800 OPUS 40-80 300-4000	JISTEL 250/500 JISTEL 6000 (IS)	8750 1650.9750	MATRACOM 65x0 DIGIMAT 55x0	TELCOM 100 320	MERIDIAN SL 1
MAX CAPACITY (ports)	TELIC : 4000 OPUS 8000	10000	20000	8000	6000	8500
COMMENTS	Protocol conversion provided by a specific gateway	Networking via a gateway on T7 interface		Modules on fibre optic loop connection	Data traffic handled by separate module	Star with remote units
INTERFACES	TELIC : 3 x 64 kbps (2 digital tel sets T261 + asyn term or 3 asyn term) OPUS :digital tel + asyn term.	T4 analog tel + asyn term T5 asyn or syn T7 syn 64 kbps	ROLMLINK 3 x 64 kbps ROLMPHONE (incl. V24)		65 R 68 R	ADM Digital tel + asyn or syn term. AIM : asyn term ASIM : asyn or syn term Digital featurephone
NUMBER OF WIRES RANGE	2 wires, 800 m (4 wires if 4020 multiservice terminal used)	2 wires, 600 m U burst method	2 wires, 1,2 Km	4 wires, 1,5 km	4 wires	2 wires, 1,2 Km
EVOLUTIONS	S2 Supports lap D (ISPN)	Digital telephone set T 144				Basic and primary rate trials in 89

TABLE 10 : GERMANY

	NIXDORF	SIEMENS	TELENORMA
PABX RANGE	System 8818	HICOM	INTEGRAL 222 333
MAX CAPACITY (ports)	3000	1600	1000
COMMENTS	Specific applications provided by servers (88 X 0)	Features provided by integrated servers	Servers for non voice communication
INTERFACES	TA Dig. set. Digiform Workstation BTO1	CTE Multiterminal 3510 Digital set	Integral adapter TX93 telephone set TX90 workstation
NUMBER OF WIRES RANGE	2 wires, 2 Km 4 wires, 0,8 km	2 wires, 3 Km 4 wires, 1 Km	2 wires, 1,8 Km 4 wires, 0,6 Km
EVOLUTIONS	Integration of broadband		Transmission of full motion picture

TABLE 11 : ITALY

	DIAL	FACE	FATME	ITALTEL	SIEMENS	TELETTRA
PABX RANGE	TELIC OPUS (see ALCATEL)	BCS 5100 5200	MD110 (see Ericsson)	OFFICE 1000 5000 10000	OMNI	TAU-SDN
MAX CAPACITY (ports)		5000		3000	2000	2000
COMMENTS				Star with remote units	Bus architecture	
INTERFACES				Digital telephone sets : TDI1 TDI Plus	Omni T TA	TA
NUMBER OF WIRES RANGE				2 wires, 1,5 Km	2 wires, 1,7 Km	4 wires
EVOLUTIONS				ISDN PABX : DAWN Support of So		

TABLE 12 : NETHERLANDS / SWEDEN

	ERICSSON	PHILIPS
PABX RANGE	MD 110 (BCS 150)	SOPHO - S
CAPACITY (ports)	10000	2000
DESCRIPTION	Distributed architecture Integrated gateway to LAN	Distributed architecture with multisite networking
INTERFACES	Digital set (Diavox Courier) TAU-T (asyn or syn) TAU - S (asyn or syn) TAU-PC (asyn)	LAM 308(2 x V 24) and 309 Digital set (Sopho set)
NUMBER OF WIRES RANGE	2 wires, 1 Km burst method	2 wires, 2 Km Us echo cancelling
EVOLUTIONS	DPNSS/DASS 2 available	DPNSS/DASS 2 available

TABLE 13 - UNITED KINGDOM

	GEC	MITEL	PLESSEY
PABX RANGE	ISLX BTEX Monarch, Lyric	SX 2000	ISDX CDSS
CAPACITY (ports)	5000	2500	2400
DESCRIPTION	non blocking switch Support DASS2/DPNSS	Non blocking switch Support DPNSS	Support DPNSS/ DASS2
INTERFACES	DTA (asyn or syn term) IDC (asyn) 256 Kbps UIDC (2 asyn or syn term) dig. set : S link 300 and 400	Dataset (asyn or syn term) Digital set : Super set 3 and 4 DN	Digital set ISDT (+ asyn or syn term)
NUMBER OF WIRES RANGE	2 wires, 1,5 Km (UIDC) burst method	2 wires, 4 Km echo cancellation	2 wires
EVOLUTIONS			Specialised terminals

PART 2

RESULTS OF THE FIELD SURVEY

During the field survey national questionnaires were used. They are found in volume 2/Appendices.

The results of the 40 questions have been consolidated on five majors topics :

1 - ESTABLISHMENT CHARACTERISTICS

2 - PABX

2.1 Type of PABX
2.2 Date of installation
2.3 Intention to install a digital PABX
2.4 Number of telephone sets connected to the PABX
2.5 Distant PABX
2.6 Data analysis

3 - WIRING

3.1 Date of installation
3.2 Number of wires
3.3 Usage of special cables
3.4 Modification and extension of existing wiring
3.5 Number of distribution frames
3.6 Distance from PABX to telephone sets
3.7 Data analysis

4 - TERMINAL AND EDP EQUIPMENTS

4.1 Impact of establishment size
4.2 Telephone sets with extra functions
4.3 Telematic terminals
4.4 EDP equipments

5 - NETWORKING

5.1 Knowledge of ISDN
5.2 Detailed analysis of service and network use

1 - ESTABLISHMENT CHARACTERISTICS

In this study, "establishment" has an economic meaning. An establishment is a set of estalishments located at the same geographical location (usually a square).A firm or a company or an enterprise can be composed of one or several establishments.

The number of establishments of the four countries : France, Germany, Italy, United Kingdom is given in Table 14.

COUNTRY	FRANCE	GERMANY	ITALY	UK	TOTAL
Establ.	48531	53390	33750	57584	193255

Table 14 : Number of establishments of more than 50 employees equipped with a PABX

Among the universe of establishments of 50 or more employees equipped with a PABX, 80 % have 50 to 199 employees, 14 % between 200 and 499 and 6 % have more than 500 employees.(Figure 4)

Industry and Construction Sector has the largest number of establishments and represents 41 % of the establishments while the Services Sector represents 33 %. The third Sector concerning Administration and Public Services includes 26 % of the establishments (Figure 5).

The complete distribution is given in Table 15.

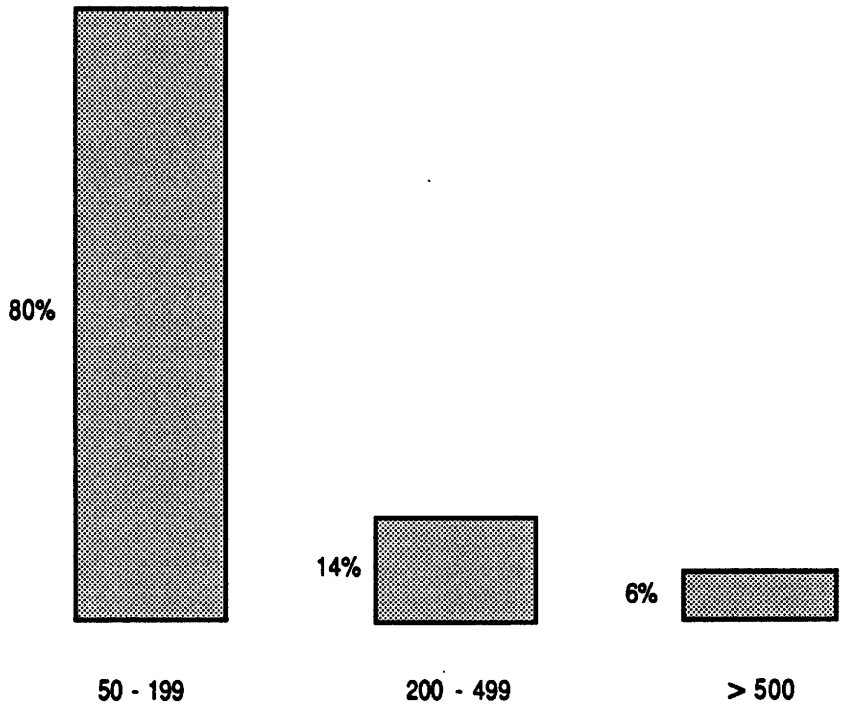

Fig.4 DISTRIBUTION OF THE ESTABLISHMENTS ACCORDING TO THEIR SIZE

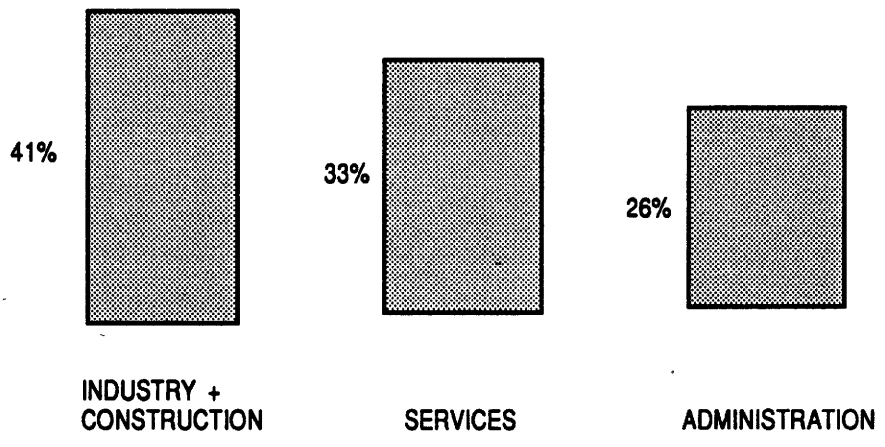

Fig.5 DISTRIBUTION OF THE ESTABLISHMENTS ACCORDING TO THE SECTOR

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SECTOR / SIZE	INDUSTRY	SERVICES	GOVERNM.	TOTAL
50-199	59673	52276	42910	154859
200-499	12926	7919	5635	26480
+ 500	5913	3897	2146	11916
TOTAL	78512	64092	50651	193255

Table 15 : Number of establishments according to sectors and sizes.

The average size of establishments in Industry is bigger than in the other sectors. In Industry, 76 % of the establishments have between 50 and 199 employees against 82 % in the Services Sector and 85 % in the Administration/Government

Table 16 lists all the sectors which have been considered.Reasons for excluding a sector are : small size of establishments (agriculture,forestry,fishing,domestic services) ; difficulties of interviews (diplomatic representations and police/army) ; high specificity (post office/telecommunications).

Table16 : Detailed sectors

- Industry
  Manufacturing and process industry (except publishing and press)

- Services
  - Retail and wholesale
  - Mail order
  - Hotels/cafes/restaurants/catering
  - Transports
  - Travel Agents
  - Holdings
  - Consultancy
  - Insurance companies
  - Estate agents
  - Health services (including public)
  - Recreation/cultural and Sports firms and organisations
  - Personal services (Hairdressers/dry cleaners).
  - Bank, Finance, rental companies.
  - Engineering
  - Software/DP and research firms
  - TV and radio broadcasting
  - Publishing and Press

- Government/Public Services
  - Teaching (including private)
  - Government services
  - Administration/Civil service
  - Social Security
  - Associations/Clubs (library, sports club,...)
  - Trade unions
  - Tourist office
  - Religious/Philosophical organisations
    All companies depending on state management or finance.

- Sectors excluded
  - Agriculture - Forestry - Fishing
  - Domestic services
  - Post Office/Telecommunications
  - Police/army
  - Foreign diplomatic representations.

The existence of other establishments belonging to the same company in the country concerns 57 % of the establishments of more than 50 employees. Figure 6 gives the repartition of the number of establishments.

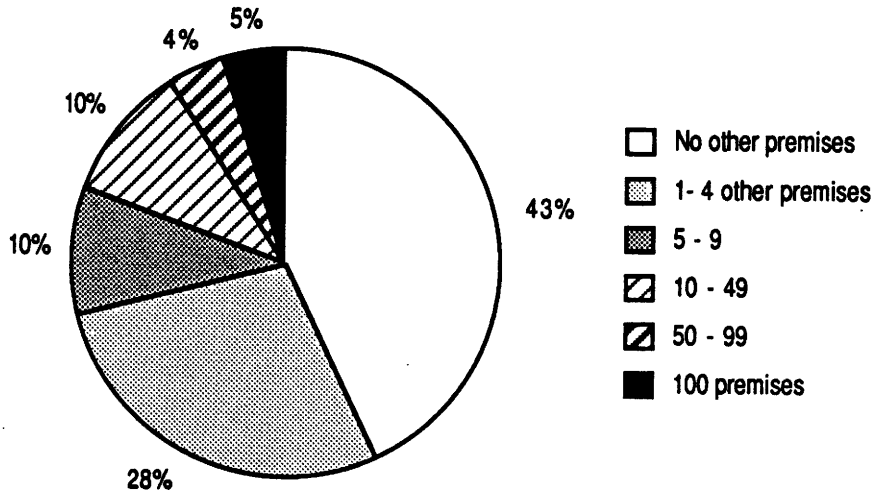

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Figure 6 : repartition of the number of establishments of the company (in % of establishments).

A quarter of the establishments (26 %) have subsidiaries in foreign countries and 12 % have their headquarter in foreign countries. These two characteristics occur more often in the largest establishments (Figure 7) and less often for the Administration and Government.

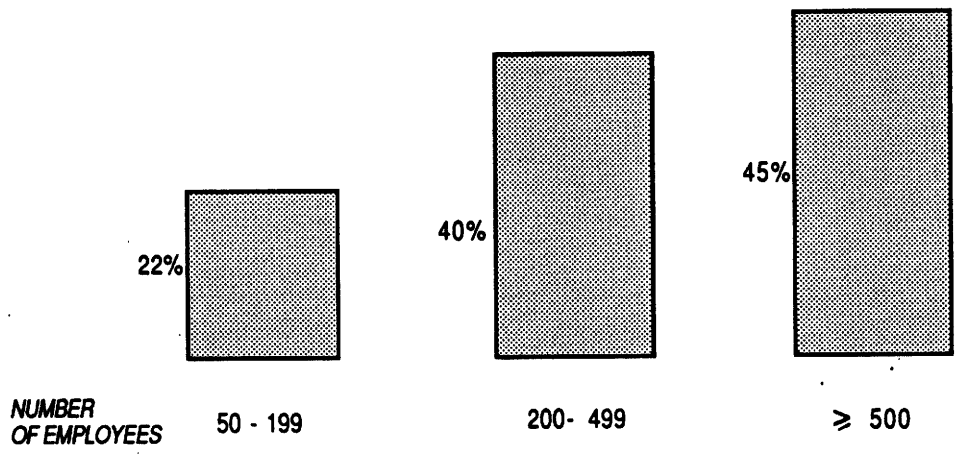


Figure 7 PERCENTAGE OF ESTABLISHMENTS HAVING SUBSIDIARIES ABROAD ACCORDING TO THEIR SIZE

Finally the annual telecommunications expenditure is an interesting indicator of the level of equipment and need for telecommunications as it will be seen in the different analysis.It is of course closely related to the size of establishment.

20 % of the establishments spend less than 100 000 francs per annum on telecommunications whilst 14 % spends more than one million. Besides the number of employees of the establishments, this expenditure increases with the existence of subsidiaries or headquarter in foreign countries and with the number of executives and managers.

The expenditure is higher in the Services Sector where 23 % of the establishments spend annually more than one million on telecommunications (the average percentage is only 14% for the total universe).

2 - PABX

The characteristics of installed PABX are of prime importance where the introduction of ISDN is concerned. The type of PABX and the intention to install a digital PABX give indications on the potential market for ISPABX and the pace of evolution in the future.

Several questions of the survey concern the PABX equipment and its evolution.

A distinction was made between SPC and electromechanical PABX. Inside SPC PABX, time division digital PABX (also called digital PABX in this subsection) using PCM transmission were taken apart from the other electronic PABX (space division, PAM transmission, ...).

Various cross tabulations have been considered. The most significant are obtained with the following characteristics of the establishment: country, economic sector, size, annual telecommunication expenditure, headquarter or subsidiaries in foreign countries.

2.1 - TYPE OF PABX

2.1.1 - Impact of the country

The percentage of establishments equipped with a time division digital PABX varies from one country to an other (see Figure8).

UK is ahead of the four countries with 52% of the establishments.

The percentage is similar in Germany and Italy (18 %) but the German installed base is 1,5 times greater than the Italian. It is noticeable that, in Germany, the number of time division PABX is scarcely greater than the number of electromechanical PABX.

Figure8 ***TYPE OF PABX PER COUNTRY***

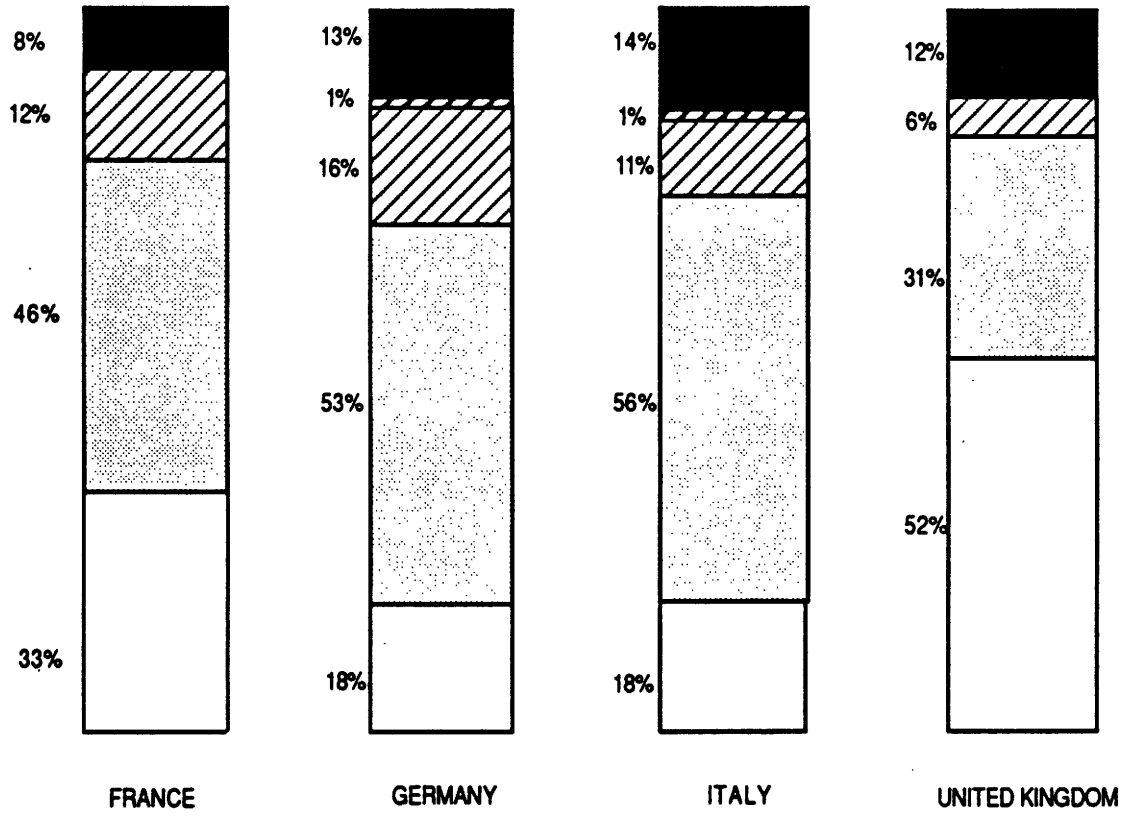
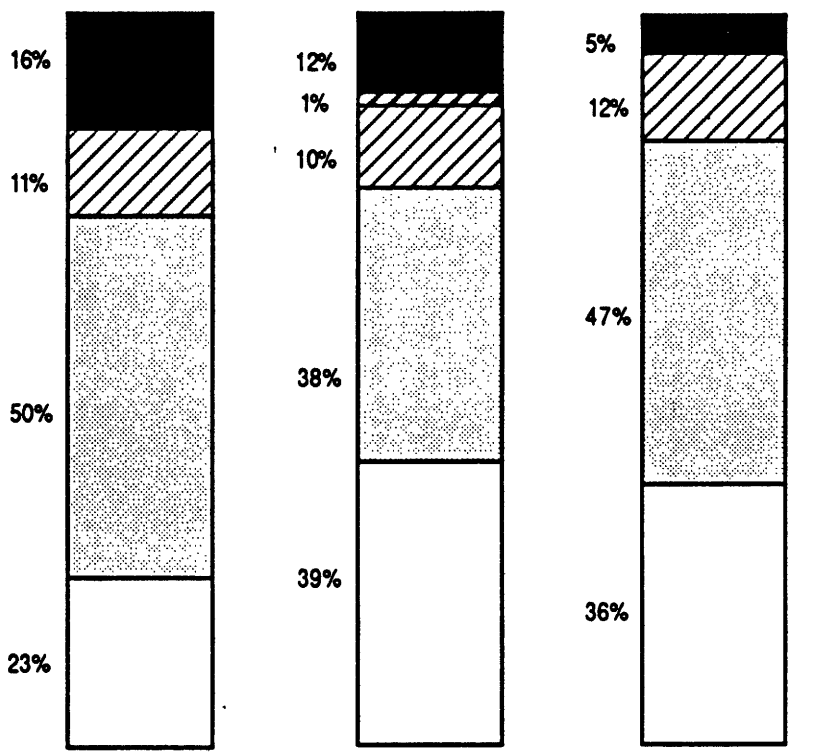


Figure 9 ***TYPE OF PABX BY SECTOR***



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2.1.2 - Impact of economic sector and employee size class

There is a clear difference between the Service Sector where 39% of the establishments are equipped with a time division digital PABX and the two others sectors: a still important base of crossbar PABX exists in the Industry/Construction Sector and the Government/Public Services.

Figure 9 shows the complete distribution of installations by sectors.

Figure 10 gives the type of installed PABX per employee size class.

- The size class 50-199 employees represents 87 % of the total number of PABX. 13% of the establishments do not know the type of PABX.

  They have relatively less time division digital PABX than the other classes (only 30% in their size class) but it represents nevertheless 72% of all installed base! The percentage of establishments equipped with electronic PABX is high (48%) leaving less than 10% of establishments with crossbar PABX.

- The size class 200-499 has almost the same proportion of time division digital PABX than electronic PABX.

- **The size class 500 or more employees has at the same time the largest percentage of crossbar systems and time division PABX.** This can be explained by the fact that the large establishments were among the first ones to be equipped with a PABX many years ago and that some of them have not felt the need to replace it yet.

The knowledge within a company about its telecommunications equipment increases with the size of the company : as it can be noticed on Figure 10, the percentage of "do not know" decreases when the size of the establishment increases.It is mainly due to the fact that there is a manager specialized in telecommunications in medium to large companies whereas this is not true in small to medium enterprises.

As the annual telecommunication expenditure is closely related to the size of the establishment, it is not surprising to find that when this expenditure grows, the percentage of establishments equipped with a time division digital PABX also grows. (Figure 11)

This is also noticeable if the establishment belongs to an international group :

- if the establishments have subsidiaries in foreign countries, 33% are equipped with time division digital PABX (25% in the other case) ;

- if the establishments have an headquarter in a foreign country the percentage increases to 52% (30% in the other case).

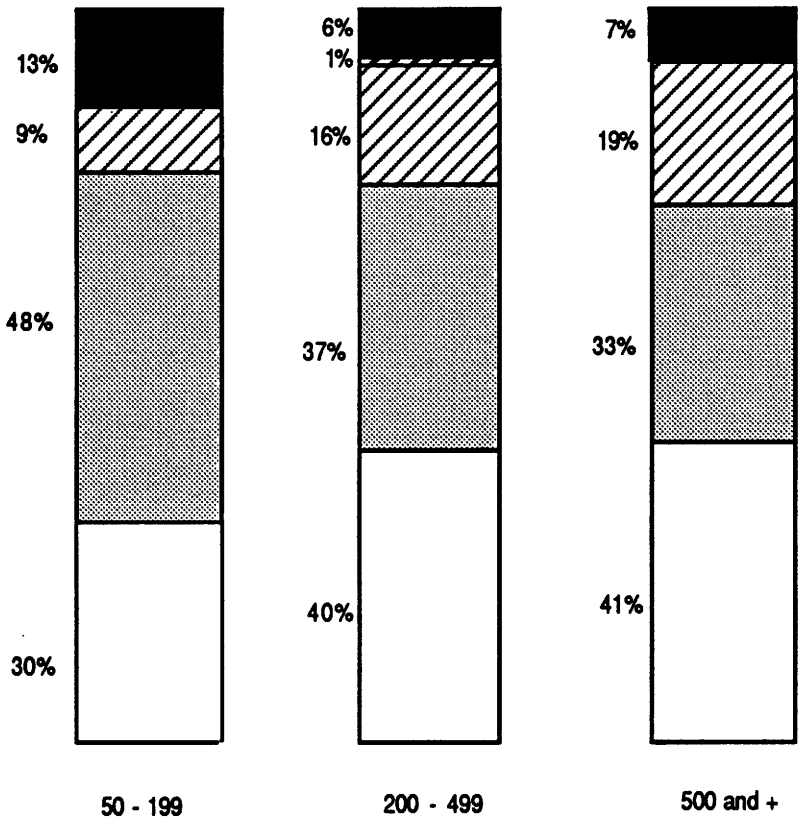

Fig.10 TYPE OF PABX PER SIZE CLASS

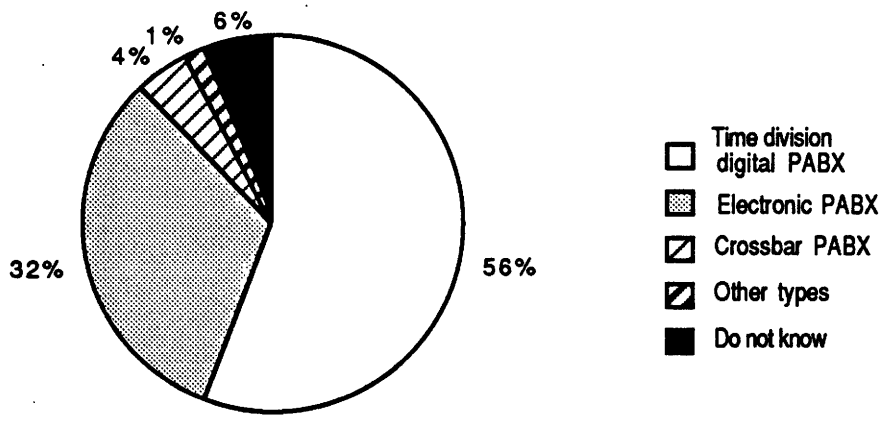

Fig.11 DISTRIBUTION OF PABX ACCORDING TO THE TECHNOLOGY IN ESTABLISHMENTS WITH AN ANNUAL TELECOM EXPENDITURE HIGHER THAN 5 MILLIONS FF

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2.2 - DATE OF INSTALLATION

This indicator is very important as it shows the importance given by enterprises to telecommunication investments.

Over more than 11% of the establishment have changed their PABX less than one year ago (Figure 12). This indication is in line with market surveys showing that the annual renewal market represents 10 to 15% of the installed base in number of extension lines.

It is interesting to note that almost **half of the PABX sold last year are electronic non time division PABX** (See figure 13).

During the past one to five years, 55% of PABX have been installed. Out of these 55 %, 4% are still electromechanical. Part of the PABX installed in the past five to ten years have already been replaced as their number represents only 21% of the total. This corresponds to the estimated average life time of a PABX (about 8 years in France). There is a majority of electronic PABX in this age class.

PABX older than 10 years represent 11% of the installed base which nearly corresponds to the replacement market of last year.

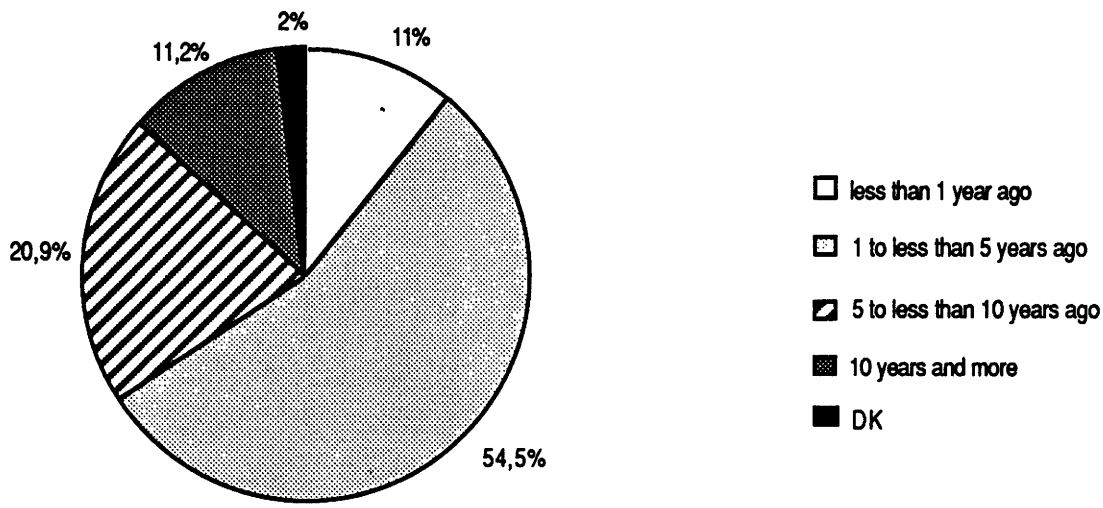
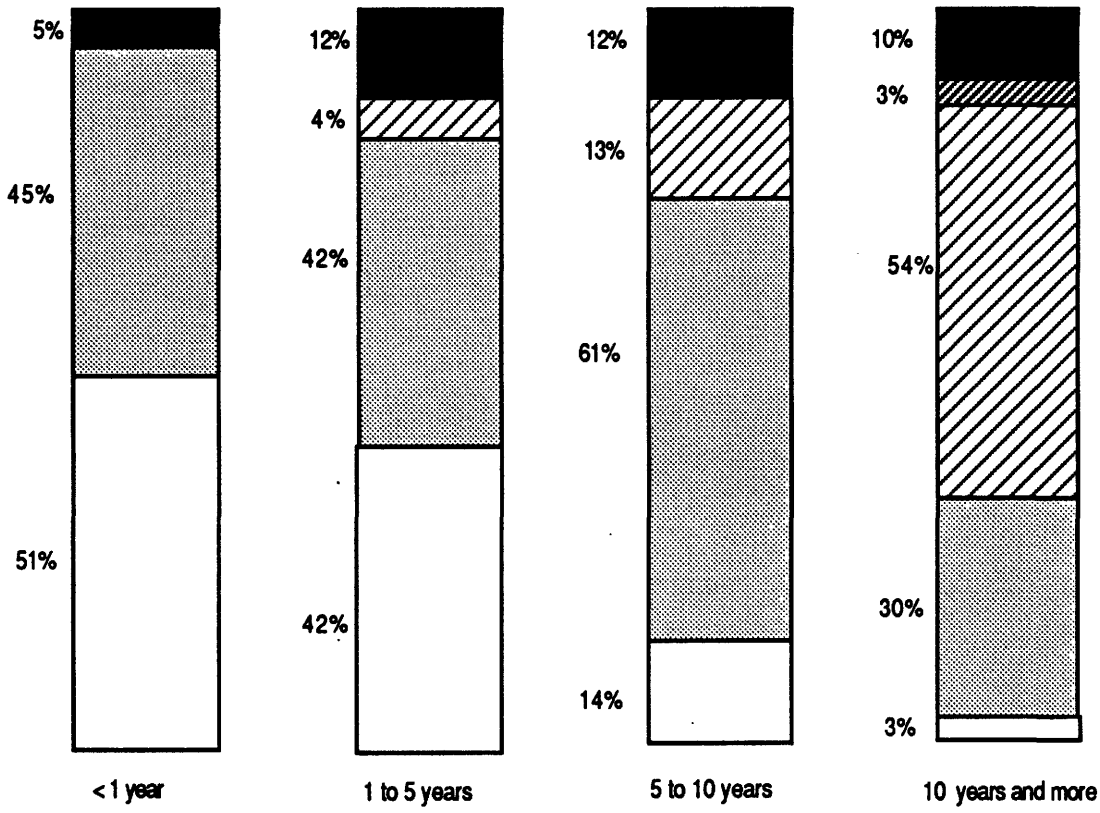
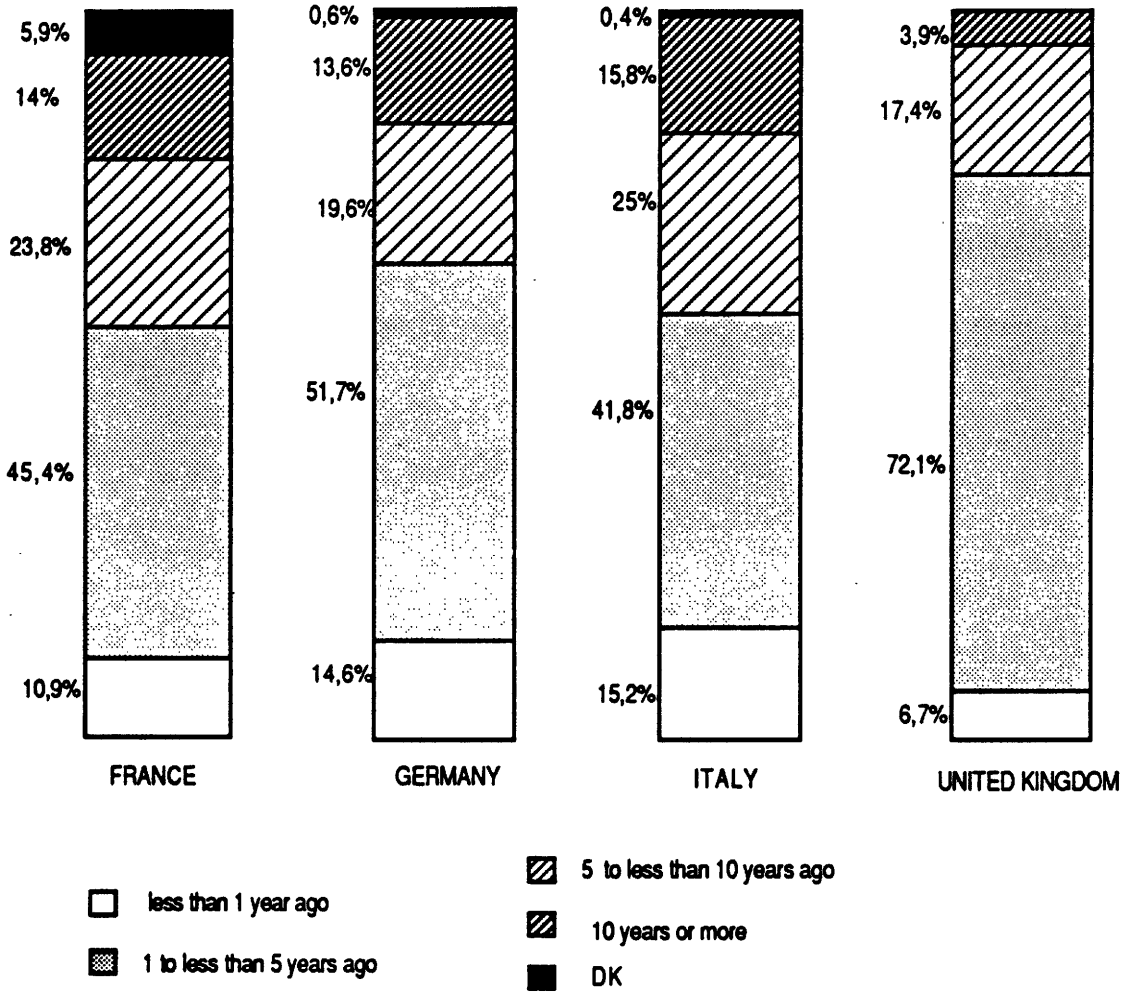


Figure 12 *DISTRIBUTION OF PABX ACCORDING TO THE DATE OF INSTALLATION*



TYPE OF PABX PER DATE OF INSTALLATION



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DATE OF INSTALLATION OF THE PABX BY COUNTRY

2.2.1 - Impact of the country

There are sharp distinctions between the four country bases (Figure 14)

- UK saw huge new installations during the past one to five years (72% of PABX). Few have been installed last year (7 %). Less than 4% of PABX have more than 10 years.

- Italy has an old base (40% of PABX have more than 5 years) but has a very active market (15% of installations last year).

- Germany has a young PABX base (66% less than 5 years) but many new installations are not made with time division PABX.

- France has a rather old base and a low replacement market.

2.2.2 - Impact of the economic sector

As it can be deduced from the type of PABX, it is not surprising to find an active market in Services (13% of PABX have less than one year) and in the 200-499 employees size class (13,2%).

The Government / Public Services Sector has a high percentage of old PABX (16%) together with 500 or more employee size class (19%).

2.3 - INTENTION TO INSTALL A DIGITAL PABX

Not very surprisingly, **a high percentage of owners of crossbar PABX are willing to install a digital PABX within the next three years (37 %).**

For establishments equipped with electronic PABX, the percentage falls to 8 % only.

2.3.1 - Impact of the country

The results to this question are in accordance with the installed base :

- the lowest percentage of positive intention is obtained in UK (8 %) which has already the largest installed base.
- the highest percentage of "yes" is found in Germany (12 %) with at the same time a high 68 % of "no". There is a specific position in Germany if we remember that 70 % of the establishments have a PABX which is not time division digital.
- Italy has the second largest percentage of "yes" (11 %).There is a high percentage of "don't know" (55 %). This shows either hesitation, or a lack of information on digital PABX and associated services.

2.3.2 - Impact of economic sector and size class

The trends appearing in the installed base are confirmed here :

- a high percentage of "yes" in the Service Sector (13 %)
- the lowest percentage of "yes" in the Government / Public Services (6 %) where telecommunication investments may not be considered of high priority.

The intention to install a digital PABX is growing with the size while, at the same time, the percentage of "don't know" is decreasing.

Table 17 : Intention to install a time division PABX
(percentage of establishments per category)

COUNTRY	FRANCE	GERMANY	ITALY	UK
	9 %	12 %	11 %	8 %

SECTOR	INDUSTRY	SERVICES	GOVERNMENT
	10 %	13 %	6 %

SIZE	50 - 199	200 - 499	500 or More
	8 %	11 %	21 %

However for establishments with more than 500 employees, if we compare the percentage of PABX installed last year (10 %) with the intention to buy a digital PABX in the next few years (21 %), we can conclude that they are waiting for evolutions in the telecommunication environment such as new ISPABX or public ISDN service opening.

2.4 - NUMBER OF TELEPHONE SETS CONNECTED TO THE PABX

2.4.1 - Impact of the country

The distribution of establishments according to the number of connected telephone sets appears below (Table 18) :

less than 20 sets	20 - 49	50 - 99	100 - 199	200 or more
13 %	26 %	28 %	20 %	13 %

However, there are important differences between one country and an other : the smallest average number of sets per establishment is found in Italy (82) and the largest in Germany (157).

The national characteristics are illustrated in figure 15 : for example they are fewer small PABX (less than 20 telephone sets) in Germany compared with Italy for example.

Large PABX (100 extensions or more) represents 43 % of the base in Germany, 39 % in UK but only 26 % in France or 21 % in Italy.

The national average number of telephone sets connected on a PABX is :

France : 99 ; Germany : 157 ; Italy : 82 ; UK : 138

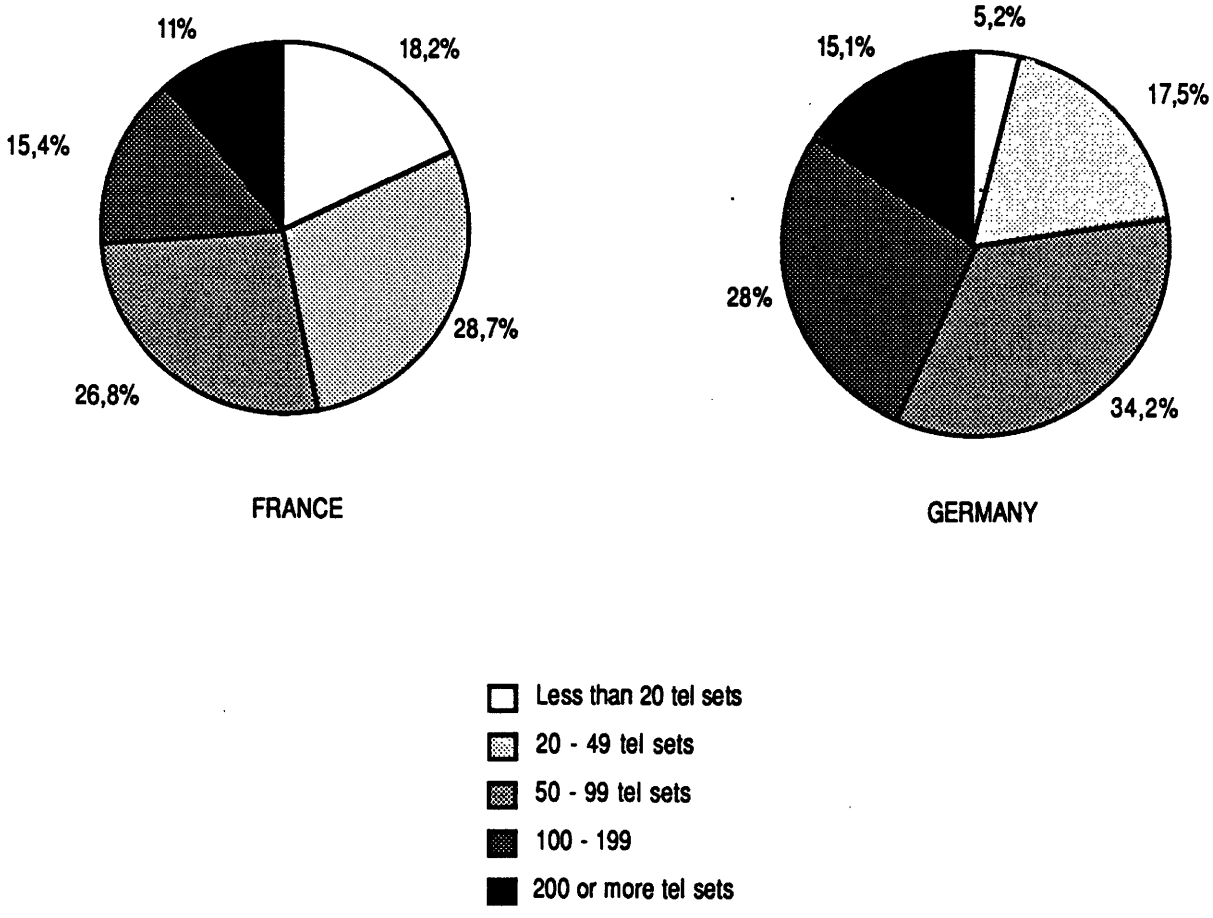

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Figure 15 : Distribution of PABX base according to the capacity

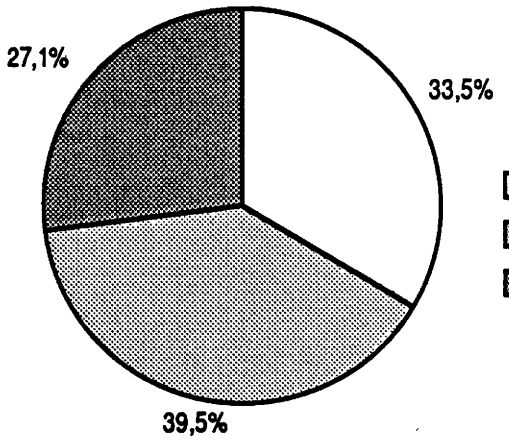
2.4.2 - Impact of size and sector

If we consider the size of establishments, we have the following distribution where we can notice that more than 50 % of the telephone sets are located in the size class 50-199 employees :

Size (employees)	50-199	200-499	500 or more
Average number of sets connected per PABX	79	172	595
% of total number of sets found in the size class	51 %	19 %	30 %

Table 19 : Impact of size

Each of the three economic sectors represents more or less one third of the installed base (number of PABX and telephone sets : Figure 16) ; however the average number of telephone sets per establishment is higher in the Service Sector (144) than in the two other sectors (125 for Government, 100 for Industry). In the Industry Sector, the ratio number of telephone sets / number of employees is of course the lowest. It means that although 42 % of the telephone sets are located in establishments of 500 employees or more of the Industry Sector (Figure 17), they are connected to medium capacity PABX.



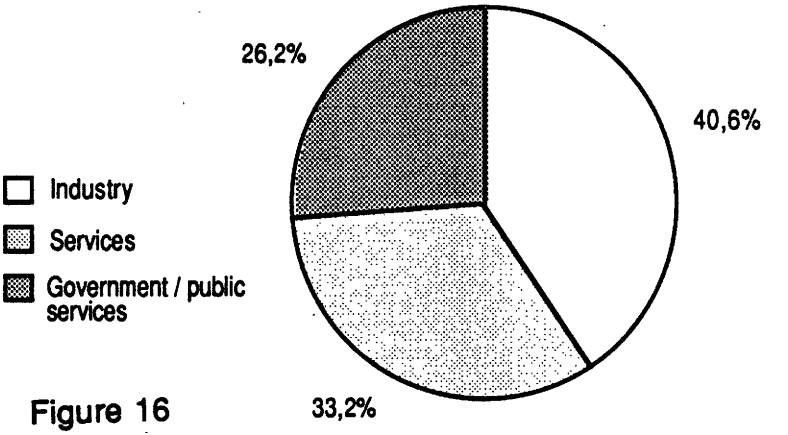


Figure 16

DISTRIBUTION OF CONNECTED TELEPHONE SETS ACCORDING TO THE SECTOR

DISTRIBUTION OF PABX ACCORDING TO THE SECTOR

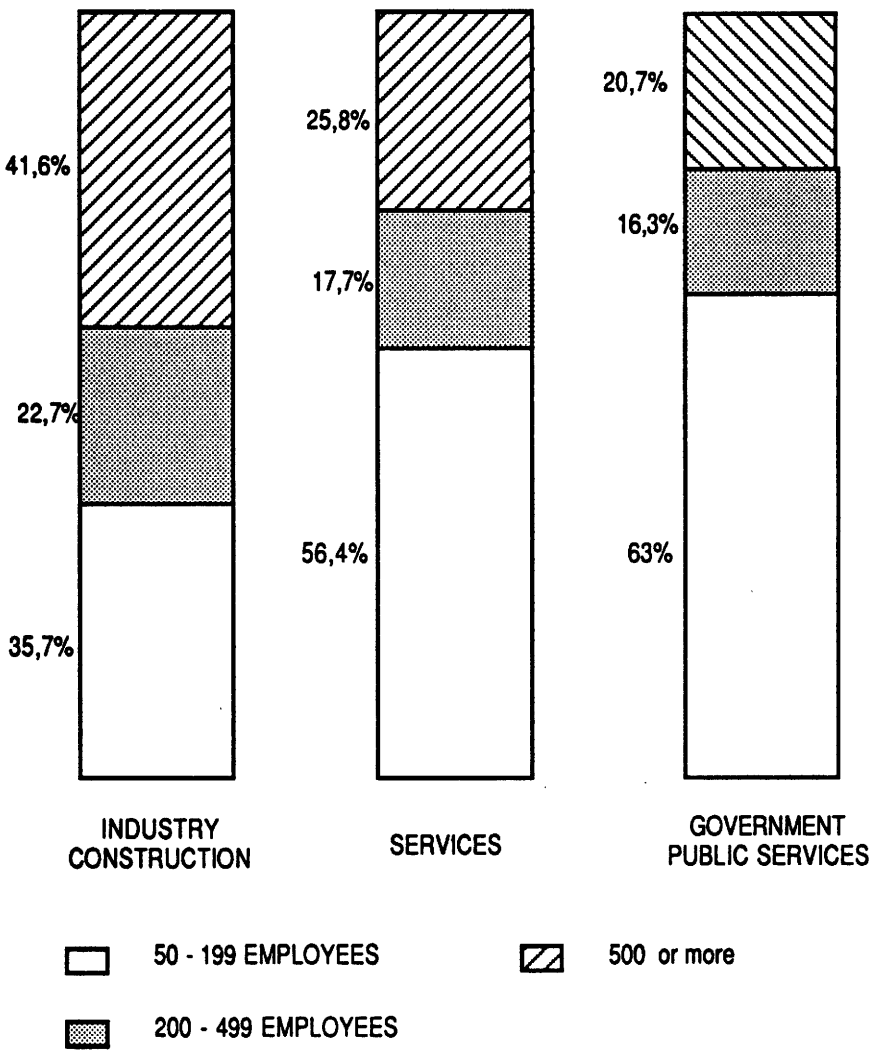


Figure 17 *DISTRIBUTION OF TELEPHONE SETS ACCORDING TO THE SECTOR AND EMPLOYEES SIZE CLASS*

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2. 5 - DISTANT PABX

Some telephone sets can be connected to a PABX which is not located in the same estalishments. This is the case in companies or organizations located in several buildings scattered in a big city. We found that it represents 6 % of the total number of telephone sets or 145 600 extensions. More than half of this figure comes from Germany.

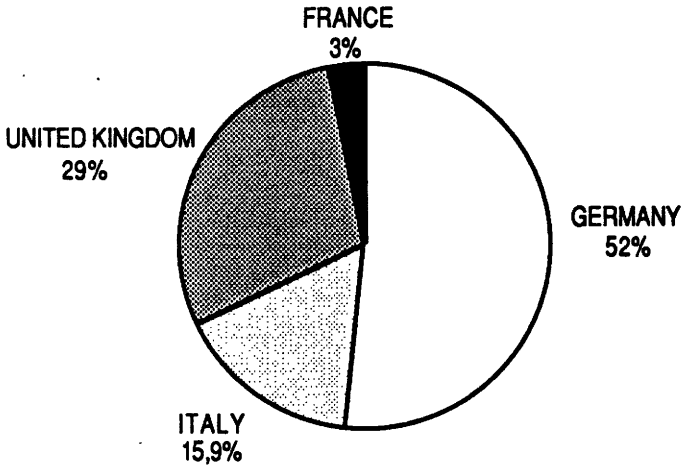

Figure 18 : *DISTRIBUTION OF TELEPHONE SETS CONNECTED TO A DISTANT PABX BY COUNTRY*

This result can be linked to the average capacity of PABX per country. As we saw before, in Germany PABXs are larger ; this means probably that the procurement policy is to buy a unique PABX for a company -let us imagine it is the headquarter- and to connect all the estalishments of the company belonging to the same area to this equipment.

Almost one half of the establishments with this type of connection are equipped with an electronic PABX.

2.6 - DATA ANALYSIS

Data analysis confirms the trends indicated by cross tables. All the information on PABX can be described by two axis : technology and size (Figure 19).

There is an important correlation between the following factors : number of employees, number of telephone sets connected to the PABX, annual telecommunication expenditure, number of floors of the establishment (horizontal axis).

On the other axis, a strong correlation is found between the type of PABX and the date of installation (vertical axis).

Countries are located according to the characteristics of the PABXs installed in their establishments : for example Italy belongs to the upper left quarter of the figure because in this country PABX use to have a medium capacity and to be electronic.

In the same way, establishments are indicated by "clouds" according to their main features : for example installations with more than 500 extensions are located in the upper right quarter of the figure meaning that they are found in large establishments (more than 1000 employees) and are often in crossbar technology.

Four clouds or classes of establishments are defined. The main criterion is the size of establishments. We will find almost the same classes in the various data analysis made in wiring (see § 3.7), number and type of terminals (see § 4.1) and PABX networking (see § 5.1).

The full description of each class will be found in § 5.1 : **this division in classes is of prime importance as each class has a specific approach to ISDN.**

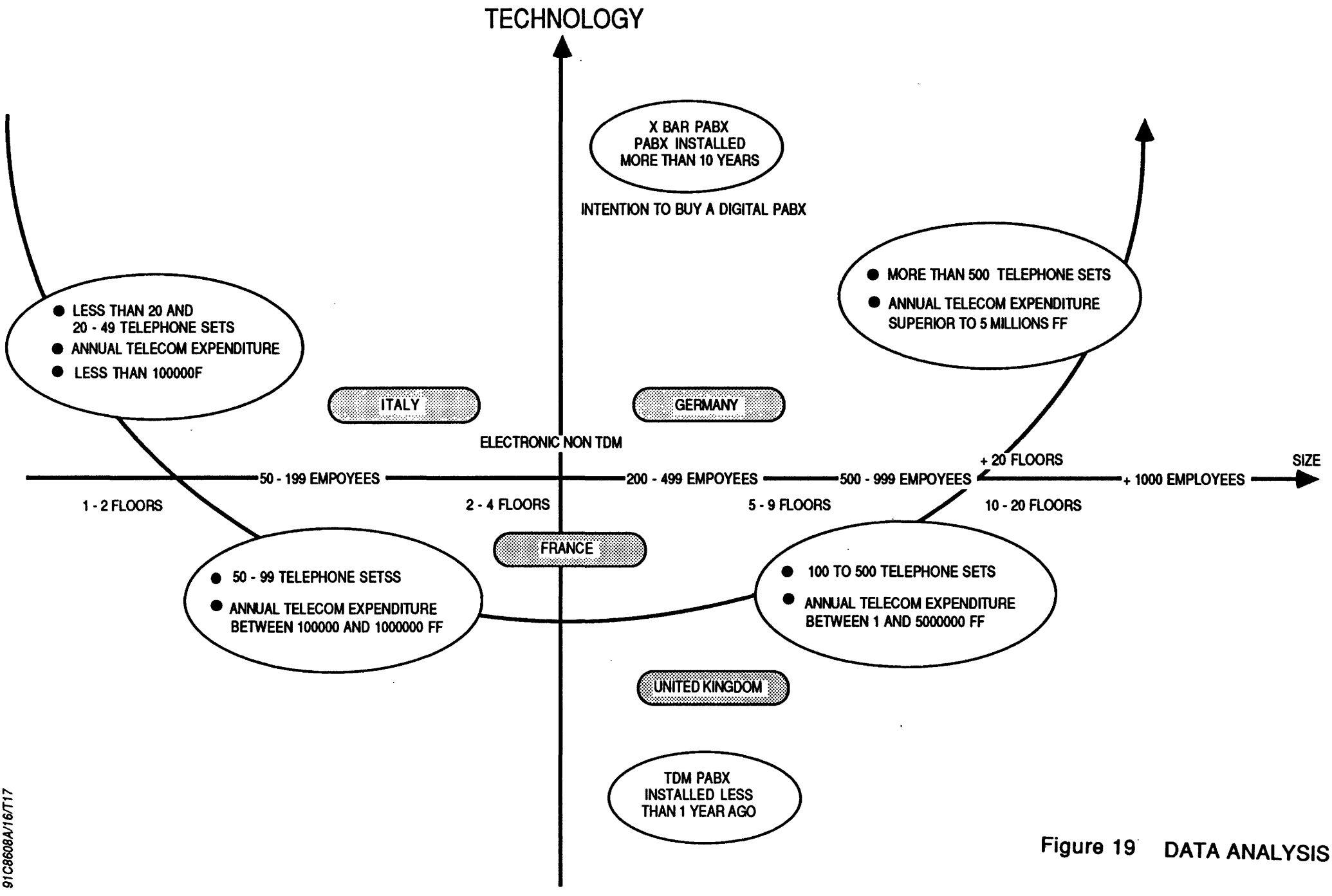

Figure 19 DATA ANALYSIS

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3 - WIRING

3.1 - DATE OF INSTALLATION

3.1.1 - Correlation with the date of installation of the PABX.

There is a very strong correlation between the dates of installation of the PABX and the wiring. It is not possible to assess that both equipments are renewed at the very same time as we used time intervals for the answers ; however we can note that the time intervals are identical for wiring and PABX installation for 74 % of establishments

The wiring installations are older than the PABX as it is shown on figure 20 (compared to figure 12). In particular 20 % of wiring installation (only 11 % for PABX) are more than 10 years old.

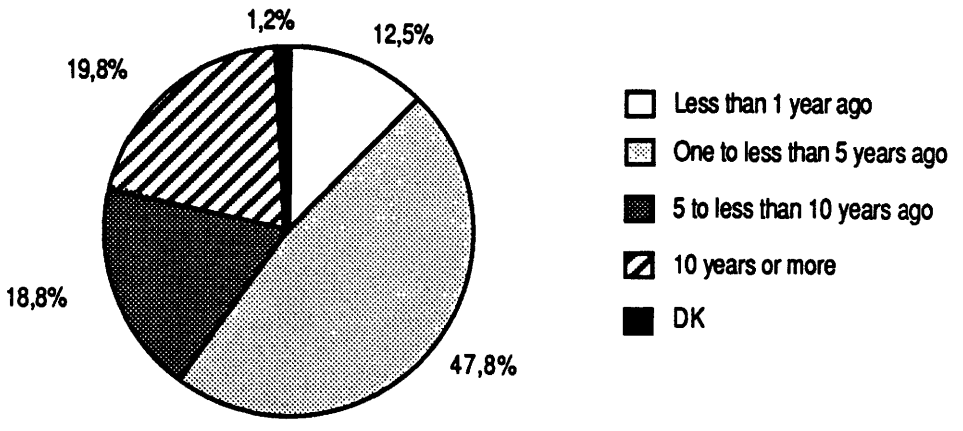


Fig.20 DISTRIBUTION OF WIRING ACCORDING TO THE DATE OF INSTALLATION

Over the last 12 months, 12 % of wiring installations (11 % of PABX) have been renewed. Among these 12 % of new installations 60 % have been made as the PABX was changed.

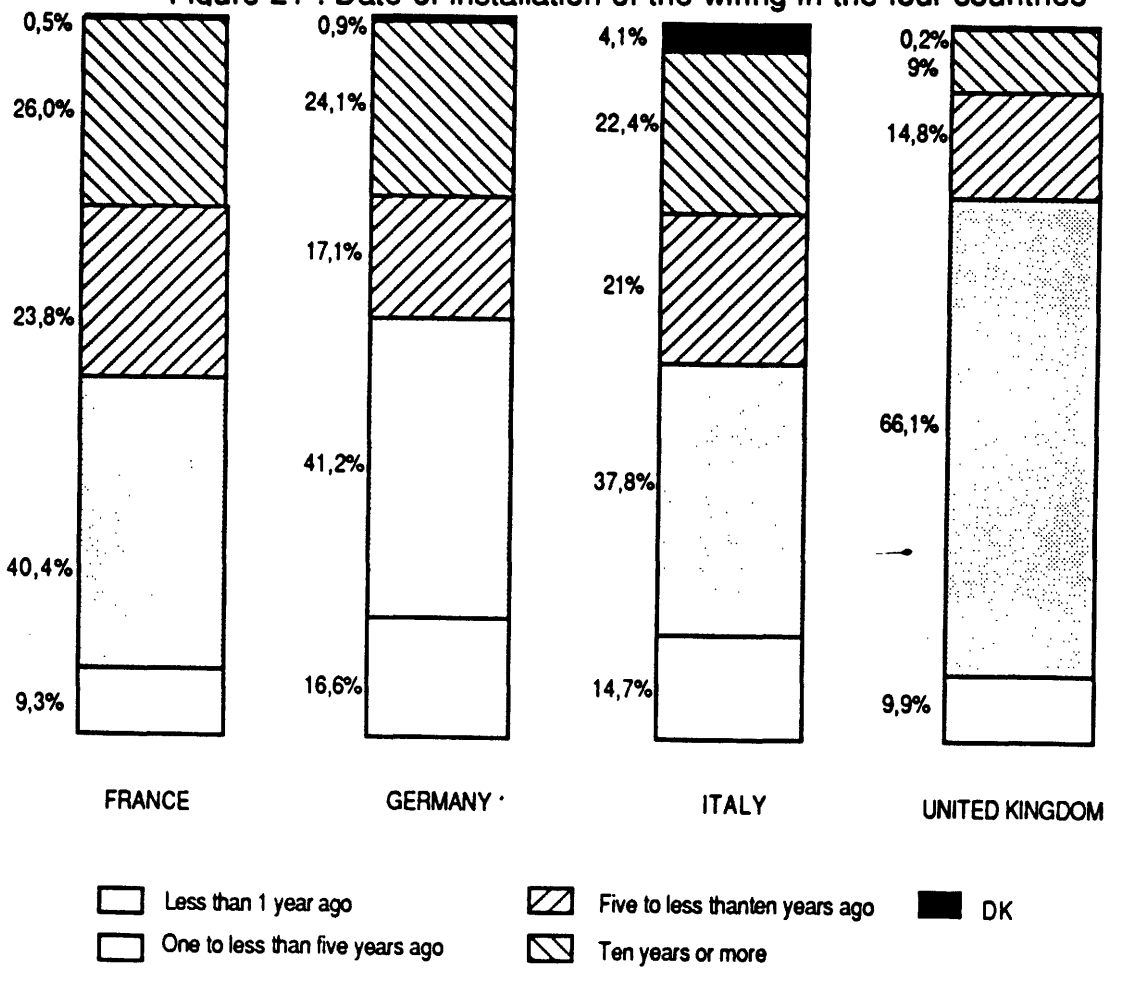
Only 48 % of the wiring belongs to the 1-5 year interval. This shows that the wiring market has been growing during the last few years.

3.1.2 - Impact of establishment characteristics

Due to the correlation between the two equipments, we will find the same characteristics as for the PABX installation date :

- large number of wiring installations one to five years old in UK (76 % of installations are less than 5 yearsold)
- old base in Italy but important replacement
- Germany has both a large number of old and young installations.
- very old base in France (50 % have more than 5 years) and slow replacement.

Figure 21 : Date of installation of the wiring in the four countries



The Service Sector is again very active (15 % of new installations over the last 12 months). However investments in wiring do not quite follow investments in PABX, (18 % of wiring installations have more than 10 years but only 9 % of PABX). The Government / Public Services Sector has a high percentage of old wiring installations (25 %) together with a low replacement rate (10 %).

The size class 500 employees or more shows an equipment policy stressing the wiring (16 % of new installations over the 12 last months).

It is the opposite for the size class 200-499 which has the oldest installed base (48 % of more than 5 years).

Finally, it should be noted that if the establishment belongs to an international group the wiring installation is younger.

3.2 - NUMBER OF WIRES PER SOCKET

The percentage of establishments where the telephone sockets are generally connected by 4 wires (or more) is similar for three countries out of the four and close to 50 %. It is lower in Italy where it is 33 % only (Figure 22).

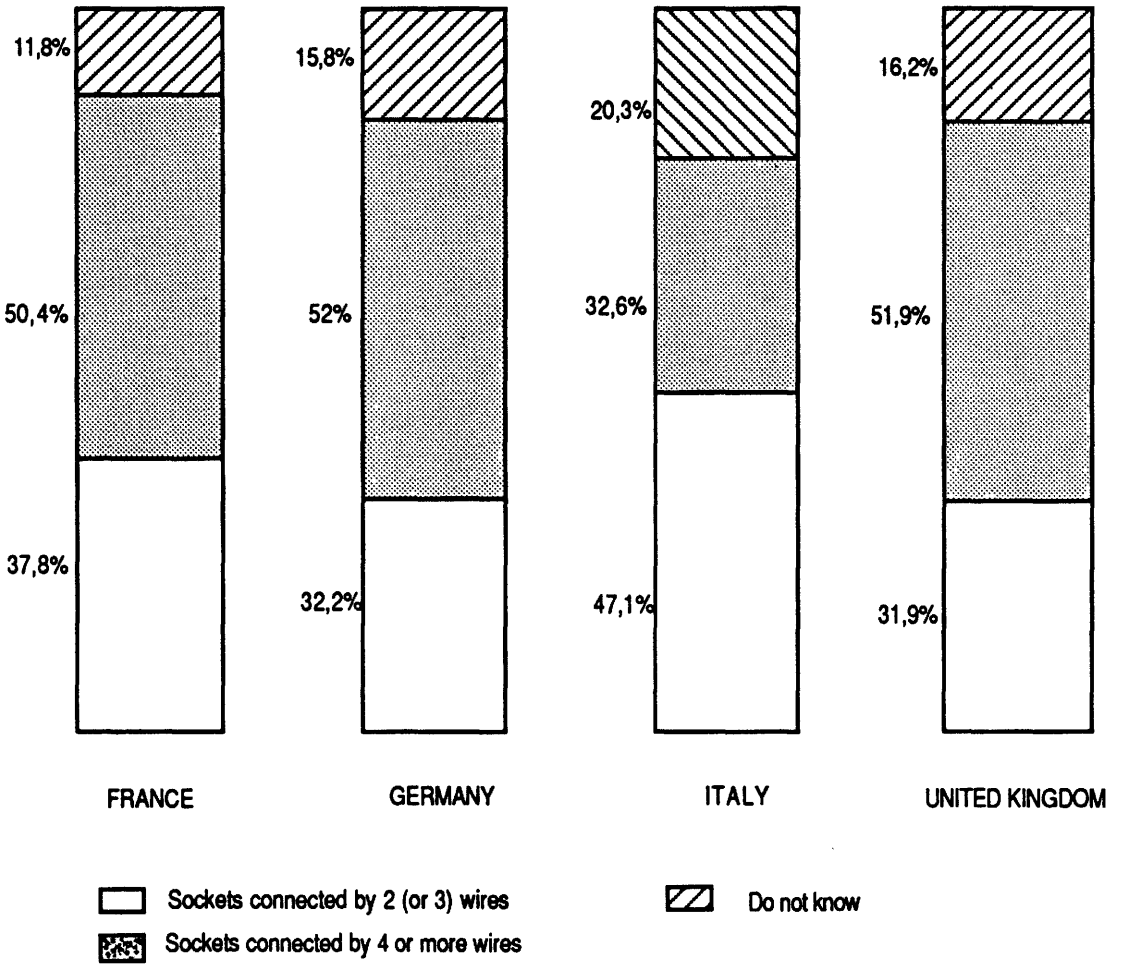
It should be noted that the question applies to the socket independently of the equipment plugged to it (which may require only two wires) and implies that 4 wires (or more) are available only down to the closest distribution point.

Either due to national regulations as in Germany where a socket must be connected by a starquad, either due to the market constraints as in France where it is difficult to find suppliers providing a one pair distribution cable, the results are almost identical.

The Government / Public Service Sector has less connections with 4 wires than the other sectors : 43 % against 49 % for Services and 51 % for Industry/Construction.

There is a correlation between employee size class and the percentage of establishments with 4 wire connections : it increases from 47 % (50-199 employees) to 55 % (200-499 employees) and 56 % (500 employees or more). This confirms that large establishments are careful on their wiring installations.

(figure 22)



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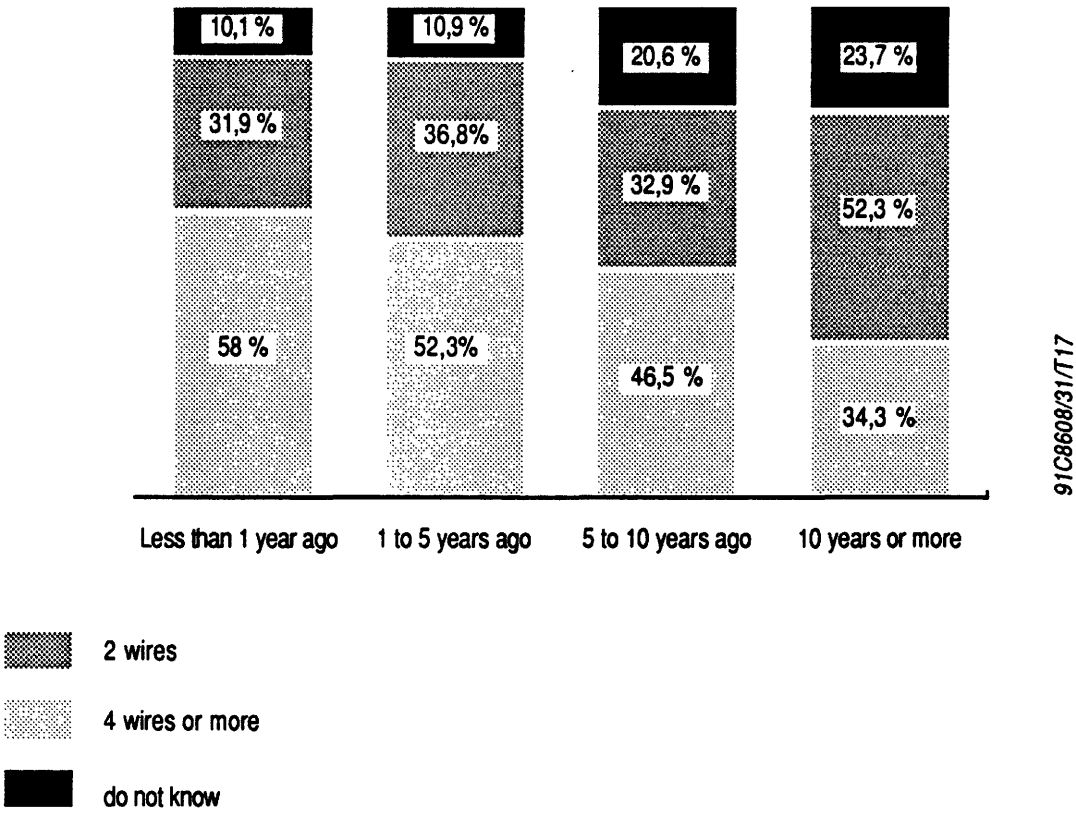
(Figure 23)



The percentage of establishments with 4 wires between the telephone sockets and the distribution frame decreases when the wiring installation becomes older (Figure 23). Clearly the 4 wire connection is a growing concern **even if one third of the wiring installation performed over the 12 last months used 2 wire connections.**

3.3 - USAGE OF SPECIAL CABLES

Besides plain telephone distribution cable, it is interesting to see if special cables such as shielded cables or cables used in smart buildings such as IBM BCS or Bull CS are widely used.

3.3.1 - Impact of the country

The number of telephone sockets connected by special cables appears below :

	FRANCE	GERMANY	ITALY	UK	TOTAL
Number of sockets concerned (in thousands)	490	274	95	199	1059
% of the total number of sockets in the country	10 %	3 %	3 %	2 %	4 %

Table 20 : Impact of the country on the use of special cables

France is more concerned by this phenomenon. It may be due to the fact that there is no regulation on wiring in this country and that consequently the versatility of the market is high : if a new type of cable appears customers are ready to switch very quickly. Furthermore, the Bull CS was developped under the auspices of France Telecom which is equivalent to an official label at a time when enterprises are thinking of ISDN.

3.3.2. - Impact of establishments characteristics

We found that the large establishments were more involved as it is shown in table 21. This confirms what we already noted in § 3.2 on establishments with more than 500 employees.

employee size class	50 - 199	200 - 499	500 or more	TOTAL
number of sockets concerned (in thousands)	312	160	587	1059
% of the total number of sockets	2 %	3 %	8 %	4 %

Table 21 : Impact of the size class on the use of special cables

The usage of special cables also implies a percentage of 4 wire connections higher than when plain cable is used (Figure 24).

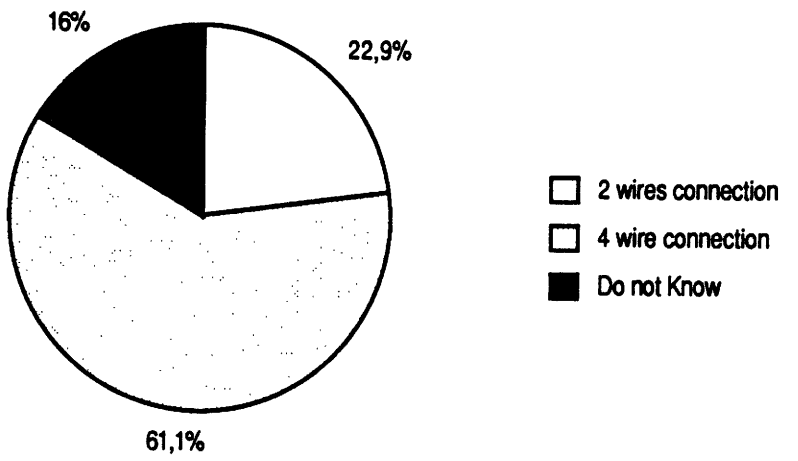


Figure 24 : *DISTRIBUTION OF TELEPHONE SOCKETS ACCORDING THE NUMBER OF WIRES OF THE CABLE TO THE DISTRIBUTION FRAME*

It is noteworthy that, if an establishment uses special cables in its wiring installation, then it is more probable that 4 wire connections will be used even with plain cable. In table 22, the percentage of 2 wire connection devreases as the percentage of sockets connected by special cables increases.

% of sockets in the establishments connected by special cables	0 %	less than 5 %	5-25 %	more than 25 %
Number of establishments	99099	60570	15745	5167
% of establishments using 2 wires	38 %	35 %	28 %	14 %

Table 22 : Correlation with the percentage of sockets connected by special cables and the number of wires

As we saw previously the establishments located in France (see Figure 25) or in the employee size class 500 or more (63 % of the establishments of this category) are using more special cables for wiring than the others.

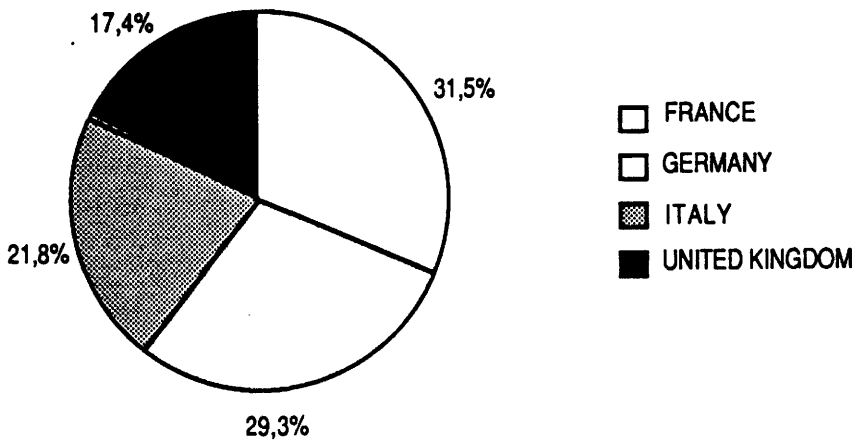


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Figure 25 *DISTRIBUTION OF ESTABLISHMENTS USING SPECIAL CABLES*

It is also true for establishments belonging to the Government / Public Sector : 50 % of establishments of this sector are using special cables (only 41 % of establishments in the Service Sector).

3.4 - MODIFICATION AND EXTENSION OF EXISTING WIRING

Should the connection of an ISDN telephone set require 4 wires to the MDF, are they spare cables in the existing wiring or is it possible to expand the installation easily if two wires are used nowadays ?

The wiring installations do not seem overdimensioned as **a proportion of establishments varying from 16 % in Italy to 27 % in France offer a possible increase of the sockets by 50 %.** Considering the average lifetime of a wiring installation, this proportion seems reasonable.

On the other hand, **saturated installations represent a proportion of establishments varying from 22 % in France to 38 % in Germany and 39 % in UK.** If the situation in Germany can be explained by the date of installation of wiring (41 % has more than 5 years) it is much more difficult to find a reason in UK : is it connected to the engineering aspect of installations or a large growth of telephone sets ?

The Government / Public Services Sector shows deep constrasts : in 30 % of the establishments of this sector, it is estimated that an increase by 50 % is possible. But at the same time, in 34 % of the establishments, the possible increase is less than 10 %.

A similar situation is found in the 50-99 employee size class (23 % of the establishments can increase their sockets by 50 % whereas 33 % offer less than 10 %).

It is not surprising to find a growing proportion of installations which are saturated when their age grows. **However, one quarter of the wiring installations installed over the last 12 months can now accomodate an increase of less than 10 % !** (Table 23)

Date of installation	less than 1 year ago	1-5	5-10	more than 10 years ago	All
Number of installations	24071	92378	36301	38237	190987
% with a possible increase of less than 10 %	25	27	38	44	32
% with a possible increase of more than 25 %	58	53	32	31	46

Table 23 : Percentage of increase of the sockets according to the date of installation of the wiring

The ease of modification or extension of wiring do not seem to be a major problem. It can be performed through false ceilings, false floors or extra tubes between MDF and secondary distribution frames. It will be helpful in the case where the 4 wire connection provided to the telephone socket but very often ending in the secondary distribution frame will need to be extended to the MDF.

Modifications are easier when the wiring has been installed recently and, as there is a correlation between the dates of installation of PABX and wiring, the ease is greater with digital time division PABX (table 24).

Type of PABX	Digital PCM	Electronic	Electromechanic
% of establishments with easy modification	92	84	82

Table 24 : Easiness of modification correlated to PABX type.

3.5 - DISTANCE FROM PABX TO TELEPHONE SETS

The distances have been classified in four intervals according to the ranges of the various S-bus configurations : 0-150 meters (short passive bus), 150-500 meters (extended passive bus); 500-1000 meters (point to point), more than 1000 meters.

For the four countries, the distribution is as follows (table 25) :

	0-150 m	150-500 m	500-1000 m	more than 1000 m	DK	Total
Number of sets (thousands)	15739 (66 %)	4956 (21 %)	1364 (6 %)	1017 (4 %)	829 (3 %)	23906

Table 25 : Loop lengths

Almost 66 % of all telephone sets are within 150 meters of the PABX and can be connected in a short passive bus.

Only 4 % of sets are located at more than 1000 meters and will require special connections.

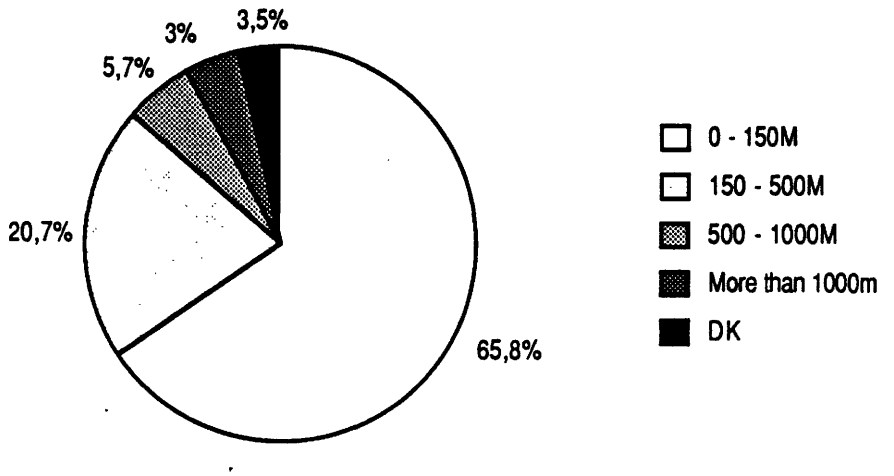


Figure 26 : *DISTRIBUTION OF TELEPHONE SETS ACCORDING TO THE DISTANCE FROM PABX*

We will focus our analysis on the connections longer than 1000 m.

3.5.1 - Impact of the country

The distance from the PABX to the telephone sets is correlated to the size of the PABX. As the largest PABX are found in UK and Germany, it is not surprising to find that these two countries represent almost 86 % of the number of telephone sets located at more than 1000 meters from the PABX.

	F	G	I	UK	TOTAL
Telephone sets located at more than 1000 m from the PABX (in thousands)	86	470	50	402	1017
percentage	9	46	6	40	100

Table 26 : Impact of the country on long loop length

The results of Germany and UK can be due to the procurement policy of companies in these two countries as it was pointed out in paragraph 2.5 : large PABX are bought and installed in a central point from where a star network connect all the distant locations.

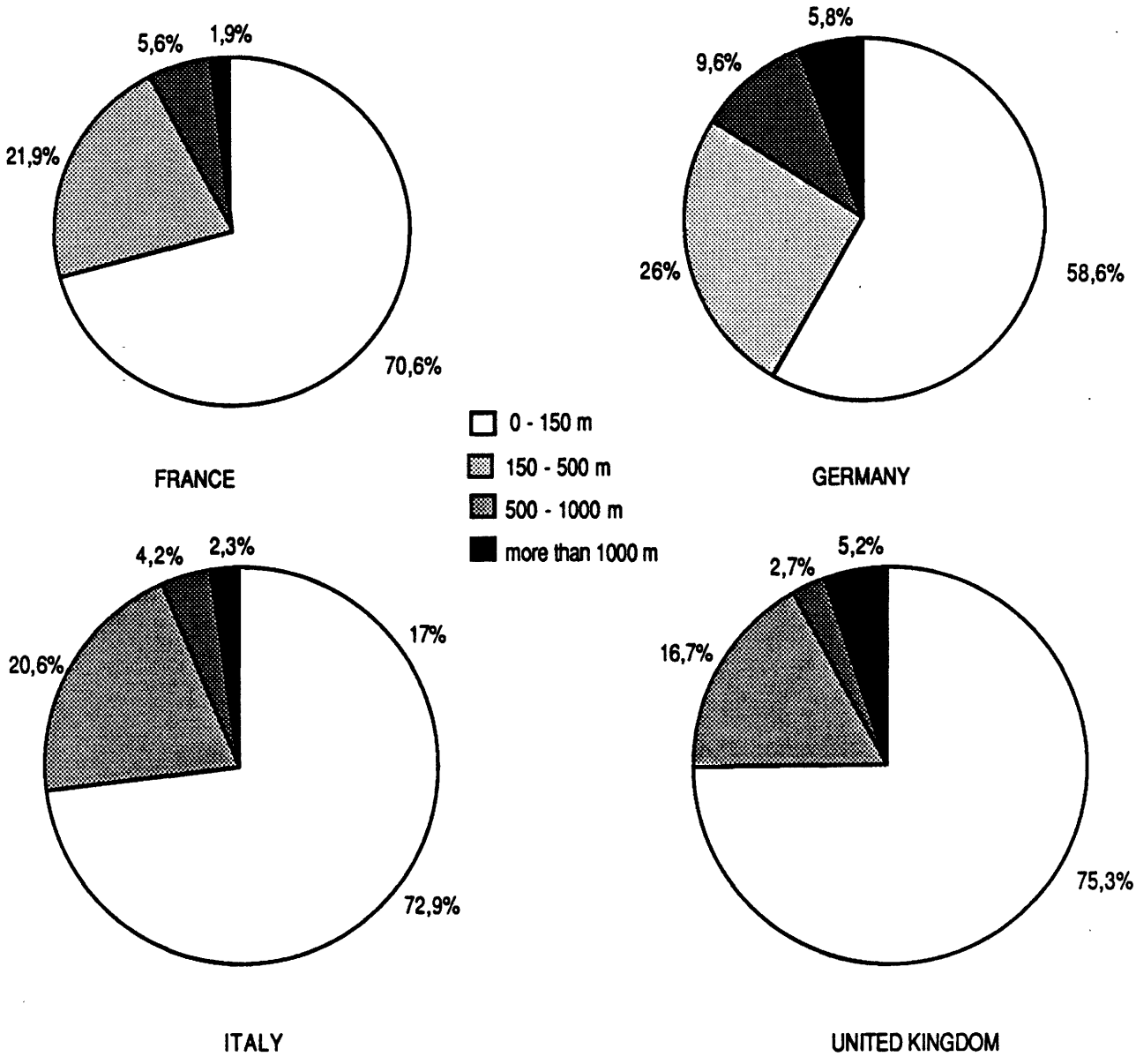


Fig. 27 DISTRIBUTION OF TELEPHONE SETS ACCORDING TO THE DISTANCE PER COUNTRY (EXCLUDING DON'T KNOW ANSWERS)

These long connections are concentrated in 5 % of all establishments. If we consider the establishments where connections of more than 1000 m long are found we have the following results (table 27) :

	F	G	I	UK	TOTAL
Number of establishments concerned by long connections	2135	4195	1534	2079	9943
Percentage of establishments in the country	4 %	8 %	5 %	4 %	5 %

3.5.2 - Impact of establishment characteristics

The correlation between the size class of establishments and the distance to the telephone sets appears clearly in the following table (Table28) :

Size class of establishment	50-199	200-499	500 or more	Total
Number of telephone sets located at more than 1000 m from the PABX (in thousands)	95 (9 %)	135 (13 %)	787 (78 %)	1017 (100 %)
Number of establishments with connections longer than 1000 m	4918	2422	2603	9943
Percentage of establishments in each size class	3 %	9 %	22 %	5 %

More than 77 % of the telephone sets requiring a long length of cable are located in establishments of 500 employees or more.

Two economic sectors are responsible for 90 % of these long connections : the industry / construction and the Government / Public Services sectors. It can be explained by the larger area generally covered by establishments in these two sectors (Table 29).

Services	Industry Construction	Services	Government public Services	TOTAL
Number of telephones sets located at more than 1000 m from the PABX (in thousands)	413 (41 %)	98 (10 %)	506 (49 %)	1017 (100 %)
Number of establishments with connections longer than 1000 m	5541	1487	2915	9943
% of establishments in each sector	7 %	2 %	6 %	5 %

The following figures 28 and 29 give the distribution of establishments according to their proportion of telephone sets with connection longer than 1000 m and the distribution of the corresponding telephone sets.

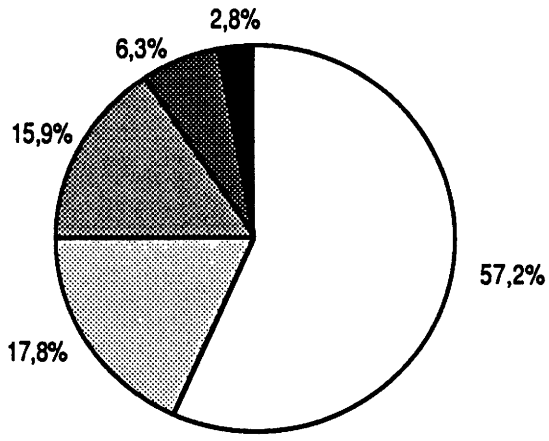
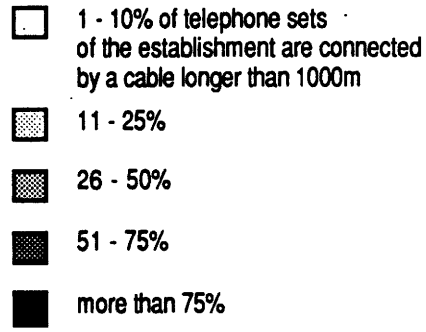


Figure 28 *DISTRIBUTION OF ESTABLISHMENTS*



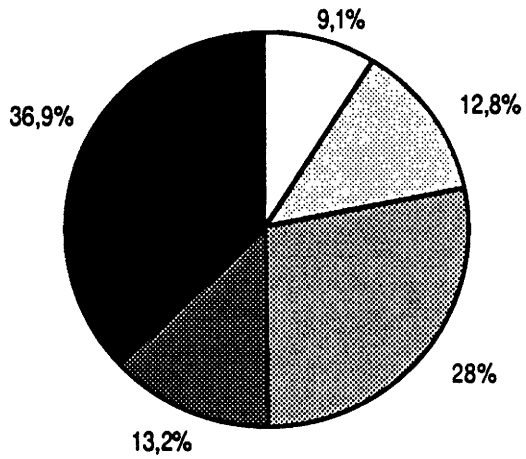


Figure 29 *DISTRIBUTION OF TELEPHONE SETS WITH A CONNECTION LONGER THAN 1000 m*

3.6 - NUMBER OF DISTRIBUTION FRAMES

The architecture of the internal wiring of an establishment have an impact on the way modifications can be performed on the connections of equipments. One can think, a priori, that if intermediate distribution frames (IDF) are scattered in the estalishments, extensions of the connected terminals will be easier provided that spare pairs exist between IDF and main distribution frames.

Among the four countries, results from Germany are noteworthy as they indicate that more than 70 % of establishments have no IDF (Table 30) :

COUNTRY	FRANCE	GERMANY	ITALY	UK
% of establishments without intermediate distribution frame	39 %	71 %	34 %	20 %

The impact of establishment characteristics is important, especially the employee size class which is correlated to the geographical lay out of the establishment (Table 31) :

SIZE CLASS	50-199	200-499	500 or more	TOTAL
% of establishments without intermediate distribution frame	44 %	36 %	22 %	41 %

This can be compared to the influence of the number of floors in the premise (Table 32) :

	1-2 floors	2 to 4	5 to 9	+ than 10
% of establishments without intermediate distribution frames	50 %	40 %	37 %	26

3.7 - DATA ANALYSIS

The two main axis describing the wiring information are size and age (Figure 30).

Along the horizontal axis are found the variables depending on the size of the establishments : number of employees, number of telephone sets, annual telecom expenditure, number of floors and buildings and distance between the telephone sets and the MDF.

On the vertical axis, there is a strong opposition between old installations (wiring and PABX) and new ones.

Establishments are indicated by clouds which can be connected by a convex curve because medium capacity PABX (100-199 extensions) are largely time division. The main features of each cloud are indicated on the figure. Countries are found near the clouds describing the best the characteristics of their establishments. UK for example is near the cloud corresponding to installations 1 to 5 years old. On the other hand, Italy is near the clouds of small size establishments.

Some indications on the distance between telephone sets and MDF are given. This distance is correlated with the size : in small establishments the majority of telephone sets are within 150 meters of the PABX ; on the left hand side of the figure are found the establishments (usually with more than 500 telephone sets) where some telephone sets are located at more than 1000 meters from the PABX.

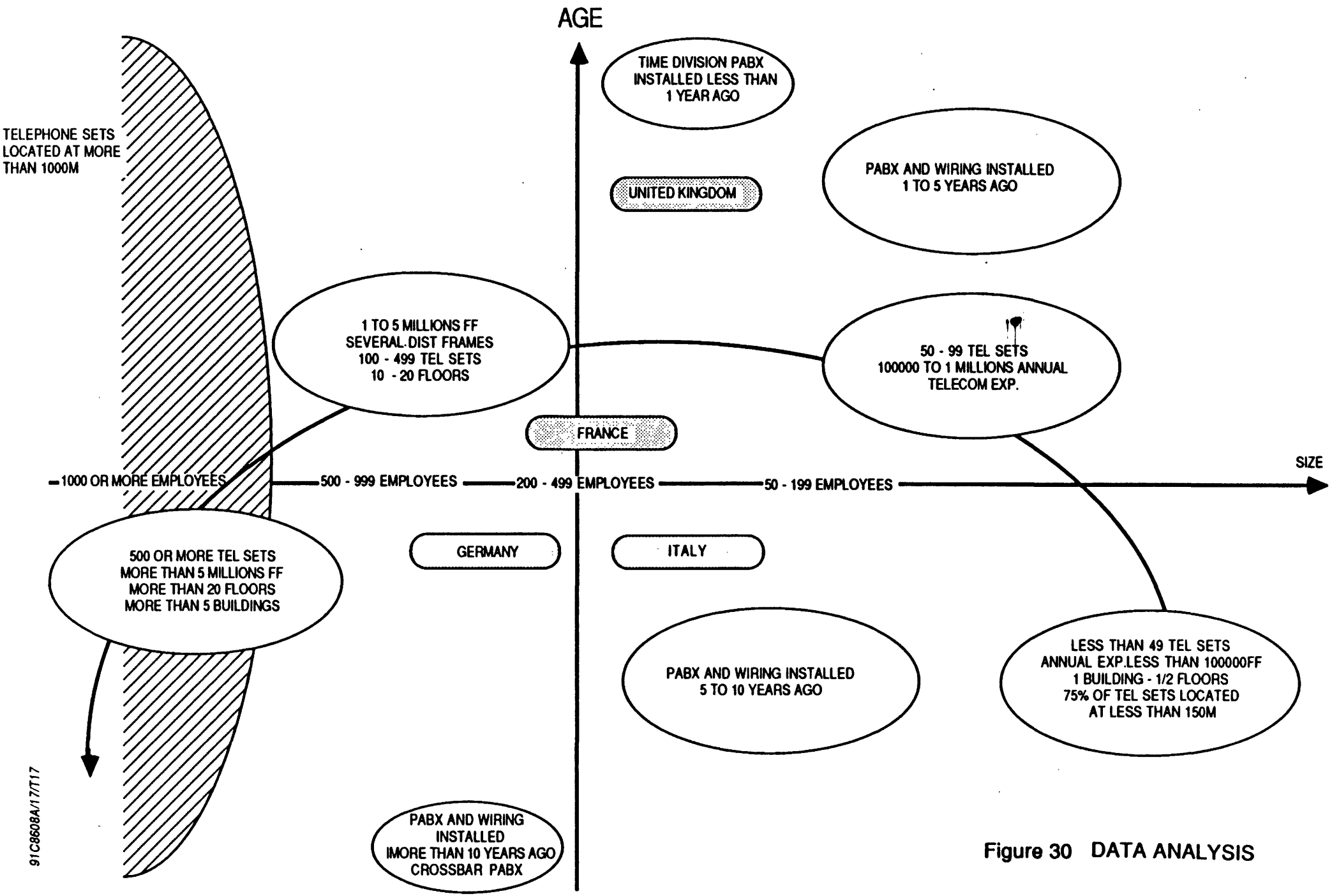


Figure 30 DATA ANALYSIS

4 - TERMINALS AND EDP EQUIPMENTS

In the survey, questions have been included concerning all terminals and devices which could be connected to ISDN in the future and therefore possibly to an ISPABX.

This section analyses the results relating to:

- **Telephone sets and particularly those which have extra function such as visual indications (lamps associated to keys, digital displays) : they are usually installed in the offices of high level executives and managers. We can assume that they are very likely to be replaced by ISDN telephone sets which will provide an extension of the functions already available. Furthermore the extra cost associated to extra functions was not a drawback for their installation.**

- Telematic terminals: facsimiles, telexes, word communicating processors and videotex terminals will be replaced by more efficient terminals: Group IV facsimiles transmitting quickly high volumes of black and white documents with a good resolution, second generation videotex with a larger screen (better resolution, alphageometric image standard) and sound synchronized with picture.

- Data terminals including CAD-CAM and high resolution graphic workstations, EDP equipments which are susceptible to become intelligent terminals (micro, medium and large computers).

The following Table shows the total number of terminals (thousands) owned by establishments having more than 50 employees.

Type of terminals or equipment	Number (thousands)
Telephone sets	23 905
(of which telephone sets with extra function	1 276)
Facsimile	243
Telex	248
Communicating word processors	517
Videotex	394
Micro computers	1 991
Data terminals	2 189
CAD-CAM and high resolution graphics terminals	165
Large and medium computers	302
Total of terminals which could be connected to an ISPABX	29 954

Table 33 : Number of installed terminals

Amongst terminals which could be connected to an ISPABX, the more numerous categories which could benefit from ISDN capabilities are besides telephone sets with extra function (4% of the total), data terminals and microcomputers (14%).

This last percentage is likely to evolve quickly due to the rapid growth of microcomputers evaluated to 15% annually in the EDBS survey.

In the longer term, microcomputers will become in fact intelligent integrated workstations and will be equipped with emulation cards, replacing partly dedicated telematic terminals.

These terminals or devices are generally not connected to the PABX.

4.1 - IMPACT OF ESTABLISHMENT SIZE

The impact of the establishment size on their equipment in terminals and EDP devices is obvious.

It is shown in the following table which gives for main types of terminals an average number per establishment according to their size (Table 34) :

	50-199 employees	200-499 employees	+ 500 employees	Total
Telephone sets with extra functions	79	172	595	124
Facsimile	0.9	1.4	4.7	1.2
Communicating word processors	1.9	5	8.2	2.7
Personal computers	7	16	38	10
Data terminals	8	22	41	12
Large and medium computers	1.3	1.6	4.5	1.5

Influence of other factor (sector, country) is discussed in sections below.

Moreover, the data analysis (see figure 31) carried out has made clear the relative under equipment of small companies and the existence of little establishments with no equipment : no telematic terminals, no computers, no data terminals and only a few

The other extreme exists too: some large establishments with more than 1 000 employees are "over equipped", they have more than 10 medium and large computers, more than 500 telephone sets, more than 6 facsimile machines, more than 10 CAD-CAM or graphic terminals, more than 50 micro computers, they expend more than 5 millions Francs a year for telecommunications services.

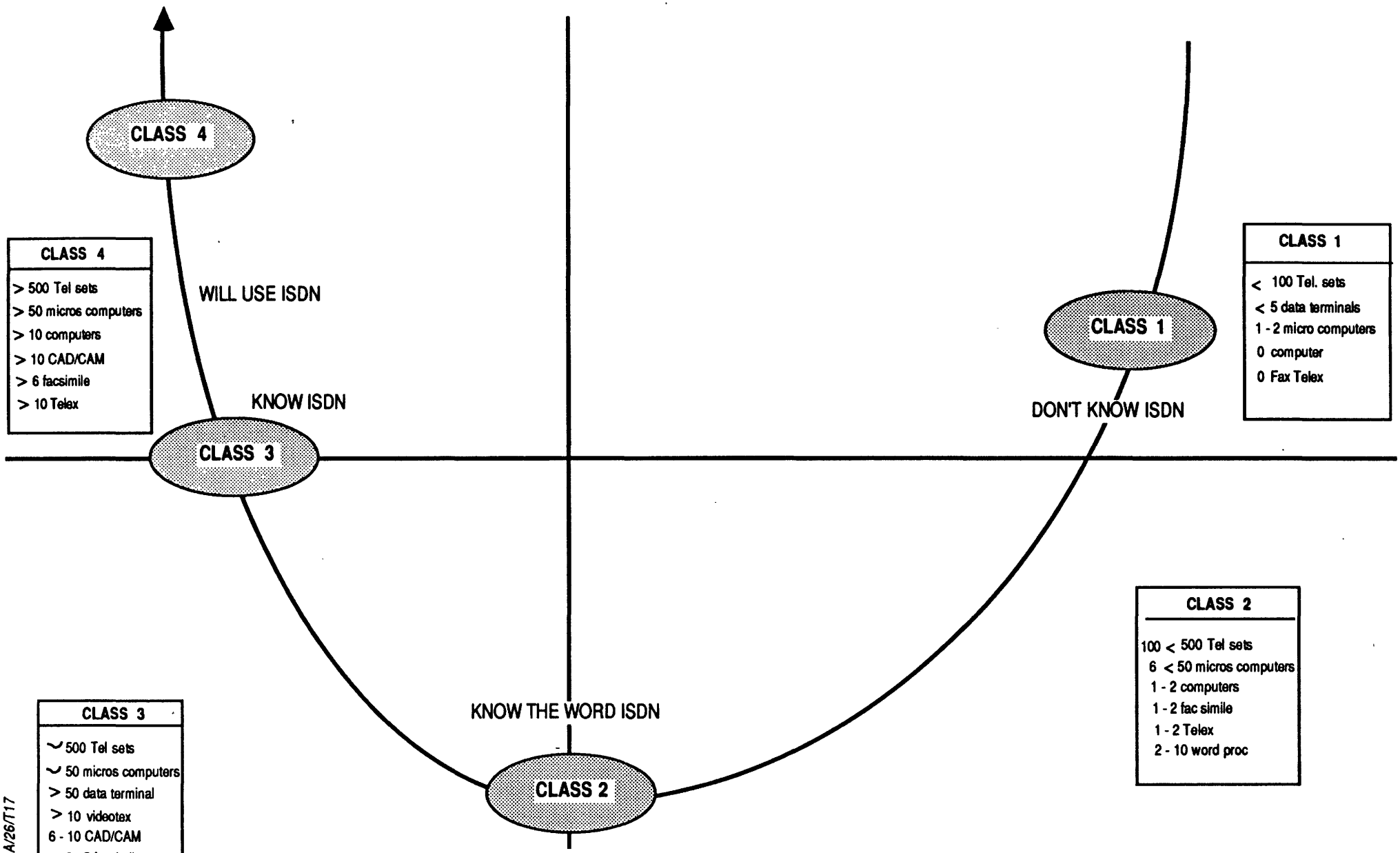


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Fig. 31 TERMINALS AND EDP EQUIPMENT

The knowledge of ISDN is clearly linked to a minimum size (more than 500 employees, more than 200 telephone sets, more than 20 personal computers, several medium and large computers, telecommunications expenses of more than 1 million). This aspect will be developped more in detail in paragraph 5.1.

4 2 - TELEPHONE SETS WITH EXTRA FUNCTIONS

The 193 255 establishments of more than 50 employees own a total of 23 905 000 telephone sets.

Telephone sets with extra functions represent slightly more than 5 % of this total (1 276 000 sets).

57% of establishments are equipped with telephone sets having extra functions. This percentage does not change very much according to the sector but is variable according to:

- the establishment size (55% of establishments having between 50 and 199 employees equipped against 73% of those having more than 500 employees);
- their percentage of executives and managers (53 % of establishments with less than 5% of executives and managers against 64 % for those having more than 10% of executives) ;
- the country (see figure 32).

4.3 - TELEMATIC TERMINALS

4.3.1.Facsimile and telex

74% of establishments having more than 50 employees are equipped with at least one facsimile machine. This ratio is now equal to the telex ratio with the same kind of pattern as regards the penetration in the different sectors (figure 33) and the fact that both telex and facsimile are used as collective equipment: for instance 66% of establishments have 1 or 2 facsimile, 8% only have more than 2. This latest figured can be compared for instance to the percentage of establishments installed on more than 10 floors (near 9%). Telex distribution is quite similar to the facsimile one.

FIGURE 32

PERCENTAGE OF ESTABLISHMENTS EQUIPPED WITH TELEPHONE SETS HAVING EXTRA FUNCTION ACCORDING TO THE COUNTRY

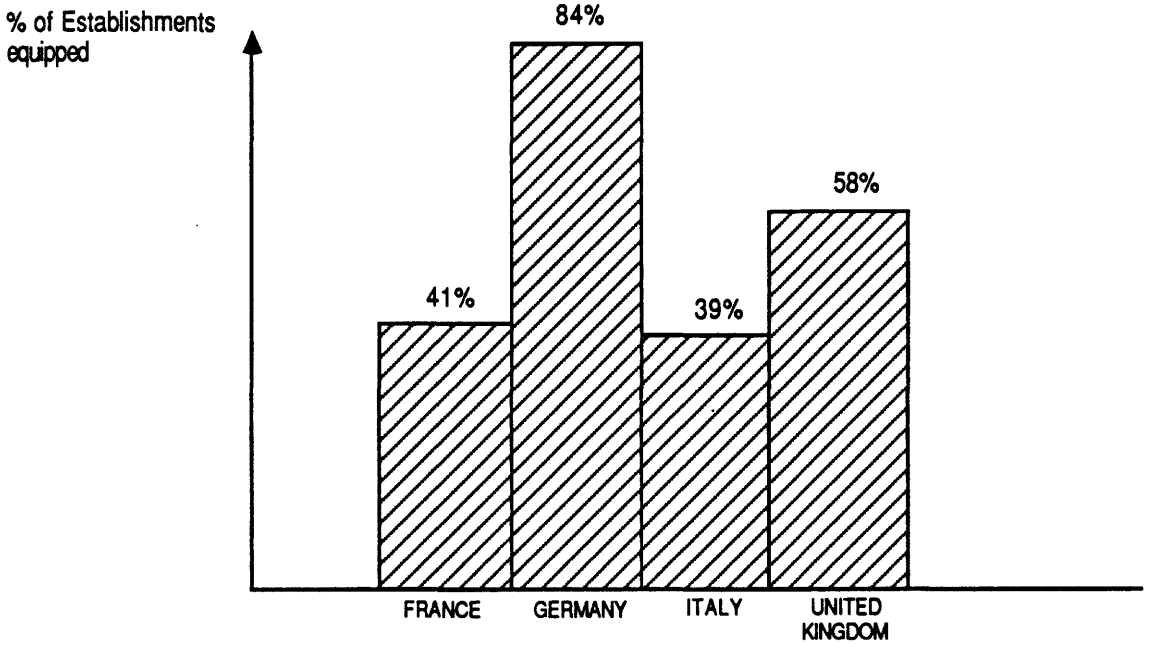

FIGURE 2

PERCENTAGE OF ESTABLISHMENTS EQUIPPED WITH FACSIMILE AND TELEX ACCORDING TO THEIR SECTOR

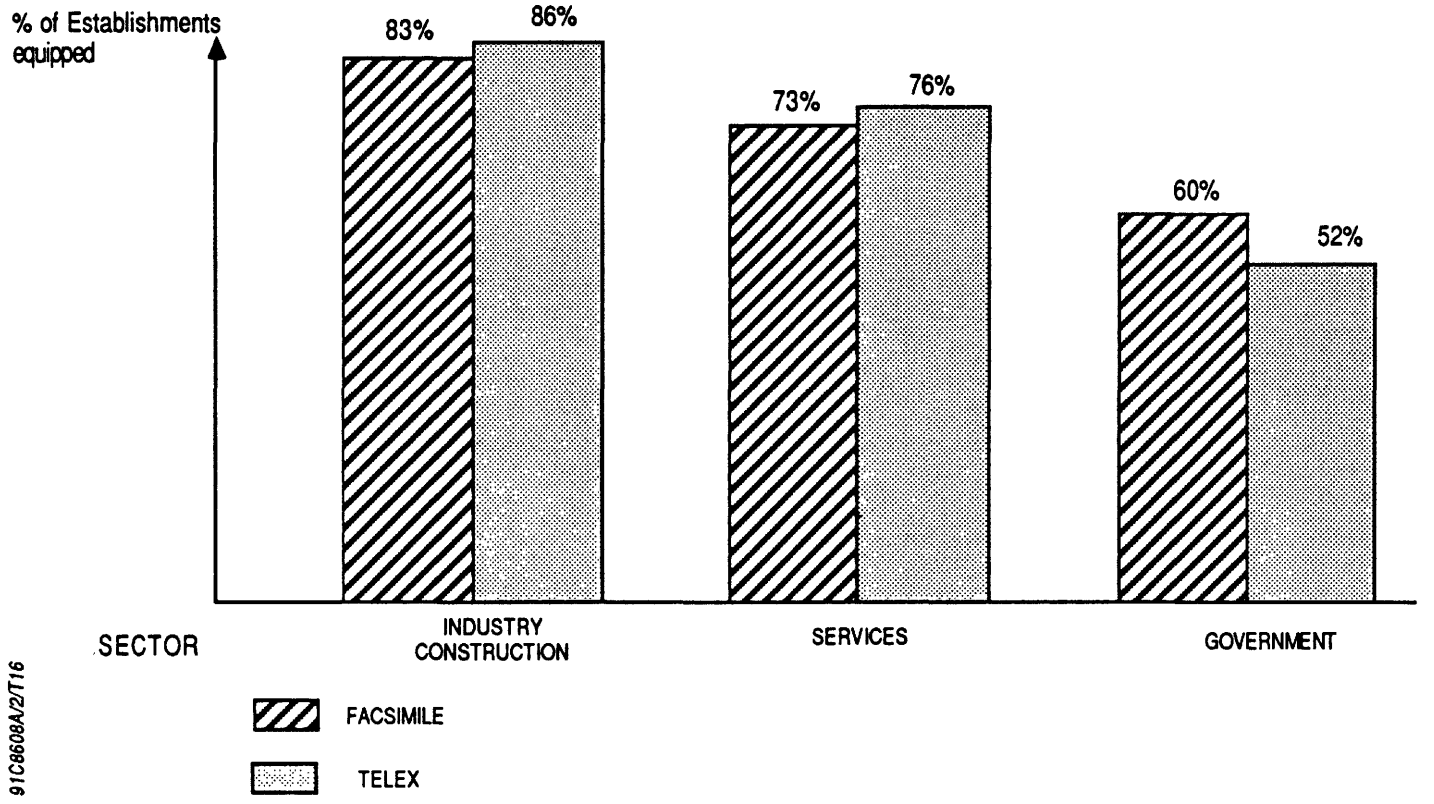

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FIGURE 34.

PERCENTAGE OF ESTABLISHMENTS EQUIPPED WITH FACSIMILE ACCORDING TO THE COUNTRY

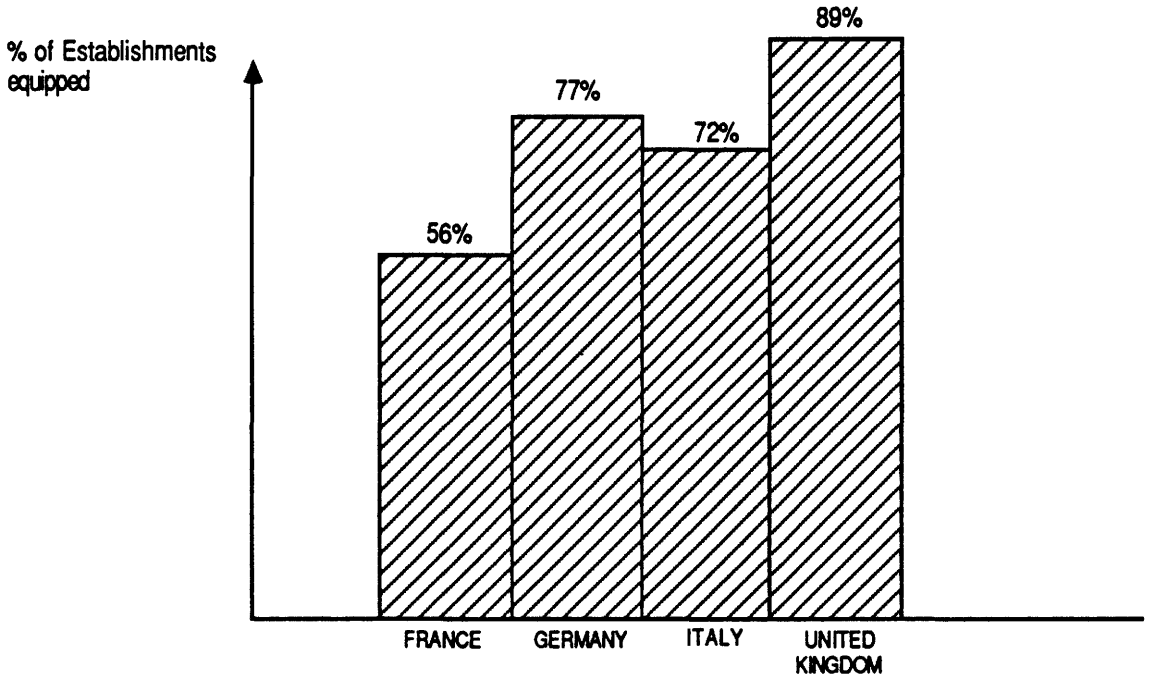
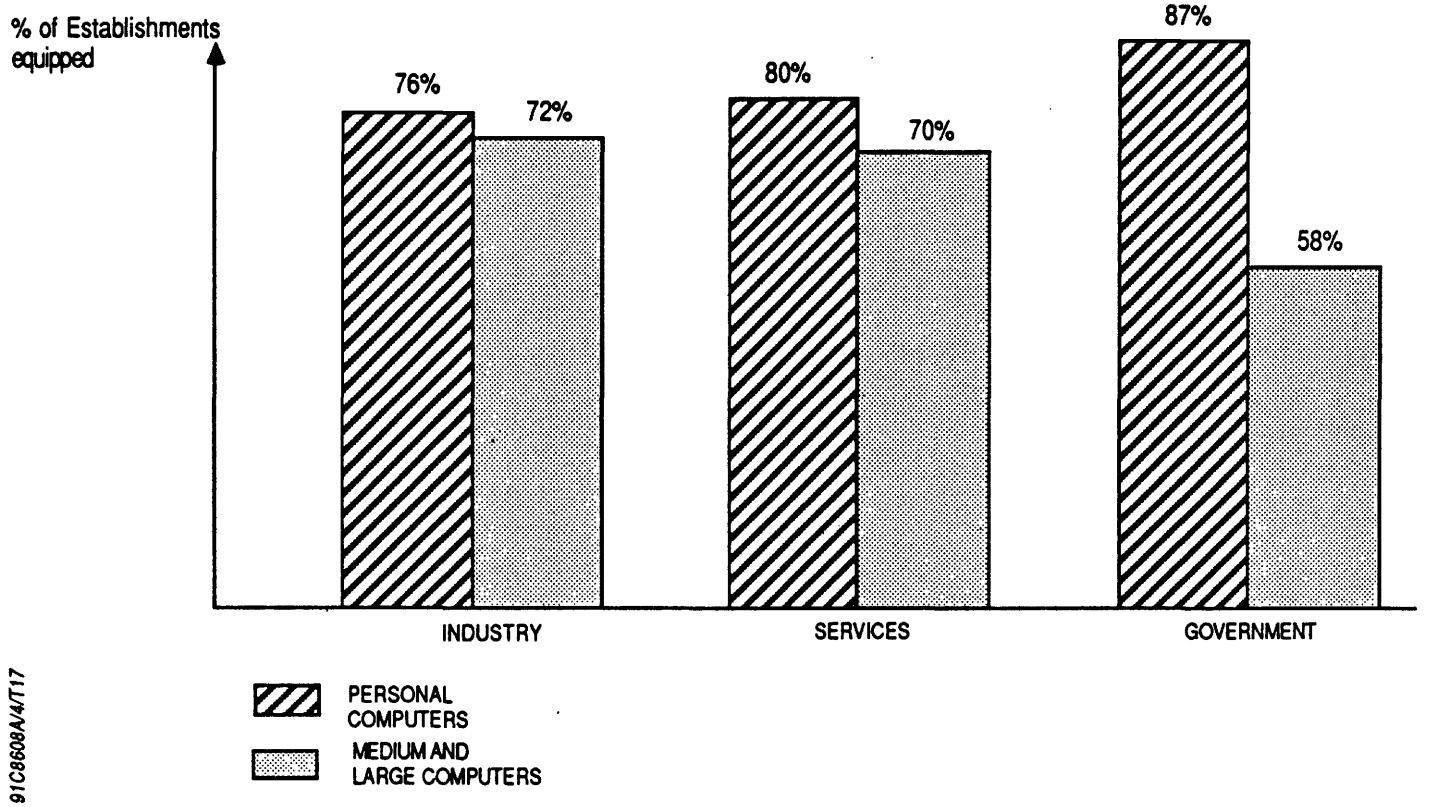


FIGURE 35.

PERCENTAGE OF ESTABLISHMENTS EQUIPPED WITH PERSONAL COMPUTERS AND MEDIUM AND LARGE COMPUTERS ACCORDING TO THE SECTOR



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Nevertheless telex and facsimile have not the same penetration in the different countries. Facsimile penetration rates are rather different in the four countries as shown in Figure 34. Telex penetration rates are closer except for Italy slightly underequipped with 66% of establishments having at last one telex against an average of 73% for the four countries.

4.3.2 - Communicating word processors

Only 33% of establishments are equipped with communicating word processor (a little more in Germany 41%, a little less in France 22%) with a penetration quite comparable in the different sectors.

Nevertheless, the number of communicating word processors is greater than the number of facsimile machines because half of the establishments equipped with communicating word processors have more than two machines and one third have more 6.

4.4.1 - Videotex

Videotex penetration rate (39%) is hardly superior to communicating word processor and shows a similar kind of distribution. For well-known reason, there is a peak in France at 92% and a gap for Italy (13%).

Government and services use more videotex than industry: around 45% of establishments equipped against 31%.

4.4 - ELECTRONIC DATA PROCESSING EQUIPMENT

4.4.1. - Computers

81% of the establishments considered have at least one microcomputer, 68% have at least one medium or large computers.

As expected, two third of establishments owning medium or large computers have only 1 or 2 of them whilst half of those equipped with personal computers have more than 6.

Moreover, patterns of penetration in sectors are rather different (see figure 35) specially for Government which is quite underequipped with medium and large computers and slightly in advance for personal computers.

Italy and UK are a little more advanced for personal computers (84% of establishments equipped) compared to Germany (75%). Nevertheless, the average number of machines per establishment is greater in UK than in Italy. France is slightly behind the other countries for large and medium computers (63% establishments equipped).

4.4.2 - Data terminals

The percentage of establishments having data terminals (59%) is comparable to the one of establishments owning medium and large computers (68%) and the effect of the sector is quite similar with an underequipment of Government and Public Services.

Two third of establishments equipped with data terminals have more than 6 of them.

Italy has 43% of establishments equipped with data terminals against 64% in France. For France, this could be explained by the fact that connections to data network counterbalance the lack of medium and large computers.

Only 21% establishments are equipped with CAD-CAM or high resolution graphic terminals.

5 NETWORKING

This sub-section examines the equipment in leased lines and trunk lines, the use of digital services and the implementation of networks. The use of ISDN will likely depend on the existing networks and services used by the companies, and specially the digital services.

The following table (Table 35) gives the percentage of establishments which use networking and connection to digital services available in the four countries considered.

SERVICES	% OF ESTABLISHMENTS
TIE LINES FOR VOICE	47
TIE LINES FOR DATA	52
PACKET OR CIRCUIT DATA NETWORK	23
CONNECTION TO DIGITAL SERVICE	12
LOCAL AREA NETWORK	18
KNOWLEDGE OF ISDN	22
WILL CERTAINLY USE ISDN	9

While the tie lines for voice and data transmission are connected to the PABX, only 15 % of the existing local area networks (LAN) are connected to the PABX of the company.

The data analysis carried out (section 5.1) underlines the impact of the number of dedicated lines and the use of new services on the knowledge of ISDN.

This knowledge and the plan to use ISDN is closely linked to the size of the existing in house installation and specially with the annual telecommunications expenditure as shown in the table below (Table 36).

	LESS THAN 100 000 FF	100 00 TO 1 MILLION	1 MILLION TO 5 MILLIONS	MORE THAN 5 MILLIONS
Will certainly use ISDN	2 %	10 %	13 %	48 %

5.1 - KNOWLEDGE OF ISDN

The figure 36 displays the structure of the equipment of companies concerning trunk lines, dedicated lines, connection to public packet or circuit switched data network, LAN, digital services in comparison with the knowledge and the use of ISDN.

The level of equipment, which depends of course on the size of the company, goes along with the level of knowledge and the certainty to use ISDN.

Four classes may be observed with two extreme classes : one is very numerous with low equipment and the other one concerns few establishments with a high telecommunitation expenditure.

Class 1

The first class (on the left side) concerns the smallest establishments, between 50 and 199 employees. They are underequipped with often no tie line or only one for voice or for data transmission, no connection to packet or circuit switched data network. They have less than 10 trunk lines and less than 50 telephone sets. **Usually the person surveyed did not know ISDN before, often not even the word.**

Besides their size (50-199 employees), their characteristics are an annual telecommunications expenditure of less than one million francs. An over-representation of the industrial sector can be noticed. In average, the establishments of industry know less ISDN (16 %) than in the other sectors (24 % in Administration and 27 % in Services). The establishments located in Italy are over-represented in this class.

The class 1 concerns about 70 % of the establishments of more than 50 employees of the four countries.

Class 2

In this class, the establishments are better equipped with 2 or 3 tie lines for data transmissions and 2 to 5 tie lines for voice, one connection to packet or circuit switched data networks. They have 10 to 30 trunk lines and at least between 50 and 200 telephone sets.

Their knowledge of ISDN grows with the equipment and they know at least the word "ISDN".

The characteristics of this class are mainly a size between 200 and 500 employees, usually no more than ten estalishments in the country and no subsidiary abroad. France is over-represented in this class.

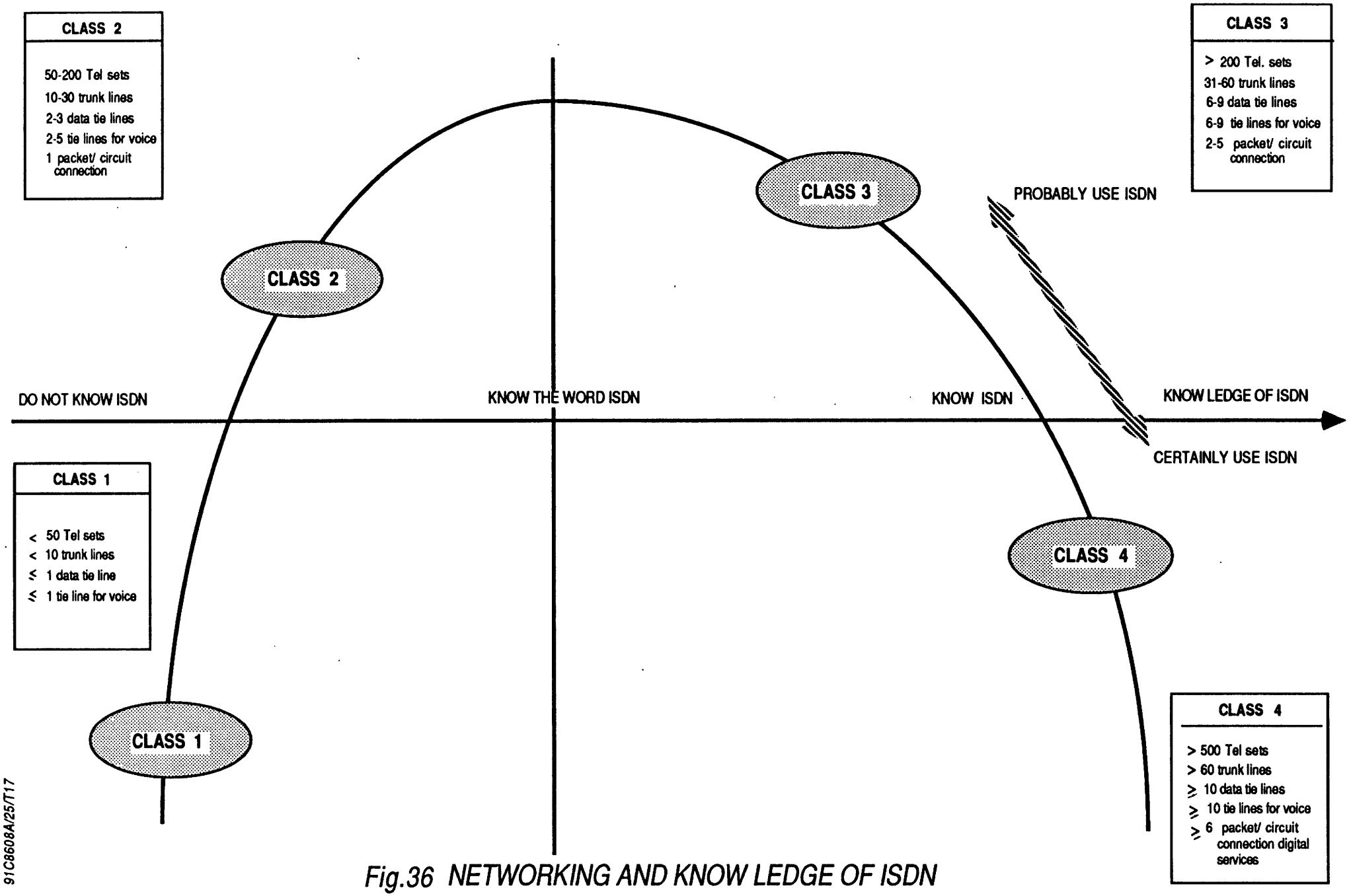

Fig.36 NETWORKING AND KNOW LEDGE OF ISDN

Class 2

In this class, the establishments are better equipped with 2 or 3 tie lines for data transmissions and 2 to 5 tie lines for voice, one connection to packet or circuit switched data networks. They have 10 to 30 trunk lines and at least between 50 and 200 telephone sets.

Their knowledge of ISDN grows with the equipment and they know at least the word "ISDN".

The characteristics of this class are mainly a size between 200 and 500 employees, usually no more than ten estalishments in the country and no subsidiary abroad. France is over-represented in this class.

Class 3

The class 3 has almost the same features as the class 2, but with a higher level of equipment : 6 to 9 tie lines for voice and 6 to 9 tie lines for data transmission, 2 to 5 connections to packet or circuit switched data networks. They have between 31 and 60 trunk lines and more than 200 telephone sets.

They know what is ISDN and declare they will probably use it.

Their characteristics are : an annual telecommunication expenditure between one and five millions.and subsidiaries or headquarter in foreign countries more frequently than the mean average. United Kingdom and Germany are over-represented in this class.

The classes 2 and 3 represent about 20 % of the establishments. The sector of services and administration are over-represented here.

Class 4

This class is apart from the others, due to a very high level of telecommunications equipment and it includes the largest establishments with more than 1000 employees.

The establishments in this class have more than 10 tie lines for voice and more than 10 tie lines for data transmission, more than 6 connections to packet or circuit networks. They own more than 60 trunk lines and more than 500 telephone sets. Those establishments already use digital services.

They know what ISDN is and declare they will certainly use it.

Their annual telecommunications expenditure is over five million francs.

This last class represents around 10 % of the establishments of more than 50 employees, these establishments will be likely the first to come to ISDN.

In fact, as may be observed, the certainty of (declared) future use of ISDN grows rapidly with the number of connections to wide area network. The threshold seems to be over 15 trunk lines, more than 3 data transmission tie lines, more than one connection to packet or circuit switched data networks, connection to a digital service, existence of a LAN.

The knowledge of ISDN and its future use varies strongly among the four countries.However among the establishments which know ISDN, the percentage of certainty of future use is the same (except for Italy). It suggests that there is a problem of lack of information more than an absence of needs for ISDN. The graphics 37 and 38 underline those points.

5.2 DETAILED ANALYSIS OF NETWORKING

5.2.1. Trunk lines

The Figure 39 gives the percentage of establishments according their number of trunk lines. One can notice that 22 % of the establishments have less than five trunk lines while 9 % have more than 30 trunk lines connected to PABX.

The average number of trunk lines increases of course with the size of the company as shown below.(Table 37) :

SIZE OF EMPLOYEES	50 - 199	200 - 499	500 et +	TOTAL
Mean average trunk lines	12	22	39	15

The number of trunk lines also depends on the country considered. The percentages of establishments having 10 or more trunk lines are the following : 36 % in Italy, 42 % in France, 56 % in Germany and 68 % in United Kingdom (Figure 40)

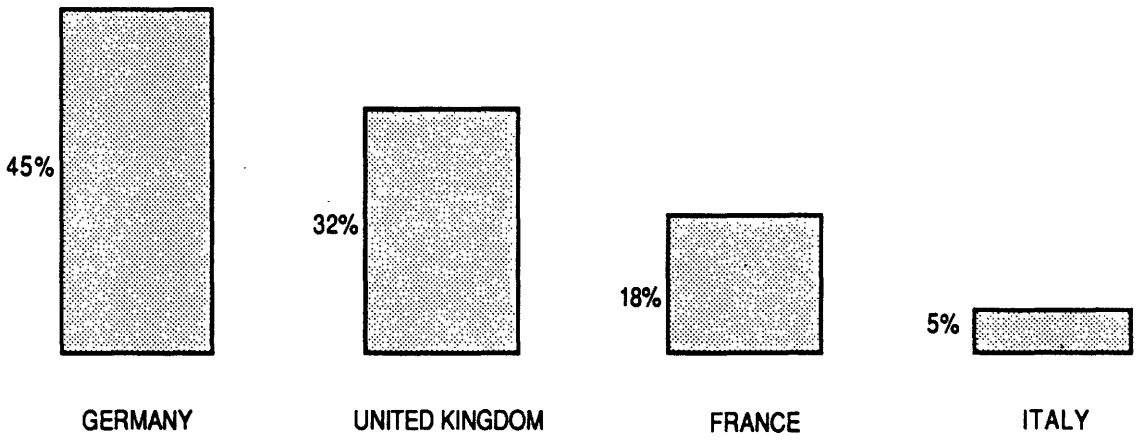

Figure 38 % of establishments which know ISDN according their country

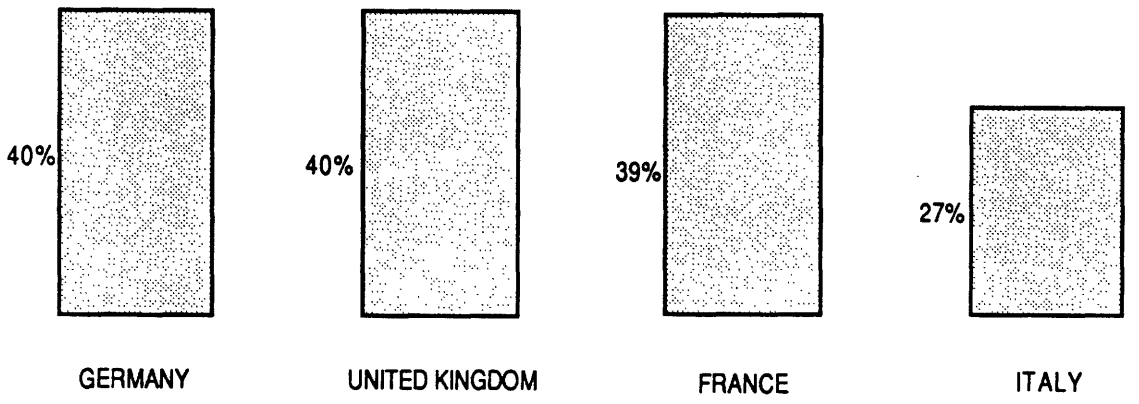

Figure 39 % of establishments which declared "use certainly ISDN" among the establishments knowing ISDN.

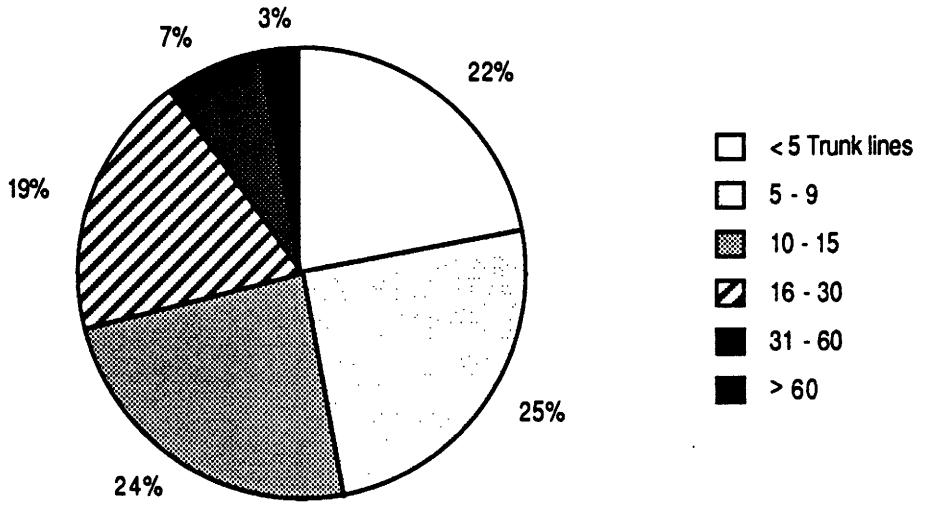

Figure 39 - Distribution of establishments according their number of trunk lines

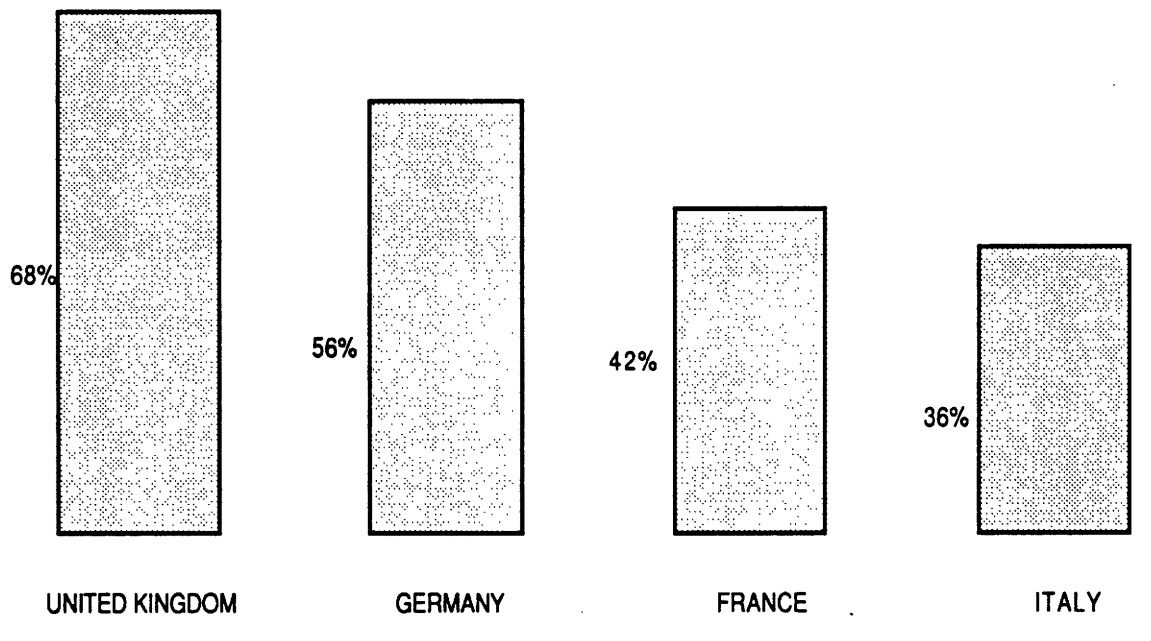

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Figure 40 - % of establishments having 10 or more than 10 trunk lines according to the country

5.2.2. Tie lines for voice connected to PABX

47 % of the establishments of more than 50 employees in the four countries have at least one tie line. Considering the most equipped, 12 % of the establishments have 10 tie lines or more for voice (Figure 41).

As the table below indicates it, the establishments of more than 500 employees use twice more tie lines for voice than those having between 50 and 199 employees (Table 38)

ESTABLISHMENT SIZE	50 -199	200 - 499	500 et +	TOTAL
average number of tie lines for voice	2,5	3,2	5,2	3

Besides the size of establishments, the number of tie lines for voice increases of course with the number of estalishments in the country and the existence of subsidiaries or a headquarter in foreign countries.

Establishments in Germany use less often tie lines for voice as well as for data transmission than the other three countries : 72 % of the establishments have no tie lines for voice while the average number for the four countries is 53 %. It could be explained by a low growth during the five last years partly due to the expectation of ISDN.

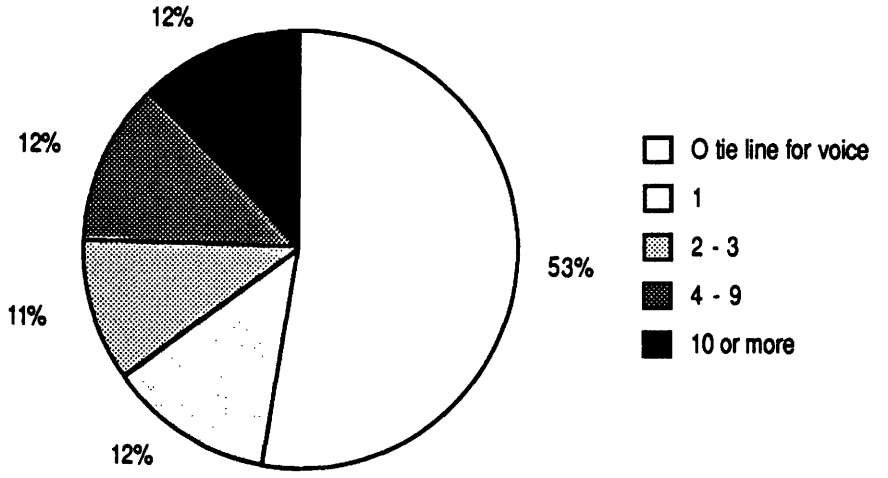

Figure 41 Distribution of establishments according their number of tie lines for voice

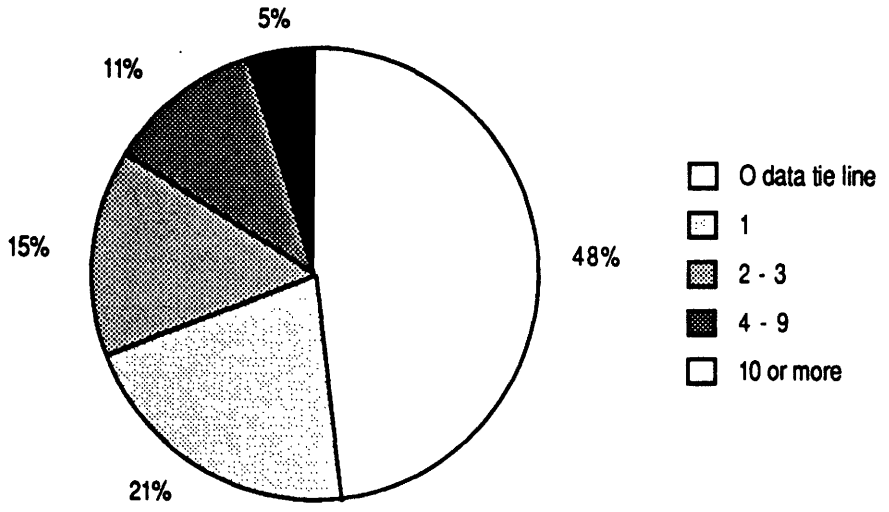

Figure 42 Distribution of establishments according their number of data transmission tie lines

5.2.3. Tie lines for data transmission

48 % of the establishments of more than 50 employees have no data transmission tie lines while 5 % have 10 or more (Figure 42).

As for tie lines for voice, the number of tie lines for data transmission depends also on the size of establishments. Yet, establishments between 50 and 199 employees, and even between 200-499, have less data transmission tie lines than tie lines for voice (Table 39).

ESTABLISHMENT SIZE	50-199	200 - 499	500 and +	TOTAL
average number of data tie lines	1,7	2,8	5,5	2,1

As we mentionned it in the global data analysis, the knowledge of ISDN increases with the number of tie lines for voice or for data transmission ; however it is more linked with data transmission (7 % of certainly use ISDN for the establishment without data tie lines against 18 % in the establishments with 10 data tie lines or more).

5.2.4 - Connections to packet or circuit switched data networks.

77 % of the establishments have no connection to this type of public network, 13 % have only one connection and 10 % more than one. Here again, the future use of ISDN doubles with the present use of packet or circuit switched data networks.

The utilisation of these types of data networks depends on the size of the establishments (Table 40).

SIZE OF ESTABLISHMENTS	50 - 199	200 - 499	500 and +	TOTAL
average number of connections	0,5	1,0	2,5	0,7

5.2.5 - Local Area Networks

In 18 % of the establishments of the four countries , a LAN is implemented but it is clearly linked with the size of establishments. Under 500 employees 15 % of the establishments have a LAN while 40 % have a LAN in the establishments of more than 500 employees

There are big differences between the countries as shown in the bar-chart of Figure 43. The highest percentage is found in United Kingdom with 27 % of establishments equipped, then, 22 % in Italy and farther Germany 12 % while France has hardly 10 %.

With the existence of LAN, a significant percentage of specific cables is found twice more often than where there is no LAN in the estalishments.

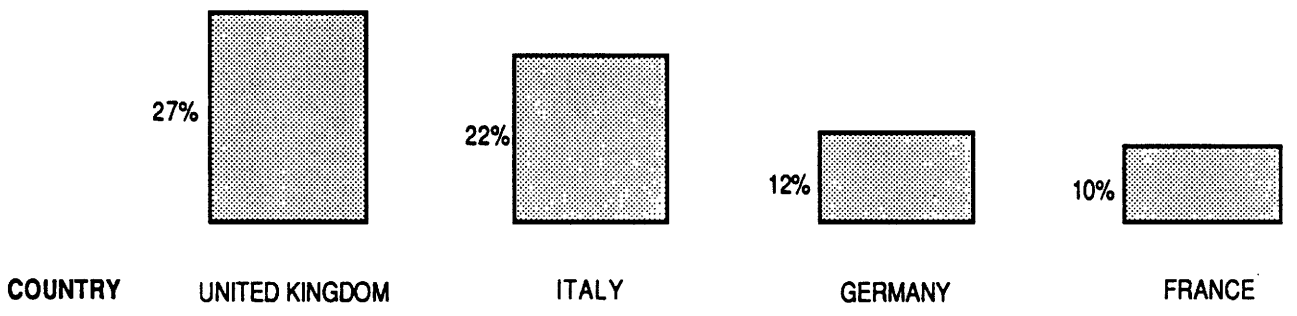

Figure 43 - Percentage of establishments with a LAN according their countries.

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