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Thomas Schnöring\*

# National Differences in Telecommunications R&D in Europe

*The isolation of national telecommunications markets in the past has meant that pronounced differences remain among the R&D systems operating in the countries of the European Community. The intended opening up of public procurement markets by the end of 1992 could therefore lead to substantial distortions of competition among equipment manufacturers if considerable structural changes do not take place.*

In the telecommunications sector, research and development (R&D) activities are an important prerequisite for the ability to compete in the world market, particularly for the equipment manufacturing field. The R&D systems prevailing in telecommunications in different European countries have largely grown up in mutual isolation. As a result, different funding mixes for R&D have emerged drawn from the four sources of network operators, manufacturers, the government and research bodies. In some countries, R&D is primarily carried out or directly funded by the network operator, while in others it is chiefly the manufacturers which finance such work, getting back the costs via the price of the end product. If public procurement is now opened up in accordance with the Sectoral Directive on the awarding of contracts in the telecommunications sector issued by the European Community in September 1990, these differences may generate substantial distortions of competition among equipment manufacturers. Taken to the extreme, such competitive distortions could call into question the success of the single internal European market.

The Wissenschaftliches Institut für Kommunikationsdienste (WIK) has conducted a comprehensive survey, in collaboration with the Fraunhofer Society's Institut für Systemtechnik und Innovationsforschung, covering the systems of telecommunications R&D in ten countries.<sup>1</sup> This article will draw a comparison between the R&D systems in the EC countries of Germany, France, Great Britain, the Netherlands, Italy and Spain,<sup>2</sup> and outline worldwide trends in the structure of such systems. It will then look more closely at the EC's policy of opening up public procurement markets, before concluding with a

discussion of the tension between the traditional, national R&D practices and the complete opening of public procurement which is being aimed for by 1993.

National differences in R&D policy and in the regulatory and market structures of the telecommunications sector have inevitably meant that pronounced differences remain among the R&D systems operating in leading industrial countries. The relatively thorough isolation of national telecommunications markets in the past has helped maintain these in-grown peculiarities. However, now that markets are being liberalized and opened up to international competition, these traditional R&D structures too have been subjected to structural change. The structures roughly outlined below depict the situation in the respective countries in the mid to late 1980s, and some have undergone further changes since then due to the dynamism of developments.

## The Level of R&D Expenditure

Table 1 shows the level of R&D expenditure in six member countries of the European Community (The Federal Republic of Germany – D; France – F; Great Britain – GB; Italy – I; The Netherlands – NL; Spain – E). To start with, the level of R&D expenditure generally reflects the size of the country's economy. All the countries concerned spend a remarkably large proportion of their total national R&D budget on telecommunications. The

<sup>1</sup> The findings of the survey have appeared (or will shortly appear) in the following publications: H. Grupp, T. Schnöring (eds.): *Forschung und Entwicklung für die Telekommunikation – Internationaler Vergleich mit zehn Ländern*, in: *Schriftenreihe des Wissenschaftlichen Instituts für Kommunikationsdienste*, Vols. 9 and 10, Bad Honnef; parts of the project's findings also appear in Nos. 49, 51, 52, 54 and 59 of the "Diskussionsbeiträge des WIK" series.

<sup>2</sup> The other countries covered by the survey were Sweden, the USA, Japan and South Korea.

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proportion ranges from 5% in Spain and the Netherlands to 13% in France and Great Britain, and underlines the high priority currently accorded to the telecommunications sector in all countries.

In principle, surveys of civil telecommunications markets also need to take military R&D expenditure in the field into account, in as much as this also generates spill-over effects into civil areas. Interviews with companies brought to light examples of such spill-over effects, particularly in radio technology; as a whole, however, the view predominated that the pace and direction of technological development are both increasingly being determined by the civil sphere. For that reason, all consideration of R&D budgets below will be confined to civil telecommunications, but it should be borne in mind that both France and Great Britain spend a relatively large amount on military R&D in this field. In the case of the countries for which no information on the distribution of R&D expenditure was available, it is assumed that all expenditure occurs in the civil sector.

### The Role of Network Operators

There are substantial differences from one country to another in the size of the network operators' R&D budgets and the extent to which their activities in this area are dovetailed in with those of manufacturers, universities and research institutions. In addition, network operators exert substantial influence via their procurement policies, equipment standardization policies and other measures.

Figure 1 shows the proportion of R&D funding provided by network operators. There is considerable variation in this, the spectrum ranging from 60% in France to 7% in the Federal Republic of Germany. A relatively broad middle range lies between these two extremes where the differences are less pronounced and the funding share of network operators lies somewhere near the 20% mark.

The funding levels are not the same as the amount of R&D actually carried out by the network operators. In some countries, a large proportion of their R&D expenditure

goes to finance work carried out externally by manufacturers, universities and research institutions. Figure 1 also therefore shows what proportion of a country's R&D is carried out by its network operator(s). Readers will notice that France then loses its leading position to the Netherlands, while the contribution made by the Deutsche Bundespost is still the lowest.

External funding contributions made by network operators may be regarded as *one* indicator among a number of others as to the intensity of R&D cooperation or of quasi-vertical integration between network operators and manufacturers, and for the amount of influence the operators have over R&D conducted by other organizations. Nevertheless, the country studies do also show that there are many in which network operators bring their influence to bear upon manufacturers' R&D activities via other mechanisms, and in which there is close cooperation between the two sides. In academic discussions, the main arguments put forward in favour of an intensive R&D association between network operators and manufacturers are as follows:

- A vertically integrated system offers a better chance of being able to make use of the results of R&D, since it is often impossible to predict beforehand whether the R&D activities will be of greater benefit to the manufacturer or to the network operator.
- In order for new telecommunications systems to be developed, there has to be a permanent, intensive dialogue between manufacturers and network operators.
- In view of the pronounced increase in the R&D costs of new systems and of the high investment risk therefore involved, manufacturers need to have relatively secure expectations of future sales.

On the other hand, both our enquiry and others which have been conducted point to the problems which can be associated with vertical integration or with too close a link between the R&D activities of network operators and manufacturers. This restrains competition, and there is a risk that the development of new systems will be too closely tailored to the demands and specifications of the

**Table 1**  
**R&D Expenditure on Telecommunications, 1987\***

	D	F	GB	I	NL	E
R&D expenditure on telecommunications (in US \$ bn)	2.5	2.1	2.1	0.5	0.2	0.11
a) in the military sphere (in US \$ bn)	≈0.2	1.0	0.7	n.a.	≈ 0	n.a.
b) in the civil sphere (in US \$ bn)	2.3	1.1	1.4	n.a.	0.2	n.a.
R&D expenditure on telecommunications as % of total national R&D expenditure	11	13	13	6	5	5

\*Estimates; national currencies converted into US \$ at purchasing power parities.

network operator involved. As a result, the potential for exports may be impaired, whereas systems developed with an international orientation rather than one too closely shaped to the national network operator's specifications would improve export potential. Furthermore, because of the high R&D expenditure necessary for new, large-scale systems, most manufacturers need to rely on substantial foreign sales to make them pay.

The weight of argument either in favour of or against close R&D cooperation between network operators and manufacturers varies depending on the type of equipment or system. In the case of end-user equipment, the arguments in favour of close R&D association are less strong since the interfaces with the network itself are generally standardized and the R&D costs involved are relatively low. In the case of exchange and transmission systems, there is a much stronger emphasis on knowledge which is not accessible through interface standards alone, and the sheer amount of R&D expenditure needed is higher, which lends relatively more weight to the arguments for intensive R&D cooperation. The national R&D systems within the countries surveyed take account of these factors in as far as there is indeed generally a growing level of national R&D cooperation between network operators and manufacturers in proportion with the growing complexity of systems.

The R&D cooperation actually entered into on the ground between network operators and manufacturers takes a wide variety of forms. There are, for example, jointly owned R&D subsidiary companies. Alternatively, specific R&D tasks are contracted out to manufacturers by network operators, and the manufacturers are allowed to exploit the knowledge thus gained on third markets virtually at no extra charge. Then there are joint R&D projects involving both sides, facilitating the transfer of know-how and the sharing of R&D expenditure. Or else the network operators are paid to carry out pilot projects together with the manufacturers. In almost all countries, finally, there are joint working parties to draw up specifications for new systems, agreements on the exchange of patents, and so on and so forth.

The borderline between normal R&D cooperation involving separate enterprises and quasi-vertical integration between them are rather blurred, and difficult to discern either empirically or theoretically. The safer it is to assume that the cooperating businesses are following a single, uniform objective, the more justified it would seem to apply the term of quasi-vertical integration. Additional criteria are the durability and exclusivity of the cooperative arrangement in the R&D field.

Another aspect which needs to be taken into account when analysing the R&D policies of network operators is

that many governments pursue industrial policy objectives which they believe will benefit the manufacturers concerned by intervening in the R&D approach of their network operators without necessarily considering the latter's true future needs. This is relatively easy for them to do, given that network operators are frequently state-owned or at least state-regulated. Furthermore, the monopoly positions occupied by network operators mean that they usually have the financial means to expand their R&D expenditure beyond what would be the optimum level from the purely entrepreneurial point of view. Such "over"-investment in R&D can, with the help of the right transfer mechanisms for know-how, be placed at the disposal of the manufacturers and thus generate for them better export opportunities. De facto, there is currently no large national network operator anywhere in the world which has been exposed to intensive competition long enough to have developed what could definitely be regarded as competitively determined R&D behaviour. The "normal" level of R&D expenditure for a network operator therefore (unfortunately) cannot be empirically observed.

If measured in terms of external R&D expenditure, *France's* system of R&D shows a particularly pronounced degree of quasi-vertical integration. France Télécom has continued to dominate the national R&D system right up to the recent past. On the one hand, France Télécom has a major influence over all French telecommunications R&D by way of its own considerable R&D activities, joint projects with industry, development contracts awarded to domestic manufacturers, and the funding of research institutions and government research programmes. At the same time, France Télécom thus takes upon itself a substantial proportion of the technological and financial risks involved in R&D work, and is therefore also in a position to orient France's R&D system largely to its own needs and objectives. One has to remember that France Télécom is a government telecommunications authority and as such forms a constituent element in, and an instrument of, the French government's industrial policy strategy. In its approach to R&D, then, France Télécom not only follows its own goals but also industrial policy objectives relating to manufacturing industry. The structures underlying the French telecommunications sector are such that a certain share of France Télécom's monopoly rent must be presumed to be creamed off in order to fund R&D activities which serve the broader purposes of technological or industrial policy. As far as the purely commercial objectives of France Télécom itself are concerned, this situation can properly be regarded as a burden on the organization.

In *Italy*, too, the levels of actual and quasi-vertical integration are relatively high. The largest network

operator, SIP, and the by far the largest manufacturer in the field, Italtel, are both constituent parts of the state-owned IRI/STET group, along with a few other smaller network operators and manufacturers. The group has an R&D subsidiary, CSELT, which conducts a certain amount of research and development work for the other subsidiary companies. This means that the R&D activities of network operators and manufacturers are very closely intermeshed, and that the government, in its role as majority shareholder, is also closely involved. Thus the share of external financing provided by the network operators does not sufficiently reflect how tight the interrelationships are. Yet that has not meant that R&D activities also follow commonly agreed objectives. On the contrary, there are substantial amounts of overlap, and it has not therefore ultimately been possible to convert potential synergy effects into market success. This is shown, for example, by Italy's relatively weak position on the world telecommunications equipment market and the fact that Italtel has agreed to work together with AT&T, which many observers believe is ultimately attributable to Italtel's technological weakness.

### Negative Experiences

In *Great Britain*, the amount of external funding put up by the network operator British Telecom (BT) is now relatively small. However, BT does carry out substantial R&D activities of its own. Only a matter of years ago, BT was still substantially involved in joint R&D projects with the three large domestic manufacturers GEC, Plessey and STC, and BT also normally used to award development contracts to these companies for equipment items and for systems. A prominent example of such cooperation is the rather chequered career of the development of System X, the British telephone exchange system. BT has now largely moved away from the earlier model of cooperative system development under contract but under its own leadership, and the negative experience drawn from the System X project has played a considerable part in that. That has also been topped off by the changed regulatory environment in which BT now operates, which encourages it to stick more closely to its own corporate objectives. Thus the formerly close R&D cooperation or indeed quasi-vertical integration between BT and the country's major manufacturers has largely now disappeared.

In *Spain*, the network operator Telefónica funds one quarter of the national telecommunications R&D budget, but even though its activities have been considerably increased in recent years the R&D intensity remains relatively low. The organization's contribution of external funds for R&D work is also small. In practice, Telefónica plays an industrial policy role on behalf of the country's

manufacturers, and it holds shares in several such companies, most of which are majority-owned by foreign corporations. Telefónica has been making efforts for a number of years to strengthen the country's R&D capacity via such joint ventures with large foreign manufacturers.

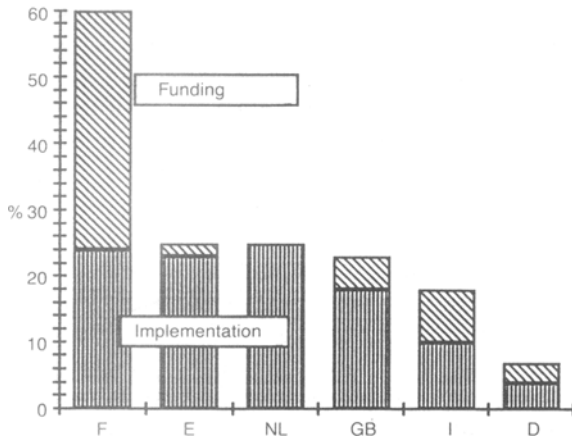
PTT Telecom BV, the network operator in the *Netherlands*, has traditionally carried out substantial internal R&D activities, essentially geared to its own aims. R&D cooperation takes place with the dominant Dutch manufacturer, Philips. There are also agreements between PTT and Philips to exchange patents, but the overall level of R&D cooperation between PTT Telecom BV and the domestic manufacturing industry would appear to be relatively low. Now that the Dutch portion of Philips' telecommunications equipment and systems division has been fully absorbed by the AT&T group, this suggests that PTT is likely in future to orient its R&D expenditure still more closely to its own business objectives. In the case of the *Netherlands*, then, there is only a low level of R&D cooperation between the network operator and the domestic manufacturing industry.

In the *Federal Republic of Germany*, both the internal and external contributions to the national R&D budget made by the network operator Deutsche Bundespost (DBP) are particularly low. From this point of view, the country represents the opposite pole to the French model. The DBP's telecommunications division, Telekom, generally pays indirectly for R&D input via higher procurement prices for equipment and systems rather than making direct, separate payments to the manufacturers concerned. Thus the volume of indirect R&D funding made by the DBP is crucially dependent upon the intensity of competition in its procurement markets. Despite the low level of direct financing it undertook, the DBP nevertheless exerted a substantial influence on the content of national R&D activities until the end of the 1970s simply by way of its procurement procedures. The idea was always to develop "postal service equipment", and possible sales opportunities on third markets did not play a significant part. To that extent, quasi-vertical integration did exist in the R&D field. At that time, the DBP's influence over the orientation of research and development was well in excess of what was apparent by looking solely at its contribution to R&D funding. In the meantime, new procurement procedures have led to increased innovative competition, and to a more pronounced opening of the domestic market to new suppliers from abroad. The pronounced quasi-vertical integration in R&D activities which used to exist between the DBP and national manufacturers has now fallen back to a low level. Even so, various elements of cooperation between the network operator and manufacturers continue to exist, via pilot

**The Financing of the R&D Budget in Civil Telecommunications, 1987**

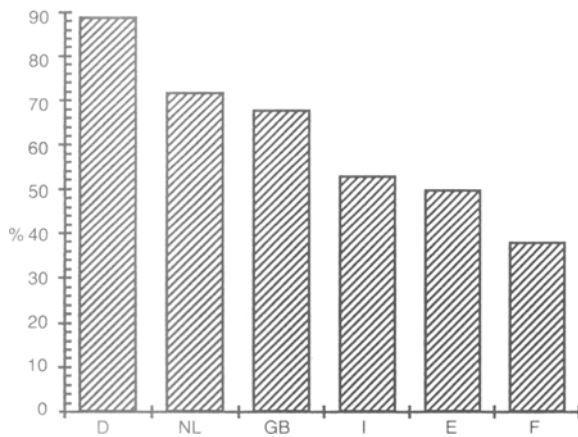
**Figure 1**

Proportion Financed and Implemented by Network Operators



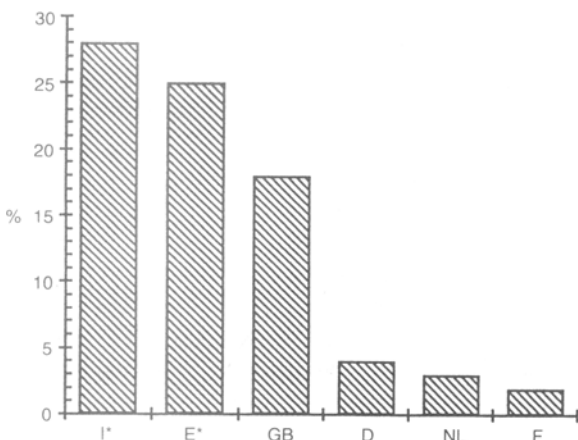
**Figure 2**

Proportion Financed by Manufacturers



**Figure 3**

Proportion Financed with Government Support



\* includes R&D for military purposes.

projects for example. All in all, though, the R&D carried out by the country's manufacturers does appear to be less geared to the requirements of the DBP than it used to be, and is oriented more strongly to those of foreign markets. As a parallel development, the DBP has now begun to expand its own direct R&D expenditure and its own involvement in the R&D field.

**Role of Manufacturers**

In all the EC countries surveyed, more than half of the research and development in the field of telecommunications equipment and systems is carried out by manufacturers. They also put up a large portion of the funds for that work. To that extent, manufacturers are very important in all the different types of R&D structure, but there are nevertheless major differences from country to country. The direct financial contributions made by manufacturers to the national R&D budget for civil telecommunications are illustrated in Figure 2. This places German manufacturers clearly at the top of the list with a funding share of almost nine-tenths. They are followed by the Netherlands and Great Britain where the shares are between three-quarters and two-thirds, while France brings up the rear with approximately two-fifths.

In reaching a judgement on the large structural differences apparent here, while one does need to bear in mind the uncertainties involved in estimating the size of the national R&D budgets and the shares of different funding sources, it still cannot plausibly be argued that the large differences between, say, France and Germany could be put down to statistical discrepancies. Moreover, the order in which the countries appear does largely fit in with the impressions gained from the qualitative aspects of the country studies.

**Role of Government R&D Support**

In most industrial nations, information technology is regarded as an engine of growth. Accordingly, governments generally encourage R&D in that field, including the telecommunications sector. The types of support given differ between countries, which makes it difficult to draw international comparisons. The main direct instruments used are direct R&D funding out of the government budget and the exertion of government influence on the R&D and procurement policies pursued by network operators. In addition, many countries have other promotional instruments for R&D available which are not specific to any particular sector, but they will not be dealt with in this survey. In their capacities as government administrative bodies or publicly owned enterprises, or because they operate in areas in which the normal rules of competition do not apply, most network operators are subject to state regulation, which presents governments

with a great deal of scope for influencing their market behaviour.

Figure 3 shows the financial contribution made by the state (N.B., not counting state network operators) to the national R&D budget for civil telecommunications. This shows that some direct financial support is provided in all countries. The figure is relatively large in Italy and Spain. In the other countries, by way of contrast, state support is often well under 10%. To judge from this comparative picture, the manufacturing industry in the first two countries could be expected to enjoy substantial competitive advantages thanks to government R&D support. However, there are a number of other aspects which need to be considered before coming to such conclusions.

The studies of individual countries have shown that not all government influence is necessarily tied up with government financial contributions. In France, the government exerts considerable influence over the R&D policies of the network operator France Télécom. In Spain, too, Telefónica is accorded responsibilities in the fields of technological and industrial policy. Until a number of years ago, industrial policy objectives also played a substantial part in the R&D and procurement policies pursued by the network operators in Great Britain and in Federal Germany. Now that the British telecommunications market has been liberalized and BT has been privatized, and since gradual changes have been brought about in the DBP's procurement policy in Germany, government influence and the financial support for R&D carried out by the manufacturing sectors in these two countries have declined.

To summarize, government support for R&D and government influence over the national system of R&D both appear to be especially pronounced in France. Although substantial government funding is provided in Italy and Spain, the efficiency of the R&D system as a whole is not regarded as very high. In the case of the Federal Republic of Germany and especially of Great Britain, government influence is now visibly in decline due to changes in the operating framework and procurement policies of the network operators. In the Netherlands, the state has long since largely refrained from getting involved in support for industrial R&D.

### Development Trends

Following a long period of stability, the telecommunications sector is now undergoing rapid structural change everywhere, and this is also affecting national R&D systems. The structures described above were those prevailing in the mid to late 1980s. Although the structural change is not occurring on a parallel basis in all countries, they nevertheless all have evident

developmental trends, and some of these will be addressed below.

R&D expenditure on new telecommunications equipment and systems has increased substantially. Manufacturers therefore need to rely increasingly on being able to market their new systems abroad as well as in their home markets. Especially among the large manufacturers, this has led to increased internationalization, both in their production facilities and in their R&D activities.

In the Federal Republic of Germany, the manufacturing business's R&D intensity as a proportion of turnover rose from 11% in 1979 to approximately 15% in 1987. That makes the industry one of the most R&D-intensive in the whole economy. The increase in development costs has been especially pronounced in the field of exchange and transmission systems. The development costs involved in a digital public telephone transmission system able to meet whatever new demands the network operators might make are currently estimated at US\$ one to three billion. Experts estimate that the major manufacturers constantly maintain a team of three to five thousand software developers for this area of public transmission networks. These enormously increased development costs are largely fixed costs, which manufacturers need to meet if they hope to secure a share of the future market. In view of the huge increase in development costs, the network operators are now less and less willing to completely reimburse—in one way or another—the basic development costs incurred by their preferred suppliers. That has generated increased pressure on the manufacturers to also sell their systems in other countries.

Many large manufacturers have tried to gain access to markets in other industrial countries, chiefly by taking over or buying major shareholdings in established foreign manufacturers. This has led to an internationalization of both production and R&D activities, a trend which is especially pronounced in Europe. However, there are considerable variations in the amount of progress manufacturers have made along this road. Among the largest, the only ones which can truly be considered to have been multinationals for many years are Philips and ITT (which has been part of Alcatel NV since 1987). They have long spread their R&D work across a number of countries, yet even then the national subsidiaries generally used to pursue substantially autonomous R&D policies to suit the national markets in which they were operating. Meanwhile AT&T, Siemens, Ericsson, GEC, Plessey and the Japanese manufacturers NEC and Fujitsu mainly concentrated their R&D capacities in their own home countries until recent years, mainly confining themselves to adaptive research in foreign markets. That

picture is now changing. At Siemens, for example, the internationalization of research activity has now progressed a long way as part of an expansive foreign strategy oriented especially towards the American market. Of the group's 7,000 R&D staff in its public telecommunications division, 39% were already working at foreign locations in 1990, putting the figure only slightly below the 44% share in the actual production field. Ericsson is currently establishing a major European R&D centre for mobile communications in Aachen. AT&T is utilizing the development capacity it has gained by purchasing a Philips subsidiary in the Netherlands to adapt its systems to suit the European markets. Similar developments are in progress in other major companies.

The changes in policies towards the institutional and regulatory framework of telecommunications markets in all countries are generally tending to intensify competition in the fields of telecommunications networks and services. Thus the formerly monopolistic network operators are now under growing pressure to orient their procurement and R&D policies more strictly to business criteria. In some countries, this has eased open the previously very close supplier relationships and cooperative R&D efforts with established domestic manufacturers and allowed new competitors into the market.

Among the countries where such trends have been in evidence are Germany, Britain and the USA. In France, too, there are signs that the prevailing R&D system, in which the dominant player was always France Télécom and the national market leader it "guided" was Alcatel-CIT, is likely to come under pressure now that Alcatel NV has been formed as an international manufacturing group. With 70% of its turnover now earned outside France, the Alcatel group will need to orient its R&D activity much more strongly than Alcatel-CIT used to do to the demands of foreign markets. Yet that in turn would call into question the leading role played by France Télécom and its own research institution, CNET. There are now quite a number of signs which suggest that the French R&D system will change in this way.

It is still difficult at present to draw any conclusions from an international comparison on what the "right" R&D policy might be for network operators in a competitive environment which are not vertically integrated. There is still no such thing as a market-determined benchmark for the volume and structure of the R&D activities of such an operator. In all countries, traditionally handed-down structures and government influence still play an important part.

It is interesting to note that cross-border R&D cooperation between European network operators has

now increased as a result of EC research and development programmes (especially RACE). This trend will be given a further boost by the initiative taken in 1990 which has now been joined by 23 European network operators, to establish a joint European Institute of Research and Strategic Studies (EURESCOM) which will be based in Heidelberg. Thus the European network operators can be seen to be internationalizing their R&D work, albeit to a considerably lesser extent than their counterparts in the manufacturing sector.

**EC Support for Internationalization**

There has been a tendency since the mid-1980s, spurred on by the EC Commission, for government R&D support in Europe to be organized on a more international basis, and that applies equally to telecommunications. The aim of such supranational support is to generate international R&D cooperation among manufacturers, network operators and research institutions in Europe, and as such it serves to reinforce an already existing trend. In Federal Germany at least, purely domestic R&D support has been declining in significance since the end of the 1980s.

The EC's RACE programme has backed a large number of cross-border R&D projects in European telecommunications. That is probably a more important factor in the programme as far as the future of European R&D systems is concerned than the actual amount of money involved, which is relatively small. During the programme's first five years (1988-1992), the sum available from RACE to all countries combined is DM 220 million. Germany's Federal Ministry of Research and Technology (BMFT) was spending an annual sum of about DM 140 million on national research promotion at the peak of its activity in the mid-eighties in the telecommunications field. Since then, however, the ministry has substantially reduced its support.

The overall tendency is for the relatively isolated national R&D systems which prevailed in the past to give way increasingly to cross-border R&D activities undertaken by multinational manufacturing companies. In the manufacturing sector, the structures are now

**Table 2**  
**Import Ratios in Cable Communications (%)**

	1981	1985	1989
Federal Rep. of Germany	5	6	21
USA	4	12	19
Japan	2	3	6

Sources: US Department of Commerce: US Industrial Outlook; The Telecom Tribune; Zentralverband der Elektrotechnischen Industrie: Statistische Berichte; own calculations.



beginning to form a similar pattern to that of other branches of industry which are both R&D-intensive and subject to oligopolistic competitive conditions on the world market. Beyond that, a finely meshed international network of cooperation involving manufacturers, network operators and research institutions is also developing. The latter trend is already quite far advanced in Europe, but can also be seen to be occurring elsewhere.

### Public Procurement Markets

For many years, the large extent to which telecommunications markets in the industrial countries were walled off meant that world trade and an international division of labour in the field of telecommunications equipment and systems were relatively underdeveloped. Since the end of the 1970s, world trade has shown above-average growth compared to the growth of the market as a whole, and trade patterns are beginning to resemble those in other comparable sectors. This trend has already moved considerably further in the field of end-user equipment than in network equipment and systems.<sup>3</sup> This difference is associated with higher barriers to market entry in the area of network devices, both of a technical and of an economic nature. However, this also continues to be partly attributable to procurement policies on the part of network operators which favour domestic manufacturers, even though the operators' scope for conducting such procurement policies is declining due to technical and economic trends and to changes in their regulatory environments.

Quite some progress had been made in opening up the West German market by the end of the 1980s, with sharp increases not only in the absolute volume of imports in the telecommunications sector but also in their share of the

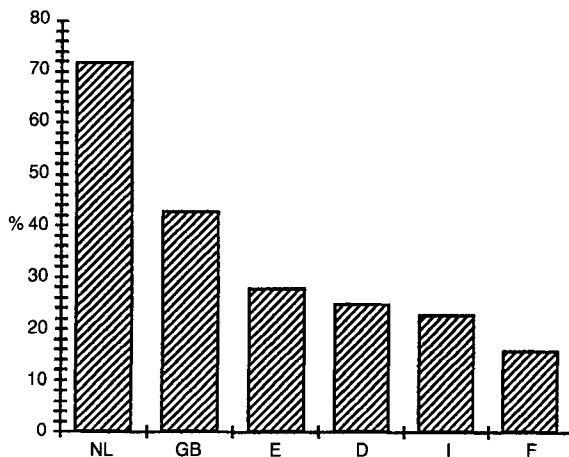
market. By 1989, that share had risen to 30%, from just 18% in 1985. There has also recently been a strong increase in Germany's imports in the field of cable communications, which includes exchange and transmission networks. In the latter area, readily comparable data are available on the import penetration in Federal Germany, the USA and Japan. In the mid-1980s, import penetration in Germany was still well below that of the USA, but the reverse is now the case, while Japan's rate of import penetration has maintained its traditionally low level (see Table 2).

Figure 4 shows estimates of import penetration in the six EC countries surveyed. The calculations are based on import statistics gathered by the EC Commission's Directorate XIII and estimated market volumes provided by EUROSTRATEGIES. Because the delimitations used by the two sources are not perfectly comparable, care is also needed in comparing the estimated import shares. Nevertheless, the picture which emerges is in line with expectations: The Netherlands, with its relatively small domestic market, has the highest import rate, the largely liberalized British market has the highest among the larger countries, and France's level of import penetration is clearly the lowest.

### The EC's "Sectoral Directive"

The telecommunications field is still expressly excluded from any *legally binding* regulations on opening up markets included in international agreements governing public contracts under the auspices of the GATT or within the EC. In the past, the fact that the technical specifications of the systems are almost invariably nationally determined always provided a substantial argument for excluding telecommunications from such international agreements. Opening up the public tendering procedures applying to telecommunications by force of legal regulations can only actually bring economic benefits if there is simultaneous progress in the process of international standardization. With this in mind, the EC Commission is pushing ahead on a parallel basis with the development of European standards and the opening of public procurement markets.<sup>4</sup> The Community has been endeavouring for some time, with the aid of a number of different instruments, to make its telecommunications markets more open, with the aim of creating a single internal market in telecommunications equipment and systems by the end of 1992. On the one hand, it is

**Figure 4**  
Estimated Import Ratios for  
Telecommunications Equipment, 1987



<sup>3</sup> W. Neu, T. Schnöring: The Telecommunications Equipment Industry, Recent Changes in its International Trade Pattern, in: Telecommunications Policy, Vol. 1, 1989, pp. 25 f.

<sup>4</sup> In October 1990, the EC Commission published its own green paper on the development of European standards and measures for more rapid technological integration in Europe.

especially important to open up the markets for public network infrastructure technology, for they account for approximately half of the overall equipment market, yet on the other, this is considerably more difficult to achieve than in the fields of end-user equipment and private infrastructure systems because of the technical, economic and regulatory circumstances involved. The EC has therefore been making efforts for some years now to motivate public telecommunications services to internationalize their purchasing policies.

An EC recommendation on the first phase of market opening in public telecommunications equipment and systems came into operation at the beginning of 1985. It provided that member countries' telecommunications services should make known their requirements for all new *end-user* equipment and for all existing end-user equipment with common specifications beyond their own borders, and that at least 10% of the remaining requirements in the telecommunications field should be put out to tender by entry in the supplement to the EC Official Bulletin. Individual governments are also required to report to the EC Commission on the progress they have made in implementing the telecommunications recommendation. Unfortunately, however, we are not aware of any Commission reports which compare the situations in different member countries.

The prevailing impression among the managers at the DBP's Telekom division who have kept an eye on the practices of other public-sector network operators in recent years is that they have not all been complying with the recommendation. In line with its procurement objective of opening up the market to international suppliers, the DBP itself has increasingly invited tenders from abroad, exceeding the target level in the EC recommendation from year to year. However, the initial reaction from new foreign competitors was very limited. As time has gone on though, more firms from abroad have at least begun to submit tenders and a small number of orders have resulted. Particularly in the field of network systems, the technical and economic barriers to market entry are very considerable, and foreign competitors need time to build up their confidence that their bids will be given "objective", equal treatment by the network operators before they are seriously prepared to join in the fray.

Since September 1990, a so-called Sectoral Directive has been in operation (Council of Ministers Directive dated 17th September 1990 on the Awarding of Contracts by Contractors in the Sectors of Water and Energy Supplies, Transport and Telecommunications). This lays down tendering rules for telecommunications networks and providers of telecommunications services with special or exclusive rights, provided the contract value is above a

certain threshold (currently ECU 600,000). Among other matters, the regulations apply to the procedures for inviting tenders and awarding contracts, and also to the observance of European standards. One part of the directive which is particularly controversial from the trade policy point of view is Article 29, which permits discrimination against products if they are predominantly manufactured outside the EC and holds that preference (albeit only a slight one) should be granted to the products of European manufacturers. The directive is addressed to the member countries, which for their part have to take the necessary measures at a national level, by July 1992 at the latest, to implement its provisions. In the remainder of this article, the contents of the directive will only be gone into to the extent that this is necessary for the discussion of the implications of the desired opening of markets, taking into consideration the differences between R&D systems from country to country.

### Opening up the European Market

Given the rapid pace of technological change in telecommunications, it is beyond dispute that R&D activities – whether in terms of their volume, orientation, efficiency or how they are funded – are an essential determining factor for the competitiveness of telecommunications enterprises, especially in the manufacturing sector. This is why it is important to consider what effects the large differences between different countries' R&D systems within Europe will have on the competitiveness of European manufacturing companies in the single internal market which is planned to become operative in 1993. The question is a complex one and therefore difficult to answer, especially since its concentration upon Europe represents a quite considerable restriction in the face of the growth of world market competition and the strength of companies such as AT&T, Northern Telecom, NEC, Ericsson and others. It is intended nevertheless to address the question in this limited context below, as it is of considerable import as far as EC policies are concerned.

We saw earlier on that there are conspicuous differences in the way R&D expenditure is funded between France and Germany. As these two countries are also home to Europe's two largest manufacturing companies, Alcatel and Siemens, the remarks below will be confined to France and the Federal Republic of Germany.

R&D expenditure represents an investment, with some degree of risk, in future competitiveness. The share of overall finance put up by manufacturers is an indicator of the extent to which manufacturers carry R&D costs and their associated risks. In this sense (purely) German manufacturers participate to a substantially greater extent

in the costs and risks of R&D than their French competitors. Under otherwise equal conditions, a higher share of financing means a disadvantage for manufacturers on international markets, because they need to recover their higher cost burdens by charging higher product prices. This indeed is the argument which has repeatedly been put forward by German manufacturers when discussing the EC's single internal market, with an eye to their competitors from France. In principle, they are right, but their position has to be put into perspective because the assumption that "other conditions remain equal" does not reflect the situation in reality.

### **The German Situation**

As long as the German market remained largely protected from import competition and all domestic suppliers were operating under comparable conditions, there was also no distortion of competition on third markets, as German manufacturers recovered their R&D expenditure by way of high domestic prices. This was essentially the relationship which existed between the DBP and the manufacturing business until the end of the 1970s. Since then, the DBP has increasingly endeavoured to encourage potential and actual competition from new, foreign manufacturers. In future, the sectoral directive will force the markets to be opened up, at least to the extent that a directive is capable of so doing. Step by step, then, the situation will change for purely domestic manufacturers. In theory, foreign competitors which have their basic development costs for a new system paid for them in their home markets would be able to bid for contracts put out to tender by DBP Telekom simply on the basis of their systems' adaptation costs, which under the normal rules of supply and demand would tend to push down the domestic price level. That would present difficulties for domestic suppliers when it came to recovering their basic development costs by the traditional means of incorporating them into the product price. Domestic manufacturers are afraid that this could happen, especially Siemens now that its largest domestic rival SEL belongs to the French Alcatel group and, at least in the medium term, has the prospect of reaping benefits from the French R&D system as a result. Although logical in itself, this line of argument nevertheless fails to consider a number of factors which are important as far as the real situation is concerned.

New competitors from abroad need to surmount considerable barriers to market entry before they could bid for DBP Telekom contracts with any chance of success. The pure development costs of adapting systems together with other costs of entering the new market are very high where network systems in particular are concerned. Thus

attempts to enter the market by new competitors carry a relatively high risk, and in the short term at least one would not expect there to be any major shifts in market shares. The initially guarded reaction by foreign competitors to international tender offers in the EC Official Bulletin are proof enough of that. At least for the time being, then, domestic suppliers will still be in a position to keep up the domestic price level and to recover their basic development costs. One can only speculate as to how long "the time being" will actually be. Hardly any estimates are publicly available of how high the absolute costs of market entry are. At any rate, experts are agreed that they will decline over time as the internationalization of industry standards, especially in Europe, proceeds. Provided that Telekom's purchasing policy is genuinely internationally oriented, there will thus be an increasing threat of new competitors entering the market, which in turn will add more weight in future to the argument that competition is being distorted.

### **The French Situation**

As shown earlier, the French R&D system is at the opposite end of the spectrum to its German counterpart. A point which needs to be considered in the discussion of the problem of distortions to competition is that the heavy direct involvement of France Télécom in R&D expenditure goes hand in hand with a powerful degree of influence over the course such development work takes. That harbours the danger that R&D work will be specifically oriented to the French market, which may have a lasting negative effect on sales opportunities in foreign markets. It is therefore to be expected that the formation of the Alcatel group will place the existing French R&D system under pressure and that it will therefore change substantially in future. The new group currently generates about 70% of its revenues outside France, and it is the requirements of these markets to which it will need to orient its R&D policies much more strongly in future. The group is therefore no longer in a position to accept the dominance of France Télécom within the French R&D system to the same extent as has previously been the case unless it is prepared to jeopardize its market chances abroad. For France Télécom's part, it too will probably call into question whether it ought to continue its traditional R&D policies, especially if the French postal reforms lead to France Télécom behaving more in line with entrepreneurial objectives. All in all, the development trends outlined above suggest that the close vertical R&D cooperation between the network operator and manufacturers will also be relaxed in France, and the signs are that it is already happening.

Yet another aspect ought also to be addressed which is likely to cast the problem of distortions to competition in a

different light at least in the medium term. In the manufacturing sector, there is a clearly pronounced trend among all the large groups to place all of their activities, including R&D, on an international footing. In this way, these corporations are gradually integrating themselves into several different national R&D systems at a time, with the various advantages and disadvantages each one entails. That does not of course go to say that all major manufacturing groups will in future be on an equally good or equally bad footing in this area. The preferential relationships with network operators currently enjoyed by AT&T, Northern Telecom, Ericsson, NEC and others will continue to have an influence on the course of R&D work and hence on the competitiveness of the manufacturers concerned. However, the conception of purely national manufacturers, on which the argument about distorted competition is based, will in the long term be rendered increasingly specious as these changes continue, and indeed this is partly already the case today.

In order to reach an overall judgement on whether the differences in the way R&D is financed from one country to another will have consequences for the competitive position of national manufacturers as the single European market approaches, it is necessary to weigh the various arguments against each other. That cannot be done with any ultimate certainty here. Given that proviso, it does appear that the differences in the size of financial contributions made by manufacturers in various EC countries, and especially those between France and Germany, are severe enough to give rise to substantial distortions to competition, even if there are a number of arguments which would tend to mitigate the severity of these effects.

In principle, the problem has been recognized by Germany's federal government.<sup>5</sup> During EC consultations on the sectoral directive, the government also stressed the need to take the differing R&D funding structures in the telecommunications sector into account, but it was not able to assert its position. Under the sectoral directive as it now stands, there exists at best the possibility of interpreting certain forms of R&D funding by network operators as government subsidies in the sense of Article 27 (5), which under certain circumstances can mean that a prospective client inviting tenders can turn down bids which appear to be unusually low. However, that assumes that network operators are willing to adopt such procedures, and one might ask why they should do so in times of generally increasing competition. They are required to adhere more firmly than before to strictly

business criteria in their corporate planning, and hence also to purchase equipment as economically as possible. This author also believes it would be wrong to suggest to DBP Telekom that it ought to follow such legal procedures since establishing fair competitive conditions is primarily the task of the federal government and the European Community, not of a telecommunications business trying to follow entrepreneurial goals. Thus it is consistent that, since the postal reforms, Telekom is aiming to increase the international dimension of competition in its procurement markets, to enable it to buy at lower prices.

In this situation, the EC Commission ought really to be thinking along the following lines: if there is any substance to the argument set out in this article and elsewhere that the major differences among EC countries in R&D funding in the telecommunications sector are significantly distorting competition among manufacturers, then it is conceivable that less efficient manufacturers may drive out more efficient ones as a result of the opening of markets; but if that indeed happened, it would be counter to the objectives of the single internal market which the sectoral directive is actually intended to help bring about, and it would also be detrimental to the EC Commission's declared aim of preserving and encouraging a European manufacturing industry which would be competitive in the world market of the future. For these reasons, at least now that it has issued the sectoral directive the EC Commission ought to look into the problem of different national R&D funding systems by making appropriate investigations.

One last remark in conclusion: there is a close interrelationship between competition among networks and services (as these are deregulated) on the one hand and competition among different types of telecommunications equipment and systems on the other. The competitive situation applying to network operators (in their own sales markets) is one of the factors which help determine their capabilities of engaging in competition-distorting practices in the equipment and systems markets upstream of them, including the R&D field. Whether such practices are generated by government industrial policy measures or by the self-interest of a vertically integrated network operator and manufacturing group earning a monopoly rent on the network and services side which is then used to subsidize the manufacturing side internally, is of no great consequence. Empirical enquiries can attempt to bring such competitive distortions to light, thus contributing to the formulation of new economic policy measures. Nevertheless, the best insurance against such practices is to establish as intensive a competition as possible among the networks and services in all countries which will also, or indeed will especially, be in the interests of the manufacturers.

<sup>5</sup> Federal Ministry of Research and Technology (BMFT) and Federal Ministry of Economics (BMWi): *Zukunftskonzept Informationstechnik*, Bonn 1989, Section 8.2.