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**Working Paper**

## Science in East and West: Transformation and integration of the East German science system

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**Science in East and West:  
Transformation and Integration of the East  
German Science System**

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Paper presented at the 4S Conference on "Science, Technology and Multiculturalism"  
New Orleans, 12-15 October 1994

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## **Abstract**

In the GDR, science was largely oriented on underpinning political objectives and in particular on promoting the economy. On the basis of a linear model of research and innovation processes, a specific hierarchically structured organizational and management structure for research was created and integrated into the overall centralist state management system. In the process of German unification, efficient nuclei of this research system were to be retained and integrated into a new science system for the whole of Germany on the West Germany model.

Although the transfer of institutions from West to East has largely been completed, research in East Germany differs considerably from that in West Germany in both quantitative and structural respects. The decline and structural deformation of industrial research is a particular obstacle to resuscitating academy-industry relations, and displays the mark of 'peripheral development' in East Germany.

## **Zusammenfassung**

In der DDR war die Wissenschaft weitgehend auf die Unterstützung der politischen Zielstellungen und insbesondere auf die Förderung der Wirtschaft orientiert gewesen. Ausgehend von einem linearen Modell von Forschungs- und Innovationsprozessen war eine spezifische hierarchisch gegliederte Organisations- und Leitungsstruktur der Forschung geschaffen und in das staatliche zentralistische Leitungssystem eingebunden worden. Im Prozeß der deutschen Vereinigung sollten leistungsfähige Kerne dieses Forschungssystems erhalten und in eine neue gesamtdeutsche Wissenschaft, die nach bundesdeutschem Muster gestaltet ist, integriert werden.

Obwohl der Institutionentransfer von West nach Ost inzwischen weitgehend vollzogen worden ist, weist die Forschung in Ostdeutschland erhebliche quantitative und strukturelle Unterschiede zu der in Westdeutschland auf. Insbesondere der Niedergang und die strukturelle Deformation der Industrieforschung behindern die Wiederbelebung von Akademie-

Industrie-Beziehungen und lassen in Ostdeutschland Merkmale einer "peripheren Entwicklung" erkennen.



## 1. Features of the Science System in the German Democratic Republic

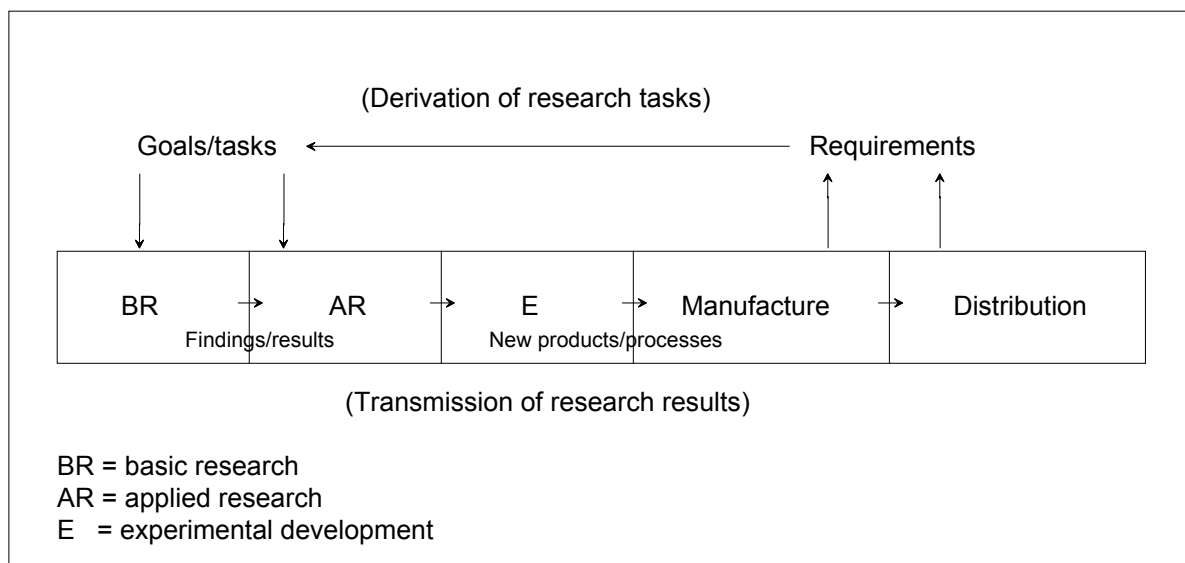
Since the Second World War, two completely distinct science systems developed in Germany, differing in size, structure, international integration and mode of functioning. Whereas in West Germany a strongly differentiated system with functionally specialized and mostly autonomous institutions emerged, East Germany science was characterized by hierarchical structures and the endeavour to integrate various functions.

In East Germany or the German Democratic Republic (GDR) it was a consistent political aim to bind scientific endeavour to economic activities as closely as possible<sup>1</sup>.

GDR policy was dominated by ideologically determined conceptions of a linear model of innovation. This conceived of utilizing the "productive force science" especially along a chain from basic research to production (SED 1971: 60). Primacy in this chain was assigned to production. The originally linear innovation model was later to be modified by including "feedback" in the derivation of research tasks (cf. Schema 1).

### Schema 1: Linear model of research and innovation

(taking into account feedback in the derivation of research tasks)

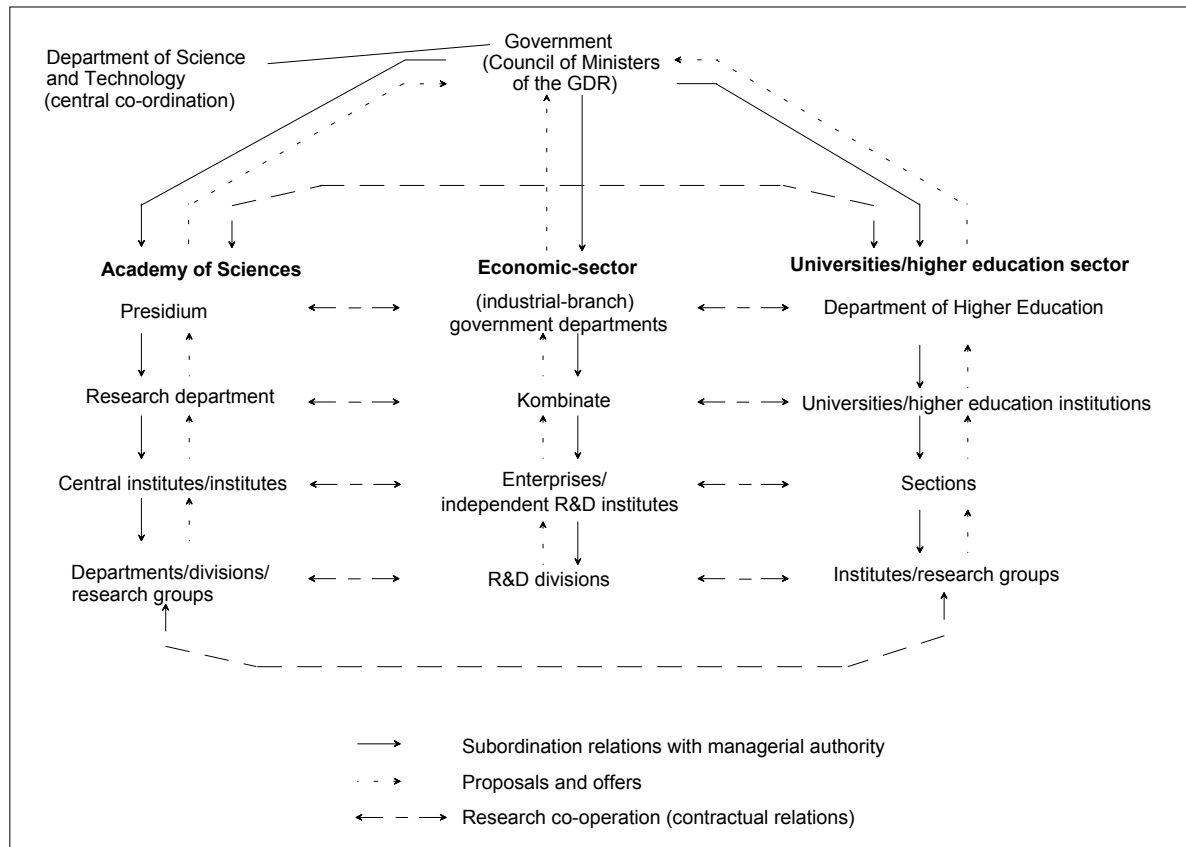


The consultation and co-ordination requirements in putting this innovation model into practical effect were to be met by providing adequate management structures in the economic and scientific sectors. The entire management system of the GDR was accordingly constructed in the form of a pyramid. Both the economic and scientific sectors were integrated in this management system. Similar hierarchies with managers of equal

<sup>1</sup> In investigating the "structure and functioning of industry-oriented research at the Academy of Sciences under the research policy conditions of the GDR", these characteristics, the changes they experienced and the special situation in the eighties were thoroughly analysed. It was established that the entire development of the Academy of Sciences in the GDR was marked by the endeavour to harness its potential to political and state goals. Consequent upon these efforts, a partial integration of fundamental research and applied research in GDR institutions did indeed occur (Meske et al. 1993).

rank were established within industry and science. Structural preconditions were thus created that were intended to provide centrally organized and controlled (especially by research programmes and by means of resource allocation) horizontal linkage between the various vertical management lines in industry and academy (cf. Schema 2).

**Schema 2: Centralized management and co-operation system of research and innovation in conformity with the "principle of democratic centralism" in the GDR**



Such links were established at all management levels. For the most part they were prescribed by law for both parties. The task of upper management echelons was especially to ensure longer-term "strategic" orientation through consultation and by co-ordinating activities; lower levels (institutes and enterprises) provided the actual co-operation between the institutions concerned, usually on the basis of contracts.

In order to perform the social tasks of science, especially its productive force function, R&D capacities in the GDR were expanded with relative continuity in both the academic sector and in industry. As indicated by a comparison between data on the GDR calculated in accordance with OECD methods and figures for R&D staffing levels in the Federal Republic of Germany in 1989, the German Democratic Republic had an R&D workforce comparable in size to that of the Federal Republic if the figure is weighted in terms of population and total employment (cf. Table 1).

**Table 1: R&D personnel in the two German states (1989)**

	FRG	GDR		Structural comparison to the FRG
	1,000 full- time equivalent	1,000 full-time equivalent	percentage of FRG	percentage (33 in col 3 = 100)
university R&D	55	14	25	76
non-university based research	51	32	63	191
industrial R&D	297	86	29	88
R&D in the humanities and social sciences	22	8	36	109
total R&D	425	140	33	100
employed (million)	27.8	9.9	36	
population (million)	62.1	16.6	27	

**Source:** Own compilation on the basis of SV Wissenschaftsstatistik 1990; BUFO 1993, Statistisches Jahrbuch 1993, Employment Observatory East Germany 12/1994

The structural differences, evidencing in particular an above average proportion of non-university research, are to be interpreted against the background that a considerably higher proportion of total R&D personnel were in fact employed under commission to and in the interests of industry. If the high figure for contract research is taken into account, the relative disadvantage of the GDR vis à vis the Federal Republic in the economic sector (61 per cent to 70 per cent of R&D personnel in industry) is at least offset, even if West German contract research is placed in the balance, since personnel allocation in favour of GDR economy then totals 76 per cent. A further characteristic was that personnel engaged in R&D in the GDR disposed of considerably lower financial and material resources. For the GDR this had a baneful effect not only on the functioning and efficacy of R&D activities in all sectors, but also on goals and not least of all on results of RaD.

## **2. Restructuring the economic and academic sectors of RaD in East Germany - macro and meso-structural changes 1990 to 1994**

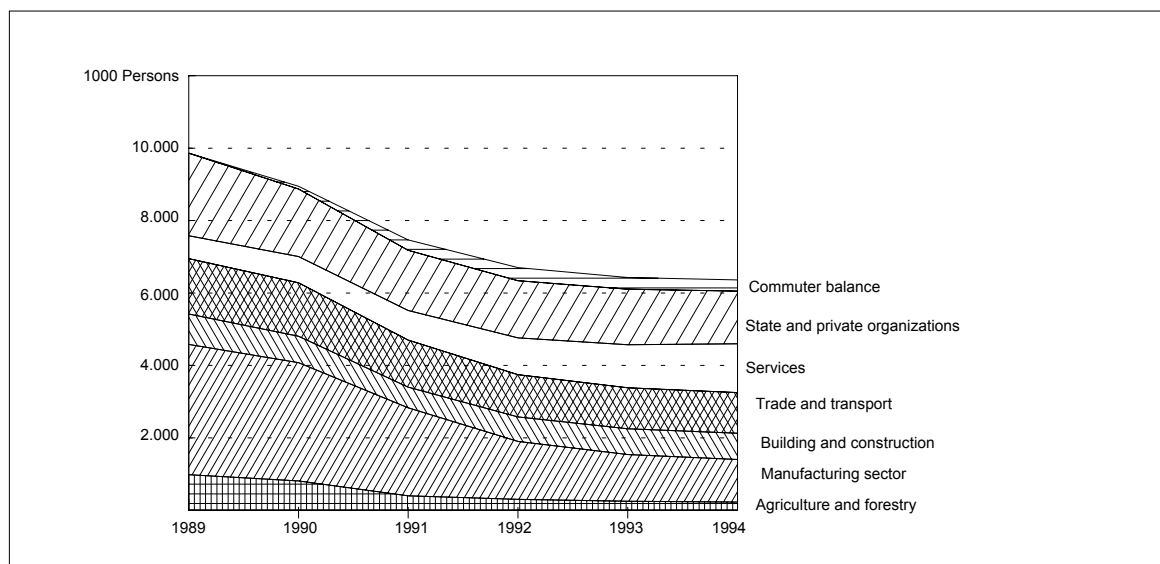
Following the political upheaval in late 1989, 1990 brought vital changes to the societal system of the German Democratic Republic. They began in the first half of 1990 with changes to the political system and in the management of state and economy. With the introduction of the Deutsche Mark as currency from 1st July 1990, change entered a qualitatively new stage. Finally, the accession of the German Democratic Republic to the Federal Republic of Germany on 3 October 1990 led to the integration of East Germany into the fundamentally differently structured societal system of the Federal Republic.

The "transfer of institutions" from West to East was intended to create the necessary underlying conditions for establishing a system of society in the "new federal states" analogous to that existing in the "old federal states". Although the transfer of institutions within the last four years has progressed quite well, it has not led to a fully integrated

German science system (Meske 1993). Precisely the simultaneity of change in all areas of society and at all "levels" has since shown itself to be a particular obstacle in the process of restructuring East Germany. Especially in the economic and academic sectors "structural breaks" occurred at all levels. Here, some facts and figures as an illustration of these changes.

The effects of the unique constellation of national economic, operational, and economic policy reorganization become evident in the decline in employment in East Germany since 1989 to about 64 per cent. This decline was most marked in industry: of 3.2 million persons in employment in 1989 only about 1.0 million or less than one third still had a job in 1994. With a share of only about 17 per cent (compared with 33 per cent in 1989) of total employment, this amounts to de-industrialization (cf. Ill. 1).

### Ill. 1: Development and structure of employment in East Germany 1989 to 1994

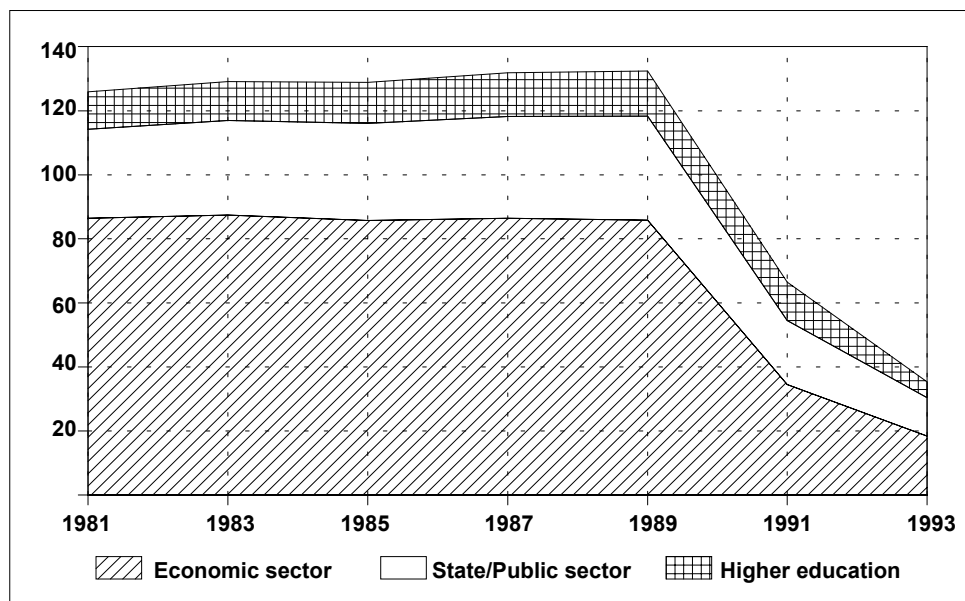


Own compilation after IWH 1993: 46

In line with the changes in total employment, between 1989 and 1993, the number of RaD staff in East Germany was reduced to 30% of its initial figure (cf. Ill. 2).

### III. 2: RaD personnel in East Germany 1981-1993

(calculated by Frascati-Manual; 1.000 FTE)



Source: SV Wissenschaftsstatistik 1990: p. 48; SV Wissenschaftsstatistik 1993: own calculation

In relation to the total number of people employed in the economy, the level of employment in RaD in East Germany has already fallen below 50% of its West German equivalent, whereas, in 1989, there were no major differences in the ratios for the two states.

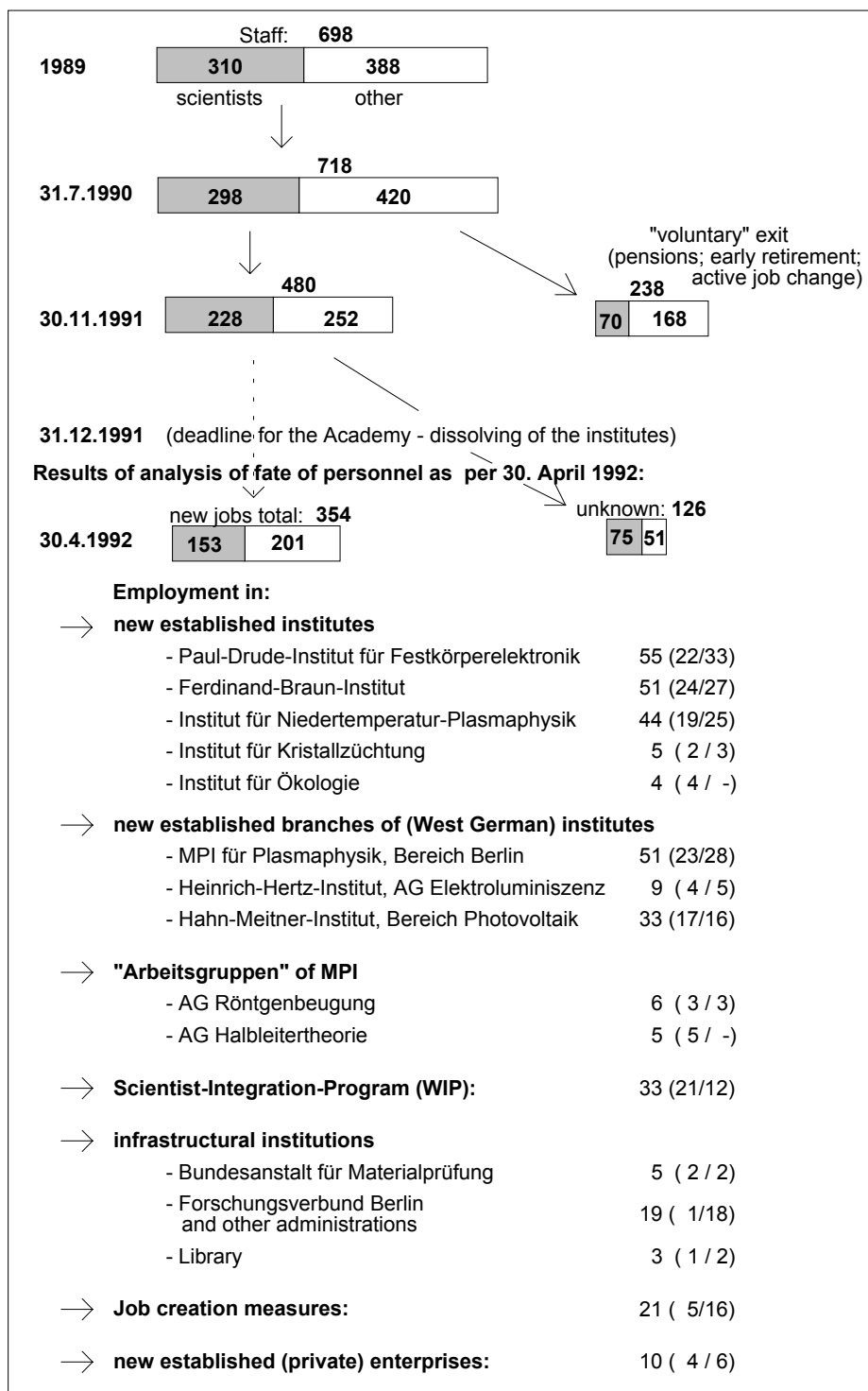
#### Academic science

In the sector of publicly financed non-university research (NUR) in the period between 1991 and 1993, fundamental institutional changes were affected by the dissolution of all former academic institutions of the GDR and the establishment of new institutions on the organizational pattern of the old federal states. This led to a drop in sectoral R&D personnel to less than a third of the original level i.e., from originally about 40,000 (of whom 32,000 were R&D staff, calculated in accordance with OECD methods) to about 12,500 in the newly set up institutions (including some 10 per cent from the old federal states).

The outcome is a research sector comparable to that existing in the old federal states only in terms of the number of persons employed.

Structural changes going far beyond the dissolution of old institutions and the creation of "successor institutions", and affecting even the intra-organizational and personnel structures of the new institutions. Only in a few cases were "core areas" or entire research groups from earlier institutions taken over by the new institutions. Old institutes were not only split up and individual divisions spun off (see Schema 3), but new institutions were set up by bringing together research groups from different institutes.

**Schema 3: Reorganisation of one institute of the Academy of Sciences of the GDR: the fate of its staff (case: Zentralinstitut für Elektronenphysik Berlin)**



Own compilation on the basis of information by C.-G. Schulz

To some extent, the new institutions were constituted on a completely new basis by individual members of staff from several former academy, industry and higher education facilities (Höppner 1994). Also the structure in terms of types of organizations is substantially different from that in the old federal states. In East Germany, the major

research facilities (Großforschungseinrichtungen, GFE), the Max Planck Gesellschaft (MPG), and the government departmental research institutions have a far lower proportion of non-university research personnel than in the old federal states. By contrast, the Fraunhofer Gesellschaft (FhG), the federal states institutes and especially so called Blue List (Blaue Liste) institutes (jointly financed by the federal government and the government of the state in which they are located, and mostly integrating basic and applied research in a special research field of national and regional importance) have a far higher proportion (cf. Ill. 3).

**Ill. 3: RaD personnel in the non-university sector in the old (OFS) and new federal states (NFS) according to research organizations (1992)**

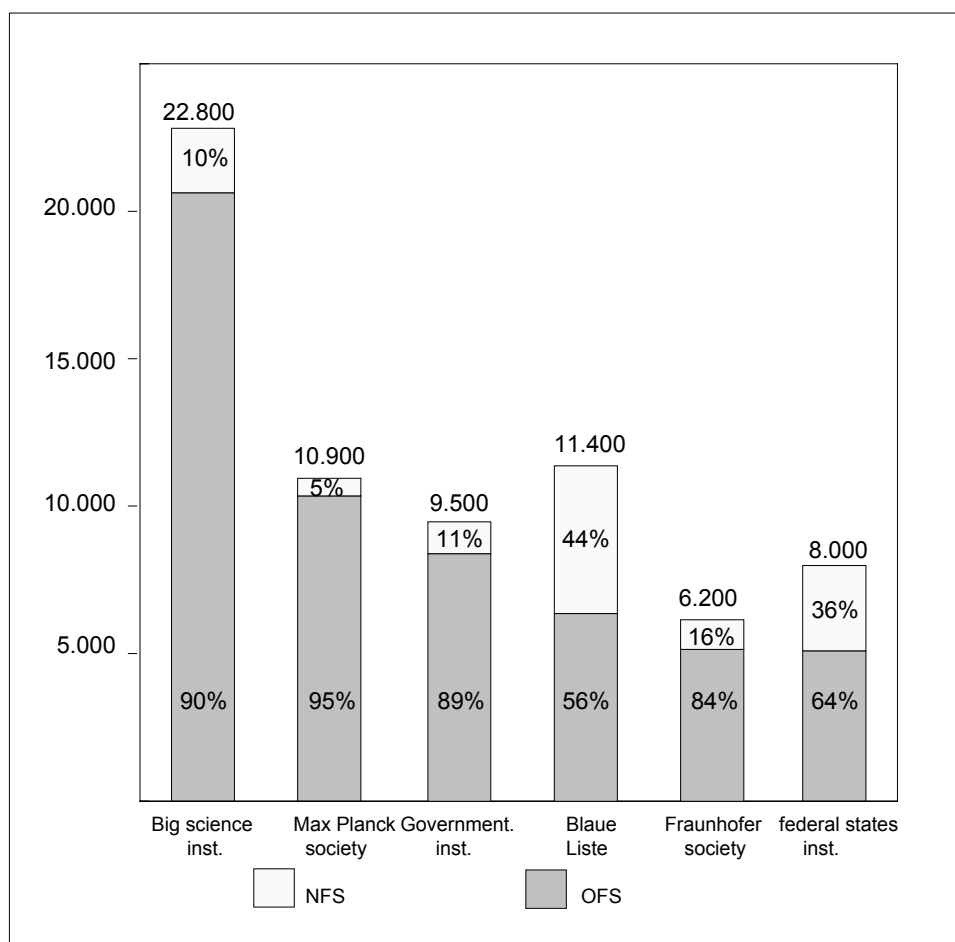


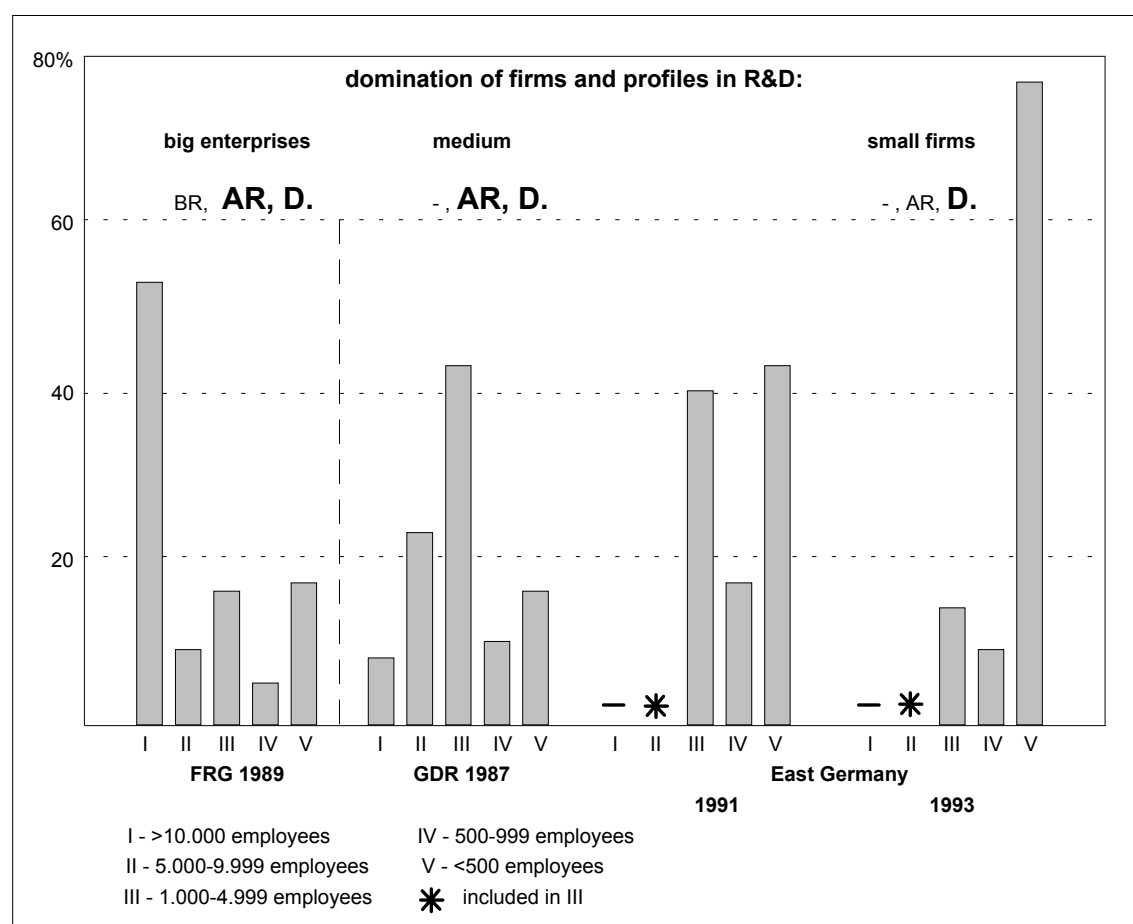
Illustration 3 demonstrated not only the differences in this structure between East and West Germany but also differences between the proportions in the "old" Federal Republic and the situation in the unified Germany. As a result of these structural changes new tensions between the different organizations have been emerged, especially between the MPG and the FhG on the one side and the Blue List Institutes on the other one.

## Industrial RaD

The greatest cut-back in RaD personnel was in the industrial sector. Staff reduction had already begun in 1990 with the decentralisation and collapse of the East German economy. The trend was reinforced by the introduction of the West German currency in July 1990.

The reduction of RaD staff has altogether been larger than the considerable cut-backs in overall employment. The reduction of the total industrial RaD personnel was connected with significant changes in its structure by size of firms: In the GDR, large-scale enterprises with a workforce of more than 5,000 provided 31.4 per cent of total R&D personnel in industry; firms with fewer than 1,000 employees provided only 26 per cent (SV Wissenschaftsstatistik 1990: 32). In the old federal states, the concentration is even greater: in 1989, enterprises in the West with a workforce below 1,000 provided only 21 per cent of total R&D personnel, whereas large-scale undertakings with over 10,000 employees (which no longer exist in East Germany) provided 51 per cent of all R&D personnel employed in industry (SV Wissenschaftsstatistik 1991: 49). (cf. Ill. 4)

**Ill. 4: Structure of RaD personnel in the economic sector by size of firms**  
(number of employees)



**Source:** own compilation after SV Wissenschaftsstatistik 1990, 1991, FAB s.a.

The share (and importance) of small and medium-sized enterprises (SMEs - in this context up to 1,000 employees) has increased in relation to total R&D personnel. A process of restructuring (or more exactly de-formation) of the formerly state-owned economic sector in the direction of small or even minimal enterprises is becoming apparent in East Germany. Meanwhile (1994) nearly 80% of all industrial R&D personnel is allocated in firms with less than 500 employees, 40% in firms with less than 100 employees (cf. Table 2).

**Table 2: R&D personnel by size of firm in the New Federal Staates (1993)**  
(only firms with R&D)

size of firm (employees)	<20	20-49	50-99	$\Sigma$ <100	100-499	>500	all firms
share of total R&D personnel (in %)	12	14	14	40	37	23	100
average number of R&D persons per firm (rounded)	4	7	10	6	16	66	11
percentage of total staff	43	22	13	21	8	6	10

source: own calculation after FAB s. a.: 18

Since, on the other hand, the proportion of total staff in smaller enterprises engaged in R&D is over 20 per cent up to 43 per cent and in each case with a very high proportion of academically qualified personnel, it can be concluded that the ratio of R&D to other areas, notably production, is not yet a "healthy" one i.e., operationally viable. This is only possible, because a total of between 80 and 90 per cent of East German firms that engage in R&D activities avail themselves of federal government support. In late 1993, the contribution of federal assistance alone to internal R&D expenditure in the new federal states amounted to about 40 per cent (in comparison to only 5 per cent in the old federal states). 80 per cent of this funding was allocated to SMEs (Bericht 1994: 9).

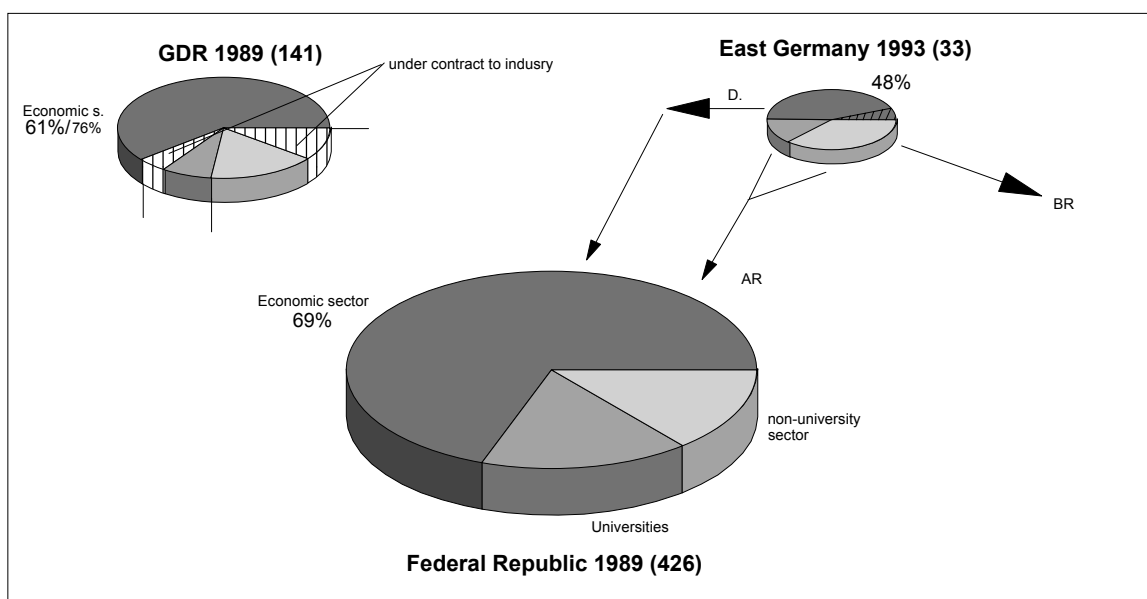
### 3. Conclusions

In *industry* there is a shift to very small firms with "undercritical" R&D groups and a profil dominated by experimental development. Actual links to academic research are already very weak, since most of the small firms and corporate R&D divisions are now scarcely in a position to deal with the demanding tasks of up to date applied research by themselves, and for the same reasons and because of financial problems the ability to commission or apply correspondingly demanding external research is also extremely limited.

The staffing situation for relations with academic science still appears to be relatively good in the industry, because of the close connections in the past, although continuously deteriorating as a result of persisting job cuts in both spheres and of a process of differentiation between the economic and academic sector of R&D.

Whereas RaD in the economic sector is dominated by experimental development - in the *academic sector* a drift to basic research could be unavoidable because of missing contracts with industry. Our empirical analyses indicate that the linkage between basic research and the practical application of scientific findings was extremely pronounced at the Academy of Sciences of the GDR, not only from an organizational point of view, but also in the behaviour of scientists (Meske et al 1993). The ongoing analysis of internal and external integration processes in newly formed research institutions in East Germany can extend knowledge about differences existing between East and West, and reveal opportunities arising from their rapprochement. In the next future there could be a danger that the more applied oriented scientists in East German academic science, now financed by special project funds, will be confronted with decreasing funds from public resources without any chance for an compensation by industry. The exception could be contract research for enterprises in the old federal states - already on the way - and therefore the emergence of a more and more dividing R&D landscape in the east. There are some features in the actual development of the RaD landscape in East Germany looking like the situation in a peripheral region connected - and confronted - with a strong and powerfully acting center in West Germany (cf. Ill. 5).

**Ill. 5: R&D personnel in Germany (1000 FTE)**



Finally, we draw attention to two states of affairs connected with the changes in East Germany, which deserve particular attention in future research.

The first concerns the development of R&D in the whole of Germany. The research landscape has meanwhile altered considerably not only in East Germany: West Germany, too, has experienced change. It involves in particular an absolute decline in R&D

personnel in the economic sector, the far-reaching 'freezing' of funding allocated to non-university research in West Germany, especially funding for large research establishments, in order to secure the preservation of and provide better funding for the corresponding institutions in East Germany, and not least of all an increase in university research almost exclusively on the basis of third-party funds. This has also changed the academic landscape in united Germany as a whole, especially in terms of sectors and forms of organization, in comparison to the 'old Federal Republic' in 1989 (see Ill. 6). Further changes are therefore to be expected.

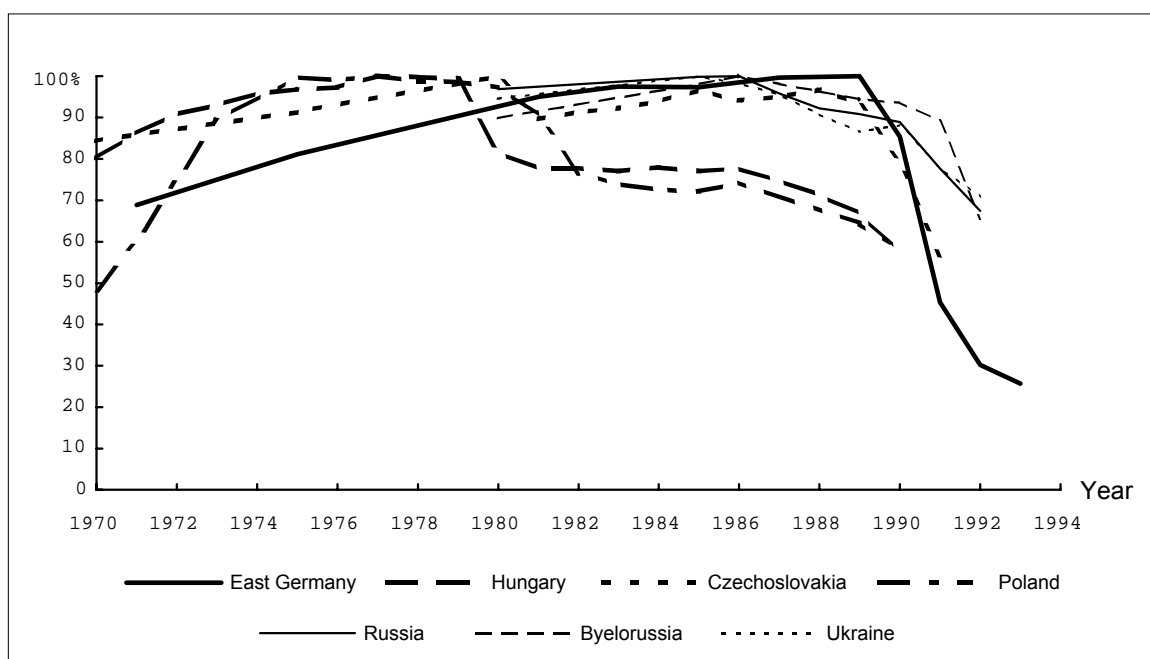
### Ill. 6: R&D personnel in Germany in 1989 and 1994 (1000 FTE)

West Germany		East Germany		Germany	
				1994	1989
*1991	Universities	5	18	81	88
	Non-university sector	12	36	73	96
	Economic sector	16	86	299	382
total:				483	566

**Source:** Own compilation after BUFO 1993; SV Wissenschaftsstatistik 1993

A second aspect concerns the conclusion to be drawn from East German experience with regard to other eastern European countries. East Germany is doubtless a special case in the conversion of R&D in the former socialist countries. Nevertheless, a number of similar factors is impacting all these countries. First analyses have shown, for example, that R&D personnel is being cut back in all these countries, although the speed and extent of reductions varies from country to country (see Ill. 7).

**III. 7: Trends in the number of R&D personnel in Eastern Europe**  
(max. value in each country in this period = 100%)



Source: Meske/Nadiraschwili 1994: 357

One conclusion that can already be drawn is that the transformation processes for science in the other eastern European countries will proceed more slowly than in East Germany. If for East Germany one must reckon with at least 5 years to restructure research organizations and a further 5 years for their consolidation and integration into the reformed scientific landscape, these periods will most likely be twice as long in the other central and eastern European countries, and presumably many times longer in the successor countries to the Soviet Union. If for no other reason, although others there are, the course and outcomes of transformation in central and eastern European countries are likely to diverge from East German experience.

It therefore seems appropriate to link future analysis of the development of R&D in East Germany very closely first with the issues relating to the formation of a new overall German scientific landscape within a united Europe, and second with the resulting potential lessons and conclusions to be drawn for the further shaping of transformation processes in science in the countries of central and eastern Europe. A number of such projects have already begun, for example on integration processes in newly established Blue List institutes in East Germany (Meske 1993a), on the restructuring of academy-industry relation in central and eastern European countries (Balázs 1993), and on the transformation of science systems in central and eastern European countries (BMFT 1994).

First interim results are to be published in the near future.

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