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Linkages between Manufacturing and Services in Germany

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Content

Graphs and tables

I Introduction

The topic "linkages between manufacturing and services" requires us to broadly distinguish between economic activities as either manufacturing or services. The main approach of this paper is to take manufacturing industries and service industries[1] as a starting point since much of the information is only available by industries. It is necessary, however, to recall that manufacturing industries are also engaged in service activities and that, conversely, service industries are engaged in manufacturing activities (although to a lesser extent). This fact is important for exploring the topic since linkages between manufacturing and services can also appear within the manufacturing firm or manufacturing industry. Service functions constitute an increasing share of functions performed within manufacturing firms (or industries) as well as of functions exchanged between firms or industries; this applies to their output as well as to their input side. The increase of service functions within manufacturing firms is intra-firm or intra-industrial change; if these functions are performed by other service firms then the change becomes visible as inter-industry change.

Distinguishing services

The statistical classification of enterprises among industries is defined by international conventions according to the principle of main economic activity, either producing goods or services. The respective products are defined in the Central Product Classification. If more than 50% of the commodities produced are considered to be goods, say machines, then the firm is classified among the respective mechanical engineering industry and it is part of the manufacturing industries.

A firm might gradually evolve from a mainly goods producing entity to a mainly service producing entity. In Germany there are prominent examples of manufacturing firms becoming a holding company. Moreover, firms are not 'permanent' institutions; they can split, sell parts, merge or acquire other firms, go bankrupt and die. They may solely organize the projects of various other firms or concentrate on headquarter functions.

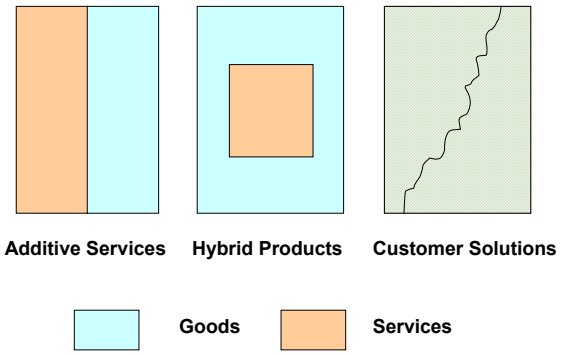
[1] In the German language "Industrie" mainly denotes industries (of at least a minimal size) engaged in production; in German, industries are called 'economic divisions'.

It is more difficult to define service products than tangible and mostly familiar goods. Since the times of classical economists, an abundance of criteria has emerged for defining services. The modern short version of this discussion reads as IHIP (**I**ntangibility, **H**eterogeneity, **I**nseparability, **P**erishability) indicating dimensions of demarcations between goods and services. The special features of services are also tied to the mode of transaction: Services are mainly distinguished from goods by the fact that they are delivered and consumed in one act (*uno actu*). The presently valid international definition reads as follows: "Services are outputs produced to order and typically consist of changes in the conditions of the consuming units realised by the activities of producers at the demand of the consumers; by the time their production is completed they must have been provided to the consumers." (cf. UN Glossary of terms). Hill (1977) discusses at length two fundamental groups, services either affecting goods (transportation of goods, postal deliveries, maintenance, repairs,...) or affecting persons (passenger transportation, medical treatment, education,...). Bhagwati (1984) distinguishes embodied and disembodied services.

The matter seems to be settled. But the common understanding actually is not as refined as the definition suggests. Ambiguity in the use of the word 'services' still reflects historical and epistemological difficulties. Definitions of commodities and services can only reflect the current 'reality' which is always changing. Even if services are taken to be well defined they still pose much more problems of measurement. In some cases the quantity of service products can only be approximated; prices are in many cases not directly observable (cf. Stille 2002).

Moreover, as products become increasingly complex, it is increasingly difficult to separate their parts either as goods or as service products. This might still be easy in the case of additive services (cf. graph 1). In this case, the consumer is, for example, supplied with a machine, and along with this 'hardware', also with an additive service like a contract on maintenance. This service can be accounted for separately. With computers it becomes more difficult. Sometimes the hardware and the software part can be discerned. But products tend to change fast and can easily become composite packages ('compacks') or hybrid products. In this case it becomes difficult to distinguish the service's and the good's part of the product and obtain a reliable statistical record. Finally, the strategy of many manufacturing firms aims at offering the customer suitable and flexible solutions of his specific problems. Motor vehicle companies might not only

Graph 1: From additive services to customer solutions in manufacturing products



want to sell cars but also mobility solutions. This can imply an inextricable combination of goods and services which can be convincingly put in either of the two groups. Unlike the (unenviable) statistician enterprises are not concerned with whether their outputs are called goods, services or both.

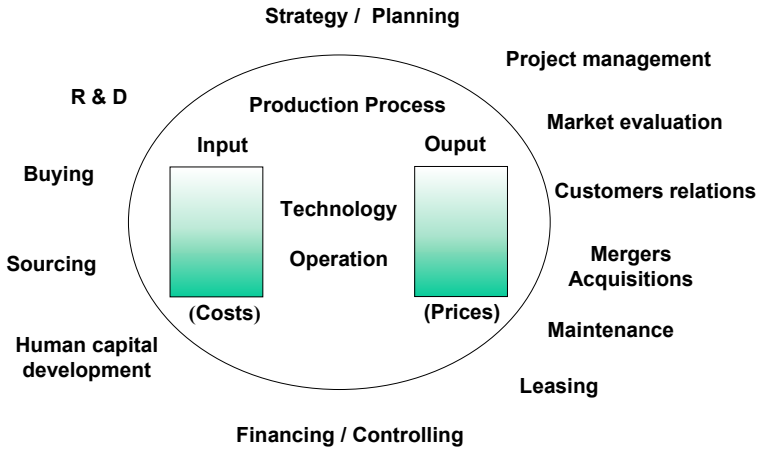
The organization of production processes is also fundamentally moving in the direction of increased use of services, reflecting technological and organizational innovations as well as the needs of globalization. Strategic aims of manufacturing firms include product innovation and differentiation, customization as well as achieving a status of "global players". Thus many (big) firms have to rely on an increased use of more refined and more specialized service inputs thereby acquiring advantages of scale and scope.

Their demand has also helped the evolution of specialized business services, which has been driven by technology and innovation as much as manufacturing. Service industries are among the highest investors in new technology and ICT (van Ark, 1999). Increased efficiency in the provision of services, on the other hand, has positive repercussions on their customers. In highly developed clusters of production it is hard to distinguish between push and pull factors.

Most of these services are called business-related services. The increased demand of firms for these services has stimulated growth in the business-related service industries as well as in the similar services performed within the manufacturing firms. Business-related services, and strategic business-related services in particular - as defined by OECD (1999), i.e. computer software and data processing services, R&D and technical services, marketing, business

organization services and human resource development services - have grown rapidly in OECD countries and have generated strong employment in the recent past.

Graph 2: Services in production processes



Make or buy (outsourcing)

Some service functions like mail and telecom have traditionally been outsourced to service firms. Others like administration or sourcing tend to be performed in-house. This division of labor is always changing. At some point of time, enterprises might consider buying the needed service functions from other firms instead of making them themselves. This alternative exists on the input as well as on the output side. Outsourcing can mean contracting out to affiliated or to non-affiliated firms.

Manufacturing firms, of course, will only decide to outsource if they can thereby save on costs and preserve/improve their competitive position, if they can improve on their flexibility, and better implement their strategic aims (cf. RWI 1995). They will decide against contracting out if it threatens to endanger core competencies, for example, by inhibiting contact with their customers or current market developments. In international comparison institutional differences, for example, with regard to liability law or the rules of co-determination can play a crucial role in the extent of outsourcing.

Since in-house and out-house solutions are in principle equivalent modes of providing for such services, the extent of outsourcing is of crucial importance to whether the linkages between manufacturing and services can be observed as intra- or inter-industry change. In the following section II, empirical information is provided for intra- and inter-industry linkages at the output side of production while section III focuses on the input side. The point of view taken is that of manufacturing enterprises, i.e. services are put into the context of their inputs and outputs. The analysis is restricted to market services, i.e. no personal or public services are considered. In section IV some conclusions are drawn with respect to the need for new concepts integrating the increasing linkages between manufacturing and market services.

II Product-related services

It is obvious that manufacturing industries even defined at the 4-digit level usually also supply a certain but generally unknown amount of service products. Product-related services are supplied by manufacturing industries in conjunction with their products and are mainly directed to solving customer specific problems. In this section the focus is on intra- and inter-industry linkages on the output side of production.

Significance of product-related services

There are many reasons for manufacturing firms to incorporate more product-related services into their products. Product-related services help to strengthen the market position by product differentiation, enhancing the range of products as well as customer relations. This also opens up the promising opportunity for cross selling, for example a car company using the addresses of its customers to advertise financial or insurance services. The value-added chain during the life cycle of an automobile not only consists of the sale of the car, but also of repairs and spare parts, of "service", of fuel, of insurance and financial services (leasing); a study by Booz Allen Hamilton estimates that the share of profits from selling the new car is less than 10% of all profits which can be reaped during the total life cycle of the car.

Data base

In Germany information on the provision of product-related services by manufacturing firms is limited. A pilot study was conducted by the Federal Statistical Office (FSO 1989). In this survey a representative set of firms from ‘producing’ industries (mining and manufacturing) – on

average about 16% of all firms - were asked two sets of questions, first about services they provide to third parties (customers) and how this can be recorded statistically and, second, which services they use for their own purposes and who is providing them. For the survey, the Federal Statistical Office produced a list of 19 different kinds of services[2]. Unfortunately, certain services like repairs, installation/assembly, and job processing were not included in this pilot study since they are part of other regular compulsory surveys of the FSO.

Ten years later two important employers' federations, VDMA (mechanical engineering) and ZVEI (electrical engineering), representing many important and large manufacturing industries, made two surveys of their member firms, in 1998 and in 2001; these were confined to the product-related services and were similar to the first set of questions by the FSO in 1989. The surveys have been coordinated among the two federations with respect to design and content of the questionnaire.

II 1 Billing

Manufacturing firms do not always openly bill their customers for the product-related services rendered. This may simply be a matter of custom; providers and customers take this procedure for granted. This also may be the case when the services provided are very limited. If the services are not billed separately, they usually are not explicitly accounted for in the firm's bookkeeping. In this case total turnover of product-related services is higher than the total of explicitly billed services. The implicit part must be estimated by the firms by imputed costs or from product or system prices. The explicit billing also might be taken as an indicator for the relevance of the services for the firm as well as for the customer. Services, of course, will be regularly explicitly billed for if the firm is also offering them independently of the hardware product.

In the FSO survey (1989), there are three groups of answers reported: exclusively separately billed for, exclusively not separately billed for, and either way. In 1988, about one-third of the firms responding had exclusively not separately billed for the services supplied; another third

[2] 1 Data processing; 2 R&D; 3 Technical planning, counselling, etc.; 4 Renting (incl. Leasing); 5 Maintenance, inspection; 5 Documentation; 7 Training of customer personnel; 8 Design of durable goods; 9 Advertisement; 10 Disposal activities; 11 Storage; 12 Transport; 13 Purchasing; 14 Selling; 15 Training of own personnel; 16 General administration; 17 Energy distribution; 18 Other services; 19 N.e.c.

sometimes billed. The frequency distribution, however, is quite distinct for the various services. Exclusive separate bills were issued most frequently for energy distribution (100%), renting and leasing (91%), and maintenance (74%). Exclusively not billed were services like documentation (79%),customeer training (77%), and technical planning (71%). Likewise the distribution among industries shows a distinct pattern. For example, exclusive separate billing was below average for mechanical and electrical engineering firms.

Table 1 Separate billing, 2000

in % of total turnover

Product related services	Mechanical Engineering	Electrical Engineering
Maintenance	79.5	75.4
Dismantlind, disposal	69.4	64.9
Leasing, financal services	63.5	61.4
Fitting/assembly	56.1	57.9
Putting into operation	53.2	47.4
Operating for customers	95.1	49.1
Training of customers	29.3	43.9
Software solutions for customers	49.1	35.1
Technical planning, counselling (incl. R&D)	25.0	26.3
Teleservice, Hotline	74.0	24.6
Certification	38.5	21.1
Documentation	27.9	15.8
Others	76.0	29.8
Total	26.7	45.0
Sources: VDMA (2002), ZVEI (2002); Calculations by DIW Berlin.		

In the surveys of VDMA and ZVEI the firms were asked about the turnover share of separate billing. The results are therefore different in comparison to 1988. In 2000, mechanical engineering firms separately billed for 45% of total product-related services' turnover; in electrical engineering this share was much lower (27%). But this only applies to the business with components; in projects the share was higher, especially for large projects.

With regard to single services, in mechanical engineering operating for customers was almost always openly billed for by the relatively few firms offering such a product-related service. Otherwise similar services ranked high with respect to open billing in the two industries:

Maintenance, dismantling etc., financial services (leasing), fitting/assembly and putting into operation. Also, separate billing is infrequently reported for similar services like documentation, certification, and technical planning. In mechanical engineering the firms indicated that separate billing of "training of customers" and "technical planning etc." is to be increased in the future.

II 2 Services provided and their turnover

According to the survey of FSO (1989), 44% of the 5321 responding firms have provided services to their customers. There has been quite a bit of variation with regard to industries. The share has been higher for export oriented industries like mechanical and electrical engineering, and lower for industries like leather, apparel and textile producing. Among the most frequently supplied services were technical planning etc.,customeer training, and, with some gap, renting (incl. leasing) as well as maintenance and data processing. Among the least important services offered were disposal, purchasing, and selling.

Exact turnover shares cannot be computed for 1988. For the various services only brackets of turnover are published for that group of firms which had exclusively separately billed for these services. The turnover is only reported for brackets of turnover - smaller than 1%, from 1% to less than 5%, and over 5%.

Table 2 Product-related services' share* in total turnover, 1988

	< 1%	1% bis u. 5%	>=5%
Data processing	88.7	9.2	2.1
R&D	71.8	22.7	5.5
Technical Planning	66.8	25.2	8.0
Renting (incl. leasing)	79.8	17.1	3.1
Maintenance	48.7	30.5	20.7
Documentation	82.1	17.9	-
Training of customers	88.8	9.8	1.5
Design of durables	71.4	22.9	5.7
Advertising	91.3	8.7	-
Disposal	79.8	9.5	10.7
Storage	70.2	24.2	5.6
Transport	70.5	21.9	7.6

Source: Federal Statistical Office Germany (1989); Calculations by DIW Berlin.
* Only firms which separatly bill for the services.

Only one-fifth of the firms offering product-related services reported a contribution for maintenance of more than 5% to total turnover, and another third reported between 1 and 5% (cf. table 2). About one-tenth of firms offering dismantling and similar services had realized more than 5% of total turnover by these means. Other services with some relevance to turnover were R&D, transport, storage and design.

In 2000, according to the VDMA and ZVEI surveys, the most frequently supplied product-related service customers training. VDMA (2002) points out that this service especially had gained in comparison to 1997 and offers as an explanation that the increased complexity of components, machines and tangible assets as well as customization require morecustomeer training. For more than 70% of the firms, also other services like putting into operation, maintenance, technical planning, documentation and assembly also belong to their supply profile. Operating, certification, dismantling etc. and financial services (leasing) were provided least frequently. But the frequency of replies does not reflect the importance of the respective service for its share in turnover.

Table 3 Product-related services' share in total turnover, 1997 and 2000

	Mechanical Engineering		Electrical Engineering	
	% of total turnover			
	1997	2000	1997	2000
Maintenance[1)]	2.7	4.4	3.1	3.8
Technical planning, counselling[2)]	1.5	3.0	1.6	3.0
Leasing, financial services	-	2.6		0.0
Fitting/assembly	2.4	2.5	4.8	2.7
Putting into operation		1.3		2.4
Software solutions for custom.	0.7	1.1	3.8	5.2
Training of customers	0.4	0.8	0.8	1.1
Operating for customers	0.0	0.6	0.9	1.0
Documentation	0.5	0.5	0.8	1.1
Teleservice	0.1	0.5	0.2	0.8
Dismantling, disposal	-	0.3	0.3	0.5
Certification	0.3	0.1	0.4	0.5
Others	1.1	0.8	0.2	0.3
Total service turnover	9.6	18.5	16.8	22.5

Sources: VDMA (1998;2001), ZVEI (1998;2001); Calculations by DIW Berlin.
1) Inspection, service, repairs.
2) Incl. R&D.

In contrast to the FSO, the turnover reported by VDMA and ZVEI does not only comprise the separately billed, but also the implicitly billed part of turnover. For (responding) mechanical engineering firms, 18.5% of total turnover resulted from product-related services (cf. table 3). This means a considerable increase over 1997. In the first surveys of VDMA/ZVEI, though, some services were not explicitly asked for. Turnover shares in 2000 have generally been higher for smaller than for larger companies. With regard to single services, the share of maintenance in total turnover (4.4%) has been highest, thereby contributing about a quarter of the turnover stemming from services. But technical planning, leasing etc. and assembly also contributed sizeable percentage points to total turnover.

According to ZVEI, in 2000 the electrical engineering industry recorded a turnover of 318 billion DM; 69.6 billion DM - or 22.5% - were achieved by the participating firms which also were selling product-related services. Other than in mechanical engineering, the electrical engineering firms' turnover was highest for software. Its share in total turnover was 5.2%, thereby contributing also about a quarter of the turnover stemming from services. ZVEI (2002, p. 14) sees the reason for this strong performance in the fact that in the area of numerical control and intelligent memory chips the supply of customized software solutions is an essential part of the product. About 24.6% of the employees are engaged in this activity. With regard to turnover, for electrical engineering firms leasing etc. did not contribute much to turnover, again in contrast to mechanical engineering. Similarly in both industries, however, maintenance, technical planning, assembly and putting into operation have produced sizeable parts of turnover.

Firms from both industries expect a further increase in services' turnover share. In electrical engineering 69% expected an increase, 22% a decrease. ZVEI believes that a share of 30% in 2005 is the lower bound of the estimation corridor since some of the firms with a high service potential did not report. With regard to single services, expectations have been highest for technical planning and software solutions for customers. Mechanical engineering firms also expected above average growth rates for product-related services, especially for teleservice and customer training. But also software solutions for customers as well as maintenance were pointed out. The expectation of high growth for some of these services like teleservice and customer

training is founded upon the actual development of new technologies for providing these services.

II 3 Make or buy

In the year 2000, about 80% of product-related services were made by mechanical engineering firms themselves. Non-affiliated firms additionally supplied 8%. In electrical engineering the in-house share was lower, but still most important (67%). Non-affiliated firms, though, contributed a much higher share (21%). These high shares of in-house provision indicate that product-related services are esteemed to belong to the core competencies of the firms.

Table 4 Make or buy of product-related services in mechanical engineering

Product related services	Services rendered by					
	firms themselves		affiliated firms		non-affiliated firms	
	1997	2000	1997	2000	1997	2000
Training of customers	65.0	96.8	7.7	1.8	4.0	1.4
Teleservice	24.6	96.3	3.1	0.7	4.2	3.0
Planning, consulting	69.2	96.3	6.9	3.0	8.2	0.7
Maintenance	76.3	93.0	13.7	3.2	13.3	3.8
Documentation	68.8	91.4	4.9	4.3	8.4	4.3
Fitting/assembly	74.1	87.0	15.0	5.2	15.0	7.8
Putting into operation		95.0		2.4		2.6
Dismantling, disposal	-	73.5	-	8.8	-	17.6
Operating for customers	12.4	69.2	2.0	7.7	1.3	23.1
Software solutions for customers	37.6	68.7	7.5	7.1	15.7	24.2
Certification	40.9	64.9	4.2	11.2	10.8	23.9
Leasing, financial services	-	59.3	-	8.6	-	32.1
Others	35.8	75.6	4.6	1.3	3.8	23.1

Source: VDMA (1998; 2001); calculations by DIW Berlin

Table 5 Make or buy of product-related services in electrical engineering

Product related services	Services rendered by					
	firms themselves		affiliated firms		non-affiliated firms	
	1997	2000	1997	2000	1997	2000
Documentation	77.1	86	11.8	5	11.1	9
Training of customers	83.3	82.5	11.1	8.8	5.6	8.8
Teleservice	77.1	82.5	12.5	6.1	10.4	11.4
Technical planning, counselling	77.8	81.6	10.4	6.1	11.8	12.3
Maintenance	75.0	68.4	11.1	12.3	13.9	19.3
Putting into operation	72.9	67.5	12.5	12.3	14.6	20.2
Others		64.9		11.4		23.7
Software solutions for customers	63.9	58.8	18.1	12.3	18.1	28.9
Certification	63.2	57.0	10.4	6.1	26.4	36.8
Fitting/assembly	66.7	51.8	11.1	17.5	22.2	30.7
Dismantling, disposal	60.4	40.4	10.4	22.8	29.2	36.8
Operating for customers	63.2	35.1	16.0	28.9	20.8	36.0
Leasing, financial services		20.2		30.7		49.1

1) Source: ZVEI (1998; 2002); calc. by DIW Berlin

The two surveys exhibit that in 2000 similar services rank high with regard to in-house solutions - customer training; teleservice, technical planning; in electrical engineering, though, documentation held the top position (cf. tables 4 and 5). Similarities in importance also show up with respect to outsourcing to non-affiliated firms – leasing/financial services, dismantling/disposal, certification, and software solutions for customers being most frequently mentioned.

In mechanical engineering 15% of the firms reported that they had outsourced during the five years before the survey (since 1995), especially to non-affiliated firms. The same percentage also planned to outsource during the next five years (until 2000), but, primarily to affiliated firms. In both periods outsourcing mainly focused on assembly and software solutions. In electrical engineering the speed of outsourcing was higher than in mechanical engineering: almost 15% of the firms indicated that they outsourced to affiliated firms, and another 16% to non-affiliated firms. Until 2005 electrical engineering firms intend to cut back on outsourcing. Less than 14% want to continue engaging in outsourcing, mainly to affiliated firms. In both industries the outsourcing momentum apparently seems to be decreasing significantly; the planned outsourcing expressed by these firms (in the next 5 years respectively) showed a decline in 2000 in comparison to 1997 (cf. table 6).

Table 6 Intended outsourcing*

	in % of firms	
	1997	**2000**
Mechanical engineering	22	15
Electrical Engineering	34	14
Sources: VDMA (1998, 2002), ZVEI (1998, 2002); calculations by DIW Berlin. *In the next five years respectively		

III Linkages on the input side

The linkages between manufacturing and services also increased on the input side of production; purchasing service functions from service firms may increase simultaneously with an increase in these functions within the firm, either as a complement to or substitute for intra-firm change.

III 1 Intra-industrial change: service occupations in manufacturing

One indication for the intra-firm alternative (make) with regard to service functions is the increase in service occupations within manufacturing firms. Measured by broad type of activity, in 1995 more than 80% of total German employment exercised non-producing activities, less than 20% producing activities like manufacturing and adjusting/maintaining machines. Even in the manufacturing industry less than half of the employed were occupied with producing activities. (cf. Grömling et al. 1998, ch.2.5). These hints are only to give the reader an idea of the magnitudes of this frequently debated topic (Stille et al. 2003) since it cannot be appropriately explored here.

III 2 Make or buy: manufacturing's input of services

The pilot study of the FSO reported on services "for own purposes" which is equivalent to service inputs. It also distinguishes who has provided them – the firm itself or other (affiliated or non-affiliated) firms. The answers of the firms which were using the specified services as inputs show (cf. table 7) that in 1988 almost 50% of the responding firms – or almost 60% of the firms

Table 7 Service inputs*: make or buy, 1988

	Pos.answers in % of all	Services rendered by		
		firms thems.	aff. firms	non-aff. firms
		in %**		
Data processing	91.3	54.5	7.8	26.7
R&D	70.6	74.8	7.6	10.1
Technical planning	80.0	61.5	4.5	23.0
Rents and lease (incl. leasing)	73.2	26.8	6.5	62.1
Maintenance	87.2	42.3	0.9	40.7
Documentation	65.2	64.9	3.8	24.1
Training of customers	43.0	80.2	3.3	12.5
Design	39.9	56.8	4.7	31.9
Advertisement	81.7	46.9	4.9	34.5
Disposal activities	83.0	15.2	1.1	77.4
Storage	88.6	92.5	0.9	2.7
Transport	90.3	31.4	1.7	52.2
Buying	100.0	94.5	3.1	0.8
Selling/agencies	91.8	87.3	4.2	2.6
Training of own personnel	77.3	64.0	1.8	20.7
General administration	100.0	91.6	3.4	1.5

Source: Federal Statistical Office Germany 1989; Calculations by DIW Berlin.
*Mining and manufacturing; ** Difference to 100%: changing suppliers.

which also were in need of such services – predominantly or exclusively provided these services themselves. The other half therefore (predominantly or exclusively) bought the services for their own purpose from other (affiliated or non-affiliated) firms. It is only this part which becomes visible as inter-industrial division of labor.

With regard to single services, the 'make' alternative prevailed in general administrative activities, and in purchasing and selling functions. Also four-fifths of the customer training was achieved within the (minority of) firms. R&D, training of personnel, technical planning, design of durable goods and data processing also were usually taken care of within the firms. On the other hand a majority of the firms outsourced disposal activities, leasing, and transport; outsourcing was least widely used for storage and customer training.

III 3 Intermediate demand: cost of manufacturing's input items

An important source of information about the service inputs bought by manufacturing industries are the "cost structure statistics" of the FSO, compulsory surveys among a sample of producing firms, which recently have been extended to some service industries as well. It contains information on the intermediate demand of manufacturing industries (cf. table 8).

Table 8 Cost of manufacturing's input items, 2000

	in %	1995=100
Input of materials	56.5	132
Goods for resale	15.6	143
Job processing	3.5	125
Repairs, inspection, maintenance	2.6	116
Temporary workers	0.6	-
Rents,lease, leasing	2.2	126
Other costs	13.7	125
Indirect taxes	4	104
Interest payments	1.3	-
Total	100	133
Sources: Federal Statistical Office; calculations by DIW Berlin.		

The share of material inputs in the sum of costs from the year 2000 was 56.5%, constituting by far the most important single item (table 8). Second place was taken by the costs of goods for resale, final products bought from other firms supplementing the firm's own product range and increasing the marketability of these products. The share of goods for resale in total cost was

almost 16%. The two items taken together represent the linkages within the (domestic and foreign) manufacturing industry, which account for almost two-thirds of all intermediate demand.

The linkages with the service industries are reflected by costs of job processing, repair/inspection/maintenance, temporary workers, financial services/leasing, and predominantly by "other costs" with a share of almost 14%. It includes items like advertisement/agencies, travel costs, provisions and license fees, post and telecommunication costs, premiums of insurance and bank fees, consultant costs. Overall, the services' cost share stood at about 20% in 2000. In comparison to other cost items the growth of service costs was below average in the period 1995 –2000. For total manufacturing, it clearly was the cost of materials and goods for resale which increased most.

III 4 Intermediate demand: inter-industry relations

The cost structure statistics are also an important primary source for compiling National Accounts, especially the Input-Output Tables (IOT). Based on a new set of IOT for the period 1991 to 2000, the inter-industry linkages between manufacturing and service industries become rather transparent. The angle of interpretation is the manufacturing's use of supplied services. These input coefficients are shown in table 9 for selected manufacturing industries in the year 2000.

On average, 66.8% of manufacturing's production value consists of intermediate supply the overwhelming part being other manufactured goods. This share was much higher than for the total economy (48,8%) showing that producing manufacturing products is much leaner than the average of all products. Only a quarter of the intermediate supply of manufacturing (17 ½ percentage-points) came from market services. This percentage is smaller than the share of market services in total intermediate use of the German economy mirroring the more intensive relations within the service industries than across the border of services and manufacturing. There are, however, exceptions; the input share of services like wholesale trade, retail trade/repair, land transport, R&D services and other business services was higher in manufacturing than in the total use.

Table 9 Manufacturing's intermediate demand for services, 2000

Input coefficients[1] of selected manufacturing industries 2000
in %

CPA	Use / Supply	24 (-24.4) chemicals	24.4 pharma - ceuticals	29 Machinery a. equipment	30 Office mach., computers	31 Electrical machinery	34 Motor vehicles	15-36 Manufac- turing	01-95 Total inter- mediate use
50	Motor vehicle services	0.05	0.09	0.17	0.21	0.09	1.12	0.32	0.45
51	wholesale trade	1.96	0.83	4.14	9.26	2.74	1.78	3.56	2.56
52	Retail trade, repair	0.34	0.18	0.22	0.05	0.16	0.37	0.32	0.24
55	Hotels, restaurants	0.21	0.09	0.17	0.23	0.23	0.14	0.17	0.26
60	Land transport	0.98	0.66	0.71	0.19	0.41	0.93	1.08	0.68
61	Water transport	0.22	0.03	0.16	0.04	0.03	0.14	0.12	0.08
62	Air transport	0.25	0.29	0.46	1.41	0.20	0.15	0.27	0.22
63	Auxiliary transport	0.59	0.29	0.94	0.09	0.13	1.53	0.74	1.45
64	Post and telecom	0.75	0.90	0.81	1.85	0.74	0.44	0.75	1.33
65	Financial intermediation	0.15	0.23	0.24	0.29	0.18	0.20	0.20	2.60
66	Insurance services	0.53	0.22	0.07	0.07	0.06	0.07	0.18	0.56
67	Auxiliary financial services	0.08	-	-	-	0.40	-	0.03	0.68
70	Real estate services	0.99	1.48	1.27	1.49	1.57	1.09	1.26	2.88
71	Leasing	0.97	1.79	1.01	1.70	1.14	0.48	1.07	1.35
72	Computer and related services	0.35	1.13	0.60	9.00	0.32	0.29	0.54	0.95
73	R & D services	0.49	10.13	0.03	0.14	0.16	0.06	0.27	0.22
74	Other business services	10.46	7.79	5.82	4.33	9.92	4.74	6.60	6.40
(50-74)	Intermediate supply of market services	19.36	26.14	16.85	30.35	18.48	13.55	17.49	22.92
(01-95)	Total intermediate supply	66.74	61.88	60.11	74.30	64.80	76.00	66.81	48.75
	Value added	32.80	37.80	39.50	25.03	35.01	23.60	32.89	50.03
	Production value	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

1) Domestic and imported goods as percentage of production value.
Source: Federal Statistical Office; calculations by DIW Berlin.

Of all market services the input share of "other business services" was highest in manufacturing (6.6%) followed by wholesale trade (3.6%) and real estate services (1.3%); leasing and land transport had a share of slightly above 1%, auxiliary transport and post/telecom services of ¾%. For various products the input structure can be quite different from this average pattern of manufacturing. For example, for pharmaceuticals the input share of R&D was much higher than on average, while for office machines and computers a very high input of computer and related services can be observed. This points to typical patterns of production processes in various manufacturing activities.

Table 10 shows the development of the intermediate supply of services to manufacturing: First of all, manufacturing has clearly become much leaner during the 1990's. The share of value-added in production value decreased by 12% during that period while the intermediate demand of manufacturing for market services increased by 27%. This has been more dynamic than the increase in total intermediate demand of manufacturing (7%). Above average increases in service inputs can be observed for electrical machinery and for pharmaceuticals, below-average increases for chemicals. Evidently, the further reorganization of manufacturing production had very positive effects on market services.

Table 10 Manufacturing's intermediate demand for services, 1991 - 2000

Domestic and imported goods
1991=100

CPA	Use / Supply	24 (-24.4) chemicals	24.4 pharma - ceuticals	29 Machinery a. equipment	30 Office mach., computers	31 Electrical machinery	34 Motor vehicles	15-36 Manufac- turing	01-95 Total inter- mediate use
50	Motor vehicle services	111	112	115	105	139	100	124	107
51	wholesale trade	103	105	102	91	118	116	103	94
52	Retail trade, repair	104	102	107	78	125	104	110	81
55	Hotels, restaurants	122	146	126	80	159	119	118	106
60	Land transport	90	96	90	82	103	97	92	75
61	Water transport	99	77	99	586	184	222	114	98
62	Air transport	156	171	286	260	260	166	199	170
63	Auxiliary transport	119	130	129	129	163	141	148	114
64	Post and telecom	112	137	133	1312	164	264	149	144
65	Financial intermediation	108	116	124	820	143	994	169	108
66	Insurance services	96	108	101	527	116	101	104	104
67	Auxiliary financial services	95	-	-	-	131	-	131	113
70	Real estate services	110	121	126	119	152	200	143	118
71	Leasing	122	137	165	134	189	179	136	124
72	Computer and related services	188	217	236	220	283	234	205	215
73	R & D services	157	193	180	166	207	175	189	156
74	Other business services	128	142	140	144	172	149	136	127
(50-74)	Intermediate supply of market services	119	153	127	142	157	139	127	116
(01-95)	Total intermediate supply	106	119	102	126	124	115	107	102
	Value added	90	79	97	65	74	70	88	98
	Production value	100	100	100	100	100	100	100	100

1) Domestic and imported goods as percentage of production value.
Source: Federal Statistical Office; calculations by DIW Berlin.

Looking at the different service industries in detail there have been four branches which had an outstanding performance even in relation to all market services: computer and related services; air transport; R&D services; and financial intermediation. Other business services did not exhibit an as dynamic development as these industries; but it is a very large industry comprising high-growth as well as sluggish 4-digit industries.

Incidentally, imported computer related services exploded (534%) during this period, three times as much as the increase of domestically supplied computer related service inputs. In spite of dramatic increases of some imported services, on average, they still played a minor role as intermediate inputs in manufacturing. Their share in total imported intermediate supply of manufacturing was only 4% in the year 2000.

III 5 Digression: comparing service inputs in Japanese and German manufacturing

Based on the most recently available input-output-tables provided by the OECD the following observations for 1995 might be of interest.
Highlighting similarities:

- Value-added as share of production is almost identical in both economies. On average, the extent of intermediate demand does not show any difference.

- Manufacturing's intra-industry division of labor in Japan (61.2%) is slightly higher than in Germany (59%).
- On average, manufacturing's intermediate input share of market services has almost an identical magnitude in both economies (26% versus 26.9%).

Table 11 Input structure of manufacturing in Japan and Germany, 1995

in %

IO-Industry	ISIC Rev.3	Japan	Germany
Agriculture, hunting, forestry and fishing	(01-05)	5.0	5.0
Mining and quarrying	(10-14)	2.6	3.0
Manufacturing	(15-37)	61.2	59.0
Electricity, gas and water supply	(40-41)	2.8	2.9
Construction	(45)	0.7	1.2
Market services	(50-74)	26.0	26.9
Wholesale and retail trade; repairs	(50-52)	8.7	6.7
Hotels and restaurants	(55)	0.0	0.3
Transport and storage	(60-63)	4.0	3.0
Post and telecommunication	(64)	0.4	1.1
Finance, insurance	(65-67)	2.2	2.9
Real estate	(70)	0.6	2.2
Renting of machinery and equipment	(71)	1.6	1.3
Computer related activities	(72)	1.5	0.5
Research and development	(73)	4.5	0.3
Other business services	(74)	2.5	8.7
Non market services	(75-99)	1.8	1.9
Intermediate consumption at basic prices		100.0	100.0
Source: OECD; calculations by DIW Berlin.			

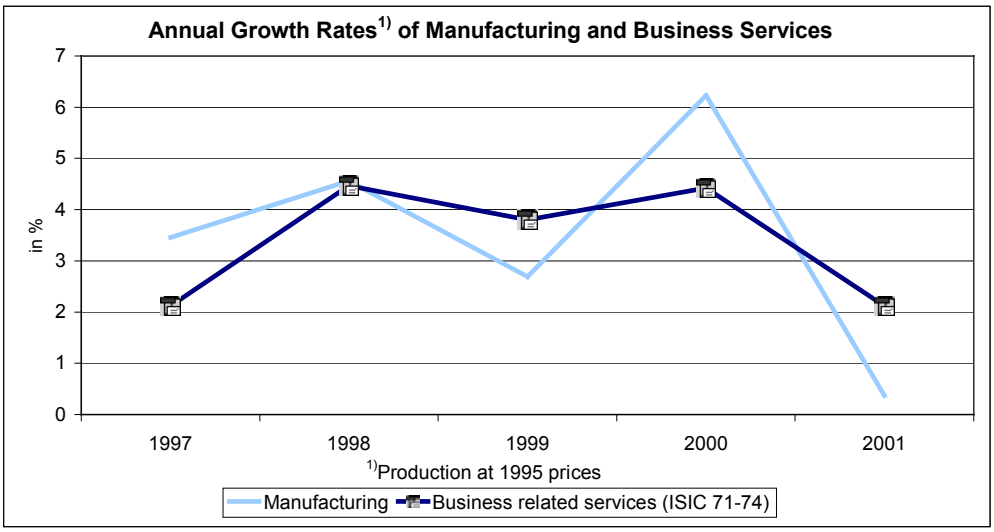
With regard to single market services, however, there are remarkable differences:

- German manufacturing's average input share of other business services is 8.7% while this share in Japan amounts only to 2.5%.
- With respect to R&D it is the other way around: in Japan the average R&D input share is 4.5%, in Germany 0.3%. It seems probable that part of the differences might be related to the way R&D is accounted for in Germany.
- For various industries several striking differences in the input structure show up (for example computer industry, motor vehicle industry).

III 6 Business cycle linkages

The increased interrelations between manufacturing and services also challenge the conventional wisdom that services are less vulnerable to business cycle fluctuations. In its Economic Outlook, the OECD (2002) maintains that the growth of the service sector had stabilized domestic demand. Manufacturers have large inventories that accentuate the cycle, which services have not done. On the other hand, the growing connectivity between business-related services and manufacturing actually makes it necessary to partly correct this view. It still may be valid for non-market services and other parts of services with low linkages to manufacturing.

Graph 3 Annual growth rates of manufacturing and business services



But it does not seem to be valid any more with respect to business-related services – ISIC 71-74: leasing, computer-related services, R&D services and other business services (cf. graph 3). It still may be true that the cyclical behavior of business-related services is not as accentuated as of manufacturing but from 1997 to 2001, there is a rather strong correlation between the annual growth rates of manufacturing and business-related services.

IV Conclusions: Towards a new concept

- The organization of production as well the range of products have undergone substantial changes. Many manufacturing firms are increasing the service component in production and in products. This integration of manufacturing and (some) services is pursued within and across firms, nationally and internationally; only parts of this change are being manifested as inter-firm or inter-industry change. The question of what comprises a core activity of an economy should not be answered following the prevailing statistical classification of industries.

- The idea of a hierarchical order of industries with manufacturing as the leader and services the follower and dependent is not very helpful; of course, in input-output terms, the demand for manufacturing products induces a higher share of service activities than the demand for services induces manufacturing activities. This view, however, neglects the fact that the major part of business-related services is not oriented towards manufacturing.

- What matters are service functions and their integration into production and products. Many service functions are among the leading growth factors creating wealth and employment. This should be the touchstone for defining core activities of an economy. Moreover, many service functions contribute significantly to innovation and more efficient organization. Frequently, they are the originator and enabler of innovative goods and services as well as the concomitant production processes, and thus an integral part of the knowledge economy. Accordingly, many service functions are among the core activities of the economy. Successful firms integrating innovation and core competencies via the relevant service functions in products and in production basically constitute the core of an economy, to equal extents in terms of growth, wealth and employment.

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