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Technology-based knowledge-intensive business services in the Netherlands: their significance as a driving force behind knowledge-driven innovation¹

By Rob Bilderbeek and Pim den Hertog

Summary

This article focuses on Dutch T-KIBS, i.e. those Knowledge-Intensive Business Services that derive their intermediate function primarily from the production and transfer of technology-related knowledge. T-KIBS concentrate in computer and related IT services, R&D services, and architectural and technical engineering services (Nace codes 72, 73, and 742/3). T-KIBS are considered to deliver a relatively powerful driving force behind economic competitiveness. (Public) R&D services excluded, all other T-KIBS show a very healthy employment growth in the early 1990s. Small SMEs dominate the T-KIBS size structure; in particular technical engineering and architecture show a highly polarised size structure. Dutch beta-oriented R&D is predominantly being executed within industrial enterprises; a very limited proportion is situated in service firms. Reversely, (business) services appear to be just a minor player in ICT-oriented R&D, contrasting with their high ICT-expenditures. Further,

- T-KIBS are heavily concentrated in urbanised areas, clustered along freeway corridors;
- T-KIBS show a relatively modest degree of foreign ownership (internationalisation).

In particular, technical engineering and IT services appear to be major actors in knowledge transfer to their clients. Input-output analysis indicates that the services cluster is one of the clusters with a high knowledge-intensity delivering a substantial and often specialised contribution to innovation in other clusters. In-firm 'own' R&D staff is highly concentrated in big enterprises. The main customers of computer and technical engineering services are concentrated in non-manufacturing industries. Excluding R&D services, government is clearly T-KIBS' best client category. ICT may be considered as a major driving force behind T-KIBS development, bringing about a strong interdependence between computer services, technical engineering and legal, accountancy and economic advisory services. Apart from R&D services, T-KIBS Dutch constitute a rather coherent cluster of knowledge-intensive services, with strong collaboration and outsourcing ties.

KIBS, particularly T-KIBS, constitute an important category of bridging institutions linking knowledge producers and knowledge users. There are clear indications for confirming the hypothesis that KIBS are developing into an informal (private) or "second knowledge infrastructure" partly complementing and partly competing with the more institutionalised formal (public) or "first (public) knowledge infrastructure". This applies in particular to the computer and related IT services and the architectural and technical engineering services which are developing into a rapidly growing "second knowledge infrastructure".

A comparison at first glance suggests that German (T-) KIBS follow a pattern of development that is comparable with the Dutch pattern, albeit that German KIBS seem to be in an earlier stage of development, and probably are much closer related to techno-economic developments in the manufacturing sector. The differences in economic structure and the relative openness of the Dutch economy are obvious candidates for explaining these differences.

1. Introduction

This article focuses on Dutch T-KIBS, i.e. those Knowledge-Intensive Business Services that derive their intermediate function primarily from the production and transfer of technology-related knowledge. Knowledge-intensive business services (KIBS), and technology-based

¹ This article is largely based on a report prepared within the framework of the "SI4S"-project (Services Innovation For Services) in the Targetted Socio-Economic Research programme of the European Commission. Cf. Bilderbeek, R.H. and P. den Hertog with H. Meihuizen (1998). For further information please contact Dialogic, tel. +31.30.2520445, fax +31.30.2520686, email: dialogic@dialogic.nl.

ones in particular (T-KIBS), are primarily, although not exclusively, located in the commercial services cluster. KIBS industries are defined as

- private (or semi-private) companies or organisations
- relying heavily on professional knowledge i.e. knowledge or expertise related to a specific (technical) discipline or (technical) functional domain, and
- supplying intermediate products and services that are knowledge-based.

Earlier research has substantiated the innovative role of KIBS, both through literature research and case studies (Miles et al., 1995, Bilderbeek et al., 1994). The number of service industries that can be classified as KIBS is considerable; KIBS actually cover a rather wide range of services. For instance, major parts of the professional service sector can be considered knowledge-intensive, be it technology-based or not. In other service sectors, specific segments with a relatively high professional component can be identified as intensive users of knowledge. Table 1 gives an overview of knowledge-intensive business services.

In order to reduce the number of relevant industries to be included we focused our attention on those KIBS that derive their intermediate function primarily from the production and transfer of *technology-related* knowledge, so-called technology-related KIBS (T-KIBS²). In our view this focus means zooming in onto a category of service activities which is assumed to be highly innovative in itself and facilitating innovation in other economic sectors, including both industrial and manufacturing sectors. T-KIBS, therefore, are considered to deliver a relatively powerful contribution to economic competitiveness. We

would like to emphasise that this specific focus on T-KIBS is not meant to imply a disregard of the organisational component of (service) innovation. On the contrary, it is quite likely that T-KIBS-related innovations will have a substantial organisational component.

Starting from the prerequisite that T-KIBS should be convertible to statistical categories (in order to facilitate quantification), we have attempted to identify T-KIBS in terms of NACE-codes (cf. Eurostat, 1996) as much as possible. Generally speaking, this proved to be not so easy. *Business services* are not documented as a statistical category in a consistent and harmonised way. As Hales (1997) points out, even this rather general category of services are being treated quite differently, thus complicating international comparability. Moreover, inconsistency in underlying definitions and lacking availability of data add to a general picture of statistical wasteland. This is the more so for the specific category of knowledge-intensive business services, and in particular technology-based KIBS. For this (sub)category it is virtually impossible to construct a viable database on a national level, let alone for international comparisons.

However, T-KIBS are expected to be highly innovative in themselves. Furthermore, they are believed to deliver an often powerful contribution towards facilitating innovation in other manufacturing and service firms. Therefore, we have used a working classification of T-KIBS for micro and meso level data collection, differentiating between T-KIBS that are relatively well-attributable to NACE-codes and 'more tentative' T-KIBS.³ Below, we will focus on 'sure T-KIBS' (table 2).

Table 1
Knowledge-intensive business services: an overview

- Accounting and bookkeeping
- Management consulting (be it in new technologies or not)
- Specific building services (e.g. architecture, surveying, construction engineering, etc.)
- Facility management services
- Technical engineering services
- Research and development services (excluding university-based R&D)
- R&D consulting services
- Design (be it in new technologies or not)
- Environmental services
- Computer and information-technology-related services (including software services)
- Legal services
- Marketing and advertising
- Exploitation and trade in real estate
- Training (be it in new technologies or not)
- Specific financial services (e.g. securities and stock-market-related activities)
- Temporary labour recruitment services
- Press and news agencies

Based on: Miles et al., 1995.

² At first hand the rationale for the specific focus on technology-related KIBS may seem a bit one-sided. After all, the importance of non-technology-related knowledge in innovation processes is probably even more important in service industries and innovation processes mediated by services compared with manufacturing industries. Therefore, by choosing this focus we might run the risk to be sided with the technology deterministic approach of innovation, inadvertently so. However, recognising the significance of non-technology-related knowledge has also its drawbacks, in particular in terms of providing a clear operational definition of innovation. In general, the more comprehensive the definition of innovation, the less operational. It is for this reason — the need to use a relatively clear-cut operational definition of innovation — that we have made a deliberate choice for a specific segment of KIBS: the technology-related KIBS.

³ The category of 'more tentative' T-KIBS consists of industries which may be 'hidden' within a broader statistical category or may be difficult to assess whether or not playing a role in distributing technology-related knowledge. What has been put forward here on the general complexity of getting operational and internationally and intersectorally comparable data, applies even more for the 'more tentative' T-KIBS categories. They include technology-related (T-) publishing (Nace-code 221), T-market research (7413), T-economic and management consulting (7414), T-labour recruitment and provision (745), T-training (8042/8022/8030), logistic services and related transport services (632), T-KIBS in telecommunications (6420), patent bureau's (7411.5), and wholesale in machinery, equipment etc. (in this latter category the underlying hypothesis is that machinery and equipment wholesale services act as distributors of (technical) knowledge and related expertise). Most of the industries mentioned constitute an often not officially recognised subcategory of a more general statistical category.

Table 2

"Sure T-KIBS"

T-KIBS categories	NACE-codes
Hardware consulting services	7210
Software consulting and supply services	7220
Data processing services	7230
Database activities	7240
Maintenance and repair of office equipment	7250
Other computer related activities	7260
Computer and related IT services	72
R&D on natural sciences and engineering	7310
R& experimental D on social sciences and humanities	7320
Research & (experimental) Development	73
Architectural and engineering activities and related technical consulting	742
Technical testing and analysis	743

Most of the above-mentioned statistical categories have a rather clear-cut relationship with *technological innovation*. This certainly applies for 'computer and related IT industries'. Since information and communication is of major importance for service (-mediated) innovation, we expect this industry to be a main component of T-KIBS. Quite likely some computer training activities and the organisation and running of relevant conferences and seminars will be included in the sub-category of other computer related activities (NACE 7260). Some international inconsistency in classifications used is likely (e.g. telematics will probably be registered in various categories).

Below, we will focus on several aspects of Dutch T-KIBS development, their significance (2.), their structure (3.) and their role in clients' innovation processes (4.). In section 5 we will present the main conclusions about Dutch T-KIBS

development. Finally, we will make a (very preliminary) comparison with German KIBS development (6.).

2. The significance of (Technology-related) Knowledge-Intensive Business Services⁴

The development of employment offers a convincing testimony of the increasing significance of the service sector. Whereas overall employment increased by 15 % in the last decade, the business services sector (to which T-KIBS belong), almost doubled the number of jobs within a decade (90 % more jobs in the 1985-95 period), equivalent to 6.6 % annually⁵ (full-time equivalents). Business services thus are by far the fastest growing sector. Considering the popularity of part-time contracts, job growth has been even stronger.

In 1996, about 176 000 people were working in the Dutch T-KIBS sector.⁶ T-KIBS employment increased with about 35 % in the 1990-96 period. With the exception of R&D services (with a modest 6.1 % growth in this period, in full-time equivalents), all other T-KIBS show a very healthy growth. In particular in IT, architectural and technical engineering

⁴ The framework of this article offers insufficient room for presenting all the quantitative support that we found. For a more elaborate presentation we refer to Bilderbeek, R.H. & P. den Hertog with H. Meihuizen (1998).

⁵ Taking a longer time horizon enables us to put things better in perspective: since 1975 employment in the Dutch business services almost tripled, with an average annual growth rate of 5.4 % !

⁶ Quite likely this underestimates total R&D employment, considering that R&D employment is expressed in full-time equivalents whereas employment in the other T-KIBS categories is expressed in the number of employees (including part-time employees).

Table 3

Employment in Dutch T-KIBS, 1990-1996 (1993 = 100); number of employees, 1990 and 1996 (x 1,000)

Nace-code	T-KIBS categories	(a) 1990	(b) 1993	(c) 1996	(d) 1990	(e) 1996	growth '90-96
		index figures (1993=100)			(in 1,000)		(%)
72	Computer and related IT services	93.8	100	131.3	50.0	70.0	40.0 %
73	Research & (experimental) Development*	98.1	100	103.8	17.9	19.0	6.1 %
742	Architectural & technical engineering services				57.3	80.5	40.5 %
7421	Architectural services	78.0	100	109.5	17.3	24.3	40.5 %
7422-9	Technical engineering etc. consulting	82.8	100	116.4	40.0	56.2	40.5 %
743	Technical testing & analysis	-	100	119.6	5.0**	6.5	30.0 %
	T-KIBS	130.5	176.0	34.9 %			

* Total R&D employment, expressed in full-time equivalents, includes R&D in research institutes. Comparison of absolute employment figures is complicated by a shift in statistical measurement in 1993.

** Estimate.

Source: CBS, 1997.

Table 4

Development of employment in R&D in research institutes, academic institutions and enterprises, 1990-96, 1993=100, and in full-time equivalents (1990 and 1996)

R&D categories	(a) 1990	(b) 1993	(c) 1996	(d) 1990	(e) 1996	growth '90-96
	index figures (1993=100)			(in 1 000)		(%)
R&D in research institutes	98.1	100	103.8	17.9*	19.0	6.1 %
R&D in universities	95.7	100	98.0	24.5*	25.1	2.4 %
R&D in enterprises	103.3	100	124.6	31.5*	38.0	20.6 %
Total R&D employment				73.9*	82.1	11.1 %

* Comparison of absolute employment figures is complicated by a shift in statistical measurement in 1993 (due to the transition from the SBI '74 standaard bedrijfsindeling 1974 into the SBI '93 id. 1993 standard). Figures in column (d) have been converted from the SBI '74 into the SBI '93 standard, in order to facilitate comparison with column (e).

services the number of jobs increased with an *average annual growth rate of 5.8 %* (table 3).

The moderate development in R&D employment in research institutes and in universities contrasts with a 20 % increase in R&D employment in enterprises (table 4).

These data suggest a clear shift in emphasis from public funded to privately funded R&D. This shift contrasts with the development in other T-KIBS, i.e. in computer services and architectural and technical engineering services. Secondly, despite the compensating effect of this shift in terms of R&D employment, *overall* development of R&D employment does not keep pace with the booming IT, architectural and technical engineering services.

Value added figures confirm this picture of rapidly growing business services and booming T-KIBS. Compared to an overall value added growth of 28 % in the last decade, the 'other commercial services' sector (of which KIBS constitute a part) shows the most powerful growth: 76 % in the 1985-95 decade, or 5.8 % annually (i.e. 2.7 times the growth rate of the overall economy). Recent turnover figures indicate a continuation and even acceleration of this favourable development; especially computer and related IT services show a very solid 37.6 % growth in 1993-96 (i.e. 11.2 % annually on average).

Therefore, *business services and in particular T-KIBS constitute a centre of growth*, both in terms of employment and of production figures. Within T-KIBS, IT, architectural and technical engineering services, and to a lesser degree R&D within enterprises are the growth champions.

3. The structure of Dutch T-KIBS

Dutch statistics do not provide an abundance of available data on the structure of T-KIBS. Here we will first present some conclusions in terms of firm size structure and employee age distribution (3.1). After that, we will pay some attention to Dutch Research and Development services (3.2), the spatial distribution of Dutch T-KIBS (3.3),

their knowledge-intensity, educational level and training (3.4) and their degree of internationalisation (3.5).

3.1 Firm size structure and employee age distribution

A large majority of T-KIBS firms (91 %) are active in architectural and technical engineering services (Nace 742) or computer services (Nace 72). R&D-services and technical testing represent T-KIBS categories of rather minor importance, accounting for the remaining 9 % of firms.

Within the computer and related IT services software houses dominate the picture: about 89 % of all computer service firms are primarily providing software services. Within architectural and technical engineering services, the latter dominate the categories of medium-sized and bigger companies (over 20 employees), whereas architecture offices dominate the SME category. In Dutch T-KIBS as a whole the very small firms prevail: about 2 of each 3 T-KIBS firms or institutes has less than 5 employees, and 87 % of all T-KIBS firms (or institutes) have less than 20 employees. At the other extreme only 5 % of all T-KIBS firms (or institutes) employ 50 or more people. *Small SMEs dominate the T-KIBS size structure.*

In particular, technical engineering and architecture services have a *highly polarised size structure*: a limited number of relatively large firms accounts for a major part of total turnover whereas the bulk of small SMEs accounts for less than 11 % of total turnover.

The age distribution in Computer and related IT services is relatively 'young', not surprisingly considering the dynamic development of this sub-sector; only 11 % of employees here are 45 years or older.

The age distribution in R&D services is relatively 'old'; here are virtually no younger employees, and relatively many old researchers.

Compared with average employee mobility of 4.3 % in 1995, employees in Dutch business services appear to be substantially more mobile (6.7 %). Within business services, T-KIBS shows even higher mobility rates: average job mobility in R&D services is 7.3 %, in architectural and/or technical engineering services even 8.4 %.

3.2 Dutch Research and Development services

Available data provide some further insight into the composition and structure of R&D services, in terms of the distribution of employees (full-time equivalents) over technology areas. *Natural science and engineering ('bèta') R&D activities appear to be predominantly executed within industrial enterprises: 57 % of R&D staff are employed there, whereas 29 % work in research institutes. Of the remaining 14 % non-industrial R&D, services account for about 73 %.* Within this service R&D volume of about 5 200 person years, some 44 % is situated in Business and other services (i.e. 4.4 % of total bèta R&D employment). Social science and humanities-based R&D also provide an input to innovation, and particularly to service innovation.

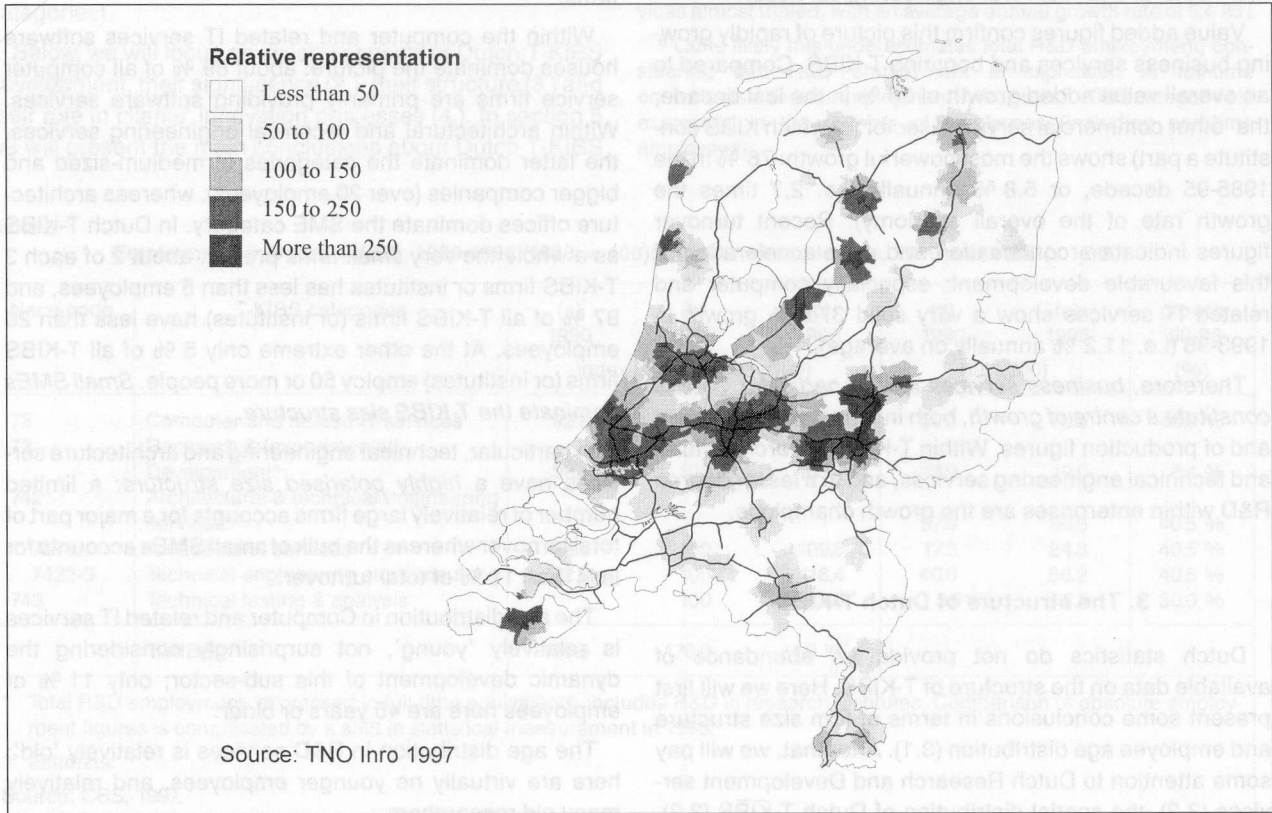
Electronics is the most significant field of research performed by enterprises and research institutes, accounting for about 12.3 % of total bèta R&D efforts. About 90 % of research in this field was conducted in industrial enterprises, primarily in the electrotechnical and medical equipment industry. Among the other significant technology areas are medical and pharmaceutical technologies (7.2 %), process technologies (6.8 %), food and agricultural technologies (6.6 %), and information and communication technologies (6.4 %).

Only a *limited share (about 8.6 %) of natural science and engineering-based R&D capacity is situated in service enterprises.* About half of this bèta R&D capacity is concentrated in Business and other services. Within Business and other services, not surprisingly the most important technology area is information and communication technology (about 18.9 % of total R&D capacity). Services and in particular business services appear to be just a minor player in terms of R&D capacity focused at ICT. About one third of total ICT-focused R&D capacity (1,100 FTEs) is situated in service enterprises; transport, storage and repair, and business and other services account for about 79 % of this capacity.

Figure 1

The spatial distribution of Dutch T-KIBS

Relative representation technology based knowledge-intensive business services
1993, narrow definition



3.3 Spatial distribution of Dutch T-KIBS

In spatial (geographical) terms, Dutch T-KIBS are heavily represented in the Randstad (the central western, highly urbanised area between Amsterdam, The Hague, Rotterdam and Utrecht), with an offshoot to the province of Gelderland. Outside this extensive area, T-KIBS concentrate in other urban areas.⁷

Apart from this pattern, T-KIBS are *clustered along* an east-west *corridor along* the A12 freeway (connecting The Hague with Oberhausen), linking

- the Rotterdam-The Hague region, with a concentration of technical engineering firms and research institutes,
- the growth region of Utrecht, with a concentration of computer software firms, and
- parts of the province of Gelderland, with a combination of 'old' and 'new' elements.

Next to this A12-corridor, the southern fringe of the Amsterdam agglomeration represents a very strong concentration of T-KIBS activity.

In growth terms, Dutch T-KIBS are prospering in the Randstad region, particularly in the southern fringe of Amsterdam, the Utrecht agglomeration, and the Gouda / Woerden region in the 'green heart' of the Zuid-Holland province. Secondly, several parts of the provinces of Gelderland and Noord-Brabant show substantial growth as well, in particular in and around urban areas.

This pattern of spatial development is quite likely to be considered as a continuation and even strengthening of the current structural pattern. Underlying this pattern is a set of factors determining the location of T-KIBS firms which is specific for the kind of KIBS to be provided. For instance, in (offshore-related) technical engineering one of these specific factors is the vicinity of headquarters of big oil and offshore companies in and around The Hague and Rotterdam; for software houses it is the need to be close to major clusters of customers, which translates into a preference for having a central location where major governmental bodies (a major client category) are located as well.⁸ Moreover, as for most professional service providers, it is often crucial for T-KIBS providers to be at arm's length of their customers. Many individual T-KIBS professionals spend a substantial proportion of their working time at the client's premises. A countervailing factor, however, is traffic congestion; these problems lead increasingly to an unchecked spread around the current clusters of T-KIBS locations, in particular along major traffic corridors.

3.4 Knowledge-intensity, educational level and training

A general overview of the knowledge-intensity of several Dutch service clusters is presented in table 5.

The measurement of knowledge-intensity in this table is based on weighted assessments of the educational level of

the working population in a particular cluster.⁹ The (admittedly somewhat obsolete) data indicate that, with the exception of the education cluster, professional services score highest in knowledge intensity, and within this category research and scientific institutes in particular. The professional services cluster scores — immediately after the education cluster — highest in knowledge intensity, and not surprisingly within this category research and scientific institutes in particular.

In T-KIBS the higher educational levels are relatively well-represented and the lower levels almost non-existent (this may be due to lacking data, also). Computer and related IT services seem to have a higher average educational level than technical engineering and architectural services and R&D services. Compared with the average of manufacturing industry, financial services, transport, storage and communication services and (remarkably) public utilities are putting — relatively speaking — a lot of effort in employee training. Business and other services are playing a rather inconspicuous role in this respect, just below the average.

3.5 Internationalisation of T-KIBS

Another aspect of Dutch T-KIBS structure is the ownership structure, in particular the degree of foreign ownership. Available data indicate that nearly a quarter of Dutch "top-firms" are part of or owned by a foreign mother company (about 13 % European-owned, 4 % US, 0.6 % Japanese). Compared with this *relatively modest degree of foreign ownership* (considering the open character of the Dutch economy), the business services sector is only slightly different from the rest: both IT services, R&D services and architectural and technical engineering services have been less internationalised, as yet, than the overall economy. This could indicate that internationalisation is a relatively new phenomenon in business services and T-KIBS in particular, and that the absolute level of internationalisation is still rather modest. Data support the finding

⁷ Spatial distribution is expressed in terms of relative representation, calculated as follows. The 'map' shows 'potentialised values', a sort of spatially advancing averages. Not only are these averages determined by 4-digit postal area scores, but also by surrounding areas with a maximum range of 10 kms. The contribution to potentialised values is 1 for the 4-digit postal area itself, and decreases for other surrounding areas directly proportional with the distance to the central area. The relative representation is the number of jobs per head of the potential working population (everybody between 15 and 65 years old), expressed as an index of the national average (which is 100; cf. Louter et al., 1994).

⁸ Increasingly, however, congestion problems in combination with the required vicinity lead many KIBS providers to a more deconcentrated pattern of location.

⁹ This indicator of knowledge-intensity is based on Louter (1994) and data from CBS (1985). This index has a maximum value of 300 and a minimum value of 0; the higher the value, the more knowledge-intensive.

Table 5
The knowledge-intensity of the Dutch service economy in clusters.

		Educational level/ knowledge intensity (***)
Transport & trade services	Transport Wholesale services	89.9 92.5
	Retail services	83.5
Financial services	Banking	110.9
	Insurance	114.2
Communication & Information services (Multimedia)	Communication services	.
	Audiovisual services	.
	Publishing	.
Professional services	Business services	128.2
	Research & scientific institutes	136.7
	Real estate exploitation & trade	109.8
Recreation, tourism & Cultural services	Recreation, tourism & sport	92.3
	(Social-) cultural institutions	128.6
Personal Services	Hotels & restaurants (cafés)	73.5
	Repair services	91.7
	Other personal services (cleaning, hairdressing)	67.0
Health care	Hospitals, GPs, vets	127.7
Education	Universities, schools	160.1
Community services	**	119.0
Public administration		117.3
* Research and scientific institutes excluded.		
** Employers' organisations & trade unions included		
*** Based on the 'education index' developed by Louter et al. (1994). This index ranges from a maximum of 300 and a minimum of 0; underlying data are drawn from CBS (1985).		
Sources: CBS, NV Databank (1994).		

that *internationalisation in the European context often boils down to Europeanisation*: the majority of international relationships confine themselves to Europe (cf. Ruygrok and Van Tulder, 1996).

4. The role of T-KIBS

Most of the available data related to the role of T-KIBS firms in their clients' innovation processes refer to one or more of the elements of T-KIBS: computer services, R&D services and technical engineering services. For some of the parameters put forward, limited data availability has forced us to confine ourselves to business services, as the broader category to which T-KIBS belong. Below, we will present:

- T-KIBS as carrier and source of knowledge (4.1)
- In-firm R&D collaboration and outsourcing (4.2)
- T-KIBS clients (4.3), and
- ICT as trigger for T-KIBS delivery.

4.1 T-KIBS as carrier and source of knowledge

Table 6 shows what proportion of turnover of computer and related IT service and technical engineering service delivery actually involves knowledge transfer to client firms.

Both technical engineering service and (in particular) computer and related IT service providers appear to be *major actors in knowledge transfer to their clients*. Moreover, the proportion of total turnover with a knowledge transfer component is steadily increasing over time. Especially technical design and consulting play a prominent role in this type of T-KIBS-mediated knowledge transfer.

International expert assessments indicate that computer and related IT services, architectural and (technical) engineering services and R&D services are '*high interaction*' T-KIBS, indicating that these services may be attributed a high degree of *interactiveness* between T-KIBS provider and his client (cf. Bilderbeek and den Hertog, 1997). With the exception of (natural science based) R&D services, T-KIBS are not considered a *source* for innovating T-KIBS clients. Software services are attributed an exclusive *carrier* role, whereas computer services in general, and hardware consulting services in particular, as well as technical engineering services are seen as both facilitators and carriers of innovation with their clients.

By linking input-output tables with innovation surveys embodied R&D flows can be identified (indicating technology flows both within and among clusters). Among the clusters with a high scoring diffusion index are *both, the non-commercial and the commercial services*, which contribute substantially to their role as a *major innovation engine of the Dutch economy*. Commercial services, together with the manufacturing metal-electro cluster are

Table 6

Knowledge transfer through computer and related IT services and technical engineering
1989-94, in % of turnover

	1989	1990	1991	1992	1993	1993	1994
Computer & rel. IT services						SBI '74*	SBI '93*
number of firms (in 1 000)	4.6	5.0	5.5	5.8	6.9	8.5	9.1
net turnover (in mill. Dfl.)	5,862	6,608	7,307	7,550	8,008	8,777	9,071
knowledge transfer share (%)	56	56	58	56	59	58	59
Techn. engin. etc. services							
number of firms (in 1 000)	7.5	7.9	9.0	9.8	11.3	10.8	11.4
net turnover (in mill. Dfl.)	7,191	7,959	9,076	9,913	11,772	10,224	10,392
knowledge transfer share (%)	85	87	95	94	96	98	98

* Intertemporal comparison of these figures is complicated by a shift in statistical measurement in 1993 (due to the transition from the SBI '74 [standaard bedrijfsindeling 1974] into the SBI '93 [id. 1993] standard).

Source: CBS, 1996, p. 95.

playing a rather generic role in this respect; these clusters are the most important suppliers of — often highly — specialised and complementary knowledge and R&D intensive products and services to nearly all the other clusters (table 7; cf. Roelandt c.s. for further background).

Both commercial and non-commercial services are among the economic clusters with a high knowledge-intensity delivering a substantial and often specialised contribution to innovation in other clusters. Compared with these clusters showing a more or less average pattern in terms of internally and externally provided knowledge, the media services cluster poses an eye-catching exception, with 90 % of all technological knowledge coming from outside

the cluster. This particular cluster may have a less substantial internal knowledge base than the other clusters, where more than half of the knowledge used comes from within the megacenter.

Taking a closer look at specific categories of technology, the general pattern shows that the major part (80 %) of knowledge used comes from within the megacenter. Zooming in onto the source of ICT knowledge, the commercial services and transportation and communication clusters are using primarily knowledge from inside, showing an average pattern. In contrast, the other megacenters with a substantial services component (health, non-commercial services) depend much more on knowledge from

Table 7

Flows of embodied R&D (Dfl mln, 1992)

	C	CI	CS	NCS	E	H	AF	M	MF	PTC	Export	Priv. cons.	Gov. cons.	Stock	Total
Construction (C)	131	1	13	10	0	1	1	1	4	3	6	68	0	0	241
Chemicals (CI)	47	939	39	24	6	7	46	12	96	33	669	182	0	-5	2 096
Commercial services (CS)	59	40	895	112	19	33	82	44	110	47	88	435	37	0	2 000
Non-comm. services (NCS)	5	5	13	172	1	2	2	3	9	2	14	117	440	0	782
Energy (E)	1	12	2	1	95	0	2	0	2	0	6	8	0	0	129
Health (H)	0	2	1	4	0	137	4	0	0	0	26	267	3	0	442
Agro-food (AF)	0	1	10	3	0	2	319	0	1	0	108	85	0	1	529
Media (M)	0	1	12	6	0	1	2	67	2	1	13	29	2	-0	136
Manufacturing metal-electro (MF)	157	30	93	72	17	17	61	39	1 390	38	995	595	1	22	3 536
Ports, transport and communication (PTC)	2	1	18	6	1	2	2	4	3	139	79	36	0	0	293
Total	402	1 031	1 096	409	139	201	520	170	1 626	262	2 003	1 821	482	19	10 182
Diffusion index	-0.5	0.7	0.6	0.7	-0.1	0.8	0.0	-0.2	0.8	0.1					

Source: Roelandt, den Hertog, Van Sinderen & Vollaard, 1997, p. 21.

outside the cluster. These findings underline the key significance of ICT for services, in particular for commercial services and transportation and communication services, both as a source and as a user. This is not surprising considering that the main providers of computer and related IT services are concentrated in these particular clusters.

Apart from their role as a source of knowledge commercial services also have a knowledge absorptive role. This may be interpreted as a support for the mixed role of business services, both as a source, a carrier and a facilitator of innovation processes at their clients. In terms of Roelandt's cluster typology, the commercial services clearly are not relatively autonomous and autarkic regarding their innovation processes.

4.2 In-firm R&D, collaboration and outsourcing

In 1994, the Dutch economy comprised about 2 600 firms with their own R&D staff, involving a total of 35 678 R&D employees. The majority of these firms (57 %) were SMEs (with 100 or less employees), employing however only 12 % of total in-firm R&D staff. At the other extreme, big firms (with over 1 000 employees), comprising 7 % of all firms with an own R&D staff, account for 59 % of total internal R&D staff. *In-firm 'own' R&D staff, therefore, is highly concentrated in big enterprises.* The non-manufacturing industries show a more even and less polarised pattern. This applies for business and other services as well.

Of all firms somehow involved with R&D, in 1994, 28 % were actually collaborating with other firms, whereas 36 % were outsourcing R&D. Comparing manufacturing with non-manufacturing industries, the latter are involved with a higher degree of R&D collaboration and outsourcing. Business and other services are even more *collaborating* in R&D (46 %), whereas R&D *outsourcing* occurs remarkably less than the non-manufacturing average (27 %). Within the service sector differences are quite substantial, showing financial services and in particular the transport sector as rather heavy outsourcers.

4.3 T-KIBS clients

The main customers of *computer and related IT services* are concentrated in the non-manufacturing industries; manufacturing industries as a whole took 19 % of total sales. Within the manufacturing sector the high tech industries accounted for just 3 % of total sales of computer services. Within the non-manufacturing industries the largest client categories are distinctly business and other services, both accounting for 14 % of total sales.

In relative terms, *technical engineering and consulting firms* are delivering even more to non-manufacturing industries. Just like computer services, this T-KIBS

category has business and other services as their most significant client category (both 12 %).

R&D services show a somewhat different pattern: here manufacturing industries represent a relatively significant client category, judging by the substantial volume of R&D expenditures of manufacturing firms (29 % of total R&D sales) compared with the manufacturing share in total value added (19 %).

Government is clearly T-KIBS' best client; this is most dramatically so for R&D services. Among the most important client categories of T-KIBS as a whole are primarily (commercial or non-commercial) services. This same pattern also occurs for computer services and technical engineering services. A rather striking contrast offers R&D services in this respect: among their most significant client are (petro)chemical industry, oil refinery and metal-electro-industry (table 8).

All three T-KIBS categories show a rather healthy export volume, ranging from 17 % (technical engineering services), and 19 % (computer services) to even 26 % (for R&D) of total turnover.

4.4 ICT as a driving force for T-KIBS development

The interdependence between computer services, technical engineering services and law, accountancy and economic advisory services is quite strong. Apart from R&D services, having only a relationship of some importance with advertising, T-KIBS constitute a rather *coherent cluster of knowledge-intensive services*, with strong collaboration and outsourcing ties.

An explanation for this T-KIBS clustering may be found in *ICT as a driving force behind T-KIBS development*. Computer services benefit from this. Moreover, *T-KIBS are major ICT spenders*, excluding research institutions which are minor ICT spenders. Within the service sector (accounting for 76 % of all automation costs by far the biggest spender in computer technology) banking and IT services spend most on automation (both 17 %), whereas transport, wholesale (9 %) and *other professional services* (8 %) take the second place.

Within automation costs, the proportion spent on computer specialists with fixed (non-flexible) labour contracts decreases gradually from 42 to 36 %. Available data suggest that this decrease is (more than) compensated by a *gradual increase of temporary employment of computer specialists*, from 6 % in 1985 to 16 % in 1994. In this period the overall number of fixed and temporary computer specialists increases slightly from 48 % to 52 %. Not surprisingly, *business services are the main employing sector of computer specialists* about 55 % of the profession work there. In absolute terms, the *service sector also is by far the biggest hardware investor*. Internationally speaking, the Dutch market belongs to the runners up in ICT spending, after three Scandinavian countries.

Table 8

**The volume of Dutch T-KIBS services provision to their largest client sectors
(ranked by volume) and their export volumes (in mill. Dfl.), 1994**

Nace-code	71	73	742	71+73+742
T-KIBS-sectors			Technical Engineering and Architecture	
Client sectors	Computer services	R&D-services		Total T-KIBS
Government	517 (1)	1189 (1)	106 (4)	1812 (1)
Law, Accountancy & economic consulting	447 (2)	3 (17)	360 (1)	810 (2)
Wholesale	353 (3)	18 (10)	9 (12)	380 (3)
Computer services	218 (6)	1 (20)	124 (3)	343 (4)
Technical engineering & architecture	168 (7)	4 (15)	151 (2)	323 (5)
Banking	294 (4)	13 (12)	0	307 (6)
Retail	246 (5)	15 (11)	0	261 (7)
Education	93 (11)	84 (2)	17 (10)	194 (8)
Petrochemical industry	113 (9)	71 (4)	8 (15)	192 (9)
Chemical industry (final products)	90 (12)	80 (3)	6 (16)	176 (10)
Other business services	66 (19)	5 (14)	103 (5)	174 (11)
Oil refinery	90 (12)	65 (5)	13 (11)	168 (12)
Employers & employees organisations	71 (18)	21 (9)	76 (6)	168 (12)
Public transport	142 (8)	3 (17)	0	145 (14)
Metaelectro industry	73 (16)	54 (6)	9 (12)	136 (15)
Hotels, restaurants etc.	75 (15)	4 (15)	48 (7)	127 (16)
Real estate	81 (14)	3 (17)	42 (9)	126 (17)
Advertising	36 (20)	41 (7)	45 (8)	122 (18)
Machine tools	73 (16)	39 (8)	9 (12)	121 (19)
Oil & gas	109 (10)	8 (13)	4 (17)	121 (19)
Export of goods & services	1 618	1 276	1 692	4 586
Source: CBS, based on I/O-tables.				

Empirical data on Dutch T-KIBS support the idea that these firms often have an important intermediate role in transferring knowledge and contributing to innovation processes in their client firms. (T-) KIBS are important carriers and facilitators of innovation in their client firms. Especially computer and related IT services, and architectural and technical engineering services not only boomed in the last decade in terms of number of firms and turnover development, but also play an important role in processes of knowledge transfer to *other industries*. This at least indicates that KIBS contribute to service-mediated innovation in client firms triggering sectoral renewal and contributing to processes of integration and convergence both at the level of the firm and of the branch of industry.

5. Main conclusions about Dutch T-KIBS development

As an overall conclusion, *KIBS, and in particular T-KIBS, constitute an important category of bridging institutions linking knowledge producers and knowledge users*. Within T-KIBS, the available data clearly suggest a dichotomy between R&D services on the one hand, and computer, architecture and technical engineering services on the

other. This dichotomy applies to the source of funding, the prime sectoral client base, and the rate of expansion.

Considering the above, there are clear indications for confirming the hypothesis that *KIBS are developing into an informal (private) or "second knowledge infrastructure" partly complementing and partly competing with the more institutionalised formal (public) or "first (public) knowledge infrastructure"*. This applies in particular to the computer and related IT services and the architectural and technical engineering services which are developing into a rapidly growing "second knowledge infrastructure" (cf. den Hertog and Bilderbeek, 1997)¹⁰. R&D services show a somewhat different pattern: their growth rate is definitely lower; moreover R&D services operate predominantly in the public sphere. If anything is clear from this, it is the apparent shift from public to private T-KIBS. *Public T-KIBS are loosing ground quite rapidly at the benefit of commercial T-KIBS*.

¹⁰ Some further research will be conducted in the TSER-sponsored so-called RISE project.

There is a clear tendency of closer collaboration between different kinds of T-KIBS. In particular, there is a rather strong interdependence between computer services, technical engineering services and economic consulting services, to such a degree that we are inclined to refer to a *cluster of knowledge-intensive business services*. Remarkably, R&D services — operating in a different market, more dependent on public funding, and with clients predominantly in manufacturing industries — are not included within this cluster.

Contrary to the shift towards a “second knowledge infrastructure”, we consider a shift towards a “third phase”, involving an infrastructure of “networked ‘KIBS’ service professionals” as much more speculative, although some elements seem to materialise as well. Support for the emergence of networks in which professionals operate without a traditional organisational context, may be found in the increasing rate of personnel mobility. Temporary employment agencies are no longer exclusively involved with lower-skilled categories of personnel, but also with the recruitment and intermediation of high skills functions like technical engineers, lawyers, etc.

6. Tentative comparison with German KIBS

Given the high degree of interdependence between the German and the Dutch economies it is tempting to make a (T-) KIBS comparison. Although the Dutch economy at large may seem to be much more a service economy, the same kind of patterns may occur in the interaction between German (T-) KIBS providers and their clients. Here we take the liberty to confine ourselves to a quick scan comparison. We emphasise that this article is primarily based on a study of Dutch T-KIBS. A more thorough comparison requires a systematic comparison with other international studies.¹¹

Unlike in the Netherlands, demand for KIBS in Germany comes mainly from its strong manufacturing base, quite likely due to differences in economic structures. Due to the ongoing strengthening of the German service sector,¹² KIBS clients are increasingly service firms themselves. Preissl (1998) points out that the traditional pattern of internal departments providing knowledge-intensive services to manufacturing tends to shift towards more external KIBS provision. Clearly, this phenomenon is both related to a general pattern of externalisation strategies and increasing specialisation in KIBS provision. Therefore international differences might boil down to differing ratios between internal and external KIBS provision. Taking its still prevailing pattern of internal KIBS provision into account, the German economy might thus prove to be as “KIBS-intensive” as the Dutch economy (or even stronger). Data to substantiate this hypothesis seem to be lacking, as yet.

Supply figures of German KIBS suggest a shift in turnover from technical, advertising and consulting services towards ‘other business services’, including the — particularly flourishing — sector of IT-related services (cf.

Preissl, 1997a, p. 52). Within the German KIBS industry, emphasis shifted from producing new technologies (typically supported by technical consulting) towards diffusing and implementing technologies which are strengthened by management and IT consulting services. Dutch KIBS show a similar shift, primarily due to the spectacular growth of computer and related IT services, not so much to an absolute decline in technical services.¹³

As far as differences between German and Dutch externalisation of KIBS occur, these might be partly related to cultural differences: Preissl indicates a “comparatively big fear to open the company to outsiders who might stick their nose too deeply into company matters”. Although the awareness of KIBS in realising innovation and improving the national system of innovation is emerging, it seems still not to be as well developed as in the Netherlands. The NIW (et al., 1996) report on Germany’s technological performance suggests that service providers could assume an important role of “leading customers” in making Germany an attractive location for providers of advanced technologies. As yet, “compared to their counterparts in France and Great Britain, German service providers are hesitant to draw know-how from abroad” (op. cit., p. 17). Whereas the German service sector’s own R&D capacity is considered to become increasingly important, empirical data do not seem to confirm such a tendency in the Netherlands.

Other factors potentially explaining the relative reticence to outsource T-KIBS refer to German entrepreneurs being not quick in absorbing new management concepts, and to lacking international experience and lacking knowledge of foreign languages in many German firms (Preissl 1998, p. 23-25). Although services increasingly contribute to processes of (manufacturing) innovation, Preissl concludes that the general pattern doesn’t show a shift in firm managers’ perception about the relevance of services to their business as yet.

Nonetheless, there are some empirical indications for a development of KIBS that is comparable with the development in the Netherlands. For one thing, German KIBS seem to be gradually taking over part of the role of (semi-) public technology transfer agencies. This might then be in accordance with the assumption of KIBS developing into private “second knowledge infrastructure” partly com-

¹¹ We have based this quick scan comparison mainly on Preissl (1998), NIW et al. (1996), and Preissl (1997a, b and c).

¹² Input-output data analysis suggests an increase in service inputs from 14.7 % in 1990 to 17.9 % in 1993, most of which may be attributable to the residual category of “Other market services” containing mostly KIBS (Preissl, 1998, p. 5). Cf. also NIW et al., 1996, pp. 14-16.

¹³ Unclear is if (and to what extent) German technical services overlap with Dutch technical engineering services. To the extent that this is so, German and Dutch (T-)KIBS development may diverge: architectural and technical engineering services belong to the category of fastest growing T-KIBS (in terms of number of jobs an average annual growth rate of 5.8 %).

plementing and partly competing with the more institutionalised formal public or "first knowledge infrastructure". But, clearly, as far as this shift occurs in Germany, its KIBS market and the user's experience with KIBS are only just starting to gain momentum (op. cit., p. 28).

As a very preliminary conclusion of this quick scan comparison, it seems that German KIBS tend to follow a pattern of development that is comparable with the Dutch pattern, albeit that German KIBS in this respect may be in an earlier stage of development, and probably are much closer related to techno-economic developments in the *manufac-*

turing sector. However, we need to take into account differences in institutional contexts and in the national innovation systems in particular. The differences in economic structure and the relative openness of the Dutch economy are obvious candidates for explaining these differences. However, we emphasise that the results of this quick scan comparison (focusing primarily on the German vs. the Dutch economy) should be interpreted with according care. More thorough analysis is required to substantiate these findings in order to provide a more solid base for related policy development.

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Zusammenfassung

Der vorliegende Aufsatz konzentriert sich auf technologische wissensintensive Dienstleistungen für Unternehmen (sog. technological knowledge-intensive business services oder T-KIBS) in den Niederlanden. Dabei geht es um jene Gruppe von unternehmensorientierten Dienstleistungen, deren hauptsächliche Funktion in der Produktion und der Vermittlung technologiebezogenen Wissens besteht. T-KIBS gehören meist zu den Kategorien informationstechnische Dienste, FuE-Dienstleistungen sowie Architektur- und Ingenieurdienste. Sie leisten einen entscheidenden Beitrag zur Wettbewerbsfähigkeit einer Volkswirtschaft. Darüber hinaus weisen T-KIBS in der ersten Hälfte der neunziger Jahre ein beachtliches Beschäftigungswachstum auf. In der Mehrzahl handelt es sich um kleine Firmen. FuE findet in den Niederlanden meist innerhalb der Industrieunternehmen statt, nur zu einem geringen Teil sind diese Aktivitäten in Dienstleistungsunternehmen ausgelagert. Unternehmensorientierte Dienstleistungsfirmen geben zwar viel für Computer aus, beteiligen sich aber kaum an Forschung und Entwicklung im Bereich der Informationstechnik. T-KIBS konzentrieren sich auf Städte und haben ihre Büros vornehmlich entlang der großen Autobahnlinien. Nur zu einem geringen Teil sind die Firmen in ausländischem Besitz.

Anbieter von Ingenieur- und von mit Informationstechnik verbundenen Diensten spielen eine wichtige Rolle beim Transfer von Wissen zu ihren Kunden hin. Aus der Input-Output-Analyse geht hervor, daß diese Branchen sehr wissensintensiv sind und in erheblichem Umfang spezialisiertes Wissen an ihre Kunden weitergeben. Die Kunden von Ingenieur- und Computerdiensteanbietern kommen zum größten Teil nicht aus der Industrie. Mit Ausnahme von FuE-Diensten finden T-KIBS-Firmen ihre Abnehmer hauptsächlich im öffentlichen Sektor. Die Informationstechnik kann als wesentliche treibende Kraft für die Entwicklung von T-KIBS gelten, die die verschiedenen technologischen und nicht-technologischen Dienste miteinander verknüpft.

T-KIBS stellen eine wichtige Brücke zwischen den Produzenten und den Anwendern von Wissen dar. Es gibt deutliche Anzeichen dafür, daß KIBS sich zu einer "zweiten Wissens-Infrastruktur" entwickeln, die die stärker institutionalisierte formale „erste (öffentliche) Wissens-Infrastruktur“ zum Teil ergänzt und zum Teil zum Konkurrenten hat. Dies gilt insbesondere für informationstechnische Dienstleistungen sowie für Ingenieur- und Architekturdienste.

Ein kurzer überblicksartiger Vergleich mit Deutschland scheint keine wesentlichen Unterschiede zu ergeben, obwohl in Deutschland die wissensintensiven unternehmensorientierten Dienste noch weniger ausgeprägt sind als in den Niederlanden. Sie lehnen sich hier auch noch viel enger an die technologische und ökonomische Entwicklung der Industriebetriebe an. Diese Unterschiede gehen wohl hauptsächlich auf Abweichungen in der strukturellen Zusammensetzung der Ökonomie und auf die relative Offenheit der niederländischen Volkswirtschaft zurück.