Measuring Innovation Oriented Activities for Business Services: Traditional versus Knowledge Based Indicators

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Abstract:
The paper discusses shortcomings of traditional indicators for measuring innovation oriented activities if applied to business services. Using a survey on a regional level in the Austrian province of Styria an attempt is made to quantify the knowledge base of firms by means of the qualification level. This indicator is then used to reveal hidden technological innovation potentials. A comparison of traditional versus "new" indicators for innovation is made and additional approaches to measure innovation in services are discussed.

Key words: indicators for innovation , service sector, technological knowledge base

1. Introduction

Services are now the largest sector in advanced economies. Yet we still have limited knowledge about its theoretical base and its empirical dimensions - services have been largely overlooked in economic, industrial and innovation research. This is true especially for the latter: Indicators and traditional methods for valuating productivity and innovation in the manufacturing sector are only to a limited degree applicable to business services. The internal innovation and knowledge organisation in services is as a rule only weakly formalized; in contrast to manufacturing firms, business services mostly do not have e.g. an organised research and development unit. Therefore quantitative indicators such as investments and employees in R&D or patents may give a distorted picture. Other factors such as human

resources and their qualification, investment on “intangible assets” have gained increasing significance but are up to now hardly available for empirical analyses.

For the first time a survey on a regional level tried to quantify the knowledge-base of Styrian firms by means of the qualification level, i.d. the share of academics, technicians and engineers. With this “new” innovation-indicator hidden technological innovation potentials can be revealed.

In this paper we first want to give a short survey on to the differences between sectors regarding the usefulness of different innovation related indicators. We then analyse by using the above mentioned survey to what degree outcomes differ between traditional indicators measuring innovation activities and unconventional indicators such as the “technological knowledge base” in and between sectors. Furthermore we discuss additional approaches of measuring innovation in services.

2. Innovation activities in the service sector - General characteristics and sub-sectoral aspects

Our present understanding of innovation is primarily an understanding of “manufacturing” innovation. Hence the Oslo Manual (1997) gives a clear definition of technological product and process innovation, where the term “product” is used to cover both goods and services. Service innovation may be technological innovations but are often non-technological innovation too. Service innovations are the creation of new knowledge or information, or new ways of handling things or persons, they are often small adjustments of procedures and thus incremental and rarely radical (Sundbo, Gallouj1998).

The field of services innovation studies has expanded, with two main results of significance here. It has been recognised that many services are active in the innovation process, not merely passive recipients of others’ innovations and the importance of non-technological elements of service innovation has been accepted (Bilderbeek R. et al, 1998). This resulted in a better understanding of the general characteristics of service sector innovation e.g. product intangibility, the client intensity (Kline&Rosenberg, 1986), soft and non-technological innovation patterns (Haukes 1998), importance of human and organisational capabilities

(Gadrey et al.1995). Gallouj et al.(1997) discerned a total of six innovation models[1] that could be used for describing services innovation.

But the increased interest in service innovation is connected with the fact that the economic development of the service sector is mainly based on the use of information and communication technology (ICT) (Hutschenreiter et al 1999). ICT as "generic" technology is applied in all branches in the service sector. Thereby ICT changes the technological profile of the traditional sectors fundamentally but also generates new dynamic sectors as electronic data processing, modern telecommunication services and diverse business services which show high growth rates (Dachs, Leo 1999). Many services particularly knowledge services such as accountancy, consultancy, training services etc. are increasingly based on the use of ICT. Even in services which are not directly based on ICT, this technology has an increasing role such as for example administration technology or sales and distribution (Internet). The development of ICT and international ICT communication networks is a crucial factor in the evolution of the service innovation system.

The innovation patterns of services firms vary considerably. The nature of innovation varies a lot between sub-sectors within the classification system (NACE). The complexity of functional specialisations of labour plays an evident role, complex, or back-office intensive, services turn out to have different innovation patterns than other services. In information intensive services the scope for use of information technologies is very different from the similar scope in personal services (Gallouj 1998). In principle one can differ between more highly standardised large-scale services such as cleaning or bank services and highly customised services, which means that the service production is a "tailor made" individual solution to the customer's problems. There can be more or less technology involved in the service production and delivery, complementarily the service will be less or more labour intensive. To understand the development of innovation patterns some generic trends summarized in a model by Hauknes 1998 on the basis of national reports and surveys are described.

The Hauknes model of forces driving innovation in the service sector

According to Hauknes (1998) there exist external and internal driving forces which influence the innovation process in a service firm. The intrinsic "drivers" include three so-called agents:

[1] They distinguish between radical innovation, improvement innovation, incremental innovation, ad hoc innovation, re-combinative innovation and formalisation innovation.

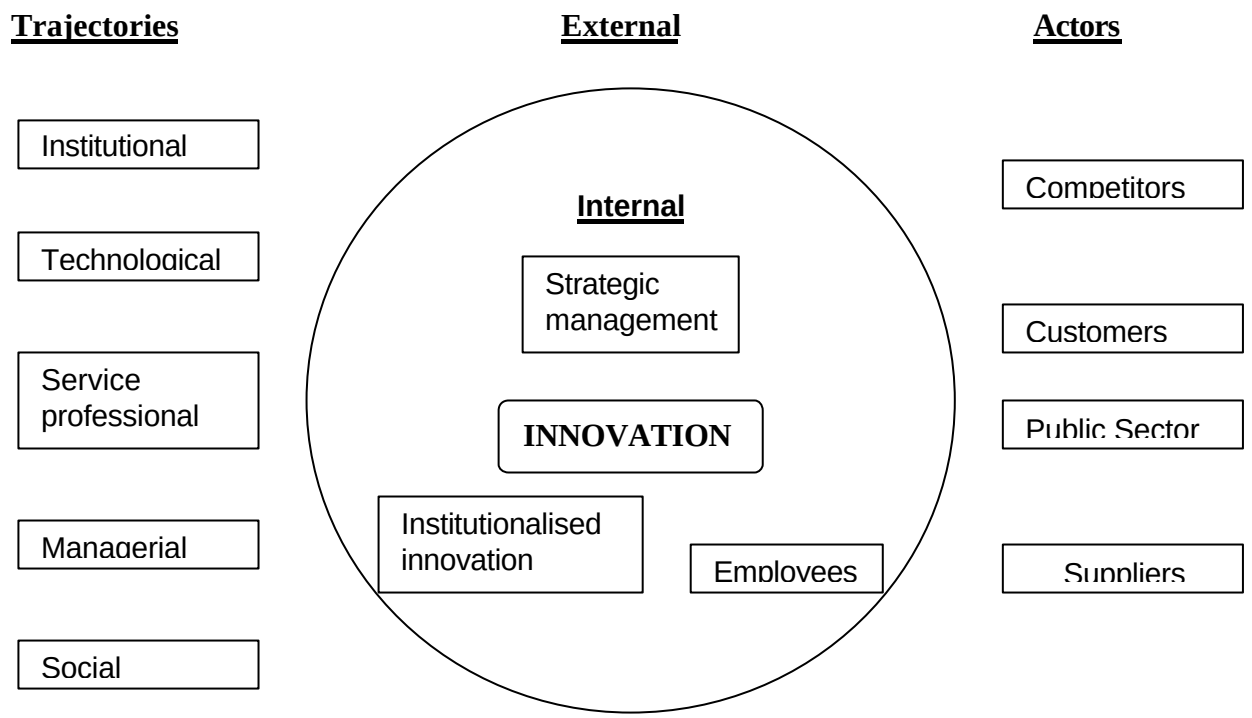
management and strategy formulation (strategic management), employees and institutionalised innovation efforts e.g. in the form of formalised innovation or R&D units.

The external forces can be devided into trajectories and actors:

Trajectories are ideas and logics that are diffused through a large number of actors in a social system (being a nation, an international network etc.). Three types of trajectories can be identified. The most important is service professional trajectories: methods, general knowledge and behavioural rules that exist within the different service professions (e.g. catering (how to cook)). Another type of trajectory is general management ideas or ideas for new organisational forms such as motivational systems, service management etc. The third type is technology trajectories. New logics for using technology that generally influences service products and production processes. Examples are the diffusion of ICT and more specifically the Internet.

Actors are persons, firms or organisations whose behaviour influences the service firm's capabilities for selling services and therefore also their innovation activities. Customers, also competitors are actors of major importance. Suppliers and especially KIBS (Knowledge Intensive Business Services) suppliers are important sources of innovation as well.

Fig. 1 Driving Forces (see Hauknes, 1998)



Source: Hauknes J., Service in innovation – Innovation in services, SI4S Final report, 1998

Knowledge Intensive Business Services - KIBS

Services are not only technology users but also becoming increasingly technology suppliers. Particularly knowledge intensive business services[2] (KIBS) play an important role, they produce and transfer specialised information (some financial services such as accountancy firms, advertising, marketing and consultancy companies, architectural, engineering and R&D services). On the one side KIBS have the potential to act as an innovator on the other side they are also very important in the diffusion process of innovation. They provide "new knowledge" to their clients that is more often an individual solution to the customer's problems. So the feedback of clients can shape innovations in service firms, just as much as service firms can influence their customers' innovation. For example IT support services, management consultancy, and technical engineering typically cooperate with their clients in highly interactive ways. This positive interaction can result in new impulses for modernization and rationalization processes. Thus KIBS generate important spill-over effects for the whole economy (Mesch 2000).

Problems in measuring innovation in the service sector

The problems in measuring innovation in the service sector mainly stem from the characteristics of the service activities. First, there is the close relationship between client and service supplier, which has an important influence on the innovation process. Second, the solutions become more often tailor-made and are not standardized. Hence the question arises if a small change in the content of a service is an innovation or just a client specific variation. Third, the innovation output is often intangible, it is rarely possible to measure the productivity effects because the focus is on quality improvement rather than on higher productivity.

So the definition of innovation in services is not explicit. There is a lack of indicators which would express the total innovation activities. In the majority of cases traditional innovation indicators which are used in manufacturing are applied e.g. R&D expenditures, R&D staffs and other indicators related to R&D. But there are problems in using these indicators since very few service firms have formalized R&D departments although many have R&D activities. There are also attempts to use indicators that include non-R&D activities such as acquisition of patents, training, market research etc. The conclusion is that no sufficient set of indicators has yet been found (Sundbo and Gallouj 1998).

[2] After NACE classification: KIBS are a subset of the category business services, furthermore the sectors electronic data processig and R&D have to be added.

3) Differences in the significance of innovation indicators between sectors

The following statements are based on the Austrian National Innovation Survey in the service sector carried out by WIFO[3] (1999) within the framework of the Community Innovation Survey (CIS). In detail the following sectors within the service sector were investigated: Wholesale trade (NACE 51), architectural, engineering and other technical activities (74.2), computer and related activities (72), land, water and air transport (60-63), telecommunications (64) and financial intermediation (banking and insurance; 65-67). The Oslo Manual definitions of innovations were used in the questionnaire. The focus was set on the innovating firm (subject approach) and not on individual innovations (object approach).

Results:

56,6% of the service sector firms have introduced a new/improved product or process during the period of 1994-1996 which is 9 percentage points less than the manufacturing sector. It can not be concluded that service firms in general are less innovative: in contrast the sectors air transport, financial intermediation, telecommunication and data processing show an innovation rate that is above over the manufacturing average. Organisational innovations which are quite frequent in the service sector are only considered to a limited extent in this kind of survey. They are only taken into account if they result directly in the introduction of a new or measurably improved service.

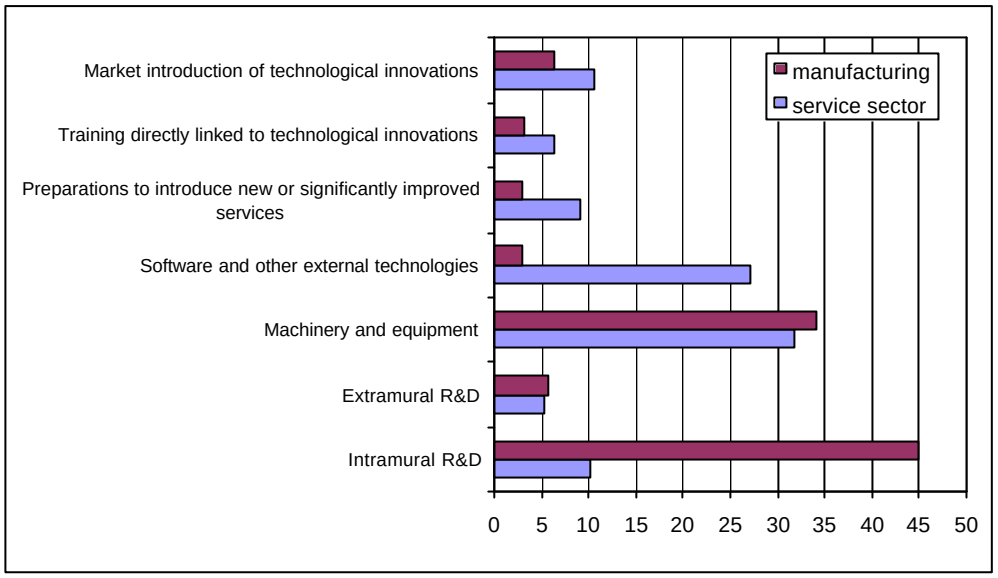
Innovation input

One of the most important indicators of measuring innovation are the total expenditures on innovation activities. The innovation intensity (innovation expenditures by turnover) amounts to 2% in the service sector, which is far below the manufacturing average of 4%. Businesses that outperform the average innovation intensity both in the service and manufacturing sector are data processing, telecommunication and technical services.

The total expenditures on innovation are broken down by different categories: *Research and development (internal, external), machinery and equipment, software, preparation for introduction of innovations, training and introduction into the market.* There are two main differences regarding the expenditures profile between manufacturing and service sector. First, service sector firms invest much more in software and (existing) external technologies, second, expenditures in R&D have quite an inferior significance.

[3] Wirtschaftsforschungsinstitut – National Institute of Economic Research

Fig. 2 Innovation Expenditures in %



Source: WIFO

Investment in machinery and equipment as innovation input has almost the same relevance for the manufacturing and the service sector. The share of training shows the importance of human capital in the innovation process in the service sector. The relatively higher expenditures for the preparation of innovation introductions can be interpreted by relative higher adaption costs in external technologies.

In general the service sector follows an innovation strategy that differs considerably from the manufacturing sector. Innovations are mostly realized with the use of new technologies. They are based mainly on external knowledge that is acquired by investments in machinery, software and other external technologies (Wieland 1993).

Differences between sub-sectors within the service sector

The sectors electronic data processing and technical services differ significantly from the average pattern of expenditures. Their R&D expenditures amount to 50% which is quite above the average of the service sector and slightly over the industry average.

In contrast internal R&D has no importance in air and land transport. In these sectors innovations are based on machinery and equipment, in the financial sector they are based on external technologies, mainly software. In 1995 the financial sector invested much more in software than the whole industry. Banks and insurances were the first users of electronic data processing in the service sector.

Electronic data processing sector (EDP) – a very knowledge oriented sector, spends much more money in staff training than other branches. The high share of expenditures for preparing innovation in the telecommunication sector shows the size of the launching costs in this quite recently liberalised sector.

On the basis of expenditure categories one can distinguish between research intensive companies and technology users. In research intensive companies the innovations are mainly based on their internal R&D, typically there is a high share of R&D expenditures. This innovation strategy is mainly applied by the EDP-sector and technical services which both belong to the business services.

In contrast technology users are companies where innovations are based on technology developed elsewhere. One characteristic is the high share of machinery, equipment and software of total expenditures. The majority of branches in the service sector belongs to this category. However, the mere use of these technologies helps to develop a stock of technological knowledge in many services which is a necessary precondition to absorb new technological developments.

Innovation output

To get a complete view of firms' innovation activities one has to look not only at the innovation input but the "success" of product and process innovation. The success can be measured by share of turnover the service firm has gained with new/improved products (services) or processes. In the Austrian Innovation Survey (WIFO 1999) no innovation output was measured in the service sector, so the following statements are based on the Mannheimer Innovation Pannel carried out by ZEW (2000).

In the total service sector (except for financial intermediation) 20% of the turnover is obtained from new products and processes. A quiet different result can be observed by breaking down to single branches within the service sector. The sectors electronic data processing and telecommunication boast a share of 46%. Technical services and consultancy services reveal a share of 30% which is still above the average. Because of the mainly intangible character of innovations in the service sector the innovation output is difficult to measure (Mesch 2000).

The clearest distinction between the manufacturing and service sector can be found in the patent statistics. Only 5% of the innovating firms have applied for a patent registration during 1994 and 1996, one exception being architectural and engineering services with a share of 34% of patent registrations. Patents are the most widely available indicator of output of

technological activities. But they are not the suitable instrument to measure the innovation output or R&D in the service sector, as most of the innovations are not patentable e.g. algorithm in software (G.Sirilli 1998).

Traditional innovation indicators developed for the use in manufacturing sector surveys give some information about the innovation activities when applied to the service sector but are quite far from measuring innovation and its effects on productivity and employment.
R&D intensity gives additional information but innovations are only in exceptional cases the result of strategic research efforts. Often they are a by-product resulting from a problem-solving process where mechanism of learning by doing are to the fore (Mesch, 2000).
Also the innovation output measured by turnover gives some information, but how can one measure output e.g. with regard to consultancy, carrying passengers, treatment of patients? A mere quantification in terms of number of consultancy hours, number of passengers, number of patients would not do as the quality of the service is not appropriately reflected.
Therefore other indicators will have to be developed and applied which respond to the characteristics of innovation in the service sector, mainly by considering the intangibility of output, the inadequate assignment of R&D activities to firms' resources (persons, money) and the high degree of heterogeneity within the service sector.

4. Regional innovation survey in Styria: Traditional versus knowledge based indicators

A recent survey on a regional level tried to quantify the knowledge-base of Styrian firms by means of the qualification level, e.g. the share of academics, technicians and engineers. With this "new" innovation-indicator pioneered by the School of Technology Management and Economics of Chalmers University of Technology in Gothenborg (Sweden) hidden technological innovation potentials can be revealed particularly in firms that do not have an organised research and development unit and therefore are not able to quantify their R&D activities which is often true for service sector firms. The technological knowledge base is a very important input-indicator for the innovation process – perhaps the most crucial one in the future as the continuous flow of qualified (technical) staff more and more becomes the key determinant of sustainable competitiveness. In the regional innovation survey in Styria carried out by the Institute of Technology and Regional policy the share of "technical academics" separated from "other academics" and the share of engineers and technicians separated from other "A-level graduates" was surveyed.

Table 1 Share of high qualified employees in the service sector

	Number of Enterprises	Median[4]: Share of Technical Academics	Median: Share of Technicians	Median: Share of other Academics	Median: Share of other A-level Graduates
50, 51 Wholesale trade	15	0	1,2	0	2,0
55 Hotels and restaurants	15	0	0	0	13,3
60 to 64 Transport	18	0	0	0	0
65 to 67 Financial intermediation	12	0	0	0	27,3
70, 71Real estate, renting	5	0	2,8	2,4	0
72 EDP	8	13,3	24,0	1,7	8,3
74.2 Architectural, engineering and other technical activities	3	20,0	16,7	0	0
74 Other Business services	15	0	0	13,4	8,6

Source: JOANNEUM RESEARCH

- Most of the "technical academics" and also "technicians and engineerings" can be found in the sectors electronic data processing (72) and architectural, engineering and other technical activities (74.2).

[4] For calculating the average the median not the mean value was used because of the high variance.

- "Other academics" are represented strongly in (other) business services (74).
- "Other A-level graduates" can be found mostly in the sectors financial intermediation (65 to 67) and hotels and restaurants (55).
- In comparison to the manufacturing sector the construction (45), paper (21), machinery (29) and electronics (32) reveal the highest share of "technical academics" (appr. 2 to 3%). This technological knowledge base output is far below the average of EDP (72) and architectural engineering and other technical activities (74.2).

Table 2 Share of high qualified employees in the manufacturing sector

	Median: Share of Technical Academics	Median: Share of Technicians	Median: Share of other Academics	Median: Share of other A-level Graduates
Mining	2	1,62	0,69	0
15 Food	0	0	0	0,9
16 Textiles	0,41	0,55	1,07	0
19 Leather products	0,15	0,12	0,06	4,55
20 Wood	0,67	0,45	0	0
21 Paper and paper products	2,47	4,99	1,11	2,37
22 Publishing	0	0	0	2,08
24 Chemicals	1,67	7,69	0	0
25 Rubber and plastic	0	3,28	0	1,23
26 Non-metallic mineral products	0	1,72	0	0
27 Basic metals	1,53	2,67	0,38	1,25
28 Fabricated metal products	0,47	4,55	0	0,86
29 Machinery	2,17	7,69	0	1,54
30-33 Electronics	2,02	9,46	0,72	2,44
34 Motor Vehicles	0	2,44	0	9,09
36 Furniture	0	3,81	0	0
40,41 Energy	0	3,6	0,31	3,09
5 Construction	2,74	2,52	0	0

Source: JOANNEUM RESEARCH

In total the share of qualified employees in the service sector is higher than in the manufacturing sector. Consequently the knowledge base plays a more significant role in the service sector. An outstanding *technological* knowledge base can be found only in two sub-sectors, 72 EDP and 74.2 Architectural, engineering and other technical activities.

Furthermore other traditional indicators e.g. the "innovation intensity" was surveyed in the questionnaire.

Table 3 Branches ranked by share of enterprises with innovation intensity > 5%

	share of enterprises with innovation intensity > 5% (in %)
72 EDP	88
74.2 Architectural, engineering and other technical activities	67
21 Publishing	43
25 Rubber	40
26 Non-metallic mineral products	40
34/35 Motor vehicles	40
30-33 Electronics	39
29 Machinery	39
28 Metal products	33
20 Wood	30
36 Furniture	25
Total	**25**
15/16 Food, tobacco	24
60 Transport	21
10-14 Mining	20
45 Construction	15
74 (not 74.2) Business services	14
17/18 Textiles	11
65-67 Financial intermediation	10
55 Hotels and restaurants	8
50-52 Wholesale	7
27 Basic metals	0
40/41 Energy	0
70/71 Real estate, renting	0

Source: JOANNEUM RESEARCH InTeReg; WIFO

The average Austrian "innovation intensity" in the service sector amounts to 2% which is half of the manufacturing sector (see chapter 3). In Styria 53% of the firms in the service sector spend less than 2% of turnover for innovation activities (manufacturing sector 29%). Table 3 shows the share of Styrian enterprises that reveal an "innovation intensity" which is higher than 5% (overall 25%). First in the ranking is EDP (72) with 88% of the firms spending more than 5% of turnover in innovation activities. Second of the ranking would be architectural, engineering and other technical activities (74.2) but the number of replying firms was very small.

The next table gives an overview of Styrian sectors that reveal high figures at least for one of the chosen indicators:

Table 4 Styrian sectors compared to different innovation indicators

Ö-NACE	Share of product innovation[5]	Share of Process innovation[6]	Innovation intensity > 5%[7] (∅ = 25%)	Share of technical academics
20 Wood	≈	**60%**	≈	≈
21 Publishing	**86%**	**86%**	**43%**	≈
25 Rubber	**60%**	≈	**40%**	≈
26 Non-metallic mineral products	≈	≈	**40%**	≈
27 Basic metal	≈	**70%**	≈	≈
29 Machinery	**75%**	**67%**	**39%**	(Median) **2,2%**
30-33 Electronics	**79%**	**63%**	**39%**	(Median) **2,0%**
34/35 Motor vehicles	≈	≈	**40%**	≈
45 Construction	≈	≈	**40%**	(Median) **2,7%**
72 EDP	**88%**	≈	**88%**	**High**[8]
74.2 Architectural, engineering and other technical activities	n.s.	n.s.	n.s.	**High**

Source: JOANNEUM RESERCH InTeReg

- Expectedly table 4 shows high figures within the manufacturing sector in machinery (29) and electronics (30-33), but also the branches publishing (21) and construction (45) show surprisingly high figures.
- In the service sector EDP (72) and Architectural, engineering and other technical activities (74.2) reveal the highest figures.
- Interesting are the sector-specific patterns, e.g. the high share of process innovation in wood (20) and basic metal (27), or the high product innovation in EDP (72).

In total the share of qualified employees in the service sector is higher than in the manufacturing sector which emphasizes its significant role in this service sector. An outstanding *technological* knowledge base can be found only in two sub-sectors, 72 EDP and 74.2 Architectural, engineering and other technical activities reflecting the high degree of diversity between sub-sectors in services. Furthermore an outstanding technological knowledge base in general goes along with high innovation intensities. Further research will be required to clarify the role of high qualified staff (in particular those without a technical background) in the residual service sector.

[5] Firms with product innovation
[6] Firms with process innovation
[7] Innovation intensity: innovation expenditures by turnover
[8] Number of replying firms is very small

5) Proposal for future innovation measurement in the service sector

One way to overcome the methodological deficits with regard to measuring service innovation e.g. the absence of R&D departments in these firms or the problems arising from the low average size of these firms) has been pioneered by the School of Technology Management and Economics of Chalmers University of Technology in Gothenborg, Sweden (see e.g. Jacobsson, S. et al., 1995). When it comes to technological innovation these indicators can give new insights in particular when applied to service sector firms. These qualification indicators can be seen as complementary or even as a substitute to traditional R&D and patent indicators.

The basic assumption is that technological knowledge is mainly "embodied" in scientists and engineers and that their work is mainly technology-related. On an operative level educational data is applied for a better classification of enterprises according to the respective knowledge base, beyond conventional innovation indices, product classifications or industry codes. Moreover this indicator is very suitable for surveying service sector and SMEs' innovative activities for it does neither require the presence of R&D departments nor patented knowledge. In a paper by Jacobsson (Jacobsson, S. et al., 1996) the distribution of innovative activity between large and small firms and the technological competence of these firms is explored by using R&D, patent and finally educational data. It concludes among other findings that R&D data underplays the role of service sector firms in a regional and/or sectoral picture of technological activities. Furthermore, educational data may capture the character and the diversity of firms` technological competence better than patents do. Another advantage is the opportunity to evaluate how technology diffuses as well as how the technology base of firms, industries and regions evolves - in other words it does have a strong dynamic element which reflects structural changes with very little time-lag. To give a concrete example the paper finds that in the respective state (Sweden) the most noticeable increase in electronic engineers did not take place in the in the industrial sector but in the service sector.

A key disadvantage so far has been the lack of data in this field, mostly due to the heterogeneity of educational levels in different states. Sweden has so far been the only country with relevant data at hand. This reason for not using educational data as an indicator

for assessing technological activities across countries will probably diminish in the future keeping in mind the EU-wide efforts to harmonise qualification levels.

As specified above a set of qualification indicators have been used in a regional innovation study in Styria in order to give first insights and to set a baseline for future surveys in this field. Moreover recent work in Austria by the authors` institute has revealed a way which

- may yield relevant data on a regular basis
- is based on a complete inventory count
- would not require any additional surveys as is it based on administrative data already there but untapped so far.

The basic idea of this technological knowledge base monitoring is to tap and process existing administrative data in a new way: The original data will be taken from the Austrian "Hauptverband der österreichischen Sozialversicherungsträger" (head organisation of the regional social insurance bodies) which includes individual data on all Austrian enterprises (with at least one employed person) and the total population of employed persons on a regular basis. The strictest level of confidentiality has been applied: the database does not contain names or locations of neither individual enterprises nor employees.

What can be expected from this approach are quantitative statements about the technological knowledge base (in a first step this would mean the percentage of engineers and technicians) broken down by:

- Sectors (including any sub-sectors within the service sector)
- Region
- Income
- Age
- Gender

and moreover the dynamics of these indicators on an annual or even monthly basis. Another opportunity would be a monitoring of the *mobility* of qualified staff between sectors, sub-sectors and regions.

The project is in a pilot phase which deals with data availability and processing issues and has therefore not yielded any results so far. However the authors are positive that this approach

will give new insights in the technological innovation activities in the service sector in Austria.

6) Policy conclusions and recommendations

- Economic analyses in the service sector are considerably difficult because of the lack of statistical data in wide fields of the regarding sectors. The introduction of a specified service sector innovation panel would not only increase the understanding of the significance of the service sector but macroeconomic developments could be clarified in more detail and policy measures could be adapted to the characteristics of the service sector and its sub-sectors.
- Traditionally the technology and innovation policy is targeted to high-technological sectors (e.g. in the framework of R&D promotion). Bearing in mind the heterogeneity of the service sector policy instruments have to be adapted to their individual characteristics. There are explicit differences between distributive services (trade and traffic) and business services. Moreover the importance of small enterprises (which are typical for some service sectors) for innovation activities should not be underestimated.
- Market success is one of the most important indicators for innovation activities. For evaluating the firm’s innovation potential one has to consider both input and “success”. A clarification of "market success" in the service sector and its sub-sectors will be necessary and will require more research due to the non-quantifiable output characteristics of many services.
- The (technological) knowledge base becomes more and more significant for being competitive, especially in the service sector with its focus on intangible assets in particular human resources. So the concept of measuring innovation input by assessing the individual firms' (technological) knowledge base would give the opportunity to get new insights into sub-sectors, regions and the dynamics of change in the service sector.

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