

**D**ANISH **R**ESearch **U**NIT FOR **I**NDUSTRIAL **D**YNAMICS

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**Innovation surveys:  
A researcher's perspective**

*By*

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# **Innovation surveys: A researcher's perspective**

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## **Abstract**

An earlier version of this paper was prepared for the joint OECD/Eurostat workshop on innovation surveys, OECD, Paris, June 30<sup>th</sup> 1999. The paper addresses some issues about the nature of innovation surveys (particularly the new Community Innovation Surveys) and how they might be improved to take on board several crucial developments in contemporary advanced economies. In particular the following topics are discussed: the increased distribution of innovative activity across firms and networks; the problems of service sector innovation and the comparability of services and manufacturing firms; and the problems of labour in the innovation process.

**Keywords:** survey, service sector, innovation

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## **Introduction**

The Community Innovation Survey has been a useful step forward in terms of generating data for use on innovation research. However, there are several areas that could be improved. The following discussion is set out as a kind of ‘wish list’ of possible additions and modifications to existing innovation surveys. It would obviously not be possible to attend to all the points raised below (which reflect this particular researcher’s own prejudices and research agenda). They may not suit other researchers at all and this should be borne in mind. Many of the observations stem from research done at CRIC in Manchester using and referring to other work in progress and other data sources such as the CBI Innovation Trends Survey and the Employment in Britain data sets.

The paper is set out to address five perceived problems with present surveys which are grouped under the following interrelated, broad categories:

- What should the unit of analysis be?
- What is an adequate definition of innovation?
- What issues need to be addressed regarding comparability between sectors?
- What about labour?
- The learning economy

## **Units of analysis**

### The firm, the network or the innovation itself?

The unit of analysis has traditionally been the firm, but this seems less and less relevant as we near the enter the new millenium. For example, as firms are increasingly outsourcing (including the outsourcing of R&D, see Howells, 1999) innovation takes place increasingly across a network of firms and other institutions

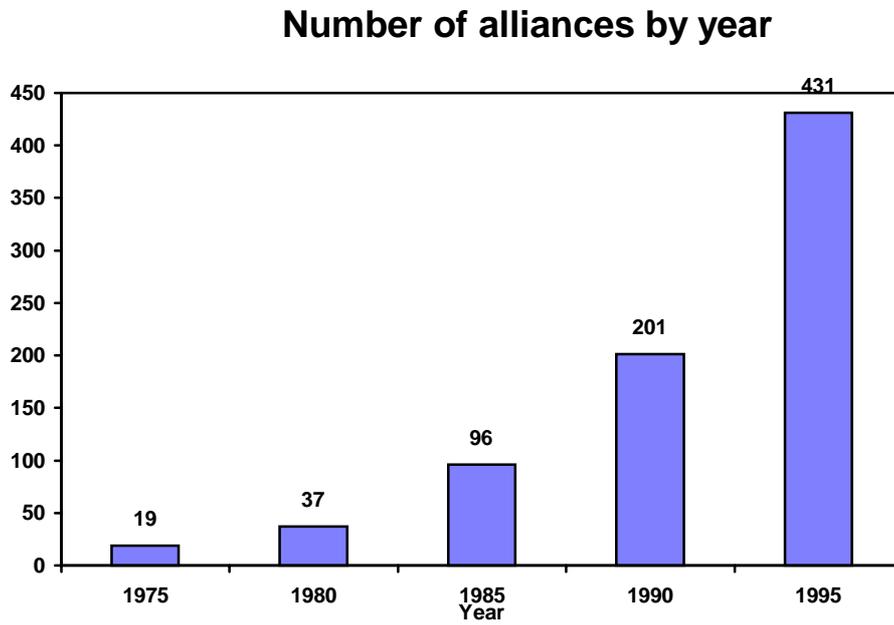
rather than within one firm. Also the increased use and development of information and communication technologies allows easier dispersion of innovative activity.

Also the spreading of the costs of risk has made it attractive for certain firms to adopt a distributed model of innovation. Returns on R&D have declined over the past few decades. Firms going down what might be termed a 'core competence' model of production increasingly rely on external sources of ingenuity in order to develop new products, services or other related processes.

Moreover, the ownership of the firm is increasingly dispersed across a variety of types of shareholder. Therefore issues surrounding corporate governance are also relevant here. Shareholding structures can also have a significant influence on the innovation strategies of firms (Tylecote, 1999). The availability and the restrictions on the availability of funds for innovation are pertinent here, but questions of firm ownership structures, mergers and acquisitions etc. are rarely asked in surveys.

An example of the increased reliance of firms on collaboration can be seen in figure 1 which uses data for technological alliances in the pharmaceutical industry. The growth of networks has been documented by several researchers (e.g. see Hagedoorn and Schakenraad, 1990) and is structured along several different relations. For example, figure 2 shows the depth that networking has reached in the computer industry using IBM as an example (see Tomlinson 1999a).

**Figure 1**      **Number of technological alliances in the pharmaceutical industry**

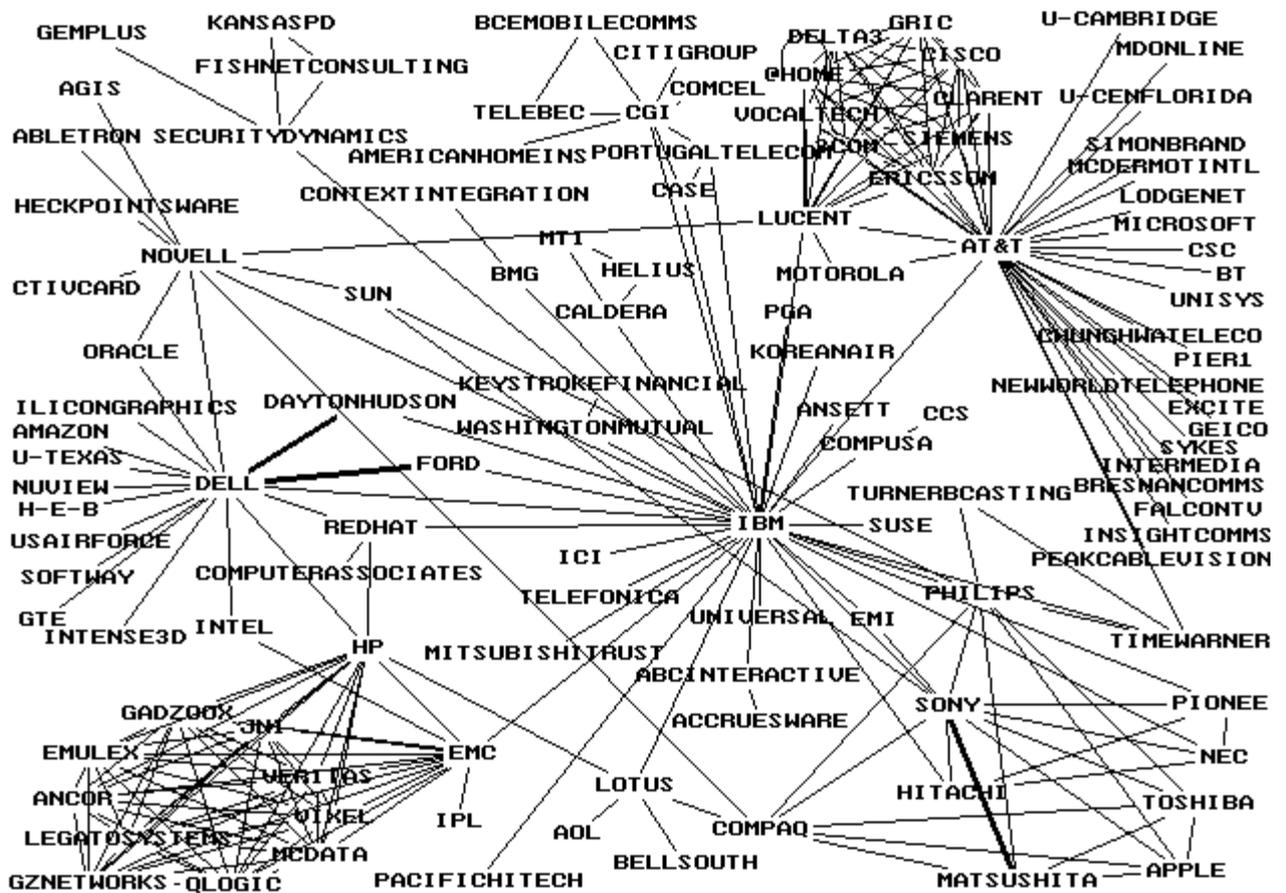


Source:

Ramirez

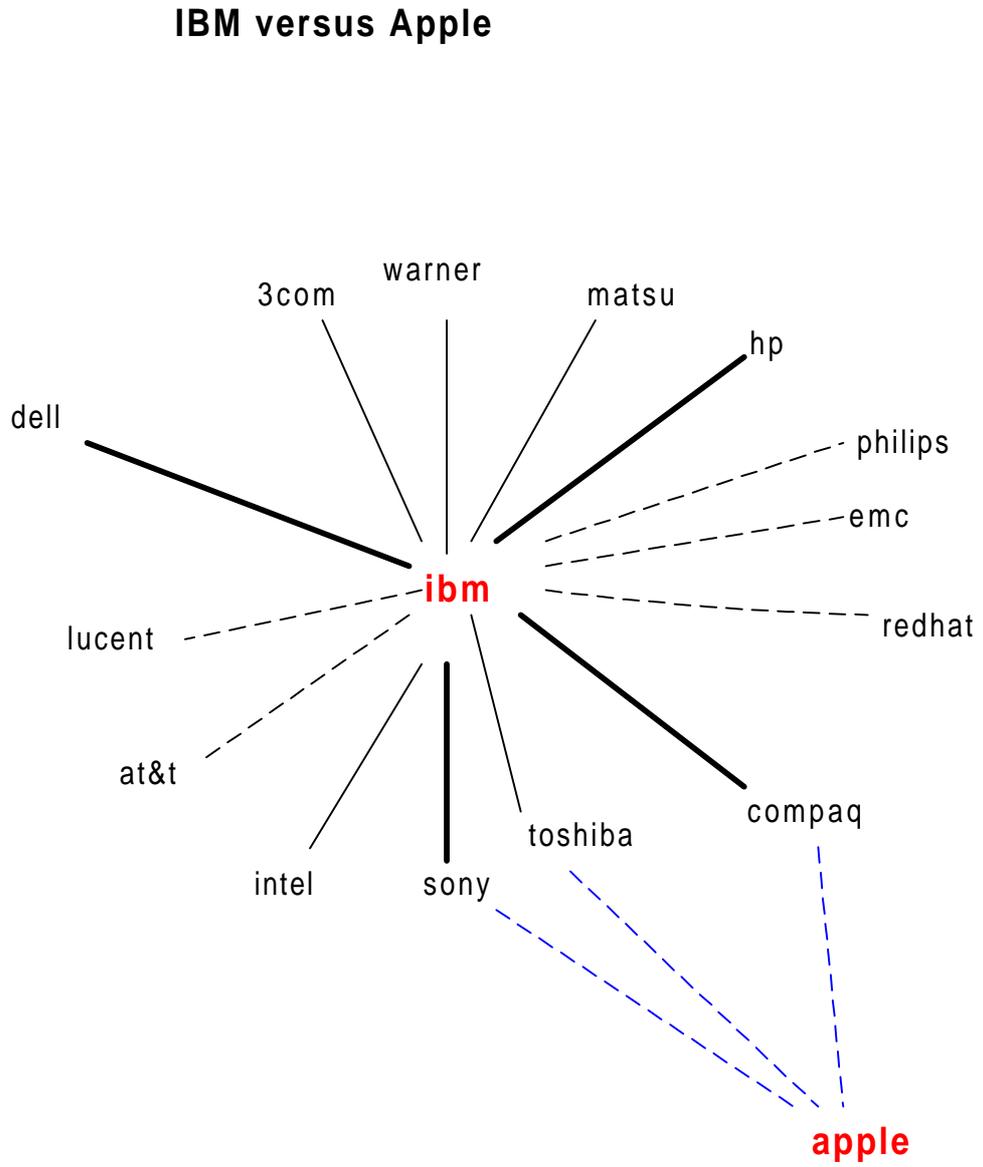
1999.

**Figure 2** Network generated from 2 layers of IBM's connections  
(Jan-Mar 1999)



Source: Tomlinson 1999a

Figure 3 Competing networks: IBM versus Apple 1999



Source:

Tomlinson

1999a.

If we are to understand innovation now then questions about what happens between firms and other institutions are just as important, if not more important, as what happens within them. The different relations developing between firms such as those along the supply chain, the development and setting of industrial standards, or R&D collaborations, all have a different influence on the innovation process. Influences which at present cannot easily be disentangled with the data available. Furthermore the nature of competition has fundamentally changed. If we take a more distributed view of production then it is networks of firms that collaborate or compete rather than individual firms. And sometimes there appears to be collaboration and competition taking place simultaneously. Figure 3 shows the developing competitive networks between IBM's core and Apple during Apple's recent rejuvenation<sup>1</sup>. Note that the networks are formed of firms from different sectors and with quite different competences.

The interlacing of these networks of firms is extremely complex and may be overriding the traditional relationships that used to hold sway, such as the relationship between innovation and firm size or sectoral considerations. Thus innovation surveys, if they are to remain useful, must address the issue of the unit of analysis first and foremost. When an innovation is the product of a network of firms what sense does it make to talk about an individual firm's size or sector? Several small firms may contribute to an innovation by collaborating, but individually may not report any innovative behaviour themselves. This does not mean that firm size is unimportant, merely that the interpretation of traditional 'independent' variables needs to be considered with care.

This leads us to the problems of sampling and questionnaire design. It would be near impossible to set up a sampling frame based around networks, so it would appear that firms will have to remain the sampling units of innovation surveys. However, the present structure of questionnaires is not as helpful as it might be with respect to networks and collaborations.

For example, although the CIS asks about collaboration and some of the external sources of information, it cannot be related to specific innovations. We cannot tell whether certain innovations were done alone or as part of a network or a combination of the two. This stems from the crude nature of the innovation questions themselves. It seems that it would be more helpful to ask firms about specific important innovations rather than simply whether they have innovated or not.

To give some idea of the real nature of this problem, table 1 shows some random examples from the DTI CIS2 dataset where firms were asked to describe their most important innovation. This table is restricted to those firms that claimed to have introduced new to market innovations (arguably the most stringent definition of innovation in the survey). As one can see, there is a huge range of different types and extents of innovation between firms of different sectors. Many manufacturers claim that a new process was more important than a product. Some manufacturers list software as a new development while some services list a new material product. The majority of service firms mention some computerised or IT driven technologies.

It would appear that to simply ask the question 'have you innovated or not?' and then base the rest of a questionnaire around this crude response seems shortsighted. It might be better to ask what the firm's most recent or most significant innovations were and then ask questions related to these innovations. In this way we would be able to disentangle the extent of collaboration or innovation expenditure for particular innovations rather than an indefinite and unspecified collection of 'innovations'. This would not, of course, restrict questions about overall innovation expenditures or other questions about firm organisation as a whole etc. which are still necessary to assess general levels of innovative activity.

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<sup>1</sup>This was generated using network analysis (Cliques analysis) of a Spring 1999 database.

**Table 1**      **Examples of the respondents ‘most important’ innovations**

Sector (NACE)	Innovation
14	New type of asphalt
15	New type of bread
17	Absorbant polyester
18	Non-iron garments
19	A new dog collar
22	A new software package
24	A new warhead
25	New packaging for vegetables
26	Mechanisation of the production process
27	New machinery for production
28	Development of management information system
29	Teabag machine
30	Touch screen PC
31	Robotic product assembly
32	Kanban system of stock purchase
34	Waste shredder
51	A 24 hour service
60	Cell phones for drivers
62	A new type of passenger seat
64	A new software package
65	EDI
66	New IT sytem
67	Introduction of PCs
72	Intranet
73	New chemical technology
74	Introduction of networked computers

## **The problems of defining innovation**

Following the previous discussion the next obvious point comes when defining innovation. This also has a considerable bearing on comparability between sectors which we return to below. An innovation in services for example is not generally the same as an innovation in manufacturing. We have already argued that there is limited utility in asking simply whether innovation has taken place or not. However, the definitions of innovation used in surveys need clarification. It is too easy for the respondent to misinterpret the intentions. For example, the UK CIS service questionnaire asks for 'significantly improved services or methods to deliver services'. It would be more useful, perhaps, with respect to service delivery to know whether delivery was improved qualitatively or quantitatively. A 'significant' improvement could be either increasing the target customer base or improving the service to its existing customers, or both. Clearly there are differences in interpretation and significance of these two factors, but both could illicit a 'yes' response to the initial question. What might be a supply driven innovation could easily be conflated with a demand driven increase in market share. These are quite different in character. The latter may not even be considered particularly innovative while the former might involve considerable inventive effort.

Clearly there are no easy solutions to problems such as this, but this type of problem repeatedly occurs throughout the services and manufacturing questionnaires in CIS. Some of the problems of ambiguity in the phrasing and filtering throughout the questionnaires could easily be eliminated. This brings us to another problem of the comparability of definitions between sectors to which we now turn.

## **Sectoral considerations: Manufacturing, KIBS, other services**

Recent research (such as the TSER SI4S project on services, see Hauknes 1998) has highlighted the need for rethinking the role of services in the economy. No longer are services seen as a non-innovative homogenous mass, but as segmented, heterogeneous and sometimes highly innovative. From this research new definitions and

categorisations of the service sector are emerging that focus, for example, on Knowledge Intensive Business Services (KIBS) which include marketing firms, designers, financial services etc. or Technological-KIBS (T-KIBS) which include software firms, IT support, engineering consultants etc. Both of these subsets of the service sector are generally providing highly innovative production solutions to manufacturing firms as well as other services. There is also considerable evidence at macroeconomic level that these services have a significant impact on the economy as a whole (Tomlinson 1999, Antonelli 1998).

However, when it comes to innovation surveys, there is little attempt to distinguish between the types of innovation undertaken by KIBS and other services, and moreover there is little realistic comparison possible between manufacturing and services innovation due to the nature of the questions. For example the wording of the questions for services and manufacturing product innovation in CIS (which are supposed to be equivalents) are actually quite different:

Services q1a: Between 1994-1996, has your enterprise introduced onto the market any new or significantly improved services or methods to produce or deliver services?

Manufacturing q1a: Between 1994-1996, has your enterprise introduced onto the market any technologically new or improved products?

The preamble to both these questions emphasises that the innovations considered should be 'technological' innovations which is also a critical problem with respect to service firms who may have different orientations to the word 'technological'. Table 2, for example, shows that in financial services in Denmark many product innovations were not considered to be technological.

**Table 2 Innovations, dependence on technology in the Danish Financial Services Industry 1980s**

Per cent

Type of innovation	Organizational	Process	Product	Market	All types
Not technological	94	16	47	70	54
Not technological, but dependent on technology	6	23	42	30	30
Technological	0	62	11	0	16
TOTAL	100	101	100	100	100
N	16	13	45	10	84

Source: J. Sundbo, Innovation in services, Denmark, National report to the SI4S project, Roskilde 1997

One of the main problems with CIS question 1a is the increased blurring of the distinction between a ‘product’ and a ‘service’. This was also reflected in table 1 above. Increasingly manufacturing firms bundle their products with services, such as automobile manufacturers who give a servicing package away with their new cars, or offer financial services to allow the car to be purchased. Or computer manufacturers that bundle software with their PCs and now increasingly provide telephone support for the user in case of problems. Similarly service firms have problems with the term product as well. Is a new hamburger a new service or a new product? Is a company that writes a software package providing a service or a new product? How can we compare an innovation where a manufacturing firm bundles a new service with the material product (which is surely an innovation) with a service firm that claims to have introduced a new product, but might answer ‘no’ to q1a because they have not fundamentally changed the service or delivery mechanism.

There are two alternative strategies with respect to this problem. First we might consider that it is not meaningful to compare innovations in manufacturing with innovations in services in any case. In this case we can define new sets of questions for manufacturers and service providers that are appropriate to their realms and not worry about the problem of comparability (in this regard we might also have separate questionnaires for KIBS versus non-KIBS within services as they tend to be fundamentally different). We should also note here that increasingly innovations

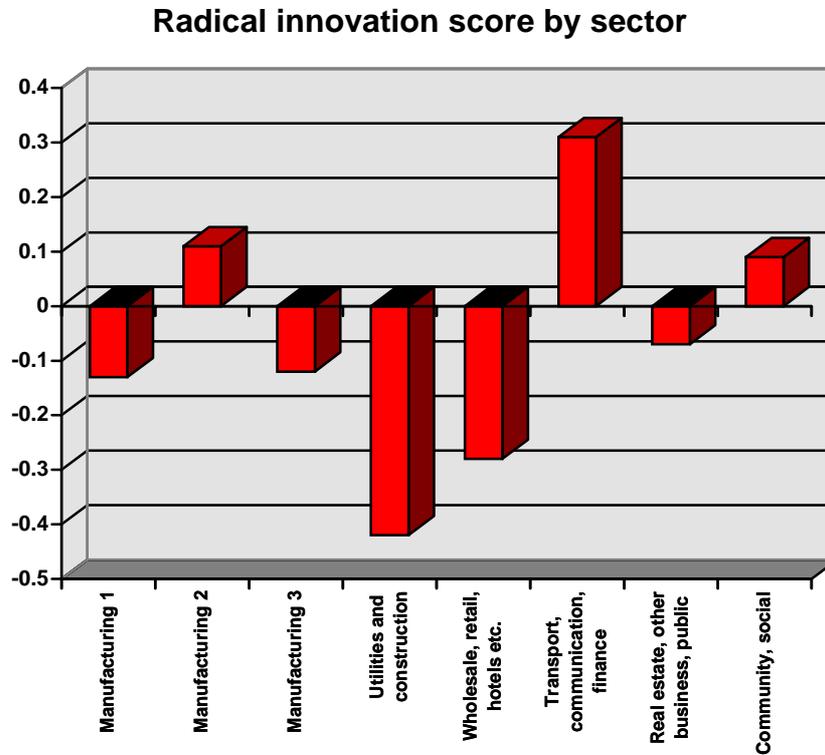
involve manufacturers and service firms working together – this was discussed above – such as those involving designers and consultants.

There is some evidence from CBI data that identifiable innovation styles are shared by manufacturing and service firms in the UK (see Coombs and Tomlinson 1998). Indeed in terms of a radical innovation stance which includes R&D, market research and use of new technology, some service sectors scored higher averages than manufacturing (see figure 4). So, on the other hand, comparability may be desirable at least if only to show that services can be just as innovative as manufacturers. In this case we must at least make distinctions between innovations that involve new material products and immaterial (perhaps more process-like) innovations for both manufacturers *and* service firms. Rather than trying to fit our pre-existing prejudices about innovation in services and manufacturing into different questions we could ask both sectors more or less the same questions (suitably rephrased along this axis).

### **R&D and other innovation expenditures**

Another problem for sectoral comparison between manufacturing and services is the bias towards R&D expenditures in the resourcing innovation questions in the CIS. Most service firms do not have an R&D department and few of them would consider product development in the same manner as manufacturers. Whereas it is relatively easy for manufacturers to get to grips with this part of the questionnaire it may need revising for services. This is exacerbated by the repeated inclusion of the word ‘technological’ in most of the questions. Many service innovations require non-technological research and tentative trials rather than hard R&D and therefore a considerable proportion of innovation expenditure might be missed out by some firms.

Figure 4



Source: Coombs and Tomlinson 1998

### Labour issues and the learning economy

Perhaps one of the most neglected areas of detail in current innovation surveys is their lack of data on a crucial resource of the innovation process: labour. Although questions are asked in the CIS about the number of qualified scientists or R&D personnel there is little else to go on. When innovation takes place, it has an impact upon the whole organisation and therefore requires particular structures of people and internal communication networks in order to implement new ideas. Lundvall's work on the learning economy and some of the research it has generated has tried to integrate labour issues into the picture (see Lundvall and Johnson 1994, Lund and

Gjerding 1996). The DISKO project at DRUID has made several steps forward and lessons could be learned for the next round of the CIS.

For innovation to succeed in a competitive environment requires flexible and skilled workers who are keen to learn. Lifelong learning strategies are also now seen as vital elements in national employment policy (see OECD 1994). Recent work at CRIC has also used employment data from a learning economy perspective and shown that the most flexible workers are also the ones in organisations that foster communication between workers, foster working in groups and use quality management strategies. This goes hand in hand with training and investment in the employees of the firm. There is also some evidence that workers in flatter hierarchies are more likely to be part of an innovative organisation (Tomlinson 2000).

Another crucial issue for innovation is whether firms can find and retain specialised staff. There are no questions about labour mobility or turnover in the CIS. If firms have a high turnover of staff then they may find it more difficult to innovate, but we have no adequate data on this. Tomlinson and Miles (1999) have done some preliminary work on this issue where they find that different careers and mobility patterns have different impacts on learning and skills at the employee level.

There is a considerable body of work on labour skills and mobility, but unfortunately the work on S&T labour, employment data and labour market data are difficult to integrate into present innovation research at firm level. Things would be much improved if some more detailed questions about the organisation of labour within firms, the training facilities and fostering of learning, the communication channels etc. were asked directly in innovation surveys. This would at least allow us to investigate the competitive advantages of firms due to non-technological changes and bring a degree of organisational culture into innovation research. Non-technological organisational innovations may be crucial correlates of other types of innovation, but the CIS does not allow us to gain a deeper understanding of these processes.

## **Conclusions**

While innovation surveys such as the CIS have proved to be useful and a significant step in the right direction, much work needs to be done in refining our tools if researchers are to understand the developing dynamics of contemporary economies with respect to innovation and competition. In terms of addressing the development of networks and the increasingly distributed nature of production and innovation, in terms of the blurring distinctions between products and services, in terms of labour in the knowledge based or learning economy and in terms of revising our definitions of innovation to enhance our knowledge of the service industries, hopefully the next CIS and other innovation surveys will be able to shed more light on at least some of these issues.

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# **D**anish **R**esearch **U**nit for **I**ndustrial **D**ynamics

## The Research Programme

The DRUID-research programme is organised in 3 different research themes:

- *The firm as a learning organisation*
- *Competence building and inter-firm dynamics*
- *The learning economy and the competitiveness of systems of innovation*

In each of the three areas there is one strategic theoretical and one central empirical and policy oriented orientation.

### ***Theme A: The firm as a learning organisation***

The theoretical perspective confronts and combines the resource-based view (Penrose, 1959) with recent approaches where the focus is on learning and the dynamic capabilities of the firm (Dosi, Teece and Winter, 1992). The aim of this theoretical work is to develop an analytical understanding of the firm as a learning organisation.

The empirical and policy issues relate to the nexus technology, productivity, organisational change and human resources. More insight in the dynamic interplay between these factors at the level of the firm is crucial to understand international differences in performance at the macro level in terms of economic growth and employment.

### ***Theme B: Competence building and inter-firm dynamics***

The theoretical perspective relates to the dynamics of the inter-firm division of labour and the formation of network relationships between firms. An attempt will be made to develop evolutionary models with Schumpeterian innovations as the motor driving a Marshallian evolution of the division of labour.

The empirical and policy issues relate the formation of knowledge-intensive regional and sectoral networks of firms to competitiveness and structural change. Data on the structure of production will be combined with indicators of knowledge and learning. IO-matrixes which include flows of knowledge and new technologies will be developed and supplemented by data from case-studies and questionnaires.

***Theme C: The learning economy and the competitiveness of systems of innovation.***

The third theme aims at a stronger conceptual and theoretical base for new concepts such as 'systems of innovation' and 'the learning economy' and to link these concepts to the ecological dimension. The focus is on the interaction between institutional and technical change in a specified geographical space. An attempt will be made to synthesise theories of economic development emphasising the role of science based-sectors with those emphasising learning-by-producing and the growing knowledge-intensity of all economic activities.

The main empirical and policy issues are related to changes in the local dimensions of innovation and learning. What remains of the relative autonomy of national systems of innovation? Is there a tendency towards convergence or divergence in the specialisation in trade, production, innovation and in the knowledge base itself when we compare regions and nations?

**The Ph.D.-programme**

There are at present more than 10 Ph.D.-students working in close connection to the DRUID research programme. DRUID organises regularly specific Ph.D-activities such as workshops, seminars and courses, often in a co-operation with other Danish or international institutes. Also important is the role of DRUID as an environment which stimulates the Ph.D.-students to become creative and effective. This involves several elements:

- access to the international network in the form of visiting fellows and visits at the sister institutions
- participation in research projects
- access to supervision of theses
- access to databases

Each year DRUID welcomes a limited number of foreign Ph.D.-students who want to work on subjects and projects close to the core of the DRUID-research programme.

**External projects**

DRUID-members are involved in projects with external support. One major project which covers several of the elements of the research programme is DISKO; a comparative analysis of the Danish Innovation System; and there are several projects involving international co-operation within EU's 4th Framework Programme. DRUID is open to host other projects as far as they fall within its research profile. Special attention is given to the communication of research results from such projects to a wide set of social actors and policy makers.

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