Linköping Studies in Arts and Science • 334

Innovation and Employment in Services

The case of Knowledge Intensive Business Services in Sweden

Johanna Nählinder

Linköping Studies in Arts and Science • 334

At the Faculty of Arts and Science at Linköpings universitet, research and doctoral studies are carried out within broad problem areas. Research is organized in interdisciplinary research environments and doctoral studies mainly in graduate schools. Jointly, they publish the series Linköping Studies in Arts and Science. This thesis comes from the Department of Technology and Social Change at the Tema Institute.

Distributed by:
Department of Technology and Social Change
Linköping University
SE-581 83 Linköping
Sweden

Johanna Nählinder
Innovation and Employment in Services.
The case of Knowledge Intensive Business Services in Sweden

Edition 1:1
ISBN: 91-85457-05-1
ISSN: 0282-9800

Printed by: Unitryck Linköping 2005.

Acknowledgements

The book you are now holding in your hand is the tangible output of my years as a doctoral student. Little did I know when I first started that my time as a doctoral student would be so enriching. Many important aspects of my PhD reside not in the book but in all the experiences I have acquired in the process. I can only begin to thank everyone who has assisted me throughout the often absorbing work.

Most important has been my supervisors. Staffan Laestadius took an active interest in the project and provided me with enthusiasm and additional viewpoints on the complicated matter of services. Your contribution and energy has been crucial and I am grateful for that. I am greatly indebted to Charles Edquist who has been very inspiring and important for me. His faith in my potential and project cannot be overestimated. Leif Hommen acted as assistant supervisor the first years. The thesis has much improved from his sage and industrious comments.

Several researchers have graciously taken the time to comment on my work. Brita Hermelin provided constructive comments on my halfway seminar and Fulvio Castellacci gave a thorough critique at the final seminar and thereby helped me in the process from manuscript to finalized thesis. I would also like to thank Marianne Löfgren, Lars Ingelstam and in particular Mats Bladh, members of the final seminar committee, for the valuable comments and support you gave me. Esa Manninen, Henrik Kronblad, Rurik Holmberg and Fulvio Castellacci all read at a very late stage: thank you!

The department is a fantastic interdisciplinary environment and workplace. I would like to thank Eva Danielsson, Christina Lärkner and Margareta Norstad for being the backbone of the department and handling the administrative tasks swiftly. Not least thanks for all coffee breaks - that is important too! The D-99 cohort, the doctoral students admitted in 1999, Henrik Bohlin, Elin Bommenel, Anna Green, Satu Heikkinen, Per Högselius, Jonas Johansson, Ericka Johnson, Petra Jonvallen, Anja-Sofi Karhi and Charlotta Mellander, has been important, not least for fun and for constant reminders of the interdisciplinarity of our studies. In particular Anna Green and Ericka Johnson were important to me and without you life at the department would have been more dull. I will miss you.

I have had the pleasure of taking part in several research groups. When I started at Tema T, the SIRP group acted as a great source of inspiration. In particular Marie-Louise Eriksson, friend and critical reader, and Esa Manninen, with whom I have had many thought-provoking discussions on product and process innovation and employment, and not least Mark Sellenthin, always ready for a short discussion. Thanks! Lately, MITS has given me new perspectives and sharpened my thinking. Thank you all for inspiring discussions and broadening my perspective! Mats Bladh has been a fantastic reader and the final thesis would not look the same if it was not for you. A special thanks goes to Kajsa Ellegård. Your support means much to me.

I spent three months with a Marie Curie fellowship at CRIC/PREST at Manchester University. These months were immensely inspiring and I look back upon my manchunian days with joy and pleasure. I would like to thank all researchers who readily opened up their office doors for me and took from their valuable time to discuss innovation and KIBS with me, in particular Mark Tomlinson, Bruce Tether and Ian Miles. Truly, your contribution to my thesis cannot be overestimated. A special thanks to all of you, at the department and at Ashburn Hall, which made my stay special: Sharon Hammond, Joyce Wilson, and Ishty Hussain at CRIC and the PhD student crowd: Andrea Mina, Elvira Uyarra, Davide Consoli and Renato Redondi in particular.

The empirical part of the thesis is based on the database which NORSTAT gathered for me. Thank you so much Henrik Kronberg for the job you did and how you did it. I enjoyed working with you. A special thanks goes to the enthusiastic, intelligent interviewers at NORSTAT; Sofie Apell, Thomas Drost, Kerstin Hallenrud, Olle Hedman, Jenny Hilding, Oscar Holm, Anders Larsson, Kim Lindh, Mattias Pettersson and Cim Rudfeldt who did their best at interviewing KIBS firms and making sure the data collected was superb. Also thanks to all the firms who took time to respond to the telephone interviews. Without your contribution, there would not have been a thesis. Without the financial support of VINNOVA, for the survey and a period of funding, the survey would never have been made. Thank you! Dawn House made a superb job with the language editing.

A PhD project is more than a job - periodically it is close to a life style. A special thanks goes to you, family and friends, and in particular mum and dad who helped me to put work into perspective and who have encouraged me all the way through. Writing a doctoral thesis would indeed have been a lonely job if it wasn't for your reality checks. Words cannot express my gratefulness for you Staffan who has shared my every day life first as my boyfriend and then as my husband. Your support and encouragement is beyond words and coming home to you and Adam is an everyday treat.

Linköping, July 2005

Table of Contents

List of tables and figures

List of figures

List of tables

Acronyms and abbreviations

In addition to the acronyms and abbreviations presented here, the industrial classification codes of ISIC rev. 3 are commonly referred to. The verbal description of these is found in Table 4-3.

Types and combinations of innovations

(See also Figure 8-5).

GPI	goods product innovation
SPI	service product innovation
Oπ	organisational process innovation
Tπ	technological process innovation

A	firms which made GPIs
B	firms which made GPIs and SPIs
C	firms which made SPIs
D	firms which made GPIs and Tπs
E	firms which made GPIs, SPIs and Tπs
F	firms which made GPIs, SPIs and Oπs
G	firms which made SPIs and Oπs
H	firms which made GPIs, Tπs and Oπs
I	firms which made GPIs, SPIs, Tπs and Oπs
J	firms which made SPIs, Tπs and Oπs
K	firms which made Tπs
L	firms which made Tπs and Oπs
M	firms which made Oπs
N	firms which made GPIs and Oπs
O	firms which made SPIs and Tπs

Other acronyms and abbreviations

CATI	Computer-Assisted Telephone Interviewing
CIS	Community Innovation Survey
CI	Confidence interval
FDB	Företagsdatabasen (the firm database)
ICT	Information and Communication Technology
IEK	Innovation and Employment in KIBS-survey
ISIC	International Standard Industrial Classification of All Economic Activities
ISTAT	Istituto Nazionale di Statistica (the Italian National Statistical Office)
IIEC	Innovation induced employment change
ITPS	Institutet för tillväxtpolitiska studier (Swedish Institute for Growth Policy Studies)
KIBS	Knowledge Intensive Business Services
KIBS*	asterisk denominates that an aggregate two-digit operationalisation of KIBS is used. See further Table 4-4.
m-CIS	Community Innovation Survey, manufacturing sector part
n.e.c	not elsewhere classified
NACE	Nomenclature statistique des activités économiques dans la Communauté européenne (Statistical Classification of Economic Activities in the European Community)

NUTEK	Verket för näringslivsutveckling (the Swedish Business Development Agency)
OECD	Organisation for Economic Co-operation and Development
OLS	ordinary least square
P-KIBS	professional KIBS
PRV	Patent och registreringsverket (the Swedish Patent and Registration office)
R&D	Research and development
RAMS	registerbaserad arbetsmarknadsstatistik (registerbased labour market statistics)
s-CIS	Community Innovation Survey, service sector part
SE-SIC92	Swedish Standard Industrial Classification
SI4S	Services in Innovation, Innovation in Services - Services in European Innovation Systems
SME	Small and Medium Sized Enterprises
T-KIBS	Technology based KIBS
TOL	Toimialaluokitus (Finish Standard Industrial Classification)
TPP	Technological Product and Process innovation
UNSD	United Nation Statistics Division

1 Introduction

It is impossible to imagine today's world without constant advances in production. Where would we be without the steam engine, the telephone or plastics? What would the world be like without the labour-saving advances of Taylorism or the assembly line?

As economic historians have pointed out, over centuries, improvements in production processes and the creation of new products have contributed to economic growth. But there is more to innovation than the large-scale radical innovations that, at least in the mirror of afterthought, changed society. Innovation is an everyday phenomenon that incrementally alters the economy and society.

Innovation is not always a change in a tangible product or the production process of such a product. It may also be a change in what we usually label a service. Most importantly, innovation is more than merely technical change. Far from the common perception of the economy, services contribute substantially to our well-being and therefore, a considerable part of innovations in the economy are innovations in services.

Innovations generate economic growth, but they also influence employment. Innovation is often perceived as a destroyer of jobs. The Luddite riots, where workers in 19th century England destroyed the machines which they perceived as threatening to their livelihoods is an often cited case. But innovations not only destroy jobs. Through creation of new goods and services it is also an important source of jobs. Innovation is a dual concept and therefore we distinguish between product and process innovation where product innovations tend to lead to more jobs and process innovations to labour-saving. Now, the twin concepts should not be reduced to the tautological interpretation product innovation equalling labour expansion and process innovation equalling labour-saving. The concepts are identified not by their consequences for employment but their function. For the time being, it is important to keep in mind that innovations are destroyers as well as creators of jobs.

In the long run, the Luddite argument does not hold. Without the labour-saving impact of process innovation, there would be no employees to produce new products. In the short run, the Luddite argument sharpens the consequences of process innovation for employment. There is no guarantee that a product innovation conveniently absorbs the surplus labour. It also points to the fact that the employees dismissed due to process innovation are not necessarily the same that will be demanded for production of product innovation. The interaction between process and product innovation which appear in the long run, is no automatic event in the short run. In the short run, it is important to remember how the labour force is heterogeneous and how, therefore, Luddite reactions to process innovation may be understood, especially for some groups of employees.

The last decades have borne evidence of a changing economy where new technology in manufacturing industries has led to fewer and fewer people employed in the

production of artefacts. Meanwhile, more and more people are employed in service production. Despite this ongoing trend, there is very little research on how innovations affect employment in services and, indeed, what an innovation in services is. This calls for a refocus in research from the production of artefacts to the production of services. Since service production is based on different grounds than goods production, also the products (product innovation) and new methods of production (process innovation) are likely to be different and maybe also have a different impact on employment.

Service production takes place in service sectors as well as in manufacturing sectors. Of special interest is perhaps a bundle of service sectors, often referred to as knowledge intensive business services (KIBS). KIBS are the heart of the economy, bridging the manufacture of material artefacts to the production of services. KIBS firms have as their main task the solution of client problems. They are knowledge-brokers of innovation systems since they produce and sell information and intermediate products that, besides making themselves prosperous, also make other firms prosper. They sell services to firms that choose not to have competencies in-house. Some KIBS firms are outsourced departments of large manufacturing firms. But the growth in KIBS firms also mirrors an increase in demand of professional services.

1.1 Two purposes and two research questions

This thesis will investigate innovation in services, more precisely innovation in KIBS sectors in Sweden and the impact they may have on employment. There are thus three main key words in this thesis which delineate its focus: *KIBS, innovation* and *employment*. The relation between these keywords is outlined in Figure 1-1. The main task of the thesis is thus to investigate the causal relationship, if any, between two phenomena (innovation and employment) within a particular sector (KIBS).

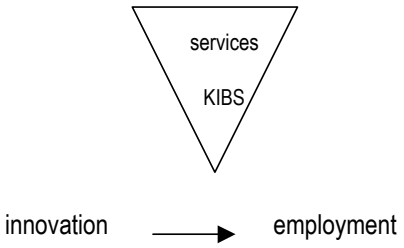

Figure 1-1. A schematic presentation of the purposes.

This task is concretised into two purposes and two research questions. The research questions are stepping stones to the purposes: without the research questions the purposes are lacking in substance.

The research questions are:

1. How may the concept of KIBS be understood and defined?

2. What is an innovation in services and what are the limits of the concept?

The purposes are:

1. The first purpose is to investigate whether KIBS firms are innovative, and, if so, what types of innovation they do.

2. The second purpose is to investigate whether and how process and product innovations affect the number of employees in the Swedish KIBS sectors.

In Figure 1-1, we see how the first purpose focuses on the relationship between innovation and KIBS (i.e. are KIBS innovative?) and the second purpose focuses on the relation between innovation and employment, as depicted by the arrow. It also illustrates that focus is on how innovation impacts employment, and not on how employment influences innovation. Also, the first purpose is a necessary prerequisite for the second purpose.

The research questions investigate the phenomena. The first research question investigates KIBS. At the top the triangle Figure 1-1 is the word services and below it the acronym KIBS indicating that the concept of service sector is narrowed down to KIBS sectors. This is the focus of research question one. The second research question investigates the concept of innovation, since innovation, when related to services (and not in manufacturing) is far from a clear concept.

1.2 A note on method

Several different methodological approaches may be used to address the purposes and research questions. This thesis uses quantitative data. However, it is important to emphasise that a great deal of conceptual work, as well as literature studies, is used to underpin the research questions and purposes. Therefore, it could be argued that qualitative studies are used as a basis, or foundation, for the quantitative analysis (Bryman 1995:160).

One reason why a quantitative approach is used is to facilitate generalisation, not only to theory, but also to population (Yin 1994:10). Quantitative data, in contrast to qualitative data, may also help in finding connections that are difficult to detect in the single firm. Further, it is a helpful tool to get a general picture of KIBS firms as a sector or set of sectors.

Very little quantitative data on KIBS in Sweden exists to date. Despite this, the concept is used in policy discussions. Therefore, a survey of KIBS firms, which I refer to as *Innovation and Employment in KIBS* (IEK for short), has been made for the purposes of this thesis. The survey, the resulting database, developed for this thesis are unique, not only in Sweden, but in Europe, in size (consisting of 967 KIBS firms which answered approximately 40 questions) but also in coverage of KIBS sectors. The database may therefore be considered an important contribution in itself, not only as an instrument to answer the purposes and research questions. The IEK database is a useful tool to examine the KIBS sector further, as well as to investigate the relationship between innovation and employment.

Although quantitative data and quantitative methods are useful tools, they should be employed with great caution. The result of the analysis is dependent of what proxies are used and how they are used. Data without context and thought is worthless. The analyses made in the thesis are made with this understanding. Chapter 6 is devoted to the IEK survey, the methodological challenges and considerations.

1.3 Outline of the study and some central concepts

The thesis consists of eleven chapters and two appendices. The chapters include an introduction, theoretical discussion, methodological explanation, empirical presentation and conclusion.

Following this introductory chapter, chapters 2 to 5 provide the theoretical building blocks necessary to address the purpose and research questions. These chapters focus on the key words of the thesis of Figure 1-1: KIBS, innovation and employment. Directly after the theoretical chapters we find the methodological chapter. Chapters 6 to 9 present, discuss and analyse the empirical findings from different angles. The following two chapters (10 and 11) present the conclusions of the thesis. Two appendices follow the references section.

The outlines presented below highlight the main topic of these chapters, how they relate to the purposes and research questions and define some terminology. These short outlines thus function as a tool, or reading instruction, to facilitate the reading of the thesis. An additional tool has already been presented: the list of abbreviations.

Chapter 2 - Innovation takes place in services
This is the first theoretical chapter. It targets the left-hand concept of Figure 1-1 (innovation) and relates to the second research question.

It presents two fundamental concepts of the thesis, innovation and services. It discusses what a service is (in relation to a good). It confronts the notion that services are not innovative and goes on to discuss what an innovation in services is and the limits of the concept of innovation. It further presents (two variants of) the taxonomy of product and process innovation. Four *types of innovations* are introduced: *goods product innovations, service product innovations, technological process innovations and organisational process innovations.* These are very important tools throughout the thesis. Figure 2-4, which relates the concepts of process and product innovation to the firm, is central throughout the thesis. Lastly, it discusses how the concepts could be understood in the context of services.

Chapter 3 - Innovation influences employment
The second theoretical chapter targets the arrow of Figure 1-1. In contrast to the preceding chapter, this chapter is concerned with the causal impact of innovation on employment. It presents the theoretical base for the second purpose.

The term *innovation-induced employment change* is introduced to separate the change in employment due to innovations from other employment change. It uses the extended taxonomy of product and process innovation, as introduced in the preceding chapter, since different types of innovations have been empirically shown to cause

different employment effects. Product innovations usually cause job growth whereas process innovations usually cause job loss. It is also shown that these findings are based on manufacturing sectors (and not on service sectors) and that product innovations only include goods product innovations and process innovations only include technological process innovations. The chapter also distinguishes between *direct* and *indirect effects of innovation* on employment. It discusses and structures the relevant literature and discusses the applicability to innovation in services.

Chapter 4 - KIBS - a critical review and conceptualisation
The third theoretical chapter is concerned with the upper concept of Figure 1-1: KIBS which is the third fundamental concept of the thesis. KIBS is more than merely the set of sectors where the purpose and research questions are tested. The concept of KIBS is much-discussed, and many conceptions are related to KIBS. Therefore a number of the most common stylised facts are presented in the chapter. A very important distinction is between *KIBS features* and *KIBS firms.* Here it is argued that it is not viable to base a definition on KIBS features. The definition of KIBS is presented in Table 4-4 and the difference between KIBS firms and KIBS features is depicted in Figure 4-3. It is also argued that we may identify two different types of KIBS: technology-based KIBS (T-KIBS) and professional KIBS (P-KIBS).

Chapter 5 - Understanding innovation and employment in KIBS
Chapter five fulfils an important function of presenting a background on KIBS in Sweden, revisiting the research questions and purposes and summarising the position prior to the empirical part of the thesis. The background on KIBS in Sweden is based on newspaper articles and available data. The size structure of KIBS firms and sectors is presented, together with information on innovation in KIBS taken from the s-CIS2 database. The employment structure is also presented.

Chapter 6 - Methodological considerations
Chapter six is a bridge between the theoretical and empirical chapters. The empirical chapters are all based on a survey (labelled *IEK*, innovation and employment in KIBS) tailor-made for this research project. The survey, which contains a wide range of information on 967 KIBS firms, is presented and the methodological challenges encountered are discussed. As a complement to chapter six, there are also two appendices, one which contains all details on the execution of the IEK survey and the other all the questions on the survey. The survey was implemented as computer-assisted telephone interviews and this choice of survey method is discussed.

Chapter 7 - The KIBS firm's features
Chapter seven is the first of three chapters that focus on the results of the implemented survey, IEK. This chapter focuses on the KIBS firm, its characteristics and relations. It thus revisits the second research question.

The distinction between KIBS firms and KIBS features was presented in chapter four and is now revisited. Seven questions in the IEK survey are compiled into a KIBS-index that measures the *"KIBS-ibility"* of KIBS firms. KIBS firms have KIBS features to a very high degree, but the point is made that it is difficult to base a definition of KIBS firms on KIBS features. Another important conclusion is that there is no single

group of firms that have a statistically significant lower KIBS-ibility, indicating that the definition of KIBS, presented in Table 4-4, is fairly accurate. The two remaining sections of chapter seven investigate the relations with other firms through investigating their position in the innovation system and also the extent to which KIBS firms function as *sources of innovation*.

Chapter 8 - The innovative KIBS firm
This second empirical chapter focuses on innovative KIBS firms. It thus revisits the second research question and provides an answer to the first purpose. The chapter discusses the number of product and process innovating firms and returns to the question of what an innovation in services is and how it differs from, for example, variation in products. It also develops the extended taxonomy of product and process innovation where the *combinations of innovations* made in different firms are taken into consideration.

Chapter 9 - Sorting out the innovation-induced employment change
This third and final empirical chapter discusses the impact of different types of innovations on employment. It is dedicated to providing an answer to the second purpose of the thesis. First of all the distinction is made between the change in employment caused by innovation (innovation-induced employment change) and other employment change. These two do not always go hand in hand. Not all firms have an innovation-induced employment change, but all types of innovation have an innovation-induced employment change. The impact of types of innovations and combinations of innovations upon innovation-induced employment change is analysed in regression analysis which show that only a small part of variation in innovation-induced employment change may be attributed to types or combinations of innovations. Also, in many cases the direction of impact is not what was expected. This is thoroughly discussed. Finally, the importance of different objectives to innovation is also scrutinised. The results of analysis is discussed in reference to chapter 3.

Chapter 10 - Conclusions
This chapter ties the threads together and discusses the main results found in the survey and in the thesis as a whole. It thus provides answers to the research questions and purposes as presented in chapter 1.

Chapter 11 - The empirical results and possible implications
The last chapter discusses some of the findings from an empirical viewpoint. The chapter is very short but focused on some implications of the research.

2 Innovation takes place in services

> A KIBS firm produces software. In this particular case the firm produces a flight simulator for a client. What distinguishes it from other "on the shelf" flight simulators is the possibility to log the game, the virtual reality glasses you wear and that it does not involve ordinary computer equipment but rather close to reality joysticks: everything to make the simulator as close to reality as possible. The client is a research organisation that will use it to make experiments with pilots.
>
> The KIBS firm is set in a nice building in Stockholm with large windows and a breathtaking view, but all the offices we pass are empty until we come to the core of the office at the very end of the corridor. You need a PIN code to enter. The room is not particularly large and full of computers. The light is soft. The blinds are down and you cannot see the view. The firm from which they rent the plants is upset since the plants die from lack of light. Two groups of people are in the room and they are working together on different projects. Most of them are relatively young, thirtyish, and I can only see one woman.
>
> The group working on the flight simulator consists this Friday afternoon of two persons, one who comes from the client firm. They are going over how the simulator should work. The KIBS firm employee is about twenty-five, enthusiastic, and does not have a university education.

I have started this chapter with an example of a product made in a service sector firm. As we will see in chapter 4, this is a knowledge intensive business services (KIBS) firm, but that is of minor importance for the moment. The reason for introducing this instance is to provide an example upon which many dimensions of innovations in services may be applied. Is this an innovation? What kind of innovation is it? And to whom is it an innovation? How do we distinguish an innovation from another type of change? This section will provide the tools for answering some of these questions. The concept of innovation was originally developed for goods, not for services. As we will see throughout the thesis, innovations in services are often regarded as peculiar innovations: therefore this chapter on innovation in services starts with discussing what a service is in contrast to a good. Later on in this chapter, a taxonomy which will accompany us throughout the thesis will be presented. The extended taxonomy on product and process innovation is, as we will see, both a good instrument for identifying a wide range of innovations and, also, a valuable tool for analysing the employment effects of innovation.

2.1 What is an innovation (in services)?

Innovation is a concept commonly associated with the manufacturing sector and with the production of goods. The manufacturing sector is also a producer of services, as will be discussed later on, but the point here is how the concept of innovation was developed with goods production in mind.[1] The first to distinguish between product and process innovation, two concepts which will accompany us throughout this thesis, was Joseph A. Schumpeter (1934/1983:66), but he did not mention innovation in services in his distinction in *the Theory of Economic Development*.

[1] Throughout the thesis, the concept "product" covers goods as well as services, in line with the *Oslo Manual* (OECD 1997:48).

Services have been sadly invisible in the common discussion of innovation and even the existence of innovation in services has been questioned. Researchers of innovation in services sometimes even defend their existence. One reason for this neglect may be that it is difficult to conceptualise an innovation in an intangible service and even harder to see how such an innovation may have importance. While, for many people, the word "innovation" is immediately associated with large technological devices, such as the steam engine discussed in the introduction, the concept of the word innovation is more inclusive. Innovation is more than merely technical change. Some innovations are changes in technology but an innovation may also be an organisational change, for example, or a service product.

2.1.1 The nature of services

Innovation in services differs from innovation in manufacturing since the output, the service product, has other characteristics than the goods product. Still it is challenging to define what a service activity is, especially one that covers all types of service activities.

Hermelin (1997:59) gives a description of service products as

> in-tangible, cannot be produced for stock, and cannot be transported.

This definition focuses on three characteristics. A service product must be consumed immediately as it cannot be stored. This is sometimes referred to as co-terminality of production and consumption. (cf. Evangelista and Sirilli 1995:208, Evangelista 2000a:128, Blind and Jungmittag 2004:2). The effects of a service product may nevertheless be enduring: classic examples are having a haircut or dental care. One must consume the haircut immediately (one cannot bring the moment of haircutting home) but once one's hair is cut the effect lasts. A service product cannot be transported. One cannot transport the haircut without transporting the person executing the service activity, i.e. the hairdresser. One cannot even touch the haircut (or drop it on one's foot); i.e. the haircut is intangible. Other examples of service products are having a lawyer set up a contract or a salesman selling something.

This is a common way to define service products, as having the characteristics that goods do not have. The negative description is also one reason why it is so troublesome to define what a service product is and, in extension, what service sectors are. Not all services fit these characteristics, however, and the service described above should rather be seen as an ideal type. As we will see repeatedly, there is a tension between this ideal type of services and how services actually are.

It is difficult to define service activities and there is wide literature addressing it. I will not, however, dwell on the definition of service products and how to find the optimal definition. Instead I refer to the discussion in Hauknes (1998) for further details.

Service activities are ubiquitous. A majority of activities in the economy are service activities, not actually manufacturing activities. Not all service activities are carried out in service sectors. In Figure 2-1 the relationship between service activities and service firms is outlined. Only a minority of all service activities is carried out in firms

of the service sectors. The service activities in the economy are represented in Figure 2-1 as the upper oval. Employees in service occupations carry out some of the service activities. This is represented in Figure 2-1 as the middle oval. Evidently, there are many service activities carried out by employees in manufacturing occupations. Finally, firms with a majority of output classified as *service products* are service sector firms. These are represented as the last, smallest oval in the figure. Thus, many service activities, service occupations and, of outmost importance in this thesis, service products, are hidden in the statistics since they are carried out in manufacturing firms.

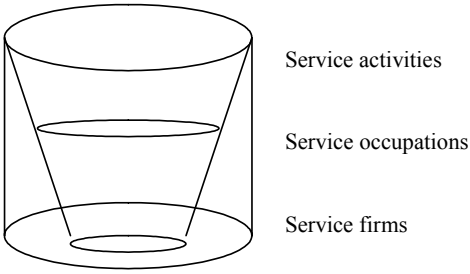

Figure 2-1. The relation between service activities, service occupations and service firms.

Comment: N.B. that the figure is not proportional.
Source: inspired by Dahlström (1995:99).

Parallel to how service products are defined negatively, service sectors are also defined negatively in that not all outputs of service sectors are de facto service products. Service sectors are a residual of economic activities. The extraction of raw materials from the environment (agriculture, mining, fishing etc.) constitutes the primary sector. Transforming raw materials into artefacts (i.e. manufacturing) constitute the secondary sector. The tertiary sector is then the residual of all human economic activities which cannot be categorised into either of these sectors. (cf. Boden and Miles 2000a:2-7).[2]

Ideally all products of the service sectors are service products, i.e. in-tangible, cannot be produced for stock, and cannot be transported. Not all service products in the service sectors fit this definition, however. One debated case is software (cf. OECD 1997:61, Flanagan 1999:61). Software firms constitute part of a service sector. Still the character of the product is much debated since the output is indeed tangible - you may drop a CD-ROM on your foot, it may be transported and produced for stock. On the other hand it may be thought of as an embodied service - what you buy is not primarily the CD-ROM but its content (see further Boden and Miles 2000a:8).

[2] Another approach is to make a positive definition of service sectors. That approach does not include the sectors "electricity, gas and water supply" nor "construction" as service sectors. In this thesis service sectors are defined as tabulation category G to O of ISIC rev. 3. For a longer discussion on the definition and classification of the service sectors, see Nählinder (2001a).

The definitions of service products and service sectors are slippery. In this thesis, the focus is on innovations in service sectors (service sector innovations) and not on innovations in service products (service product innovations). The service sectors (and more specifically KIBS as we will discuss in chapter 4) thus function as the framework within which innovations are identified. Consequently, depending on how service products are defined, some non-service innovations are included as long as KIBS firms produce them.

2.1.2 Services are innovative - but how innovative?

It is important to define what a service product is since it has implications for what may be considered innovation in service sectors. The traditional attitude to innovation in services states that services either are not innovative or at the most innovative laggards (cf. Malerba 2005:383-388, Boden and Miles 2000a:1, Licht et al. 1999:11, Tether 2003:482, Wong and He 2005:23). A massive literature on services has however demonstrated that service sectors are innovative although they do not have the same points of departure and tend to regard innovation in services differently compared to manufacturing sectors (cf. Howells 2000:4-9).

Coombs and Miles (1999:85-86) make a distinction between three approaches to innovation in services. They separate between assimilation theories, demarcation theories and synthesis theories. All three approaches agree on innovations in services being important but their conceptualisations of innovation differ.

The **assimilation** approach considers innovation in services much as innovation in manufacturing. As Coombs and Miles (1999:85) provocatively state, their most substantial change would be to include service sectors among the sectors investigated. Often they add service product innovations to goods product innovations. More to the point, they would exclude the possibility of goods product innovation in service sector, just like they exclude the possibility of service product innovation in manufacturing sectors. According to Boden and Miles (2000b:248), few scholars of innovation in services use an assimilationist approach but it is rather common among "innovation researchers who have added studies of service innovation to their portfolio." Advocates of the assimilationist approach thus imply that innovation of the same type that is taking place in manufacturing sectors is also taking place in service sectors. The OECD guide of innovation surveys, *the Oslo Manual* (OECD 1997), which has great influence on innovation surveys, has an assimilationist approach. Following that, the influential survey on innovation, the CIS (Community Innovation Survey) is also close to an assimilationist perspective on innovation in services (cf. Licht et al. 1999:6, Tether 2003:487).

The second approach, **demarcation,** would argue that due to the peculiarities of service products, innovation in services differ from innovation in manufacturing and must thus be treated as something which is different in kind. Whereas the assimilationist approach treats service sectors as odd manufacturing sectors, scholars of the demarcation approach assume that innovation in service sectors are of another type than the innovations taking place in manufacturing sectors. Scholars of this perspective also tend to focus on differences between service sectors and

manufacturing sectors and not on differences among service sectors, according to Boden and Miles (2000b:252-253).

Concepts - such as "innovation" must be specific to capture innovations in services: it is not sufficient to merely adapt conceptualisations from manufacturing. Innovation may be something different than what is understood from manufacturing studies.

The peculiarities of services would thus lead to differences in innovation processes, specificities in the choice of technology and development of knowledge (Boden and Miles 2000b:252). One example of a demarcation study would be the notorious reversed product cycle by Barras (1986), since he argues that services differ substantially and therefore also have very different product cycles.

There is thus critique from researchers on services in general and researchers on innovations in services in particular with respect to the idea that the same concepts and conceptual frameworks that apply to manufacturing and were developed within that framework would also apply to services (cf. Tether et al. 2001:1117). The adoption of concepts is, just like technology transfer, not unproblematic. Concepts developed to describe and analyse the manufacturing sector cannot be adequate to describe the service sectors since the framework obscures from viewing what might be important in service sectors.

The third approach, **synthesis**, recognises that innovations taking place in service sectors may differ from innovations taking place in manufacturing sectors and that findings on innovation in service sectors may enrich the concept of innovation in manufacturing. According to Drejer (2004:553), the synthesis approach is still in its infancy, but she mentions Gallouj and Weinstein (1997) and Preissl (2000) as contributions to the synthesis approach.

The synthesis approach (which is also denoted the rainbow economy) sees services and manufacturing as intrinsic parts of the economy. The distinction between service sectors and manufacturing sectors is blurred since manufacturing sectors produce service products and service sectors sometimes produces goods products (Boden and Miles 2000b:257). A firm like Ericsson does not only sell telephone equipment but also services like support to go with it (cf. Ministry of Industry and Ministry of Education 2004:10). Likewise service firms sometimes produce services which are embedded in goods such as a CD-ROM with software. What the client is paying for is not the CD-ROM but the content, the knowledge, embedded in the CD-ROM. The synthesis approach does not see service production as being different in kind from goods production, but rather on a continuum, where studies on innovation in services may also help to develop innovation in manufacturing.

The significance of the synthesis approach is evident if one considers the activities of the economy. The economy carries out service and manufacturing activities as outlined in Figure 2-1. Only some of all service activities are carried out in service firms and classified as service products. One implication of this is that many service innovations are carried out in manufacturing sectors, that is, many service innovations are manufacturing sector innovations. We also have the opposite case, where goods

product innovations are being carried out in service sectors. Although we take a closer look at this in chapter 8 it is hard to speculate on the extent of this phenomenon. Hence, developing concepts to identify service innovations would not only be beneficial for studies on services, but lead to a better understanding of innovation in manufacturing. It may also be added that the variation within the sectors as regards innovativeness in some cases are larger than between them (Hughes and Wood 1999:13).

The discussion of assimilationist, demarcation and synthesis approaches helps to sort theories on innovation in services. It also helps to raise questions about the content of key concepts such as innovation. The three approaches also help us to understand why some studies on innovation in services focus on certain sectors, excluding others. The most important innovation survey, *the Community Innovation Survey* (CIS), for example, does not cover all service sectors but only very few. It also covers the sectors that presumably are the closest to manufacturing. This will be discussed further later on but it can be mentioned here already that this thesis takes a synthesis approach to innovation in services which affects the way questions on innovation are asked in the IEK survey.

Taking a synthesis approach, rather than an assimilationist approach, requires openness to other kinds of change than merely technical change in a narrow sense. Therefore the definition of innovation in the very influential *Oslo Manual* (OECD 1997) cannot be taken for granted without critical scrutiny. The *Oslo Manual* definition of innovation, which will be further discussed in section 2.2.2, excludes, inter alia, changes that are not technological. If the *Oslo Manual* definition of innovation is used, the concept of innovation is constrained. On the other hand, rejection of established concepts would leave a study of innovation in services without common guide points and a huge theoretical task.

The taxonomy of product and process innovation, which will be thoroughly presented in section 2.2, must be mentioned in this context. According to Coombs and Miles (1999:87) as well as Drejer (2004:553), the taxonomy of product and process innovation is also part of an assimilationist approach and therefore may not be suitable to studies on innovation in services. The applicability and usability of the taxonomy of process and product innovation is discussed further below in section 2.2.4.

The conceptualisation of innovation must be kept in mind when service firms are asked about their innovative activities. How may questions on innovation be formulated if not to fall into the assimilationist trap? And how could it be combined with a process and product approach, and if not, what is inherit in the conceptualisations of process and product innovations which makes it impossible to include a wider conceptualisation of innovation?

Here is also the place to remind the reader of the heterogeneity of the service sector and, hence, the heterogeneity of innovation in services. KIBS, which is the part of the service sector studied in this thesis, is knowledge intensive and is regarded to be among the more innovative among service sectors. Some sectors are more innovative

than others, and this is true, not least in services. Other service sectors may be closer to the description of innovative laggards (cf. Licht et al. 1999:12, Tether 2003:486).

2.1.3 When is a change an innovation?

Returning to the example which began this section: is the customised production of a flight simulator an innovation? Will it also be an innovation to the client firm? Where, and on which grounds, do we draw the line between innovation and other types of change? This section addresses these issues by introducing a terminology that helps to stringently discuss the limits of innovation. This discussion, introduced in this section, remains central throughout the thesis.

2.1.3.1 Customisation and variety

Miles (2001a:37) says the following about KIBS:

> KIBS may be producing highly specialised services [that are] effectively new products for each client […], but many of the innovations generated "on the fly" are of little subsequent use, but remaining highly client specific.

In other words, just because KIBS firms may have a highly customised pattern of production, it does not mean that each variety, each customised product, is an innovation to the firm. This is also brought up by Evangelista (2000b:187) when he discusses innovativeness in services.

This reflection requires a demarcation between innovation and variety in production. Hipp et al. (2000) and even more so Tether et al. (2001) make the useful distinction of bespoke, customised and standardised production. Bespoke production is a one-off service whereas standardised production is a service without client-specific changes (Hipp et al. 2000:426). Customised services we find in-between the two ideal types and the three make a scale of standardisation - particularisation. A bespoke service is thus only produced once whereas the standardised service may be produced more than once (Tether et al. 2001:1125).

The distinction helps pinpoint production within the firm as being more or less standardised. Miles (2005:438) mentions railways, (conventional) telecommunications and broadcast services as examples of highly standardised services. The type of production the firm engages in may be traced to the strategic decisions of the firm (Tether et al. 2001:1117) and have various consequences for the firm even though, as the scholars emphasise, the theorisation is not yet fully developed (Tether et al. 2001:1117).

Bespoke, customised and standardised services differ in price. Standardised production is often made in large production volumes and little relation to the client in contrast to bespoke production which are one-off and in close contact with the client (Tether et al. 2001:1117). This means that bespoke services are, ceteris paribus, more labour intensive and therefore more expensive.

The production of the flight simulator is an innovation to the producing firm for example since it has never done a simulation with a graphic interface of such complexity nor has it ever made a flight simulator. The service product was

customised. But how unique must this product be in order to be an innovation?[3] Would another flight simulator focusing on some other aspect also be an innovation or just a variation of the first? Would an air control simulator be an innovation to that firm? The magnitude of change is important to consider if it is an innovation. But if they would produce another flight simulator with other characteristics, would that be an innovation? Whereof does the innovative element consist? A concept of innovation must allow for variation in output to take place without considering it innovation, or in the words of Hipp et al. (2000:428):

> Innovation requires more than the provision of variety, particularly if that variety is routine.

2.1.3.2 Is "new to the firm" an innovation?

According to the *Oslo Manual* (1997:18-19, 52) a firm may be innovative in two different ways: it may develop a brand new innovation or it may introduce an existing innovation from another firm. The first type of innovation is called "world wide innovation" or "new to the world" whereas the second is called "new to the firm". *A world wide technological product and process (TPP) innovation* is made the very first time a new or improved product or process is implemented. The CIS2, an innovation survey which will be discussed further later on, uses the wide concept of innovation of "new to the firm". Intuitively the second category may be questioned: is it really an innovative activity to introduce innovations that previously existed in other firms?

Two issues were discussed here to specify the concept of innovation. Before moving on to the taxonomy of product and process innovation a third issue of the concept of innovation will be briefly touched upon. Innovations are often looked upon an intrinsic good, not only a panacea to economic growth and progress, but also to employment. It is often taken for granted that innovations are good. This optimistic view of innovations should be questioned, not only because not all innovations create jobs (as we will see further on) but also because the progress criteria should not and cannot be included in the understanding of the concept. As soon as we equate innovation with progress, we open the door for subjective understandings of the concept. The atomic bomb, to take a drastic example, is not considered progress to many, but it is to others. Curiously, the *Oslo Manual* (1997:47) does not seem to make a point of this distinction; it discusses innovations as an "improvement" but does not seem to problematise what this entails.

2.2 Process and product innovations – a useful taxonomy?

So far, the concept of innovation has been considered rather homogeneously. From now on, however, the concept will be divided and considered in more detail according to the taxonomy of product and process innovation.

The taxonomy of process and product innovations divides innovations according to their function. *Process innovations* are innovations that alter the way goods products or service products are produced, that is, the process of production. *Product*

[3] See also discussion in Drejer 2004:557 on *ad hoc innovations* and whether or not these should be considered innovations.

innovations are new or better products, that is, products which have not previously been produced. The flight simulator discussed above is a product innovation to the software firm.

Product and process innovations are introduced for different purposes and have different impacts. This also implies that the rationale for introducing them differs (Castellacci 2004:7). They also affect prices, incomes and trade flows differently (Cyert and Mowery 1988:98). Simonetti et al. (1995:78-79) point to five main theoretical applications of the taxonomy of product and process innovation:

1. Type of innovation differs over the business cycle: firms tend to process innovate in recession and product innovate in expansive phases.

2. Type of innovation differs over the product life-cycle of a sector. In the initial phases of a sector product innovation prevails and later on, in stages of saturation and maturity, process innovation dominates.[4]

3. The impact on employment differs according to type of innovation. Whereas product innovation tends to lead to job-creation, process innovation tends to lead to job-destruction. Process innovations are usually introduced to reduce costs, rationalise or increase the flexibility or performance of production processes (Evangelista 2000a:128). The following chapter, chapter 3, is devoted to the impact of product and process innovation on employment.

4. Risk differs according to type of innovation. Product innovation is a riskier strategy to the firm, since it has to be accepted by the market, in contrast to process innovation which only implies risk in technical dimensions.

5. Appropriability and imitation vary according to type of innovation. Product innovations are easier to copy than process innovations and this also entails that different types of strategies of intellectual property rights are used to protect them. Although KIBS has not been discussed yet, it is useful to mention here that because the products of KIBS firms are knowledge intensive, they require more knowledge to appropriate the results, which in turn, should make products from KIBS firms harder to copy than other service products.

Although hardly an exhaustive list, it points to the taxonomy as an important instrument of understanding innovation. As a consequence, the taxonomy of process and product innovation is often used and exists in some variations. The most common version is a dual taxonomy which only separates between process and product innovations. Sometimes other categories are added to the taxonomy, such as delivery innovations (Miles et al. 1995:71-76) or market innovations (Sundbo 1998:3; see further Drejer 2004). In the following section, two different versions of the taxonomy is presented: the version proposed by Edquist et al. (2001:167), hereafter referred to as

[4] This life-cycle model (Utterback and Abernathy 1975) is applicable above all to manufacturing industries. Barras (1986) later on developed a life-cycle model for services, labelled the reversed life cycle.

the *extended taxonomy of product and process innovation*, and the version presented in the *Oslo Manual* (OECD 1997:47), the OECD guide for collecting and interpreting technological innovation data. For further discussion on definitional issues, I refer to Simonetti et al. (1995) for an excellent and critical review of the taxonomy of product and process innovation.

2.2.1 The extended taxonomy of product and process innovation

According to the extended taxonomy of process and product innovations, all innovations may be divided into process and product innovations and then further divided into four subcategories or types of innovations. This is represented in Figure 2-2.

<table>
<tr><td colspan="4">innovations</td></tr>
<tr><td colspan="2">process innovations</td><td colspan="2">product innovations</td></tr>
<tr><td>technological</td><td>organisational</td><td>goods</td><td>services</td></tr>
</table>

Figure 2-2. The extended taxonomy of process and product innovation.

Source: Edquist et al. (2001:19).

Product and process innovation may be further divided into goods product innovations and service product innovations and, regarding process innovation; technological process innovations and organisational process innovations.

These *four types of innovations* are central to the thesis and will be referred to frequently. Therefore they are further on abbreviated as follows:

- goods product innovation (GPI)
- service product innovation (SPI)
- technological process innovation (Tπ)
- organisational process innovation (Oπ)

Process innovations are innovations that alter the way goods products or service products are produced, that is, the process of production. Process innovations are divided into *technological* and *organisational innovations* where Tπs are new products that are used in the production process. Tπs are, for example, new machinery used in a factory or a new computer in an office. Organisational innovations are new ways of organising the production process (Edquist and Texier 1996). "Just in time" is an example of an Oπ.

Product innovations are related to *goods products* or *service products*. Product innovations are new or improved products being sold (Edquist et al. 2001:12). This is an important prerequisite in line with the original Scumpeterian concept (1934/83) - the product must be introduced to the market. As we will see later on (in section 2.2.3), a process innovation cannot be introduced to the market. A product innovation in services can be seen as a new offer to a market. The flight simulator, for example, is a product innovation to the software firm.

2.2.2 The concept of technological product and process innovations (TPP)

The second taxonomy of product and process innovation to be discussed is the one put forward by the *Oslo Manual* (OECD 1997). The *Oslo Manual*, the OECD guide for collecting and interpreting technological innovation data, focuses on technological product and process innovations (TPP). It builds its concept of innovation on the Schumpeterian tradition (OECD 1997:43) and the work of Kline & Rosenberg (1986) among others has been very influential in the view of innovation (c.f. Smith 2005:150). One such contribution which may be linked to Rosenberg is that innovation and diffusion are not clearly separated, but regarded as two levels of innovation: new to the world and new to the firm. The *Oslo Manual*'s concept of innovation is also, to great extent, the innovation concept used in the innovation survey CIS2. The *Oslo Manual*'s definition of TPP is the following:

> Technological product and process (TPP) innovations comprise implemented technologically new products and processes and significant technological improvements in products and processes. A TPP innovation has been implemented if it has been introduced on the market (product innovation) or used within a production process (process innovation). TPP innovations involve a series of scientific, technological and commercial activities. The TPP innovating firm is one that has implemented technologically new or significantly technologically improved products or processes during the period under review. The Oslo Manual sets out to cover innovations in the business sector (which excludes the public sector).
>
> (OECD 1997:47)

A TPP may be a product innovation, a service innovation or a process innovation, but not an organisational process innovation (OECD 1997:48). Thus the *Oslo Manual* distinguishes service innovation from product innovation. Inclusion of the word "technological" constitutes a demarcation from some changes that are not considered technological as well as changes which are considered insignificant improvements (OECD 1997:43). The word technological does not imply, however, that all innovative changes are technological, strictly speaking. In that case service innovation would be an anomaly, for example. This is exemplified in the quote:

> the manual deals only with "technological" innovation, which requires an objective improvement in the performance of a product
>
> (OECD 1997:43)

This also allows service innovation to be included, which would be difficult with a more narrow understanding of the concept technological.

What distinguishes TPP from other changes, according to the *Oslo Manual* (OECD 1997:18-23, 43) is that TPPs must have an impact on sales. The changes must further be substantial. TPPs are not:

> changes in products which provide largely subjective improved customer satisfaction based on personal taste and aesthetic judgement, and/or derived from following fashions, and/or brought about largely by marketing.
>
> (OECD 1997:18)

It is more difficult to draw the line between subjective and objective changes for service sectors since bespoke or customised products are more common among services than goods (as seen in the quote from Miles in section 2.1.3.1). This is particularly the case for KIBS since the problem-solving they offer tend to be customised. There are thus more cases of changes that could be subjective. Bespoke and customised production surely holds an element of "subjective improved customer satisfaction".

TPPs must furthermore be an "objective improvement in the performance of a product". This excludes so-called other creative improvements and organisational innovations, but the manual recognised that these may be very important in some industries (OECD 1997:18). The *Oslo Manual* is not very clear on this point however. The beginning of the manual (OECD 1997:43) states in bold: "In consequence, organisational innovation[s] has not been included in the measures recommended in the body of the manual". Elsewhere (OECD 1997:55) the manual concludes that "organisational change count as innovation only if there is a measurable change in output". Here (OECD 1997:55) they also state that just-in-time "should be treated as a process innovation as it has direct effect on the production of products for the market." The *Oslo Manual* is not only vague with regard to organisational innovations, their criteria for inclusion tends also to be far from clear-cut. Regardless of the position on (or exclusion of) organisational innovation, the *Oslo Manual* has defined, according to Evangelista (2000b:190), product and process innovation in a broad sense.

In short, expressed in the extended taxonomy terminology, TPPs are product innovations (services or goods) or Tπs that are (in the *Oslo Manual* terminology) objective, not subjective. The TPP concept, and therefore the results of the CIS2, is therefore restricted to technical change, mostly excluding organisational change. The terminology also differs: the *Oslo Manual* lacks one type of process innovation that the extended taxonomy includes, as seen in Figure 2-3. Hereafter the more inclusive extended taxonomy is used rather than the *Oslo Manual* TPP taxonomy.

innovations			
process innovations		product innovations	
technological	organisational	goods	services

Figure 2-3. Comparison between the extended taxonomy and the TPP concept of the Oslo Manual.

Comment: the figure presents all four types of innovations from the extended taxonomy and the types of innovations which are included in the TPP concept are shaded, that is, Tπs, GPIs and SPIs.
Sources: Edquist et al. (2001:19), OECD (1997:48).

The (extended) taxonomy of product and process innovation (as well as the distinction between four different types of innovations) is introduced here for two reasons. The first reason is that the four types of innovations cover and identify a wide spectrum of innovations, wider, in fact, than other innovation concepts. These four types of

innovations thus provide us with a definitional outline of what an innovation may be.[5] This definitional outline may then be used to discuss innovation without using the term innovation, something which will prove valuable in the IEK survey on innovation presented and analysed in chapters 6 to 9.

The second reason (which is the topic of the following chapter) to introduce and discuss the extended taxonomy of product and process innovation, is to analyse the impact innovation has on employment.

2.2.3 Some product innovations may become process innovations

The concepts of process and product innovation have been discussed and some general examples have been given. What has not been discussed is how some innovations (but not all!) may appear in more than one incarnation.

Products have different roles and thereby effects on the economy. One may therefore distinguish between *investment products*, *intermediate products* and *consumer products*. Consumer products are consumed by households whereas investment products and intermediate products are consumed by other firms/organisations. Investment products are durable products which are used as factor inputs. They are thus not consumed when used in contrast to intermediate products which are used to produce other products and thereby used up (Edquist et al. 2001:18). Consumer products are products intended for end users, i.e. consumers. Since this thesis covers business services (as opposed to consumer services), we may leave consumer products aside.[6]

The extent to which business services are investment services or intermediate services may be debated. Edquist et al. (2001:101) argue that it is rare to find an investment service:

> Most services that are sold to firms actually seem to be intermediate products and not investment products. The reason is that the majority of services sold to firms are not durable and can therefore function only as intermediate service products; only a minority have long durability and are therefore capable of functioning as 'investment services'.
>
> Services have been defined as products which, in contrast to goods, are intangible, tend to be consumed simultaneously with their production, and create values which often satisfy non-physical needs (Hauknes, 1994:8-9). If we accept this definition, it follows that most services will behave either like consumer products or, in the case

[5] Drejer (2004:559-564) mentions four types of service sector innovations: ad hoc innovations (reminiscent of customised production), external relationship innovations (specific relationship established by the firm vis-à-vis its partners), formalisation innovation (embodiedment of services) and expertise-field innovation (innovations in detecting and responding to new needs). She however reaches the conclusion that "Schumpeter's definition of innovation is in fact rich enough to encompass innovations in services". I will not go in to the comparison of the types of innovations vis-à-vis the Shumpeterian innovation concept, I will only note that it is likely that her conclusion holds also in relation to the types of innovations presented here.

[6] Some consumer products are also durables which – similar to investment products – provide services for a long time although outside the formal economy. The analytical consequences of that fall outside the focus of this thesis, however.

> that they are purchased by firms, like intermediate products. In other words, they will not function as investment goods [sic!].

Edquist et al. (2001:103) further single out service sectors which are more likely to produce investment services and some KIBS sectors are among these. Edquist et al. thus reach the conclusion that investment services are scarce. An important stepping stone in this argument is that services fulfil the ideal characteristics, which in this thesis was exemplified by Hermelin's definition in section 2.1.1. Not all services fulfil these characteristics, but they are nevertheless services. Even if a service is co-terminally consumed and produced, the effect of the service may be durable. One example, provided by Miles et al. (2000:102), is dental surgery. The effect of the dental surgery prevails long after the dentist has finished the job. It may, of course, be argued that length of effect is not the same as durability and the dental surgery cannot be repeated (without executing the service once more) - i.e. the service cannot be used to solve another problem since it has already been performed.

The reason why this terminology is brought up here is that investment product innovations have the potential to function also as process innovations. Edquist et al. (2001:100) label this different *incarnations*. Now we are approaching the main point of this section: some innovations can function both as product innovations and as process innovations.

This is presented in a schematic manner in Figure 2-4. The input product innovation is always either an investment good or an investment service. The KIBS firm introduces a product innovation made by another firm. The innovation then *functions as* a process innovation in the KIBS firm. The KIBS firm may also produce product innovations and sell them to a client. Above we saw how introduction to the market was a prerequisite for a product innovation. The other side of the coin is that when process innovations are sold to a client, it is automatically a product innovation. This is important, not least for KIBS firms, since an important part of what they do is selling Oπs. This means that some Oπs are sold as SPIs. The client firm may then use the product innovation as a process innovation. Another point is how a product innovation is a prerequisite for a Tπ. This product innovation may be produced intramurally, or in the case laid out in Figure 2-4, extramurally.[7]

We will now apply this reasoning to three different examples. First, applying the abstract reasoning to a (by now) familiar example, we can see how the software firm produces a new flight simulator (an SPI) together with its client which it then sells to the client. The client introduces the flight simulator and uses it as a process to introduce a new product (a better education for pilots). The flight simulator is thus first a product innovation for the software firm, then a process innovation which

[7] However, an intramural product innovation is not an innovation by definition since in order for a product to be an innovation, it must also have been introduced to the market. This difference is by and large academic in this case, but helps raise two other important issues. The issue is that since product innovations must be introduced to the market in order to be innovative, then a manufacturing firm may conduct service activities (as seen in Figure 2-1) but still not be a service product innovator as long as the service activities do not result in service products. The second issue is that the market is difficult to define for some innovative organisations, i.e. governmental services. This will be discussed later on.

allows for a product innovation in the R&D organisation.[8] However, we may imagine another use for the flight simulator. Hours of flight simulator training may substitute hours of real flight. In that case the flight simulator functions as a capital-saving Tπ for the client firm. The same purchased technology may thus fulfil different functions. Here is also the occasion to remind the reader that the purchase of technology (or when the firm is, in another terminology, a user of innovation) does not equal an innovative activity within the firm. The firm may well purchase technology which is not used as a Tπ or an Oπ in the firm. In short, purchase of technology is not enough for the firm to be a process innovator - it has to (as discussed earlier) *alter the way goods products or service products are produced.*

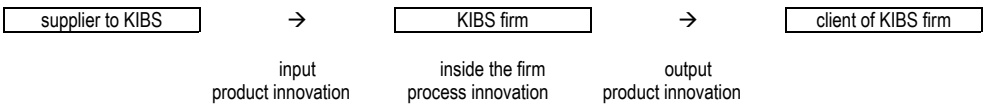

Figure 2-4. The concepts of process and product innovation related to the firm.

Comment: the figure shows a simplified relation between the KIBS firm, a supplier and a client. The supplier provides an input to the KIBS firm and the KIBS firm provides an output to the client. The figure shows how the input is sold as a product innovation to the KIBS firm but may function as a process innovation in the KIBS firm. The output of the KIBS firm is also a product innovation even though it may function as a process innovation in the client firm.
Source: inspired by Soete and Miozzo (1989:11).

The second example concerns transfer of Oπs from one firm to another, an important task for KIBS firms. An Oπ is then sold as an SPI by a KIBS firm. This may be exemplified with Six Sigma, a framework including introduction of statistical measurements for improving the quality of products through reducing variation in production (Magnusson et al. 2000:25-30, 13). It was developed inside a manufacturing firm (Motorola) and later sold as a service product (Linderman et al. 2003:194). It was thus initially sold by other manufacturing firms, not by KIBS firms. Six Sigma is thus an Oπ apt for standardised production which is sold as an SPI. It was new to the world in a manufacturing firm and sold (new to the firm) by manufacturing firms and service firms as an SPI, thus demonstrating that innovations may have more than one incarnation.

In contrast to the Tπ, the Oπ (usually) does not presuppose an investment product and usually arise within the firm (Edquist et al. 2001:15-16). It thus requires intangible investments (such as training) rather than tangible investment products. (Edquist et al. 2001:38).

[8] The client may also be an end consumer: Drejer (2004:557) presents the example of self-service in banks. This is a (labour-saving) process innovation to the bank but functions as a product innovation to the client, who gets improved access to bank accounts.

The third example concerns the products of IT firms. Many IT firms are among KIBS firms. This is apparent, not least, from the high number of firms in the IEK survey which refer to themselves as "IT firms" (question 14a in the IEK survey, see appendix II). The products of IT firms are often, according to Ylva Hambraeus Björling (2004), general manager of the sector special interest group "IT-företagen" (IT-firms"), used primarily to rationalise their clients and secondly to be the base for new products. In other words, what we see here is how the SPIs provided by the IT firms are sold to their clients where they have a dual function. In some firms they function as an Oπ or Tπ and in others as the basis for SPI or Tπs. This is important to keep in mind, since it demonstrates that SPIs in KIBS firms have a profound impact upon innovation-induced employment change in other parts of the economy.

We have here seen how the SPI of the KIBS firm may be incarnated as a process innovation in the client firm. This has two implications: (1) some services are investment products, since only investment products may have two incarnations and (2) the product of the KIBS firm has implications on the innovativeness in its clients. It is therefore important to remember that KIBS firms are not isolated islands in the innovation system.

2.2.4 Application of the extended taxonomy to innovation in service sectors

According to Evangelista (2000a:129), process innovation is more common than product innovation in service sectors. KIBS firms can carry out Tπs, Oπs and SPIs. Theoretically (see section 2.1.1) they should not make GPIs but, as we will see in chapter 8, KIBS firms are sometimes goods product innovators.

The taxonomy of product and process innovation was developed for manufacturing, and sometimes the applicability of the taxonomy to innovations in service sectors is questioned, both on theoretical and empirical grounds. In this section, three main concerns in application of the taxonomy will be discussed. Thereafter five reasons why it may be problematic to separate product from process in services will be discussed in detail.

Theoretically, the applicability of the taxonomy of product and process innovation could be questioned on three different analytical grounds. The **first** concern is whether the taxonomy would include all types of innovation taking place in KIBS sectors. The extended taxonomy does not exclude any particular type of innovation since, contrary to the *Oslo Manual* definition, it includes organisational innovation.

This is also a reminder that when discussing the taxonomy of product and process innovation, it is crucial to know what the authors intend by product and process innovation. Researchers on innovation in services, Evangelista and Hipp et al. (we will get back to them later) include not all four types of innovations in their investigations of innovation in services. In the case of Evangelista (2000a) Tπs and SPIs were included and in the case of Hipp et al. (2000:424-429) Oπs, Tπs and SPIs were included. The criticism that the taxonomy of product and process innovation is too narrow for capturing all innovations in services may be related to the fact that some versions of the taxonomy are narrower than the extended taxonomy.

The **second** concern is whether the taxonomy provides a useful framework of analysis in service sectors. Are there more fruitful divisions of innovations in services than the taxonomy of product and process innovation? In chapter 3, the impact of innovation on employment will be discussed and based on this discussion it is argued that, so far, the taxonomy of product and process innovation is the best tool for sorting out the innovation-induced employment change. In short, the taxonomy provides a useful framework for analysing the impact on employment whereas in other cases, other frameworks may be more adequate.

The **third**, and more alarming concern, is the empirical difficulty in distinguishing product from process innovations in service sectors, including KIBS sectors. It is allegedly more difficult to uphold the distinction between product innovation and process innovations in services than in manufacturing. Two empirical examples are presented here as an illustration: Evangelista (2000a) and Hipp et al. (2000).

In the ISTAT[9] survey (Evangelista 2000a:125) on innovation in services in Italy, one fourth of the innovating firms were unable to state if their innovations were product or process innovations as seen in Figure 2-5. The ISTAT survey Evangelista bases his research on uses an approach where the firms are asked to state whether they are innovative and which type of innovation has been made. Over one fourth of the service sector firms that claimed to be innovative were not able to classify their innovations as SPIs or Tπs. Before taking this as evidence that the taxonomy of product and process innovation is not applicable one should remember that Evangelista only includes Tπs and SPIs and thus misses innovations in GPIs and Oπs.[10] There may thus exist innovations in services which are not captured by the ISTAT. Service sector firms are probably better at applying the taxonomy than what first appears to be the case from ISTAT. It also shows that the extended taxonomy is better suited than a simple taxonomy to identify product and process innovations.

[9] ISTAT is the Italian National Statistical Office.

[10] Here we will take a short peek at the survey made for this thesis (IEK). It includes all four types of innovations. GPI and SPI account for 13.2 per cent of all innovations in the IEK.

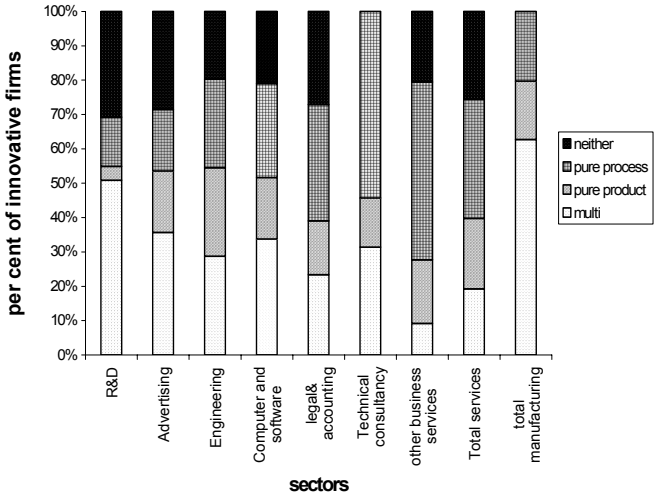

Figure 2-5. Per cent of innovating KIBS firms that have created process and product innovations.

Comment: the numbers are based on the numbers given by Evangelista in table 7.7 (2000:129) but recalculated to take into account firms that were innovative but could not distinguish between process and product innovations. "Multi" indicates a firm which made a product as well as process innovation.
Source: based on Evangelista (2000a:129).

The figure covers KIBS sectors only. Which sectors they are (and on which grounds) will be thoroughly discussed in chapter 4. For now it suffices to remember that the KIBS sectors are the part of the service sector under study. The capability to distinguish between product and process innovation differs considerably among the investigated KIBS sectors. All technical consultancy firms could distinguish between product and process innovations while little more than two thirds of the R&D firms could.

There is a difference between the firms' own classification and the researcher's classification. Hipp et al. (2000:424-429) finds that these two classifications do not match. She found that in 93 per cent of the cases firms were able to correctly identify themselves as innovative. On the other hand, 80 per cent were able to correctly identify themselves as technological product innovative, 77 per cent as service product innovative and lastly 63.5 per cent as organisational process innovative.

Both Hipp and Evangelista found that service sector firms encountered difficulties when they attempted to distinguish between, in the case of Hipp, Oπs, Tπs and SPIs and in the case of Evangelista, Tπs and SPIs. One reason may be that they do not include all four types of innovations.

2.2.4.1 Five difficulties in separating product from process innovation

There are mainly five reasons why separating process and product innovation may be difficult: (1) a dual taxonomy of product and process innovation is used; (2)

production and consumption takes place simultaneously; (3) variation in products is more common in services; (4) some innovations may appear in two incarnations; (5) one innovation may facilitate another. The last three reasons may also be applicable to manufacturing.

(1) a dual taxonomy of product and process innovation is used
In the two studies, Evangelista (2000a) and Hipp et al. (2000), more firms were identified as innovative than were identified as making a particular type of innovation as discussed in association with Figure 2-5. Part of this may be explained by the fact that not all types of innovations are included. Therefore a gap may arise and the conclusion be drawn that it is difficult to distinguish between product and process innovation. This problem is avoided through the use of an extended taxonomy of product and process innovation in contrast to a dual taxonomy of product and process innovation.

(2) production and consumption takes place simultaneously
Many services are co-terminally produced and consumed. This is one of the characteristics of service products which was discussed in section 2.1.1. This makes them hard to transport and store. The co-terminality also entails that it may be difficult to separate the process which leads up to the product from the process itself. This is also emphasised by Evangelista (2000b:187) and further Gallouj and Weinstein (1997:541).

Co-terminality affects the division between process and product innovation. Even a process innovation comes to affect the product since the process is visible to the consumer. An example of this would be having a haircut. As the consumer is present while his or her hair is cut, the client will also be aware of differences in producing the service (i.e. the process) and perceive this as a slightly different product. Another example is over-the-phone vending, where the client also is present (but on another geographical location!) and will be aware of (some) process changes. Innovations in services would therefore sometimes be hard to categorise as process or product innovations, among other reasons since the client sometimes perceives a process innovation as a product innovation as well.

This mirrors an ideal type of service which not all services fit. Not all services are co-terminal.[11] Many services are physically embodied and the embodiment in itself restricts co-terminality. Take the example of a service embodied in a CD-ROM. This service does not have to be consumed while produced and is therefore not co-terminal. The product is not the CD-ROM in itself, but the contents of this CD-ROM. If the contents are new or significantly improved the firm has made a product innovation. If the process whereby the (intangible) contents are produced changes, the firm has

[11]Co-terminality of production and consumption has interesting implications. The first is that both the producer and the client are present at the same time. This also means that the clients play a key role, something management literature emphasises (Danielsson 1995:32-37). This makes the client part of the innovation process as well (Drejer 2004:552). The second is that the producer and the client are present *at the same location* at the same time. This is also referred to as spatial proximity. However, the restriction of spatial proximity has been lessened with new technologies (such as telecom) especially in business services thus allowing for exports (Blind and Jungmittag 2004:205-206).

made a process innovation. Therefore we may conclude that co-terminality may in some cases blur the distinction between the process and the product, but this is not the case with embodied services.

(3) variation in products is more common in services
Production in service sectors is standardised to a lesser extent in service sectors than in manufacturing sectors. This will be further discussed in section 4.1.2. One implication of this is that it may be more difficult to distinguish between new products (product innovations) and variations of products. This was also discussed in section 2.1.3.

(4) some innovations may appear in two incarnations
What is a product innovation to one firm may be a process innovation to another (see Figure 2-4) as discussed above. The flight simulator described above is a product innovation to the software firm but a process innovation to the R&D organisation. As long as the level of aggregation is clear this is not necessarily a reason why it should be difficult to separate product and process innovation. The level of aggregation matters for how many and what kinds of innovations are found. Simonetti et al. (1995:79) show that the operationalisation of process and product innovation, as well as the method for gathering information on innovation, affect the results profoundly. The "level of the firm approach" used here will lead to extensive double counting of number of innovations since the same innovation may appear in several incarnations.

(5) one innovation may facilitate another
The *Oslo Manual* (OECD 1997:49) presents a fourth related reason why the distinction between process and product innovations is sometimes blurred: one kind of innovation may facilitate another. In telecommunications, for example, the introduction of an intelligent network may allow a set of new products such as call waiting or call display. This argument is also put forward by Kraft (1990:1029), who argues that product innovation stimulates process innovation. The introduction of the flight simulator (a product innovation) to the R&D organisation (where it is a process innovation) makes new types of products possible. The fact that the actions of the pilots may be logged in detail allows for new types of experiments.

There are thus mainly five reasons why separating process and product innovation may be complicated. Even if the distinction of process and product innovation might appear subtle in the service sectors, it depends on the perspective. Even if the firm or the consumer might have difficulties in separating the two, there is none the less an analytical difference which is however more or less hard to capture.

An additional reason may well be that the questions are asked in a way that the firms do not recognise or identify their activities as innovative, or, as Tether (2004:8) suggests, that since service innovations may be gradual rather than discrete events, it may be more difficult to understand these changes as innovations. As discussed earlier, innovation studies are originally developed for manufacturing sectors and questions on innovation may easily and unintentionally take an assimilationist form.

There are always borderline cases no matter which taxonomies or typologies are used. Here the extended taxonomy is useful as an important conceptual tool to identify different types of innovations. Second, and this will be investigated in chapter 3, it is claimed that product and process innovations have opposite effects on employment and one purpose of the thesis is to investigate employment effects of innovation.

2.3 Conceptualising innovation: between Skylla and Karybdis

Service sector innovations do exist and there is a need for an innovation concept that mirrors this more accurately than is presently the case. This is a considerable theoretical task. The innovation concept developed so far is wider than the innovation concept used in the CIS2 or the *Oslo Manual*. Not all changes are innovations but how can we define innovations accurately?

Conceptualising innovation resembles sailing between Skylla and Karybdis. On the one hand this sailing must capture not only technical change, but also organisational change. On the other hand it must not come too close to the trivial, it must allow for variety in products to take place without necessarily being considered an innovative activity.

Considering a synthesis approach to innovation, (as presented in section 2.1.2) one must be conscious of the limits of the innovation concepts used. There is, however, no reason not to use the extended taxonomy of product and process innovations because it would delimit the scope of innovation. The extended taxonomy of product and process innovations covers all types of innovations, including both technological and organisational change. Separating product and process innovations is admittedly difficult, as Hipp et al. (2000) show, but should be feasible from an analytical perspective.

Service sector firms, including KIBS firms, are likely to carry out Oπs and Tπs in generating SPIs (and sometimes also GPIs). However, due to the way in which service sectors are defined there are goods products in services even though it may be argued that it is the service content in these which are central, not the mode in which they are delivered. Therefore it may be argued that KIBS firms also carry out GPIs.

Returning to the example which began this chapter: the flight simulator is a product innovation produced by a software consultancy firm. The flight simulator will be a product innovation to the firm that developed it but it will also be a process innovation to the research organisation, the client firm. Both firms are part of the KIBS population, as we will see in section 4.5. This means that if both firms are included in the sample, the flight simulator will be counted twice, once as a Tπ and once as an SPI.

The delimitations used therefore have implications on the results obtained. Here a "new to the firm" approach is used instead of the more restrictive "new to the world". When the economic impact of an innovation is in focus, then new to the firm is the more important measure (Rosenberg 1982:19). This means that if the computer firm would sell the flight simulator to other clients than the R&D organisation, these other clients would be making process innovations as well, but of the "new to the firm"

type. The wider "new to the firm" approach includes more of the employment changes caused by the innovation. An innovation will lead to employment effects in the firm where it is introduced regardless of whether the innovation is new to the world or new to the firm. One of the purposes of this thesis is to analyse employment effects of process and product innovations in KIBS firms. For that reason, the wider level of investigation, "new to the firm", is more essential. The "new to the firm" approach will lead to double counting, but the focus here is not to count the number of innovations taking place in KIBS sectors but rather the employment effects they have. Therefore the wider "new to the firm" level of innovation is chosen.

The discussion on innovation is often limited by implicit and explicit assumptions. Research on innovation tends to focus selectively on some aspects of innovation. The discussion of innovation is often limited to Tπ in mainstream economics (Rosenberg 1982:4, Edquist 1997:22, Pianta 2005:569). The same tendency can also be detected in some research on gender and technology (Webster 1996). Within the field of process innovation, research on process innovation is often limited to Tπs, excluding organisational innovations despite the fact that organisational innovations sometimes have major employment effects. This is the case of the *Oslo Manual* and this has implications for how we see innovations. Further, research on product innovation is often limited to GPI, excluding SPIs.

As said previously, studies on process and product innovation have for a long time neglected service sectors, with few exceptions. We cannot assume that research results from manufacturing sectors automatically apply to service sectors as well. Further, service sectors are not homogeneous so not all research results on innovation in services are applicable to innovation in KIBS sectors. This chapter has focused on the innovation itself. The next chapter will instead concern the impact of innovation on services on the firm where it is introduced. As we will see, research on innovation and employment is a well researched area, but also here we can see that it covers predominantly manufacturing sectors.

3 Innovation influences employment

Intense discussions on how employees are affected by technology have developed over the last few centuries, beginning with the first phases of the industrial revolution. The crux is, as suggested in the introductory chapter, that innovation is a double-edged sword. Innovations both harm and boost employment in the firm where innovations are made and also in other parts of the economy.

There is thus some truth to the Luddite argument that technology takes our jobs but that is only one side of the coin. The other is that labour may be better utilised producing new products. That is, from the point of view of labour, job reducing innovations are negative, but for the firm and the economy at large, job reducing innovations are an asset. In some sense, in the long run, job reducing innovation is a prerequisite for development.

The extended taxonomy of product and process innovation helps us express this more stringently. Process innovations may lead to a better use of resources, which sometimes includes better use of labour while product innovation offer new jobs (sometimes to those made redundant). It is important to remember that this process is not automatic. The twin concepts of product and process innovation and their impact on employment is the focus of this chapter.

At the same time it is important to remember that other factors, besides innovation, have an impact upon employment. Innovation is not the only factor which influences employment change. Therefore, in this chapter, it is only the *innovation-induced employment change,* the part of employment which is effected by innovation, which is considered.

Pianta (2005:568-598) has written an excellent overview of research in the field of innovation and employment in *The Oxford Handbook of Innovation*. Of particular interest is maybe the list of ten stylised facts (2005:589-590) on the relationship of innovation and employment which may be summarised into four themes as follows:

Theme (1): job creation and job destruction are prerequisites for each other
The first and second stylised facts relate the connection between job creation and job destruction. The first of Pianta's stylised fact is *(1) "The never-ending race of innovation and employment".* This stylised fact addresses the complementarity of innovation and employment. On one hand is the negative impact of technological innovation and diffusion and on the other the positive impact of innovations (Pianta 2005:589). This is an important relationship where the two components cannot exist without each other but form what may appear to be a virtuous circle. The second of Pianta's stylised facts is *(2) "Technological unemployment can happen".* Pianta warns us not to put too much faith into the seemingly harmonious relationship of job creation and job destruction. Although inevitable, job losses are not always complemented by job growth: "jobs lost and jobs offered may take place in different areas and require different skills, leading to mismatches" (Pianta 2005:571). There is no automatic law of nature which guarantees new jobs.

Theme (2): different types and combinations of innovations have different impacts on employment

The third and fourth stylised facts concern the properties of the innovation itself. The third stylised fact is that *(3) "The type of innovation is important"*. Pianta emphasises that the taxonomy of product and process innovation is essential to understand the impact of innovation on employment. He does not take up any other concepts of innovation as important to analyse the impact of innovation on employment. This provides support for analysing the impact of innovation on employment via product and process innovations. Further, it does not suggest any other major instrument for distinguishing between job creating and job destroying innovations. This is the most important stylised fact from the point of view of this thesis and therefore, product and process innovation will structure the following two sections. The fourth stylised fact *(4)* is "*Organizational innovation is closely linked to technological change"*. Organisational innovation is important for the introduction of Tπs and has an impact upon the consequences of productivity as well as employment. It is interesting to see that he discusses organisational innovation instead of Oπ. This suggests that he does not see organisational innovation as a type of process innovation. Further, he contends that organisational innovation in combination with Tπ affects employment but he does not consider the impact of Oπ per se. This emphasises the marginal position of organisational innovation in innovation studies, including innovation and employment studies.

Theme (3): labour is not homogeneous

The next two stylised facts (numbers 5 and 6) concern the quality, rather than the quantity of employment. Stylised fact number *(5) is "One important consequence of technological innovation and adoption is change in the "skill bias" of employment"*. Pianta points to how innovation is not neutral vis-à-vis the skill background of the employees. There is plenty of research on how and why innovation affects employees differently: the so-called skill-bias technical change (cf. Pianta 2005:584, Evangelista and Savona 2003, Kaiser 2002). Number *(6)* focuses on another dimension of quality: *"Wage polarization has been significant, although the specific effects of new technologies on this trend are difficult to identify"*. Innovation has, among other factors, contributed to the wage and income polarization taking place the last decades although the exact relationship between the two is still unclear. Pianta here points to yet another dimension of the impact of innovation upon employment. These two stylised facts are, as Pianta points out in the beginning of his article, a further research development of the impact of innovation on employment. Just as there is no automatic creation of jobs in countries and regions which lost jobs due to innovation, neither is there an automatic creation of jobs fitting the employees losing jobs with jobs they can actually apply for. Skill is a very important dimension here, which is, as seen in Pianta, thoroughly researched.

Theme (4): the innovation system matters

Finally, the remaining four stylised facts all concern confounding variables which are important to explain the impact on employment. The seventh stylised fact is *(7) "Aggregate demand and macroeconomic conditions are important"*. Innovation literature tends not to focus on the role of demand. Still it is crucial to understand the impact of demand to understand the impact of innovation on employment. Pianta here

introduces demand as an important confounding variable. The impact on employment is naturally also dependent on a market for the innovation. The eighth, ninth and tenth stylised fact are *(8) "Innovation interacts with trade"*, *(9) "The national innovation system is a critical mediating influence in the effects of technological innovation and diffusion on employment"* and *(10) "Labour market conditions and institutions matter"*. These are self-explanatory. It is crucial to remember that the actual context of the firm which makes the innovation is important to the consequences it will have on employment.

Pianta's ten stylised facts help to emphasise that innovation has a dual impact on employment, that the impact on employment is dependent on what the innovation is and the context of the firm where it is introduced. He also, in contrast to many researchers, points out that labour is heterogeneous. This last point is very important, and the value of research in this field cannot be underestimated, especially if one intention is to draw policy conclusions. There are also other important aspects of innovation, such as gender, which should be included since it is relevant to the impact of innovation on employment.

It is also important in this context to notice how Pianta mainly focuses upon innovation in manufacturing sectors. This is, as we will see, typical for the whole field of research. As seen in section 2.2, may also be debated whether the taxonomy of product and process innovation (and thus the most important tool for analysing the impact of innovation on employment) is at all applicable to service sectors and innovations there within. But from the stylised facts of Pianta, it is clear that there are no other analytical distinctions which will better capture situations in which some innovations have a positive impact on employment.

Pianta focused on product and process innovation as instruments to disentangle the impact of innovation on employment. The previous chapter presented the extended taxonomy of product and process innovation and the four subgroups, or types of innovations; SPI, GPI, Tπ and Oπ. Section 3.1 will elaborate on the effects on employment of these different types of innovations.

3.1 Employment effects of product innovation

One potential consequence of product innovation is that it may increase the need for labour. It has also been shown (cf. Sellenthin and Hommen 2002:329, Pianta 2005:575) that manufacturing sectors dominated by product innovation often are high-tech with a high growth rate. The connection between product innovation and employment growth is therefore treacherously intuitive. However, many different factors influence the impact product innovations have on employment. The impact of product innovation on employment is dependent on several factors, among these may be mentioned:

1. *the magnitude of the innovation*: major innovations may be expected to have a larger impact on employment than minor innovations. This distinction also reminds us that innovations may be seen as discrete events or, alternatively, as a (continuous) process. This continuous change is another mode of innovation than the step-wise discrete innovation mode "which is central to the

conceptualisation of innovation developed in the context of manufacturing" (Tether 2004:5). Innovations are not always easy to count, and in that perspective it may even be difficult to discuss major and minor innovations.

2. *the newness of the innovation:* if an innovation is new to the world, rather than new to the firm, it may be expected to have a larger impact on employment. New to the world innovations have a larger impact on employment according to (Falk 1999:35). On the other hand, it is through the diffusion of an innovation the larger employment impacts are achieved which stresses that a new to the firm-approach is better suited for catching the impact of innovation on employment (Pianta 2005:573).

3. *degree of substitution of the innovation:* product innovations substitute other products, but the degree of substitution differs. On one end of the scale, we have innovations which satisfy an entirely new type of demand or fill a new function. These do not (by implication) substitute any previous product. The impact on employment of substituting products depends on how the substitutes relate to the function they (both) fulfil. The introduction of the substitute may alter the demand of the function. The substitute may also be produced with another process that has a different labour requirement (Edquist et al. 2001:96), i.e. one could hypothesise a complete substitute which does not increase the demand and is produced by a less labour-intensive process. In that case the product innovation would actually have a negative impact on employment.[12]

4. *the demand of the innovation:* the innovation is dependent on its context for its success. Even by definition, a change not introduced to the market is not an innovation, no matter its benefits. The demand for the innovation is thus central, not only to how we consider it, but also to the impact on employment. A product innovation facing low demand will naturally have a lower impact than a product innovation facing high demand. Pianta (2005:580) also suggests that insufficient demand is one reason why product innovation has led to lower job growth than desired. The lower demand, caused by slow aggregate growth in the 1990s, has lead to a lower (positive) impact on employment than would otherwise be the case.

5. *type of innovation:* SPIs and GPIs do not always have the same impact on employment. Although SPIs and GPIs are discussed together here, they have different characteristics, which, in turn, have implications on their impact on employment. The first difference is the range of their markets. Many service producers are traditionally dependent on proximity to deliver their products, even though telecommunications have eased the geographical constraint. (Tether et al. 2001:1119). A second reason, suggested by (Tether et al. 2001:1119), is that intellectual property rights problems in services limit the

[12] This is reminiscent of the Slutsky equation, that is, the total change in demand is the sum of the (negative) substitution effect and the (positive) income effect (cf. Varian 1993:154).

employment growth of an SPI.[13] The third difference is the extent to which SPIs tend to be bespoke. As the quote in section 2.1.3.1 showed, many innovations are made on the fly and the employment impact of such innovations is usually smaller than that of SPIs of standardised products. There is thus evidence that SPIs may generate smaller employment impacts than GPIs.

6. *incarnation of innovation:* some innovations, but only the ones that fulfil the function of investment products, may have more than one incarnation. This is visualised in Figure 2-4. Investment products are product innovations that are used (in another firm) as (technological or organisational) process innovations. This implies that even if a product innovation creates jobs in one sector/firm/department, it may be labour-saving in another context. The incarnation may well take place somewhere else in the economy, which entails that a firm-level study cannot grasp the full labour effect of an investment product innovation. The total employment impact of an investment product innovation would therefore be reduced somewhat by the negative impact the investment product innovation has in a second incarnation as a process innovation. Since only investment services may have a second incarnation (and investment services are relatively rare, according to section 2.2.3), the dual impact of SPIs should, strictly theoretically, be limited. It may also be added that this "incarnation impact" would strike outside the firm, and therefore be of limited relevance here.

7. *uniformity of production and innovation*: bespoke product innovations typically have less impact on employment since they are one-off innovations.

8. *improved versus new product innovations.* Not all product innovations are brand new products. Some product innovations are improvements in existing products. It may be questioned what employment impact improved product innovations have, unless, of course, the improvement affects the demand of the product. Evidence, referred to in Miles (2001a:23), suggests that a particular type of KIBS firms labelled T-KIBS (see further section 4.1.2) in Finland are more prone to new product innovations (in the form of new knowledge or new combinations of knowledge). We cannot assume that this is generalisable to Swedish T-KIBS as well, but it is worth keeping in mind that first, improved and new product innovations may give rise to different employment impacts, and second, that T-KIBS may be prone to new product innovations.

The aim of this list of factors that possibly effect the impact product innovation has on employment is to show how important it is to consider the heterogeneity of innovations within the large group of product innovations. The connection between product innovation and job-creation is deceptive, not least because of the variation within the group of product innovations. Product innovations are not introduced in order to create employment: employment creation is a side effect. Therefore it must

[13] It is more difficult to protect novelty in SPIs than in GPIs – see further Miles et al. (2000:98).

also be kept in mind that the objectives for introducing the product innovation may differ and consequently also the effects. A related reason why one should not automatically expect a positive employment impact from GPIs and SPIs is that even if they create jobs, these may be allocated all over the world. In short, product innovations do not guarantee domestic job-growth.

In sum, the (positive) employment effects of product innovations may be counteracted by other phenomena. It must also be remembered that the magnitude of employment impact is not automatically the same from GPIs and SPIs. We may expect smaller employment impact from SPIs than GPIs.

3.2 Employment effects of process innovation

The employment effect of process innovation may be divided into direct effects - which is what will be tested later on - and indirect effects which counteract the direct effects. Therefore it is important to be aware of these effects, even when they are not analysed.

3.2.1 Direct employment effects depend on labour productivity

Process innovations normally increase labour productivity and thereby have a potential to reduce employment. Labour productivity is the ratio between production and labour input (cf. Parkin 1994:818) and when labour productivity increases, less labour is needed to produce the same output.

However, not all process innovations are labour-saving and the degree of labour-saving also varies between process innovations and over sectors. As Peters (2004:11) points out, process innovations are sometimes introduced for reasons other than reducing labour costs: such as to improve quality, adjust to standards and regulations and reduce the cost of production (other than labour costs). This is also brought up by Evangelista and Savona (2003:461) who emphasise that the impact of "new processes and delivery systems" is dependent on whether they have a labour-saving effect or "are introduced to improve the quality of the delivery process. In this latter case the introduction of process and product innovations are complements and their effects difficult to be disentangled". This could also be seen in the flight simulator example which opened chapter 2. The flight simulator, when used to substitute flight time with simulator time, functioned as a capital-saving Tπ.

Edquist et al. (2001:35-40) show that there is a difference between Oπs and Tπs in this regard. Tπs more often seem to be labour-saving than Oπs which are also introduced for other reasons, such as to reduce capital costs, as for example "just-in-time" which was introduced to reduce capital invested in stock. Nonetheless, some Oπ has had an enormous labour-saving impact. One example would be how Oπ has transformed production processes leading to the decline of Fordism (cf. Laestadius 2005).

Tπs have a more pronounced labour-saving effect in some sectors than in others (Edquist et al. 2001:29). There is little evidence of variation in labour-saving of Oπs. This is most probably due to lack of research rather than homogeneity. The direct

impact of process innovations on employment is thus dependent on (at least) three factors: whether or not the process innovation has an objective to increase labour productivity and, if so, the degree to which it does; whether it is a Tπ or Oπ; and thirdly, the sector.

3.2.2 Indirect employment effects: compensation mechanisms

In addition to the direct effects of process innovations discussed in section 3.2.1, there are also indirect employment effects, also known as compensation mechanisms. These compensation mechanisms are developed in a neoclassical framework, which implies that they are not automatically applicable in this context. Manninen (2002:15-20), Spezia and Vivarelli (2000), Vivarelli (1995) and Pianta (2005:581) make excellent summaries of these compensation mechanisms. Vivarelli (1995:27-38) notes five compensation mechanisms, including product innovation. Spezia and Vivarelli (2000:15) and Edquist et al. (2001:85) also mention another compensation mechanism: compensation via increases in incomes. The five (remaining) compensation mechanisms all concern the impact of process innovation, Tπ and Oπs (Edquist et al. 2001:56).

The **first** compensation mechanism is *compensation via new machines*. The argument is that the investment good necessary for Tπ should yield employment increases where the investment good is produced (Manninen 2002:15). This compensation mechanism reflects the incarnation argument put forward in the section on product innovation above. Although the first (product) incarnation of the innovation created jobs, it is unlikely that this would counteract more than a small fraction of the labour-saving impact in the process innovation incarnation (Spiezia and Vivarelli 2000:16-17).

The **second** compensation mechanism is *compensation via new investments*. The gap between production costs and price of the product results in extra profits for the firm. If invested, these profits result in new production and thereby increased employment (Manninen 2002:16). This presumes that the extra profits are invested; if not, the compensation mechanism will not work (Spiezia and Vivarelli 2000 16-17).

The **third** compensation mechanism is *compensation via decrease in wages*. The unemployment resulting from the process innovation creates a downward pressure on wages which makes labour comparably cheaper. Cheaper labour, in turn, leads to higher employment (Manninen 2002:16). This is hindered by rigidities in the labour market: it is not always possible in practice to lower wages.

The **fourth** compensation mechanism is *compensation via decrease in prices*. When total cost decreases, demand increases, which in turn increases production and thereby employment (Manninen 2002:15). The mirror image of decreasing costs is increased real income also for wage earners. And that may cause increased demand as products goods as well as services which in fact may have more labour intensive production processes than was the case in the original innovative process.

The **fifth** compensation mechanism is *compensation via increase in incomes*. The compensation mechanism is mentioned by Spezia and Vivarelli (2000:15) and Edquist

et al. (2001:55). This compensation mechanism implies that increased productivity may also lead to higher wages which in turn stimulate consumption and ultimately employment (Spezia and Vivarelli 2000:15). This presumes a distribution of income according to productivity gains. According to Spezia and Vivarelli (2000:16-17), this principle is associated primarily with the Fordist mode of production.

It may here also be mentioned that product innovation is sometimes counted as a compensation mechanism. The five compensation mechanisms are presented here since it is important to be aware of them. Their veracity will not be tested for several reasons. Many of the compensation mechanisms are not effective in the short run and they are developed for an aggregate level of investigation. Nevertheless, they demonstrate that the direct effect of process innovations are counteracted by other forces and thus point to the ubiquitous complexity of the economic system.

Summing up the sections on employment effects of process innovation, we may conclude that the magnitude of labour-saving varies over types of process innovation and over sectors. Some process innovations do not have the objective to be labour-saving at all. They may also be counteracted by compensation mechanisms.

3.3 Effects of process and product innovation on employment

The discussion of this chapter thus far is summarised in Table 3-1. GPIs and SPIs both have direct effects on employment. These direct effects may be partly counteracted by, inter alia, substitution products as well as incarnations. It must also be kept in mind that investment products may have a second incarnation as a process innovation, the job-creation impact of investment products may be partly counteracted by the job-reducing effect of process innovation. This secondary impact takes place in another part of the economy. Since investment goods are much more common than investment services, SPIs have potentially greater positive employment effects than GPIs.

Labour-saving Tπs and Oπs have a negative impact on employment which is counteracted by the five compensation mechanisms. The compensation mechanisms are restricted by level of investigation and time frame, as mentioned above. Next some empirical evidence of the impact of innovation and employment in manufacturing and services will be presented.

Table 3-1. Direct and indirect impacts on employment of product and process innovations.

	direct effects	indirect effects
GPIs	positive impact	inter alia substitution, incarnation
SPIs	positive impact	inter alia substitution, incarnation
Tπs	negative impact through increase in labour productivity	compensation mechanisms
Oπs	negative impact through increase in labour productivity	(compensation mechanisms)

Comment: compensation mechanisms are not described in association with Oπs, only in association with Tπs, however, they are still process innovations. Therefore compensation mechanisms are included, but within brackets.
Source: based on sections 3.1 and 3.2.

3.4 Empirical research on product and process innovations

Innovation and employment is a vast field of research and as a consequence, there is also abundant empirical research that product innovations lead to employment growth and process innovations lead to employment loss (Pianta 2005:576-581). The impact of product innovation appears to be more robust than the impact on process innovation. Excellent overviews of the impact of innovation on employment in manufacturing have been made (Mastrostefano and Pianta 2004:3, Van Reenen 1997:278, Peters 2004:5). Although not every single study (see table 21.2 in Pianta) replicates these results, there is ample empirical evidence, regardless of theoretical level (Pianta 2005:590), that such a relationship exists.[14] But, at the same time, it is important to keep in mind that process innovation here refers only to Tπ and product innovation only to GPI.

At this point it is important to introduce two further dimensions into the discussion. The first is that of sectors covered. The overwhelming majority of studies are made of manufacturing sectors. Out of the eleven firm- and industry-level studies Pianta points to as "most relevant" (Pianta 2005:576), nine cover exclusively manufacturing sectors. As seen previously, there is no general agreement that the taxonomy of product and process innovation can at all be applied to service sectors, which makes the applicability of existing research of manufacturing sectors in this regard uncertain. In short, we cannot at this point assume that product innovations will have a positive impact on employment and process innovation a negative impact on employment in service sectors: there is not at this point enough evidence to establish that.

The second dimension is that of level of analysis. The research on the impact of product and process innovation may be divided into several levels of analysis.[15] This is not only a choice of data sources but also determines the type of conclusions that

[14] Peters (2004:6) makes another interpretation of the state-of-the-arts. She argues that "there is no clear evidence of a robust effect of process innovations on jobs in manufacturing."

[15] Manninen (2002:25) distinguishes between four major groups based on scope of analysis: macroeconomic approach, firm level studies, product innovations becoming process innovations and comparison of manufacturing sectors. The last two types of studies have little relevance here and will not be further discussed. For a thorough account of the four groups of empirical studies, see Manninen (2002:25). To the division made by Manninen may also be added other groups, most importantly studies focusing on the (impact of) single innovation.

could be drawn. There is no guarantee that results obtained at one level holds on another. In the specific case of employment and innovation, this is certainly the case.

Research on product and process innovation may be divided into sector approach research and firm-level approach research. The firm-level approach gives more information of what distinguishes the innovative firm from the non-innovator. It also gives more direct conclusions of the consequences of product and process innovation. A sector-level approach may give us information on which sectors are dominated by product or process innovations and the aggregate change in number of employees, but it cannot establish the connection between the innovations per se and their presumed effect.

The sector approach avoids the problem of the demand side (the distribution of market shares)[16] and the net effects may be investigated. The employment effects of product innovations incarnated as process innovations discussed above are potentially possible to capture in a sector approach. This would be useful to, for example, investigate the effect of ICT in the economy. ICTs have a positive impact as product innovations in the IT-firms, but are then used as process innovations with labour-saving consequences in other sectors.

The following will focus on a firm-level approach. The reason for choosing a firm-level approach, rather than a sector-level approach, is that the firm-level approach is more suitable to understand the impact of different types of innovations on employment. It is important to keep in mind that data obtained with a firm-level approach cannot automatically be applied on a more aggregated level (Manninen 2002:29). It is likewise difficult to generalise sector approach studies to the firm level.

3.4.1 Two firm-level studies on innovation and employment in services

Innovation and employment is a large empirical field, even when only firm-level studies are included. However, the number of studies diminishes dramatically when only service sector studies are included. Out of the six empirical firm-level studies Pianta (2005:577) selects, none of these include services. However there are a few firm-level studies of the impact of innovation on employment in services. The EU project *Innovation and Employment in European Firms* has produced a handful of such studies building upon the same econometrical model. A study by Peters (2004) appears to be central. Another study concerning impact of innovation on employment is presented in an article by Evangelista and Savona (2003).

The Evangelista and Savona (2003) study is particularly interesting because it contains analysis at the firm, as well as the sector-level. A particular feature with the article is that it investigates not only the quantitative aspect of employment (number

[16] Since firms in the same sector are competitors, the loss of market shares of one firm could also entail increases in market share for others. Therefore the increase/decrease of employment due to innovation may be related to take over of market shares or by expansion of the overall economic activity (Pianta 2000:82). These market share effects are difficult to control for, which may lead to odd implications. A process innovative firm in a sector where demand for the product is stagnant or even diminishing may experience market growth due to increased market shares (Manninen 2002:29).

of employees), but also a qualitative aspect of employment (skill level). Here, however, only the firm-level analysis of number of employees is taken into consideration.

The study mentions four main explanations of the impact of innovation on employment: the specific innovation strategy, organisational structure of firm, technological opportunities and demand constraints (Evangelista and Savona 2003:461). These four categories of variables thus influence the impact of innovation on employment. This is important, since it points to the fact that innovation-induced employment change in the individual firm is dependent on a number of factors other than merely the type of innovation.

This is manifested into 21 independent variables where the bulk of variables (13) are sector dummy variables which are introduced in order to control for sector-specific effects. The other independent variables are firm size (proxy of organisational structure), SPI, (technological) process innovation, innovation expenditure per employee and four indicators of innovation strategy.[17]

The data only contain information of direction on impact on employment due to innovation. As a consequence, the dependent variable is dycotomic (and therefore a logit regression is used) where positive impact on employment takes the value "1" and all other cases takes the value "0" (Evangelista and Savona 2003:461). Among these 21 variables, two refer directly to product and process innovation. SPI is one of the two variables with the highest (positive) influence on employment. The other one is innovation expenditure per employee. Process innovation, on the other hand, is not statistically significant. Evangelista and Savona thus do not show that process innovation has a negative impact on employment.

The Peters (2004) study (which builds on a mimeo, Jaumandreu 2003)[18] takes a different approach. It builds on an econometric model and is thus inductively developed. Leaving the detailed specification of the model aside, two aspects deserve attention. First, Peters (2004) investigates the service sector as well as the manufacturing sector. Second, she has two models (a basic model and an extended model) where the latter also distinguishes between different types of product and process innovations (Peters 2004:11-12). Peters divides product innovation into market novelties and firm novelties (what in this thesis has been discussed in terms of new to the market and new to the firm) and process innovations into rationalisation process innovations and other process innovations.

The dependent variable is employment growth. The independent variables are dichotomous innovation variables in different set-ups ("process" for process innovative/non process innovative, "process only" for process but not product innovative, "process & product" for product and process innovative), sales growth due to new products and seven sector variables (Peters 2004:21, 35, 39). The sector

[17] These include share of expenditure on R&D, software, training and marketing.
[18] The Jaumandreu study is labelled work in progress. The Peters study investigates the German conditions (whereas Jaumandreu the Spanish conditions) and the Peters report is a bit more developed.

variables are thus confounding variables. The sales variable, as well as the dependent variable which also takes sales into consideration, show how Peters incorporates the demand dimension of innovation.

Peters (2004) made seven different estimations of the basic model, using various regression methods, sometimes including sector variables, using different combinations of innovation variables. In five of the seven estimates, consideration has also been given to the industry price growth rate.

What Peters does is investigate the impact of product innovation and process innovation on employment growth. The main result (Peters 2004:19-20) is that the higher the sales growth rate due to product innovation, the higher the employment growth. In plain English, the more money earned due to product innovation, the more jobs created. And this impact is independent of whether the innovation is new to the world or new to the firm. One could argue here that this is a relationship which has less to do with newness (i.e. the innovation) and more with success: a successful product yields a larger production than a non-successful product although the two are always intertwined.

The evidence is less clear when it comes to process innovation. Peters (2004:22) shows how process innovation leads to job loss in manufacturing sectors, but not in service sectors and how not all process innovations, but only the rationalisation process innovations, lead to job loss (Peters 2004:27). Comparing these two studies help us to identify two important points.

First of all, the two studies present different factors as important to explain innovation-induced employment change and these, in turn, also differ from the list of stylised facts Pianta presented. This is also seen in Manninen (2002:28) who compares three firm-level approach articles and comments on the difference in methodological approaches. He mentions, among other things, how different studies use different variables. Although the scope of the studies is the same, the statistical (or econometric) techniques used differ and so do the variables.

Second, it is often a far stretch from the abstract factors to the more concrete proxies. Proxies are inevitable because often it is difficult to measure exactly the phenomena in question. Indirect variables are sometimes used instead of the occurrence of product and process innovation. (cf. Pianta 2000:84, Peters 2004, Mastrostefano and Pianta 2004).

One of the complications in measuring innovation in services is that the proxies developed for measuring innovation are developed on the bases of manufacturing firms and industries. Neither patents not R&D are, for example, reliable indicators of innovation in service sector firms.

Great care should be taken when going from the theoretical level (which factors are important to explain innovation-induced employment change) to the indicators. The indicators which are used as proxies for essentially the same phenomena may differ greatly. In the case of Peters (2004) in comparison to Evangelista and Savona (2003),

for example, product innovation is measured in different ways. Therefore it is likely to yield different results as seen in Table 3-2. But the largest difference between them is that the dependent variable measures quite different phenomena. Evangelista and Savona use a dichotomous variable which measures whether a specific firm had a positive impact on employment or not due to product and/or process innovation. Peters (2004), on the other hand, measures how much a firm has grown due to sales of product innovation. The dependent variables thus vary considerable: the two regressions to not investigate the same phenomena. However, to what extent does this affect the results? As a consequence, it is also difficult to estimate how much product and process innovation affect employment.

Table 3-2. Comparing two firm-level studies on innovation and employment in services.

	Evangelista and Savona (2003)	Peters (2004)
dependent variable	positive impact on total employment	employment growth due to sales of new products
indicator of product innovation	dummy variable: yes/no	sales growth due to new products
indicator of process innovation	dummy variable: yes/no	dummy variable: yes/no
results		
GPI	not included	⎫ positive impact ***
SPI	positive impact**	⎭
$T\pi$	included, but not statistically significant	positive impact **
$O\pi$	not included	not included

Comment: *** indicates that the result is statistically significant on a 90 per cent level, **** indicates that the result is statistically significant on a 95 per cent level.*

Source: *Evangelista and Savona (2003 table 4, model 1) and Peters (2004:21 tab 4, basic model, regression #1).*

3.5 Concluding remarks

This chapter has addressed some of the research in the field "innovation and employment". It has shown that within the research area, different levels of research are used (sector-level vs. firm-level) and how the level of investigation actually yields different results. It is also important to remember that there are two main sub-fields within the research fields: that of quantitative and that of qualitative employment. Further, some sectors are investigated more than others: there is a plethora of manufacturing sector studies and less, much less, on service sector studies. Finally, it is important to distinguish between the direct and indirect impact of innovation on employment.

Several strategic choices are made in this chapter, and the choices, and reasons underlying them may be explained in relation to Figure 2-4. The figure reminds us how a new to the firm approach of innovation is adopted. That is, the product or process is an innovation in every firm in which it is introduced. This approach was chosen since the innovation may cause employment change in every firm it is introduced, not only the first time it is introduced in any firm. From the new to the firm approach follows that a firm-level approach is taken.

This also emphasises how it is only the impact on employment in the KIBS firm which is in focus, not the indirect impact on second or third order firms in the innovation system. This exclusion of the multiplier effect is very important to make clear, since the overall impact on employment most probably is larger and more complex. For example, the innovations IT firms do are often used to reduce the need

for labour in client firms, but that dimension of innovation-induced employment change is not considered in this thesis. This delineation also avoids some measurement problems of double counting, since the employment effect in every KIBS firm is considered. In this context it is also important to remember that it is only the quantitative aspects of employment, and not the qualitative, are considered.

Before we go on to scrutinize the concept of KIBS in the next chapter, it is crucial to remember that, although the taxonomy of product and process innovation is the most viable distinction to separate the negative and positive employment change, this taxonomy cannot explain all. The chapter has presented a number of confounding factors, which makes it clear that the relationship between innovation and employment should not be taken for granted, especially not for service sectors such as KIBS.

4 KIBS - a critical review and conceptualisation

Up till now the concept of Knowledge Intensive Business Services (KIBS) has not been properly introduced. What, then, is KIBS? First and foremost it is important to point out that "KIBS" could stand for a set of characteristics among firms (what is here referred to as *KIBS features*), a type of firm (what is here referred to as *KIBS firms*) or for a sector of firms (*KIBS sector*). It should also be added, as not to create confusion, that KIBS is a concept of research and policy and not an empirically used concept. KIBS firms are (usually) not aware of being KIBS firms and thus do not identify themselves as such.

KIBS firms are firms that solve problems for their clients. They are thus firms with very specific characteristics. Examples of KIBS firms are consultancies or accountancies, labour recruitment firms or R&D firms.

KIBS firms are commonly regarded as essential for the function of the economy and help systems of innovation to function more effectively. Most researchers agree upon the importance of "KIBS" for the innovativeness of the economy. However, there is less agreement on which firms are actually KIBS firms. An important objective of this section is to show that there are major differences as to which firms are regarded as KIBS firms and this has implications for the conclusions we may draw on innovations in KIBS firms. A definition is also developed and discussed in the section.

The diversity of KIBS definitions also has implications for the reliability of knowledge on KIBS. Since there is no agreement on which firms should be considered KIBS firms it is hard to know which population of firms the results may be generalised to.

4.1 What is special about KIBS firms?

KIBS as a concept is usually used to describe a positive set of characteristics, even if, more recently, a more nuanced image of KIBS is starting to emerge. In this section, the concept of KIBS will be discussed from a number of different angles. First the concept of KIBS will be introduced through reference to similar concepts. Then three features of KIBS will be presented, where after six stylised facts of KIBS will be presented.

4.1.1 A plethora of similar concepts

Several concepts are similar to that of KIBS. The concepts mentioned here are often discussed in the same context as KIBS. Some of these are used synonymously. Most of these concepts would, if operationalised, identify more or less the same firms as KIBS firms. Examples of such concepts are business services (Hauknes 1998:33, European Commission 1999:6, Larsen 1998:1), advanced business services (Dahles 1999:5), professional business services (Tordoir 1994:232-237, Hermelin 1997:65, Nachum 1998:3, Pedersen 1999:2) and strategic business services (OECD 1999a:24). Production oriented services (Dathe and Schmid 2000:7), producer services (Karaomerlioglu and Carlsson 1999:178, Dathe and Schmid 2000:7) and R&T services (Hales 1998:8-9) are also sometimes very similar in use. The same is true for

information and knowledge services (Appelbaum and Albin 1990:66), knowledge based services (OECD 1999b:8), knowledge intensive services (Windrum 2000:4, Tomlinson 1999:445) and knowledge firms (Blomqvist 1994, Roman 1994:99-100, Pettersson 1996).

All of these concepts have family resemblance. They refer to roughly the same kind of services, even if we do not know that for certain. Since there is no common definition of any of these concepts, this is hard to claim with certainty. Take for example the concept of professional business services. Hermelin is building on an article by Tordoir (1994) when operationalising the concept of professional business service, and her operationalisation is by no means identical to the one used by Nachum (1998) and Pedersen (1999). The same is true for the definition of business services: the definition used by Hauknes (1998) is not identical to the use proposed by the European Commission (1999) in their "*Common Policy Framework*" or by the one put forward by Larsen (1998). As will be revealed further on, this is also the case for knowledge intensive business services as defined here.

Since there is no common definition of the concepts, the relation among the concepts is also unclear. One example is when Windrum (2000:4-5), describes knowledge intensive services. His description is almost identical to the description of knowledge intensive business services put forward by Miles et al. (1995). Another example is when Werner (2001:49) briefly discusses the relations among the concepts in a report. He claims that KIBS firms should be defined as a subset of business services and that the term producer services reflects that these services are linked to industrial production whereas advanced producer services and professional business services refers to the professionalism of the employees, that is, to their education.

That is not necessarily a problem however. In this crowded conceptual world filled with concepts having family resemblance with each other it is – after having identified the general structure of the territory – enough to focus on the useful and the limitations of the concept selected for use in this thesis. We do that fully aware that there are similar concepts.

4.1.2 Three KIBS features

The concept of KIBS sets out to cover very special services. Some of these are services which are new, so new that they are not always recognised by industrial classifications. They provide service products, not goods products, which are important for what is sometimes referred to as the new economy, the knowledge economy or the learning economy (Lundvall and Borrás 1997:115-120). These firms help other firms by providing competencies the receiving firms cannot afford to have themselves. They help other firms to be innovative, and they are also quite innovative themselves.

Although most researchers agree that KIBS firms are important to the functioning of the economy, it is still difficult to identify these firms. Consequently it is also difficult to test empirically the validity of these statements. The large KIBS-related literature often refers to the report by Miles et al. (1995), for example, which is cited in Skogli

(1998:1), Hauknes (1999:8), Tomlinson and Miles (1999:159), Werner (2001:50), Toivonen (2004:36), Wong and He (2005:25) and den Hertog (2000:505).

The three features, taken from Miles et al. (1995:28) are:

(1) KIBS rely heavily on professional knowledge
KIBS firms produce information or service products which generate knowledge for other firms. One of the major functions of KIBS firms is to foster "knowledge development" in the economy. The focus on knowledge also implies that many employees have a high level of education (Miles et al. 1995:25-30). Employees are carriers of knowledge. The knowledge that the firms produce and sell cannot be embedded in machines. The most valuable assets of an IT consultancy firm do not reside in its computers but rather in its human and structural capital.[19] Therefore employees of such firms are especially important since much of the knowledge that the firm is based on is effectively embedded in its labour force. Important resources such as experience, skills and contacts are tied to the employees rather than to the firm. One consequence of this is that the barriers to start a new firm may be low. Since the equipment is often relatively inexpensive and the highly educated employees are generally well paid, their wages may be transformed into start-up capital (Hermelin 1997:26-27).

(2) KIBS products are sources of information or knowledge
The products of KIBS firms are often based on new or emerging technologies. Related to this is that KIBS firms often are innovative. One such emerging technology of great significance is IT. The relationship between the new technologies is, however, not the same in all KIBS firms. Some KIBS firms are active in shaping the new technologies while others are often referred to as passive but competent users of new technologies (Miles et al. 1995:10). The first category of KIBS firms is called technology related KIBS or *T-KIBS*. The latter category of KIBS firms is, when referred to, referred to as "other KIBS". As evident even from the labelling of the categories, more effort is spent on T-KIBS since there is not even a label for "other KIBS". Here, however, they are labelled *P-KIBS*, professional KIBS, to give them more of an identity and less air of a residual category.

(3) KIBS clients are usually other businesses and the public sector
Knowledge intensive and labour-intensive, the products of the KIBS firm tend to be costly. That is one of the reasons why KIBS products are less related to the consumer market (Miles et al. 1995:28). Later on, we will see how KIBS products are primarily investment products or intermediate products.

Firms with KIBS *features* are presumably knowledge intensive and employ a highly educated labour force. Later on KIBS sectors will be properly defined, but for now

[19] According to some researchers, the firm possesses structural capital in addition to human capital. Structural capital would thus be, for example, patents, systems and inventions that are resources that do not go home at night in contrast to human capital. Structural capital is owned or controlled by the firms, not the employees (cf. Reiten 2000:45-46).

KIBS firms are exemplified as technical consultancy firms, software consultancy firms or R&D firms.

4.1.3 Insights on KIBS - six stylised facts

The literature on KIBS, or which uses the concept, is large. The purpose of this section is to present KIBS firms and sectors as they are usually described. In this section will be discussed how KIBS firms are, in a wide sense, knowledge intensive and as a consequence of this they are also innovative. Moreover, they diffuse knowledge and assist in the innovative activities of other firms. They link firms in the economy. Therefore they have, or can have, important roles in systems of innovation. The labour force is commonly highly educated and highly skilled. KIBS firms are growing and the firms are typically large or very small.

These statements, or stylised facts, on KIBS will be described more in detail below. It may, of course, be argued whether these are stylised facts in the Kaldorian sense (Kaldor 1961:178) as some of our facts are closely related to our definition. What is important, however, is that these are statements commonly associated with KIBS firms, which does not necessarily imply that they are correct for all KIBS firms in all countries. Much of what is written on KIBS is either derived from the definition (as outlined in the features), based on case studies (see for example Flanagan 1999) or based on studies focusing on one aspect or another of KIBS.

Stylised fact 1: KIBS firms are innovative

KIBS firms, and above all T-KIBS firms, are often singled out as one of the more innovative segments of the service sectors and sometimes compared to high-tech sectors in manufacturing (cf. Edquist et al. 2001:18,62, Zackrisson 2003:26). Despite a high level of innovativeness, few KIBS firms have R&D departments or do formal R&D, however.

KIBS firms are sometimes (cf. Miles 2001b:27) described as having three roles vis-à-vis innovation: as users of innovation, as sources of innovation and as agents of innovations. The KIBS firms are lead *users of innovations* such as IT software and systems. KIBS firms are heavy users of ICTs (Boden and Miles 2000a:11). However, this is hardly unique for KIBS firms. A recent report from Statistics Sweden (2004:8) shows how almost all, 96 per cent, of Swedish firms with more than nine employees, use computers. KIBS firms are also *agents of innovation* when they transfer technology between firms. Lastly, and this is a concept we will return to in chapters 7 and 8, KIBS are sometimes *sources of innovation*, meaning that they shape innovations as well as new knowledge such as contract R&D services in their client firms. Den Hertog (2000:507-508) also distinguishes between facilitators of innovation (that is, supporting the client firm in its innovation process) and sources of innovation (a larger role in the client firm's innovativeness) but in this thesis, the distinction between users, sources and agents of innovations are used to denote the innovative activities of the KIBS firm which supports innovation outside the KIBS firm.

These three roles may also be related to Figure 2-4, i.e. the KIBS firm in relation to other firms. When KIBS firms are users of innovations they introduce innovations

made in another firm. Introducing the product, the technology, also implies adjusting it to their needs. When KIBS firms are sources of innovations they contribute to innovations in other firms, i.e. KIBS firms act as agents of innovation transfer innovations between firms. This could involve for example picking up ideas from one firm, developing and introducing them to another. This also means that the arrows in the simplified figure should be two-directed since KIBS firms also get ideas from their clients in the process of co-production. This co-production is, according to Cowan et al. (2001:3) not common in manufacturing and is thus a feature in the production process which differs in services as opposed to manufacturing.

These three roles of innovation focus on how the KIBS firm enhances innovation in its environment. As users of innovation KIBS firms possibly shape technology, but this indicates a rather passive relationship to innovation. As agents of innovation they assist in the transfer of knowledge and innovation, which encourages other firms to be innovative. Not all KIBS firms fulfil these roles. P-KIBS are predominantly users of innovations (cf. Miles 2001a:8).

According to Lundvall and Borrás (1997:118), KIBS firms have three different characteristics which make them innovative. First, the often decentralised, flexible and project-based organisation of the KIBS firm is one important feature for explaining the innovativeness of the firms. Second, the management of employees, recruitment as well as learning processes, are of importance. Finally, use of IT systems and computer-based systems is claimed to be of significance for their innovativeness.

Stylised fact 2: KIBS firms were (and are maybe still?) growing
Many accounts of KIBS, including the present one, include a paragraph on the unprecedented growth of KIBS firms (cf. Tomlinson and Miles 1999:159, Nählinder 2001a:6-11, Toivonen 2004:37).

KIBS sectors (as defined in this study) have grown remarkably both in Sweden and across the OECD, as seen in Figure 4-1 and Figure 4-2. Figure 4-1 shows that the sectors employed approximately 186,000 in 1993 and that the number of employees peaked in 2001 at 346,000. One year later, the sectors employed slightly less, 339,000 employees. Figure 4-1 therefore also shows that albeit the KIBS sectors grew during a rather long period, it appears the sectors are now growing less rapidly. This probably reflects the adjustments to the ICT-related hype from the late 1990s. This will be discussed further in section 5.1. We may also note how the manufacturing sector has grown marginally, from 688,000 in 1993 to 713,000 in 2002.

Business services sectors (which contain KIBS sectors - see section 4.3) have grown throughout the OECD, as exemplified by the countries in Figure 4-2. The employment growth has been dramatic in some countries, such as France, and less pronounced in other countries, such as Japan.[20]

[20] One reason may be that Japan reports many business services in other categories OECD (1999b:18). I have not encountered any particular explanation as to why business services in France are fast-growing.

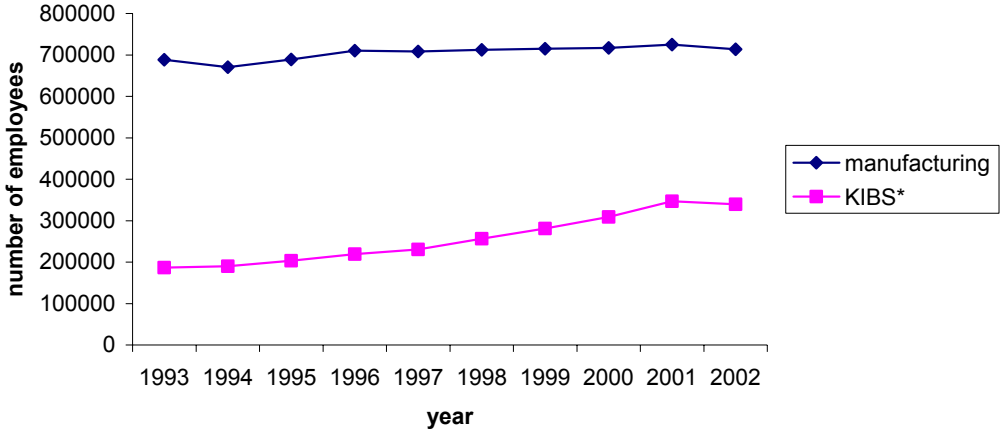

Figure 4-1. Number of employees in KIBS and the manufacturing sector in Sweden 1993-2002.*

Comment: the operationalisation of KIBS* used is presented in Table 4-4. The manufacturing sectors are operationalised as ISIC rev. 3 tabulation category D (sectors 15-37).
Source: FDB B (1993-2002).

The employment growth in business services as a whole thus differs substantially between countries, due to the fact that KIBS firms fulfil different functions in different economies. The national innovation system and its inherent path dependency is also important for how the KIBS sector develops as will be discussed further later on. For now, the point is that there are national differences in KIBS, and these also impact upon the size of the KIBS sector.

The growth rate also differs between different KIBS sectors. In Finland, for example, the two KIBS sectors of technological services and marketing suffered from the recession while computer related services increased during the nineties (Toivonen 2001a:68).

The reasons for this growth have been debated. A common argument is that the growth of KIBS sectors is mainly a statistical phenomenon. Many KIBS firms started as spin-offs or as outsourced parts of manufacturing firms. Therefore the growth of KIBS firms and the decline of manufacturing sectors would be mainly statistical and not reflect actual changes in the economy (cf. Karaomerlioglu and Carlsson 1999). Another explanation is that the growth of KIBS firms is due to an increase in demand for knowledge in the economy (Tomlinson and Miles 1999:159). KIBS firms would thus fulfil an important function in the economy and that is why they have grown. The reason why the KIBS sector has increased is likely a combination of both outsourcing and increase in demand.

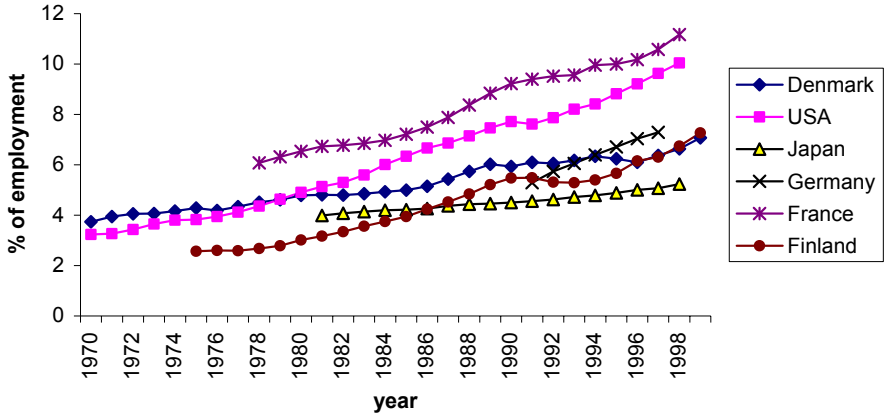

Figure 4-2. Per cent of total employment in business services in six OECD countries 1970-1999.

Comment: business services are here operationalised as division 71-74 of ISIC rev. 3. Source: Nählinder (2001b:9).

Stylised fact 3: KIBS firms create and diffuse knowledge

KIBS firms have a dual role in relation to knowledge. They create knowledge for their clients or together with their clients, and they also assist in spreading knowledge in the economy. KIBS firms often produce knowledge in close co-operation with a client or a network. This co-operation, or co-production, of knowledge extends from pooling to joint production of knowledge (Tomlinson and Miles 1999:160). KIBS firms are thus often deemed important for the development of new knowledge (Hipp 1999:150).

The diffusion of knowledge seems central to KIBS firms and is often mentioned in discussions of KIBS (cf. Howells and Roberts 2000:261, Hipp 1999:150, Lundvall and Borrás 1997:116). Cowan et al. (2001:11-16) mention KIBS as one of eleven transfer channels of knowledge in the new economy, to take but one example. Just as KIBS firms are agents of innovation, they are also agents of knowledge and facilitate the diffusion of knowledge in the economy, from one firm to another. This function as "knowledge brokers" makes them, in Lundvall and Borrás's (1997:116) wording, "crucial instruments in the learning economy".

This knowledge broker function is a by-product of what KIBS firms actually do, that is, to solve problems for their clients. This problem-solving requires knowledge and transfers of knowledge between the KIBS firm and the client firm. According to Miles (2001a:12-17), this problem-solving may be more or less complex. The KIBS firm may present information which facilitates decision-making. The KIBS firm may help to define a problem and also propose solutions to the problems. They may also implement the actual solution (Miles 2001a:12-17). In so doing, they increase the stock of knowledge (Tomlinson and Miles 1999:159). This means that (some) KIBS firms are active in problem-solving for their clients and they may do this to different

extents, from providing background information (such as auditing) to helping solve the clients' problems to even more knowledge intensive services.

Stylised fact 4: KIBS firms have a highly skilled labour force
The employment structure of KIBS firms differs from the employment structure of other service sectors. Tomlinson (1999:445) shows that, even when controlling for occupational structure, knowledge intensive services were more learning and knowledge-based than other sectors. A large part of the employees in KIBS firms are white-collar, skilled employees (Tomlinson and Miles 1999:160). The concept of *knowledge workers* is sometimes used to describe this group. Knowledge workers have access to knowledge and are likely to learn. They also have access to training. They are simply continuously learning new things (Tomlinson 1999:437-444). There are, however, cross-country and cross-sectoral differentials which should not be ignored.

Furthermore, the employees are not only particularly high-skilled, they are also prone to learning. There is, at least in the UK case, a migration of skilled labour from the manufacturing sector to KIBS firms, and skilled labour tends to stay in the service sectors (Tomlinson 1999:443). Knowledge is embedded in the employees and loss of personnel is sometimes also loss of knowledge. Mobility of employees may therefore also act as a source of innovation. Alternatively, high mobility may be a disincentive for employees to be innovative (Storey et al. 2002:1). Innovation is not neutral vis-à-vis skills and tends to favour high-skilled employees. This is analysed within the field of skill biased technical change which was mentioned in chapter 3.

Stylised fact 5: KIBS firms help other firms to be innovative
Intrinsically linked to their role as knowledge brokers is their role as innovation facilitators. The co-production of knowledge, discussed above, is instrumental for increased innovativeness in the client firms. KIBS firms are often related to the adoption, production or transfer of new technology (Flanagan 1999:13). KIBS firms also assist the development and application of new technologies to their clients (Tomlinson and Miles 1999:159). KIBS firms also affect organisational change since they influence "the learning capacity of the system" (Howells and Roberts 2000:115-120).

Muller and Zenker (2001:1511-1516) found that small manufacturing firms that interacted with KIBS firms were innovative to much larger extent than their non-interacting competitors. Of all SMEs (Small and Medium Sized Enterprises) interacting with KIBS, 76.7 per cent were innovative whereas 60.6 per cent of all non-interacting small manufacturing firms were innovative. This is further evidence that firms do not innovate in isolation and how KIBS firms may be instrumental in the innovativeness of other firms. [21]

[21] The same pattern is visible among interacting and non-interacting KIBS. 73.1 per cent of KIBS firms interacting with SMEs were innovative whilst only 62.3 per cent of non-interacting KIBS were innovative (Muller and Zenker 2001:1511-1516).

Stylised fact 6: KIBS firms link firms

KIBS firms often act as knowledge brokers or marriage brokers in the economy, thereby linking firms. It means that they help distribute knowledge in the economy, and the distribution of knowledge may lead to innovation. They may act as bridging organisations since they collaborate with a variety of clients, thereby diffusing knowledge. Linking firms and sectors make them play an important role in economic and technical change. This is, according to Larsen (2000:146), generally accepted. From the point of view of their clients, they are an external knowledge source (Muller and Zenker 2001:1503). KIBS firms may therefore be said to play a central role in innovation systems (Miles 2001b:27).

The role and strength of the KIBS firm is dependent on the national innovation system. In comparison to Australia and Denmark, Parker (2004) finds that Sweden is strong in high-tech manufacturing but less strong in business services (which include KIBS). Parker connects this to differences in the business system (a concept which resembles innovation systems).

Parker (2004) demonstrates how the national innovation systems affect the character of the knowledge economy. Sweden is strong in knowledge intensive high-tech sectors because the business system favours them and strong in ICT since the large industrial firms provide a good environment for engineers to spin-off (Parker 2004:361). Whatever the reasons for the differences in the knowledge intensive bases of the innovation system, Parker points to differences between them and how KIBS are not exogenous, but very much a part of the innovation system. Once more, it is demonstrated how the institutions, the time and the place shape economic growth and the determinants of innovation (Abramowitz 1989:70).

However, KIBS firms are not always well integrated into systems of innovation and the degree of integration differs among sectors and also according to size: larger firms are usually better integrated than smaller firms. According to Miles (2001b:26) T-KIBS are usually better integrated than for example accounting, which is a P-KIBS sector.

KIBS firms also provide us with a good example of how firms do not innovate in isolation. KIBS firms and their clients often work in a symbiotic relationship. This is a means of building new knowledge which can be applied to new situations and new clients (Flanagan 1999:116). This also has consequences for the way in which KIBS firms innovate and help other firms to be innovative. KIBS firms may act as bridging organisations within the wider economy, contributing knowledge through successive collaborations with a variety of clients (Flanagan 1999:116).

KIBS firms are usually described as fulfilling very special functions in the economy. In fact, they are more often mentioned for how they impact their environment than for how they are affected by their environment. Despite this, KIBS firms are in themselves important contributors of growth and thereby play an important role in the innovation system (Muller and Zenker 2001:1503).

This focus on KIBS as important for their environment rather than important in themselves is apparent in the three roles of KIBS firms as users, sources and agents of innovation, which predominantly focus on KIBS firms' impact on other parts of the economy, and thus on innovation systems. Thus, a substantial part of the knowledge on KIBS firms concerns how they affect innovation systems. Less effort is spent on the internal dynamics of KIBS firms.

The literature on KIBS is large and many arguments concerning KIBS firms are put forward. KIBS firms are almost always described in positive terms. For example, the other side of a knowledge intensive labour force is exclusion of the low educated, something which is seldom mentioned (Schienstock 2001, Evangelista and Savona 2002:310). Also, at times it is not always clear what empirical evidence underlies the statements and whether they are in fact derived from the KIBS features. Finally, and this will be discussed further in section 4.2.2, KIBS are sometimes defined in such a way that it is unclear which sectors or firms the result could be generalised to. The report by Lundvall and Borrás (1997) is a good example of this last point. Among other things it discusses the role of KIBS firms in the globalising economy. KIBS firms and their effect on the economy is discussed at length but only T-KIBS (technology based KIBS) are included in the definition of KIBS. Very often research on KIBS is in fact research on T-KIBS, making knowledge on KIBS indistinct.

4.2 Identifying KIBS features at a sector level

There are ambiguities concerning the concept of KIBS and above all which firms should be considered to be KIBS firms. The meaning and use of the concept is still vague. This ambiguity has consequences for our understanding of the sectors, their size, innovativeness, and effects on the economy. This section will demonstrate that definitions do not identify the same firms as KIBS.

The features of KIBS firms were described in the previous section. But where do we find these firms? How could we distinguish a sector of KIBS firms? Unfortunately, the KIBS features do not easily translate into sector features. The KIBS features are difficult to identify at a sectoral level for mainly two reasons.

First, these features are relatively speaking new and they are difficult to identify at a sectoral level since such sectors are not yet separated entities in industrial classifications. This is a fate KIBS firms share with large parts of the service sector but also with young manufacturing sectors, such as telecom or bio-tech (Manninen 2002:59, Alm 2004:57). Industrial classifications lag in their description of the economy. The manufacturing sectors, which in Sweden employ 19.3 per cent of all employees, are divided into 61 groups. The service sectors, employing 73.6 per cent, are divided into 62 groups (FDB B 2002). Thus, KIBS features may be hard to identify at a sectoral level since the sectoral classifications do not reflect recent changes in the economy.

Second, the KIBS features presented above are ephemeral. They may be present in a firm one year and not five years later. The features aim at capturing a dynamic set of traits, and this is both the strength and drawback of the concept as such. KIBS firms' increasing technology intensity (which is evident in their R&D expenditure and patent

activity - see Howells 2000:19-20) is also a part of this dynamic, even though it may be debated if this applies to all KIBS firms or only technology-based KIBS firms. Therefore, while the features and nature of KIBS are still somewhat clouded, it is in part a reflection of their economic, technical and employment dynamics. Any definition of KIBS sectors is doomed to be time-bound; the strengths and weaknesses of the concept of KIBS lie in its dynamic character.

Is it possible to identify KIBS sectors without losing the features which separate KIBS from all the other concepts discussed above? Preissl (1997:8) claims that this is difficult:

> especially a group of services which has been identified as *Knowledge Intensive Business Services* seems to be at the centre of the new dynamics in innovation systems. Unfortunately, service statistics do not allow [us] to analyze the development of these services on a comparative bases for all European countries.

But much research has indeed used the concept and has indeed operationalised it. Now I will turn to thirteen such reports and articles which have used the concept and have found measures to identify KIBS sectors.

4.2.1 Thirteen definitions of KIBS

The report by Miles et al. (1995:28-33) which forms the point of departure for most research and discussion on KIBS, conceptualises KIBS but also discusses innovation in services in general and innovation in KIBS in particular. They suggest a definition, presented here, which is based on case studies. They also make a distinction between two types of KIBS firms, traditional professional services and new technology-based KIBS which they label T-KIBS. They provide examples of KIBS services, which would be services like management consultancy, training in new technologies and building services. They do not, however, attempt to tie this to any classification.

Several papers from the so-called SI4S project - *services in innovation, innovation in services, services in European innovation systems* - explicitly deal with KIBS. The SI4S project was co-ordinated by the STEP group in Oslo and focused on dynamic interactions between service sectors and manufacturing sectors. It resulted in 35 papers, many focusing on KIBS. Five of them are included here: the reports and working papers of den Hertog and Bilderbeek (1998), Hales (1998), Windrum and Tomlinson (1998), Larsen (1998) and Skogli (1998).

Some of the reports do not give a clear operationalisation of KIBS. One example of this is den Hertog and Bilderbeek (1998), which focuses on the role of KIBS in relation to their clients. The focus is on co-production of knowledge, one of the more important features of KIBS firms. An operationalisation of KIBS sectors might not be necessary for this task. Hales (1998:1) similarly clearly states that he is not mapping KIBS as a sector, but rather "explores in a context of changing policy orientations, dynamic relations between firms and markets, and increasingly significant trade in knowledge-intensive services". In other words, he is focusing on a system rather than a sector.

Windrum and Tomlinson (1998:7) also took part in the SI4S project. They identified general trends in services and KIBS in the UK and the Netherlands. They analysed the impact on national productivity of KIBS activity, distinguishing between a general increase in the level of KIBS and other services activity and the degree of interaction within the national economy. However, unavailability of disaggregated data made them choose input-output tables where "categories containing KIBS activities" are identified: communications, finance and insurance, real estate and business services.

Larsen (1998:4, 16), who also took part in the SI4S project, maps and analyses KIBS sectors in the Danish economy. He operationalises KIBS sectors as "computer and related activities" (72), "research and development" (73) and "other business activities" (74) of the NACE rev.1. NACE is an industrial classification derived from ISIC rev. 3. Industrial classifications are a way of constructing sectors through systemising the economy based on the main output of a firm. In his conclusions, however, Larsen (1998) includes only parts of "other business activities" - "technical consulting and testing".

Skogli (1998:1) makes a very clear operationalisation of technology related KIBS sectors (not technology based, as Miles et al. 1995 discusses) for his paper on the role for T-KIBS in the national system of innovation in Norway. He defines T-KIBS sectors as "computer and related activities" (72), "research and development" (73), "architectural, engineering and other technical activities" (7421) and "technical testing and analysis" (7422) of NACE rev. 1 but adds that there are several so-called potential T-KIBS. In his operationalisation he thereby includes also R&D on social sciences as technology based. Hauknes (1999:8-9) uses the exact same operationalisation.

Muller and Zenker (2001) investigate the interaction between small and medium-size enterprises and KIBS in the regions of Alsace, France and Baden, Germany. Their definition, developed in (Muller 2001:79-80) is presented in NACE rev. 1. Translated into ISIC rev. 3, they include the following sectors: (721) "Hardware consultancy", (722) "Software consultancy and supply", (723) "Data processing", (724) "Database activities", (725) "Maintenance and repair of office, accounting and computing machinery", (726) "Other computer related activities", (7411) "Legal activities", (7412) "Accounting, bookkeeping and auditing activities; tax consultancy", (7413) "Market research and public opinion polling", (7414) "Business and management consultancy activities", (742) "Architectural and engineering activities and related technical consultancy", (743) "Technical testing and analysis", (744) "Advertising" and also (7484) "Other business activities n.e.c.".

Maskell and Törnqvist (1999:60) separate KIBS sectors from other service sectors when discussing the Öresund region in the book "building a cross-border learning region", They define KIBS sectors as NACE rev. 1. codes "computer and related activities" (72), "research and development" (73) and "other business activities" (74).[22]

[22] On page 60 they also refer to code 16, "manufacture of tobacco products" as a knowledge intensive business service. This is a typo and I would like to thank Peter Maskell (2001) for sorting it out for me.

Werner (2001:50-51) distinguishes three types of KIBS sectors: technological KIBS, KIBS for computing and software, and non-technological KIBS. Werner has made his operationalisation in the Finnish version of ISIC rev. 3, TOL-95, on a very disaggregated level. Translated into ISIC rev. 3 the following sectors are included: "hardware consultancy" (7210), "software consultancy and supply" (7220), "data processing" (7230), "database activities" (7240), "research and experimental development on natural sciences and engineering" (7310), "legal activities" (7411), "accounting" (7412), "market research" (7413), "business and management consultancy activities" (7414), "architectural and engineering activities and related technical consultancy" (7421), "technical testing and analysis" (7422), a part of "advertising" (7430) and some parts of "other business activities" (7499).

Toivonen (2001a:66, 2001b:80-85) investigates in depth the development and structure of KIBS firms and sectors in Finland. She demonstrates among other things how the boundaries between different types of KIBS sectors are converging (2001a:75). She distinguishes between seven different types of KIBS sectors: computer and related activities, research and development, legal and financial services, technical services, consultancy and labour recruitment and, lastly, training in the private sector. This operationalisation contains most "computer and related activities" (72), "research and development" (73), "other business activities" (74) and "education" (80) ISIC rev. 3 codes.[23] The Toivonen operationalisation (2001a) is somewhat wider than the Werner (2001) operationalisation.

Illeris and Plougmann (2001:56) study employment and skills in services as a part of the project *Service Development, Internationalisation and Competence*, which includes Larsen's (1998) report. They divide the service sector into several parts, among these KIBS sectors. They define KIBS sectors as "computer and related activities", "research and development", "legal, accounting, bookkeeping and auditing activities; tax consultancy; market research and public opinion polling; business and management consultancy", "architectural, engineering and other technical activities" and "technical testing and analysing".

Hipp (1999:154-159) discusses the conceptualisation of KIBS in relation to knowledge creation. She considers firms that transform information into service products as KIBS firms. KIBS firms are thus knowledge intensive and have close links to clients and their innovation processes. She applies this to the German Community Innovation Survey (CIS2) with a definition which focuses on two questions from the survey. Firms which answered that their clients come from either manufacturing or service firms (i.e. are business services) and which answered that universities and other research institutes were important or very important knowledge sources were considered as KIBS firms (Hipp 1999:167). This definition is sector independent but the *distribution* of KIBS firms is not sector independent. Forty per cent of the German science and technology services firms were KIBS firms and 32 per cent of the software firms but also 16 per cent of the wholesale firms (!) could be

[23] Toivonen (2001a) uses the TOL-95 at a disaggregated level. From the 72-74 complex, some specific codes are excluded, namely 725, 73104-73105, 7415, 74403, 746, 747 and 748 (except 74843, 74841).

identified as KIBS firms (Hipp 1999:164). The indicators she uses are problematic since it is questionable if they pinpoint the specific knowledge features of KIBS firms.

These thirteen studies are examples of studies which use the concept of KIBS and they by no means constitute an exhaustive list. Some conclusions may be drawn from these examples. The first, and most obvious, is that these KIBS-operationalisations do not coincide. The operationalisations differ even within the same project. This is the case in both the SI4S and *Service Development, Internationalisation and Competence* reports. The lack of common definitions makes it difficult to compare studies and collect an aggregate picture of KIBS sectors. I will return to this in section 4.2.2. The second conclusion to be drawn is the existence of different methods to operationalise the concept. This will be discussed further on in section 4.3.3. The third conclusion is that many of the studies suggest a further division of the concept, indicating that KIBS might not be a homogeneous concept, but rather a heterogeneous collection of service sectors. This will be discussed in section 4.3.6.

4.2.2 KIBS definitions differ greatly

The operationalisations differ greatly and there are reasons to believe that the different operationalisations would single out different firms to form a population of KIBS firms. It is even difficult to compare the studies, since they are using very different methods to identify KIBS firms and sectors. To give but one example, Windrum and Tomlinson (1998) consider parts of finance and insurance to be KIBS sectors, unlike other definitions. Comparing different studies of KIBS is thus like comparing apples and bananas. One could also argue that some studies using other concepts such as professional business services or strategic business services, would, indeed, qualify as research on KIBS.

There are a number of reasons why the definitions differ. The first is that they have different views on KIBS. Miles et al. (1995) do not set out to form a sector, for example, but rather to distinguish firms with KIBS features. The second reason is that the researchers had access to different data and made different types of studies. In many cases the availability of data has implied a specific type of operationalisation. This is the case for Windrum and Tomlinson (1998) for example. Although there are good reasons why the operationalisations differ, without agreement on the content of the concept, the concept loses value.

4.2.3 Different methods to identify KIBS

The examples discussed above use different methods to identify KIBS and this accounts for some of the differences in outcome. It is no mystery why an operationalisation based on important knowledge sources of the firm would identify another set of KIBS firms than an operationalisation based on industrial classifications. The examples above may be sorted according to the method through which the KIBS firms are identified, as shown in Table 4-1.

Table 4-1. The examples sorted according to method used to identify KIBS sectors.

list specific services	no specific definition	method of identification input - output tables	industrial classifications	indicators
Miles et al. (1995)	Den Hertog and Bilderbeek (1998) Hales (1998)	Windrum and Tomlinson (1998)	Hauknes (1999) Illeris and Plougmann (2001) Maskell and Törnqvist (1999) Larsen(1998) Skogli (1998) Muller (2001) Toivonen (2001a) Werner (2001)	Hipp (1999)

Source: based on section 4.2.1.

The **first** type of operationalisation is to list a number of specific services. This is what Miles et al. (1995) does. They list services such as training, building services and environmental services as examples of KIBS firms. The services named are very close to the features proposed by the same researchers, but it is not possible to study these types of firms on a large scale based on these examples without operationalising them further. This method makes it hard to compare studies.

A **second** approach is not to relate to a specific definition, as Hales (1998) and den Hertog and Bilderbeek (1998) do. This is very common since only a minority of studies refer the study to some sort of definition.

A **third** type of operationalisation is to identify categories containing KIBS based on input-output tables. Windrum and Tomlinson (1998:7) use "categories containing KIBS activities" which are "separately accounted for" in communications, finance and insurance, real estate and business services. This type of operationalisation is a good solution when available data do not provide other solutions. Nevertheless, it is difficult to know which firms are actually part of the selection and they do not actually form a sector. This makes it impossible to compare with other studies.

A **fourth** approach to operationalising KIBS is to identify KIBS sectors according to industrial classifications such as ISIC. This is the type of operationalisation Larsen (1998), Skogli (1998), Maskell and Törnqvist (1999), Muller (2001), Werner (2001), Toivonen (2001a) and Illeris and Plougmann (2001) use. The advantage of this type of operationalisation is that it is clear which firms should be included in the population and the operationalisation is not ambiguous. Comparing studies is relatively easy and it is also relatively easy to distinguish which types of firms are included in the populations. It is easy to define exactly how the definitions differ, as is shown in section 4.3.3. This will be discussed further on in detail. However, industrial classifications are sensitive to differences in use between countries and to firms wrongly registered, which Preissl (1997:8) and Hipp (1999) point out.

A **fifth** type of method to identify KIBS firms is according to the features of the firm. This means that indicators are used to determine which sectors or firms should be considered KIBS. This is thus not the same method as Miles et al. (1995) use. Hipp (1999) uses indicators. This method has the advantage of pinpointing the exact firms with KIBS features, given availability of data. This type of operationalisation may

easily fulfil the KIBS features and it is sensitive to changes over time, which is not necessarily negative, given the dynamic character of the sector. This is a relative measurement and comparison between countries and over time will be difficult to study with this measure without caution.

The differences between the thirteen examples and the definitions they use have been discussed at length. There is no optimal definition of KIBS. No definition can claim to give a correct picture of KIBS firms as described by the features. Neither is it feasible to design a definition which is eternal - the features themselves show the dynamic character of the firms. Each type of operationalisation has its advantages and disadvantages and all of them are imperfect reflections of the features mentioned above. The definitions are designed to fulfil different scopes under different constraints. The point is to underline the importance of clearly stating the definition used. However, they all have family resemblance covering a territory the core of which is visible although the borders are somewhat different.

4.2.3.1 Industrial classifications

The type of operationalisation which in my view best reflects the features in a sector perspective and has the most advantages compared to disadvantages would be the use of industrial classifications.

The use of industrial classifications makes it easy to define the population of KIBS firms. This is important in itself. It is also relatively easy to compare studies and compare countries. It is furthermore possible to distinguish which types of firms are included in the definition without merely exemplifying. Moreover, if it is easy to gather statistics and use previously developed statistics. This is valuable to get a more complete picture of the sectors and also to compare over time. It is further easy to sort out exactly how definitions differ.

Table 4-2. Description of ISIC rev. 3 digit levels: the case of labour recruitment.

level	digit-level	code	activity
tabulation category	1	K	real estate, renting and business activities
division	2	74	other business activities
group	3	749	business activities n.e.c.
class	4	7491	labour recruitment and provision of personnel

Comment: "n.e.c" stands for not elsewhere classified.
Source: UNSD (2004).

Industrial classifications are a way to structure the economy and they consist of hierarchical coding systems. The entities are categorised by their main activity (UNSD 2000).[24] The codes are usually on four or five structural levels (so-called digit levels) thus representing different aggregation levels of the economy. The example of "labour recruitment and provision of personnel" is presented in Table 4-2.

[24] UNSD stands for United Nation Statistics Department.

Several different industrial classifications are mentioned in this thesis.[25] Many industrial classifications are related but translating between them is precarious and should be done with great caution. Some industrial classifications, such as the Swedish SE-SIC92 or the Finnish TOL-95, are based on ISIC via the European Union industrial classification NACE. SE-SIC92 as well as TOL-95 add a fifth digit level and may therefore provide a more detailed picture of the economy. Both Werner (2001) and Toivonen (2001a) use the opportunity to present their operationalisations on this level and these operationalisations are presented here on a somewhat less disaggregated level.

4.3 KIBS sectors - business services that are knowledge intensive

Having now established a useful type of operationalisation for identifying KIBS sectors, the next task is to identify sectors that fit the KIBS features. KIBS sectors are service sectors that are both knowledge intensive and business services. What does this imply?

There is no general agreement as to the content of the term *business services* (introduced earlier in section 4.1.1). The concept is discussed at length in Nählinder (2002:15), but here it suffices to note there is a disagreement about the concept's meaning. Business services are here regarded as a wider term which includes the population of sectors in which KIBS firms are included. The concept of business services is here defined as including (in ISIC Rev. 3) "renting of machinery" (71), "computer and related activities" (72), "R&D" (73) and "other business services" (74).

Some of the sectors, which were included in the thirteen examples of section 4.2.1, are not business services in this statistical sense. Given the assumption that KIBS firms are part of business services, the education sector suggested by Toivonen is excluded. The exclusion of two other sectors is particularly important: telecommunications and financial services. Neither of these are business services in this sense.

Governmental services pose a particular challenge. Among business services sectors, some governmental services are included, such as universities. It is common practise not to include governmental organisations in innovation studies (cf. Sakurai 1995:138, OECD 1997:44, specifically on KIBS: Farina and Preissl 2000:6, Zenker 2004). I would like to argue that there are several reasons to include KIBS organisations, and not only KIBS firms, into a definition as long as they belong to a KIBS sector.

The first reason is that type of activity should be more important than organisation form. The KIBS features, which were presented in section 4.1.2, are related to the type of activity rather than to how the activity is organised. These KIBS features may be present in firms, non-profit organisations, governmental organisations, maybe even among some actors of the black market. My point here is that private firms are merely

[25] The industrial classifications are also revised as the economy changes. ISIC, for example, exists in five revisions: "ISIC" from 1948, "ISIC Rev. 1" from 1958, "ISIC Rev. 2" from 1968 and "ISIC Rev. 3" from 1989, and rev. 3.1 from 2002. In this thesis ISIC rev. 3 and its derived Swedish version SE-SIC92 is used, since most data was available in this revision.

one part of the economy (cf. Ingelstam 1997:65-129), and ex ante limiting the concept to such firms is presumptuous.

A second reason, building upon the first, is that the division between private firms and governmental organisations is not always clear. Lundquist (1992:109-114) outlines how three dimensions (at least) determine whether an activity is privately or publicly organised: responsibility (who decides what to produce, by whom, for whom), production (who produces) and financing. Many organisations (sometimes referred to as para-governmental organisations) fall in between and are thus both public and private. There is thus no easy distinction between governmental organisations and firms.[26] A certain product may also be financed publicly but executed privately and be more or less regulated by the state (Peterson and Söderlind 1992:45). One should also keep in mind that the same activity may be publicly organised at one time and in one innovation system but privately organised at other times in other systems. Yet again, I emphasise my point that it should be type of activity determining inclusion, rather than organisation.

A third, more pragmatic, reason is that even though industrial classifications distinguish private organisation sectors (in ISIC rev. 3: 1-74) from public organisation sectors (75-93), public organisations may be found in private organisation sectors. According to Tängerud (2004) governmental organisations pursuing governmental activities are classified under ISIC rev. 3 codes starting with 75. In official statistics, such as FDB (företagsdatabasen) governmental organisations are also included. In other words, governmental organisations which are not pursuing governmental activities (for example universities) are classified among the private sectors.

A possible reason why governmental organisations are commonly excluded from innovation studies is that governmental organisations do not normally operate in a market. Keeping the three dimensions of Lundquist (1992) in mind, we see how this assumption does not hold true for all governmental organisations: publicly financed entities, for example, do compete with their products in the market. The reason for excluding governmental organisations thus only holds for organisations which operate in a monopoly. It may also be questioned whether this problem of measurement should be reason enough to exclude them.

Demarcations always lead to borderline cases, and the validity of excluding governmental organisations is questionable. R&D carried out in research agencies resembles R&D carried out in universities and may be assumed to sometimes fulfil the same function. One should not confuse who provides the service (the private sector/the public sector) with the function the service fulfils. KIBS features focus on the latter.

---

[26] Yet another point should be brought to attention. The fact that KIBS are business services, i.e. directed to firms, is an implicitly made assumption of KIBS which is a consequence of their products being costly. Miles et al. (1995:28) explicitly states that public services are included in this context as KIBS services are too expensive for households.

Knowledge intensity is uncomplicated *a prima vista*, but as soon as one starts to unravel the concept, the issue becomes more complex. From the KIBS features (Miles et al. 1995:28) the knowledge-intensity is two-fold: the knowledge-intensity resides within its personnel (which is professional - i.e. based on occupation) and its products (which contain knowledge). In this definitional work, the view of knowledge is with necessity highly abstracted to a sector-level. According to Toivonen (2004:25), knowledge-related industries have been discussed since the 1970s. Knowledge in itself is a vast research area (for an excellent overview, see Eriksson 2005 chapter 2) and it is not possible to make a thorough overview of the concept of knowledge (-intensity) here for this particular definitional task. It suffices to say that knowledge-intensity is an ephemeral trait which may be present within a sector at one time but not another (Toivonen 2004:27). In the next section (section 4.4) the knowledge-intensity of different sectors will be scrutinised through the work of others, but it is still important to remember that knowledge is a much more complex concept than what may appear from this thesis.

4.4 Potential KIBS sectors

The last section presented four divisions as business services: 71, 72, 73 and 74. None of the six definitions presented in Table 4-1 include any part of division 71 ("renting of machinery") as knowledge intensive. These service sectors do not appear knowledge intensive and are therefore excluded from further discussion. The remaining sectors are thus part of three divisions: "computer and related activities", "research and development" and "other business activities". Table 4-3 includes all potential KIBS sectors and it shows the number of employees and firms for each sector in Sweden in 2002. The potential KIBS sectors are then presented. The description of the sectors is based on information from United Nations Statistics Division (UNSD 2000).

Comparing the sectors in Table 4-3, we may make at least two important observations. First, the sectors differ considerably in size. Other business activities (74) have sixty times as many firms as research and development (73). The second observation is that the average size of firm differs between sectors. Although the average is not the most suitable measurement of firm size, it is still striking to see how the average (74) firm has less than two employees whereas the average (73) firm has over ten. Even more intriguing is the fact that the average social science R&D firm has about five employees whereas the average natural science firm has more than twice as many. Apparently, although both firms occupy themselves with R&D, the firm structures differ considerably. There also appears to be a high degree of self-employment in some sectors. This is obvious not least from "building cleaning activities" and "photographic activities" where the average number of employees is less than one. Together this indicates large differences in firm structure among the potential KIBS firms.

Table 4-3. Potential KIBS sectors: number (per cent) of employees and firms 2002.

	verbal description	empl.	(%)	firms	(%)	empl/firm
72	computer & related activities	88,106	(2.4)	24,843	(2.9)	3.55
7210	hardware consultancy	3,504	(0.1)	1,031	(0.1)	3.39
7220	software consultancy & supply	71,611	(1.9)	22,153	(2.6)	3.23
7230	data processing	8,522	(0.2)	712	(0.1)	11.96
7240	database activities	1,243	(0.0)	183	(0.0)	6.79
7250	maintenance & repair of office, accounting & computing…	2,078	(0.1)	371	(0.0)	5.60
7290	other computer related activities	1,148	(0.0)	393	(0.0)	2.92
73	research and development	28,882	(0.8)	2,677	(0.3)	10.79
7310	research & experimental development in natural sciences…	27,112	(0.7)	2,343	(0.3)	11.57
7320	research & experimental development in social sciences…	1,770	(0.0)	334	(0.0)	5.29
74	other business activities	288,347	(7.8)	161,656	(19.2)	1.78
741	legal, accounting, bookkeeping and auditing activities…					
7411	legal activities	8,173	(0.2)	4,538	(0.5)	1.80
7412	accounting, bookkeeping & auditing activities; tax consult.	22,878	(0.6)	14,254	(1.7)	1.61
7413	market research and public opinion polling	3,263	(0.1)	537	(0.1)	6.08
7414	business and management consultancy activities	40,347	(1.1)	30,106	(3.6)	1.34
742	architectural, engineering and other technical activities					
7421	architectural & engineering activities	52,604	(1.4)	26,987	(3.2)	1.95
7422	technical testing and analysis	7,119	(0.2)	482	(0.1)	14.77
7430	advertising	22,152	(0.6)	12,579	(1.5)	1.76
749	business activities n.e.c.					
7491	labour recruitment and provision of personnel	12,446	(0.3)	558	(0.1)	22.30
7492	investigation and security activities	16,906	(0.5)	753	(0.1)	22.45
7493	building-cleaning activities	42,248	(1.1)	47,839	(5.7)	0.88
7494	photographic activities	3,150	(0.1)	4,186	(0.5)	0.75
7495	packaging activities	1,461	(0.0)	171	(0.0)	8.54
7499	other business activities n.e.c.	55,600	(1.5)	18,666	(2.2)	2.98
	service sectors	2,720,889	(73.6)	485,104	(57.6)	5.61
	whole economy	3,695,406	(100)	842,358	(100)	4.39

Comment: *number of employees and firms in Sweden 2002 according to ISIC rev. 3. Within brackets as per cent of all firms or employees of the whole economy. The last column contains information on number of employees per firm 2002. Group level is excluded when identical to the class level, for example 721 is omitted as it only contains one class, 7210. The service sector is operationalised as ISIC rev.3 50-93. Some verbal descriptions have been shortened.*

Source: *FDB A and B (2002).*

Computer and related activities in Sweden have about 88,000 employees in 25, 000 firms (see Table 4-3). The division consists of six groups. All groups have one class each. Hardware consultancy (721) typically analyses and presents solutions to the users' needs concerning hardware (which may or may not have associated software application). Software consultancy and supply (722) focuses on computer systems ready to use. Usually the users' needs and problems are analysed. Necessary software is produced with a focus on non-customised software. Data processing (723) includes processing and tabulation of data, which is supplied by the client and this may also be specialised. Database activities (724) include the development of databases, data storage, and so-called database availability, which means the provision of data in a certain order or sequence. Maintenance and repair of office, accounting and computing machinery (725) includes repair of the named equipment and computer peripheral equipment. Other computer related activities (729) is a category containing computer services that do not fit into any of the other categories. There is little doubt about the knowledge intensity of computer activities, except for "maintenance and repair of office, accounting and computing machinery", which both Toivonen (2001a)

and Werner (2001) exclude from their operationalisations. Muller (2001), on the other hand, includes it.

Research and development in Sweden has about 28,882 employees in 2,700 firms (2002). The division consists of two groups. Both groups have one class each. Research and experimental development in natural sciences and engineering (731) includes systematic creative work in natural sciences, medical sciences, agriculture, and engineering and technology, whereas research and experimental development in social sciences and humanities (732) includes systematic creative work in social sciences and humanities. Interesting to note is how the sector of natural sciences R&D is much larger than the social sciences R&D sector. As Table 4-3 indicates, in 2002 natural science R&D employed over 27,000 employees in 2,300 firms: the average natural science R&D firm thus employed over eleven employees. Meanwhile, the social sciences R&D sector employed less personnel (1,770) in fewer (334) and smaller firms (average 5.29 employees). "Research and development" is also usually regarded as a KIBS sector. Muller (2001) excludes both R&D sectors as KIBS. Werner (2001) omits research on humanities and social sciences from the operationalisation, but Skogli (1998) does not.

Other business activities in Sweden represent about 288, 000 employees in 162, 000 firms (2002). It is a very large and heterogeneous division and consists of four groups, each containing several classes. The first group of other business services is "legal, accounting, bookkeeping and auditing activities; tax consultancy; market research and public opinion polling; business and management consultancy" (741). The group is obviously very heterogeneous in terms of output, containing many different activities. It includes advice and representation in legal cases. It includes recordings of commercial transactions, preparation, examination and certification of financial accounts. It includes preparation of income tax returns. Further, it includes investigations that aim at sales promotion or development of new products as well as investigation of collective opinion. Finally it involves provision of advice, guidance and operational assistance in the form of business and management consulting. All researchers, with the exception of Skogli (1998), agree that this group should be considered KIBS. One reason why Skogli (1998) does not include this group may be that they are not "technology related".

The second group of other business services is "architectural, engineering and other technical activities" (742). Technical testing and analysis includes testing and inspection of materials and products. All operationalisations consider this group knowledge intensive.

The third group includes only advertising, that is creating and placing advertisement for clients. Four of the six operationalisations consider this group knowledge intensive, excluding Skogli (1998) and Illeris and Plougmann (2001). Werner (2001) considers only one part of this group knowledge intensive. It is thus questionable whether this group should be included in an operationalisation on KIBS sectors.

The fourth and final group, business activities n.e.c. (not elsewhere classified), is very heterogeneous, and some of these sectors such as, for example, cleaning can hardly be

labelled knowledge intensive. "Labour recruitment and provision of personnel" (7491) includes handling employees (personnel search, selection referral and placement) as well as labour contracting activities. "Investigation and security activities" (7492) include investigation and protective activities for individuals and property. "Building-cleaning activities" (7493) include cleaning of buildings which is not done by households. "Photographic activities" (7494) include production and processing of photographs and motion pictures, "Packaging activities" (7495) is self-explanatory. "Other business activities" (7499), is large and heterogeneous. It includes services directed to other firms, which are not classified elsewhere, for example bill collecting, translation and interpretation, telephone answering activities and fashion design. Four of the classes (investigation and security activities, building cleaning activities, photographic activities and packaging activities) are not singled out as knowledge intensive by those who operationalised on a disaggregated level. Two classes, "labour recruitment" and "other business activities" might be considered knowledge intensive. Skogli (1998) and Illeris and Plougmann (2001) do not include this category while Werner (2001) includes parts of it in his operationalisation. Muller (2001) includes business activities, but not labour recruitment, as KIBS.

4.4.1 Four sectors with debated knowledge intensity

KIBS are sectors that are both business services and knowledge intensive. Designing a definition of KIBS is complicated since the operationalisation must be able to capture an ephemeral set of features on a sector-level. Do these sectors provide knowledge intensive services that are produced by firms employing a highly educated labour force?

Hence, it is not surprising that there are some differences in how definitions have been designed. Some sectors are beyond doubt KIBS. Five "computer and related activities" are KIBS: "hardware consultancy" (721), "software consultancy and supply" (722), "data processing" (723), "database activities" (724) and "other computer related activities" (729). The part of research and development which covers firms working with natural sciences and engineering (7310) are always considered as KIBS and there is also agreement on "architectural, engineering and other technical activities" (742) from business services. This selection of sectors is, however, technology-biased since Skogli (1998) identifies T-KIBS sectors, not all KIBS sectors. Therefore, the P-KIBS sector "legal, accounting, bookkeeping and auditing activities; tax consultancy; market research and public opinion polling; business and management consultancy" (741) should most definitely be included as well. For the same reasons research on social sciences and humanities (7320) should also be included.

The knowledge intensity of four sectors is thus in question. Should "maintenance and repair of office, accounting and computing machinery", "advertising", "labour recruitment and provision of personnel" and "other business services" be included, and on which grounds?

"*Maintenance and repair of office, accounting and computing machinery*" has 2,000 employees in approximately 400 firms (2002) as seen in Table 4-3. It is not to be considered knowledge intensive, according to Toivonen (2001c). The activities do not

fit with the other activities in KIBS and their knowledge intensity is unclear. Therefore it will be excluded from the operationalisation.

"*Advertising*" is a sector with both more and less knowledge intensive segments. In 2002, it had 22,000 employees in 13,000 firms (see Table 4-3). Toivonen (2001a) has made a thorough mapping of KIBS in Finland where she also discusses how these are converging. There is nothing in her description of this sector which suggests that it does not fit the features of KIBS. Advertising firms are also increasingly moving into the field of consulting, much like other KIBS firms. They are "assuming a growing responsibility for the overall communications and brands of their client companies" (2001a:76). This all points to advertising as, on the whole, a knowledge intensive business service even if some segments, such as direct advertising activities, is less knowledge intensive. Therefore advertising is included in the operationalisation.

"*Labour recruitment and provision of personnel*" is indeed an odd sector. In 2002, it had 12,000 employees in 560 firms, according to Table 4-3. The sector has experienced rapid growth not least in Sweden (Nählinder 1998:9). They assist client firms in the recruitment of personnel. They also assist in so-called flexible staffing and outsourcing. In short, they are experts in labour competencies and in providing these on a short- or long term-basis. The firms of this sector in fact sometimes have two types of employees: employees who are hired to work at other firms and employees who organise this function. The second type of employees and their work tasks fit nicely into the KIBS definition. The other group, however, who statistically work for a labour recruitment and provision of personnel firm, are for all other practical reasons working for a firm in another sector. These employees have occupations such as engineers, secretaries or IT-consultants. It is difficult to say which category the 12,000 employees of the sector (see Table 4-3) come from. There are good reasons to include this sector in an operationalisation of KIBS sectors since it fulfils most of the criteria. Not including this category would be to close one's eyes to a large part of the economy which resembles, and is a result of, the same economic restructuring that gave birth to the KIBS phenomena: outsourcing and similar types of firm restructuring. Toivonen (2001a) also bases a category of KIBS on this sector. The conclusion is that this sector should be considered a knowledge intensive business service sector.

Lastly, the category of *other business services* is very heterogeneous. It is also rather large. In Sweden in 2002, 19,000 firms were registered in this category and it had 56,000 employees (see Table 4-3). This heterogeneous sector alone employs 1.5 per cent of all Swedish employees. The category will be included in the definition since many new firms, specifically in new types of activities, are likely to register in this category.

The KIBS sector is here discussed at a class level (four-digit level). The Swedish industrial classification SE-SIC92 is also using an item level (five-digit level). Some statistics are therefore available at a finer level. The definition will however still be based on a four-digit level and that for two reasons.

The first reason is that using a five-digit level would be difficult to compare with studies and definitions which do not use the Swedish industrial classification. Although national industrial classifications such as SE-SIC92 build on ISIC and NACE, they sometimes use a slightly different numbering system. Translating between SE-SIC92 and ISIC is not complicated but takes patience and the coding differences are not always transparent. One example from the four-digit level is how the SE-SIC92 code 74.50 corresponds to the ISIC rev. 3 code 7491. This problem is enhanced at a five-digit level.

The second reason is that using an even less aggregate level would create many more sectors without necessarily adding to the accuracy of the definition. Divisions 72-74 of ISIC rev. 3 contain 12 groups and 21 classes. The number of items in SE-SIC92 for these divisions is 44. Theoretically, if an item-level operationalisation was used instead of a class-level operationalisation, it would be possible to exclude some segments of classes which are not knowledge intensive. In practise, however, firms tend to be mis-classified more often when a more detailed level is used. This is further discussed in appendix I. Thus, more and finer KIBS sectors do not contribute to the objectives of the study since they cannot be used to exclude non-knowledge intensive segments such as direct advertising agencies as the mis-classification is larger at a detailed level.

For these reasons the internationally recognised system of ISIC rev. 3 is used instead of SE-SIC92 and the definition is established at a class-level.

4.5 A definition of KIBS sectors

An operationalisation, built on previous operationalisations, would be the classes presented in Table 4-4. The table also includes one column labelled KIBS*. KIBS* represents a two-digit operationalisation of KIBS which could be used when data on a four-digit level is not available. In no case was three-digit data available and therefore no three-digit definition of KIBS was constructed.

The KIBS operationalisation presented here contains 16 classes. The 16 classes all belong to divisions 72-74. Eight of these classes or sectors are T-KIBS. T-KIBS as a proxy for all KIBS only covers half of all KIBS employees in Sweden 2002. Therefore it is important to include these "other KIBS", or P-KIBS as I label them, in discussions as well as operationalisations of KIBS.

Table 4-4. Definition of KIBS sectors.

		T/P	KIBS	KIBS*
72	computer and related activities			
7210	*hardware consultancy*	T	included	included
7220	*software consultancy and supply*	T	included	included
7230	*data processing*	T	included	included
7240	*database activities*	T	included	included
7250	*maintenance and repair of office, accounting and computing machinery*			included
7290	*other computer related activities*	T	included	included
73	research and development			
7310	*R&D in natural sciences and engineering*	T	included	included
7320	*R&D in social sciences and humanities*	P	included	included
74	other business activities			
7411	*legal activities*	P	included	included
7412	*accounting, bookkeeping and auditing activities; tax consultancy*	P	included	included
7413	*market research and public opinion polling*	P	included	included
7414	*business and management consultancy activities*	P	included	included
7421	*architectural and engineering activities and related technical consultancy*	T	included	included
7422	*technical testing and analysis*	T	included	included
7430	*advertising*	P	included	included
7491	*labour recruitment and provision of personnel*	P	included	included
7492	*investigation and security activities*			included
7493	*building-cleaning activities*			included
7494	*photographic activities*			included
7495	*packaging activities*			included
7499	*other business activities n.e.c.*	P	included	included

Comment: *sectors included in the KIBS operationalisation presented on a division and class level of ISIC rev. 3. Also type of KIBS sector (T-KIBS or P-KIBS) is presented. The distinction follows that of Skogli (1998:1) with one important exception. While Skogli consider 7320 a T-KIBS sector, I consider it a P-KIBS sector.*
Source: *sections 4.1- 4.3.*

The definition exemplifies a top-down approach to identifying KIBS sectors. Another, bottom-up, approach would be to identify firms with *KIBS features*. This top-down approach targets most KIBS firms, that is, firms with KIBS features as we will see in section 7.1. Nevertheless, such an approach will include many firms which have not got KIBS features and exclude many firms with KIBS features in other sectors. This measurement should, when possible, be complemented with a bottom-up approach to target firms with KIBS features within the KIBS sectors. This is also done in section 7.1. In other words, within the rough population of KIBS sectors, outlined in Table 4-4, one could further investigate the firms with KIBS features. This could be done through asking a sample of KIBS firms questions related to the KIBS features.

4.5.1 The importance of a clear definition

One might ask oneself if this discussion is at all relevant. Is there a point of comparing definitions? A simple illustration may indicate an answer to this question. The left part in Figure 4-3 represents an economy where every dot denotes a firm. Some of these firms also fit the three KIBS features. These firms are indicated in the figure as solid dots. The crux is that the different definitions presented in section 4.1.1 do not only use different approaches to identifying KIBS firms, they also identify different firms as KIBS firms.

There is no optimal definition. All definitions have flaws and they are designed to fulfil certain purposes under certain empirical constraints. The definitions described here do not identify the same firms, and this, in turn, makes knowledge of KIBS

uncertain. Definitions should be transparent and replicable. Authors who used industrial classifications as a means to identify KIBS sectors normally did not discuss their operationalisation and the sectors included or excluded in the definition.

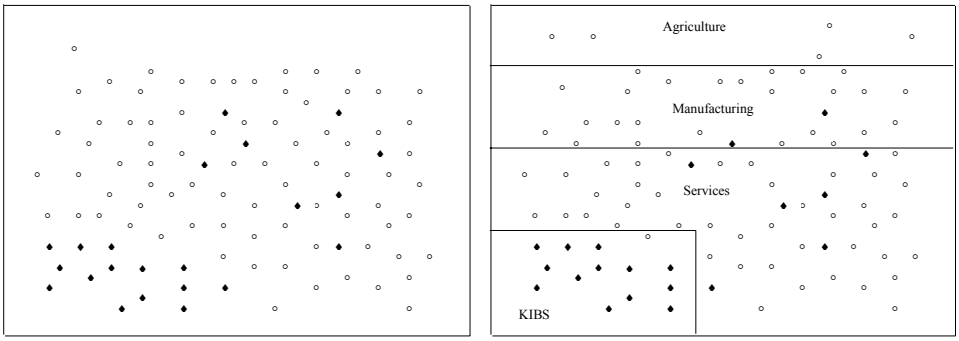

Figure 4-3. Schematic representations of an economy.

Comment: the dots represent firms in the economy. The solid dots are firms that fulfil the KIBS features and the hollow dots are firms without KIBS features. The figure on the right includes lines dividing the economy into sectors. Some firms with KIBS features are found outside the schematic KIBS sector grid and vice versa.

The advantage of using industrial classifications as a method to identify KIBS at a sector-level is that it is easy to use existing datasets. To continue with the example above (see the right figure in Figure 4-3), to use industrial classifications to identify KIBS sectors is like putting a grid on the economy. Only firms within the parts of the economy which are identified as KIBS sectors are considered. This does not cover all firms with KIBS features: not all solid dots are within the square labelled KIBS. And it also includes some firms which are not KIBS firms: there are some hollow dots within the KIBS-square.

Industrial classifications allow the sector to be mapped and compared over time. Still, industrial classifications are not an optimal tool for identifying dynamic service sectors, and it presupposes that the firms are categorised correctly, which is not always the case, as will be discussed later.

4.5.2 Still a heterogeneous sector

Even though the KIBS sectors have many traits in common, they also differ in many regards. They differ in size, some sectors being much larger than other sectors. They differ in output, even though Toivonen (2004:126-131) demonstrates that they are converging (i.e. moving into each other's fields), at least in Finland. They have different types of employees with differences in education level. Larsen (1998) shows that employees of "computer and related activities" have the lowest formal education but also the most dynamic growth. This heterogeneity even within the KIBS sectors is reflected in the studies of Larsen (1998), Skogli (1998), Miles et al. *(*1995), Werner (2001) and Toivonen (2001a) who all divide KIBS into subsections.

Most commonly, some sort of distinction between T-KIBS and P-KIBS is made. The heterogeneity of the sector calls for further divisions, but the distinction between T-KIBS and P-KIBS is problematic since it often leads to a focus on T-KIBS. Discussions of KIBS firms and sectors are often reduced to T-KIBS (Lundvall and Borrás 1997) and this is not desirable. T-KIBS cover only half of the employees in KIBS, and is thus a considerably smaller category. It is tempting to look at sectors and innovations that are similar to manufacturing as we saw in section 4.1. This is the case with T-KIBS. It is therefore important to recognise KIBS sectors as service sectors and to analyse the sectors as service sectors with service innovations, analysed in their own right.

4.6 What KIBS are. A summary

KIBS firms are specialists in solving their clients' problems. KIBS firms are business firms and sometimes public organisations which provide knowledge intensive service products that are produced by firms employing a highly educated labour force. The sectors included in our definition are: 7210, 7220, 7230, 7240, 7290, 7310, 7320, 7411, 7412, 7413, 7414, 7421, 7422, 7430, 7491, and 7499 of ISIC rev. 3.

It is interesting to notice that the thirteen definitions presented earlier are seldom neither explained nor put in relation to the KIBS features. Further, the definitions do not identify the same firms as KIBS.

The distinction between T-KIBS and P-KIBS is important if it helps to analyse two different types of KIBS firms. The distinction is less enlightening when it is used to focus only on T-KIBS at the expense of P-KIBS. T-KIBS is a poor proxy for all KIBS since its sectors have different features and since it only covers half of all KIBS firms.

KIBS firms are almost always debated for their effects on the economy and rarely for their internal dynamics. Furthermore they are almost exclusively described in positive terms. There is a need for more information on the internal dynamics of KIBS and for a more complex picture of KIBS firms.

We will briefly return to the example which opened chapter 2. The example described a flight simulator produced by a software consultancy firm ordered by a research organisation. The flight simulator is an SPI produced by a software consultancy firm. The flight simulator will be an SPI to the firm that developed it but it will also be a Tπ to the research organisation, the client.

Furthermore, since software consultancy is a KIBS sector, as defined in the previous section, it is a KIBS firm, more specifically a T-KIBS firm. This software consultancy firm probably fits the KIBS features and therefore qualifies as a firm with KIBS features. The software consultancy firm is thus one of the solid dots in Figure 4-3 within the KIBS sector of the sector grid. The R&D organisation is a KIBS organisation.

So far, the three main concepts of the thesis, innovation, employment and KIBS, have been presented in three separate chapters. The next chapter will tie the concepts of Figure 1-1 together.

5 Understanding innovation and employment in KIBS

The last chapters have discussed fragments of the purposes and research questions and research related to these. This rather short chapter has a dual purpose. First, in section 5.1, KIBS in Sweden will be addressed: the size of the firms and the characteristics of their employees will be presented with the aim of providing background upon which we may understand their innovativeness.

Second, section 5.2 will recapture the research questions and purposes and contextualise them with regard to background data provided in chapters 2 to 4. Thereby it will be clearer what will be investigated in the following chapters and why.

5.1 Small and smart! KIBS in a nutshell

The following pages will provide a sketch of the Swedish KIBS sector. It builds mainly on official statistics, and in many cases data is available only on division level. In order to separate this rougher operationalisation from the more fine-tuned class level operationalisation, the denomination KIBS* is used. All significance testing is made at a 95 per cent level.

A number of different sources are used in this section. For data on number of firms and number of employees, FDB (labelled "företagsbatabasen" – firm database) is used. Different subsets of the database are used and this is shown in the references. For information on gender, age and education of employees, RAMS (labelled "register-baserad arbetsmarknadsstatistik" – register based labour market statistics) is used. Both data sets are analysed at an aggregate level and are available from Statistics Sweden.

For data on bankruptcies, the Statistics Sweden/ITPS database (collected by ITPS: Institutet för tillväxtpolitiska studier, hence my label) is used in Figure 5-1. The data is available from Statistics Sweden. This too is analysed and presented at an aggregate level.

For data on innovation in service sectors, including KIBS, the s-CIS2 is used. The CIS2 (the second community innovation survey) is a large innovation survey, which covers innovative activities in service and manufacturing sectors in Sweden during the period 1994 to 1996. I use s-CIS2 for referring to the service sector part of the CIS2. The database consists of micro-data.

As a complement to the information received from the databases, newspaper articles are used to provide a fuller picture of the period.

5.1.1 KIBS firms are small and innovative

Size of firm is important in the context of innovativeness, since larger firms tend to be more innovative. The so-called Schumpeterian hypothesis discusses the relation between firm size and innovativeness (cf. Schumpeter 1942: chapter 7-8, Acs and Audretsch 1987:567, Bhattacharya and Bloch 2004:156). Also, according to the

Italian ISTAT, employees in large innovative firms are affected differently by innovation than employees in smaller firms (Evangelista and Savona 2002:316).

The size structure is skewed. Most firms in the economy - and in KIBS - do not have employees. About 96 per cent of all firms in KIBS* have less than ten employees. It is therefore safe to conclude that most firms - in KIBS as well as in the economy as a whole - are very small (FDB A 2000, 2002).

Firms are thus in general very small and most do not have any employees. This may also be noted in Table 4-3, where the sector of building cleaning activities (later considered not to be a KIBS sector), had less than one employee per firm. In other words, many persons are self-employed. This poses a problem when surveying firms, since it is rather complicated to survey very small firms (OECD 1997:45).

The service sector part of the Swedish CIS2, s-CIS2, contains information on 746 service sector firms from 62 sectors (four-digit class level). It does not constitute a representative sample of the service sector, or of KIBS. The sample is weighted and in weighted count covers 6,071 firms.[27] The CIS2 covers only firms with more than ten employees, that is, 96 per cent of all KIBS firms are excluded.

Table 5-1. Innovation rates (%) by sector and firm size in s-CIS2 1994-1996.

firm size	wholesale	transport	financial	KIBS	total
-19	27.6	14.3	15.5	38.6	25.9
20-49	28.0	20.4	53.7	53.5	31.9
50-199	27.7	36.0	64.0	79.2	46.9
200-499	51.8	54.2	80.5	20.8	49.4
500-999	21.2	29.1	100.0	69.4	35.4
1000 -	50.0	53.9	94.1	80.2	70.9
total	28.3	19.4	51.7	49.8	31.4

Comment: *innovation rates refer to per cent of firms which have made an innovation between 1996 and 1998. For example, 28.3 per cent of wholesale firms were innovative during this period. "Wholesale" represents (ISIC rev. 3) tabulation category G, "transport" represents category I, "financial" represents J, and "KIBS" is made up of available firms in the KIBS sectors.*
Source: *own calculations from s-CIS2 database.*

The average firm in s-CIS2 has 63.8 employees. The sample is obviously skewed. It is not normally distributed (which we should keep in mind since regression analysis is done under that precondition) and it is not in accordance with the actual distribution of the sectors. The median firm in the sample has 19 employees. This indicates that a small number of firms have many employees and this raises the average. However, in the sample there are statistically significant differences in size of firm depending on sector. KIBS firms, transport and wholesale firms are statistically significantly smaller than financial firms.

[27] When weighted, the sample is more then eight times as large. This distorts the sample, and this affects, for example, regression analysis, since the spread is smaller than what would otherwise be expected.

The proportion of innovative firms differs between firms in different sizes and different sectors, as seen in Table 5-1. There are large differences in innovativeness between different groups of firms. Financial firms and KIBS firms are considerably more innovative - about half the firms were innovative - than transport and wholesale firms where only about one third were innovative. These differences are statistically significant.

Also, larger firms tend to be more innovative than smaller firms, with the exception of firms with 500 to 999 employees. Also here we have statistically significant differences between firms of different sizes. The same trend is visible in ISTAT, the Italian case (Evangelista 2000a:126). Innovative firms also appear to be both larger and growing more than non-innovative firms.

The innovative firm in the s-CIS2 database had on average 104 employees, which is an amazing figure, since few firms have that many employees. The size structure was also different from the actual size distribution of the Swedish service sector firms, as we saw in the previous section. The non-innovative firm had on average 44 employees. The difference in size between innovative and non-innovative firms is statistically significant.[28]

The firms in the s-CIS2 sample grew 32 per cent on average during the two-year period. KIBS firms grew on average 63 per cent, but with large differences in the KIBS sectors. KIBS firms grew (on average) statistically significantly more than the others, while financial firms grew statistically significantly less.

Both innovative and non-innovative firms increased their number of employees on average, but innovative firms grew more. The average growth in employees in innovative firms was 60 per cent and in non-innovative firms 17 per cent. In other words, on average both innovative and non-innovative firms grew considerably even though innovative firms grew more.

5.1.2 KIBS are a rather large sector (with small firms)

In 2000, 10.3 per cent of all employees in Sweden worked in KIBS* (RAMS A 2000). This is a large share of the economy, comparable to the manufacturing sector which employed 18.9 per cent. Two years later, another 84,000 worked in the Swedish economy but 630 less worked in KIBS*. KIBS* thus shrunk marginally during the time period after a long period of growth as we discussed in association with Figure 4-1. In 2002, KIBS* constituted 10.1 per cent of the Swedish labour force.

The three KIBS* sectors differ greatly in size. The without comparison largest sector is the heterogeneous "other business activities" which employed 71 per cent of all KIBS employees in 2002. This is also the sector with the largest decline in size: the other business activities sector shrunk by 2,000 between 2000 and 2002. The second largest sector is the computer related sector which employed 22 per cent of all KIBS* employees and which grew substantially with 1,600 employees. Smallest is the R&D

[28] In s-CIS2, the median innovative firm had 22 employees and the median non-innovative firm had 17 employees.

sector which employed seven per cent of all KIBS* employees and which shrunk, marginally, with 144 employees.

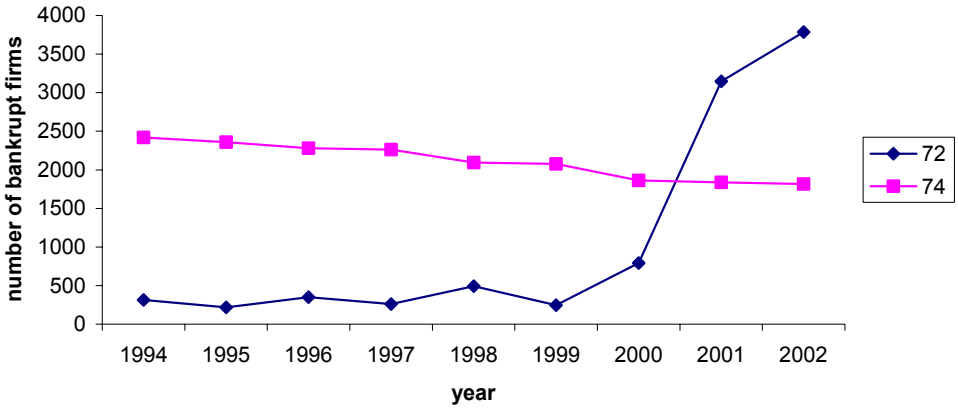

Figure 5-1. Number of bankruptcies 1994-2002 in computer firms (72) and other business services (74).

Comment: the number of bankruptcies in (73) R&D was considerably lower and is therefore not plotted in the graph. In 1994, three R&D firms went bankrupt, in 2002 seven.
Source: Statistics Sweden/ITPS (1994-2002).

Hidden in these aggregate statistics is a crisis which struck several KIBS subsectors. The recession which affected the economy in this period struck some sectors particularly hard as seen in Figure 5-1. Some sectors, in particular advertising and management consultancy are sensitive to fluctuation in business cycles and an easy target for a firm which need to cut down on costs (Ericson 2002b). Another complementary explanation is that a diminished demand from key sectors, telecom and car manufacturing, led to a domino effect among business services. First the crisis struck web consultants, then system developers, later project leaders within these sectors and finally management consultants (Myren 2003). Interesting to note is how Figure 5-1 mirrors a decrease in bankruptcies in 74 (business services where management consultancy is included) but a tremendous increase in bankruptcies in 72 (which includes computer firms). It is interesting to note how there appears to be a large number of bankruptcies in 72, even though it grew by 1,605 employees. Either the crisis of the management consultancy firms hit after 2002, or these firms did not go bankrupt, or alternatively they were not coded as business services.

This domino effect hit the IT sector hard. The sector shrunk by ten per cent, from 119,000 employees autumn 2001 to 107,000 a year later (Ahrens 2003).[29] Faced with the need to dismiss employees, the firms attempted to keep the most competent employees (Ahrens 2003). Some employees chose to start up new firms in IT or other sectors, despite the recession (Myren 2003). Many of the unemployed IT-employees were employed by former client firms who now had the opportunity to get competence they needed in-house instead of as (more expensive) consultants (cf. Svensson 2002, Ahrens 2003, Myren 2003). A decrease in demand thus could now get the competence in-house at reduced prices. This should also make it harder for the remaining IT-sector employees, as their former clients now in fact are their competitors.

This mirrors the special character of many business services, not least knowledge intensive business services: the services they provide may in many instances be internalised in the firm and therefore the same function may be inside the firm or outside the firm and so the size of the sector is sensitive to business cycle fluctuations. Therefore, as Ahrens (2003) points out, when demand once more increases for the particular service, then the in-house expertise may start up a firm and take knowledge and clients with it. This is facilitated by the fact that it is relatively inexpensive, as Hermelin points out (1997:26-27) to start up a firm in these sectors.

The management consultants were struck later than the IT-sector according to Myren (2003). Their hardship is further prolonged by the clients' hesitation to make decisions for their future. Sometimes the client firms also have in-house competence with surplus time, making hiring consultants harder to justify (Ericson 2002b).

The management consultant sector peaked during 1998-2000, and in 2002 alone it shrunk 11 per cent (Edling 2003). It was calculated that just in Stockholm 2,000-2,500 management consultants were unemployed in November 2002 (Ericson 2002b) although the sector, according to Edling (2003), started hiring again. The sector appears to have been over-established (cf. Edling 2003, Svensson 2002) and the management consultancy product has also changed. Their commissions are now shorter and more intensive and there is a strong price pressure (Edling 2003).

We will now investigate the employees of the KIBS* sectors. Who are the 418,000 employees the KIBS* sectors employed? Which subsectors do they work in? What size of firm? What level education do they have? What gender are they? How do they differ from other employees in the Swedish labour market?

5.1.3 KIBS are gender integrated

More men than women work at paid employment. The number of male employees in the economy is 2,150,000 and the number of female employees is 1,985,000 (RAMS B 2002). The number of employees in the economy increased between 2000 and 2002 by two per cent and the proportion of female employees (2.9 per cent) increased more

[29] The sectors identified by the media media do not always coincide with the industrial classification categories. (cf. managementkonsulter 2002, Nählinder 1998). The following illustration must be seen in that light. As a consequence, the pattern described here does not always coincide with the statistics presented.

than the proportion of male employees (1.25 per cent). Despite the increase in participation, there are still slightly more men than women in the labour market. (RAMS B 2000, 2002).

Male and female employees tend to work in different sectors and this phenomenon is known as horizontal segregation. Most sectors are gender segregated (as opposed to gender integrated), that is less than forty per cent of employees are women (or men).

More men than women worked in KIBS* during 2002, with 58 per cent of the employees being male. KIBS* as a whole is thus gender integrated. Out of the three KIBS* sectors, two were gender integrated while the third was masculinised (less than forty per cent were women). Close to half of the employees in other business activities and R&D were women. Both sectors also moved towards a 50/50 proportion. The third sector, computer related activities, had a predominance of men, which grew larger over the period. In 2000, 72.4 per cent were men and it increased even further to 73.4 per cent in 2002.

Gender integration is important for many reasons, not least since it mirrors a division of labour where employees' place of work is dependent on other factors than ability (Roman 1994:19). What is interesting is how gender integration could be seen as important also for the firms themselves. Jonas Wiström, managing director for the consultant firm Ångpanneföreningen is quoted in an article in Dagens Nyheter: "with a more even gender distribution we will be a more attractive employer for both women and men and we'll benefit from that" (Sandström 2004, my translation). It may also be added that there is a wage inequality in the IT-sector in Sweden, as well as in most other sectors of the economy (Jacobsson 2002).

Interesting to note, although the change is rather small, is that what appeared to be a net decrease of 630 employees was really an increase of female employees (+661) and a decrease of male employees (-1,291). Women substituted men in R&D and other business services while men substituted women in computer related activities. These differences are, however, small. The three KIBS* sectors thus present different gender patterns which also evolve differently over time.

5.1.4 KIBS are knowledge intensive

The number of employees with a low education level has decreased in the economy as a whole. A conventional operationalisation of education levels is to divide the educated into primary educated (compulsory school), secondary education (post-compulsory school but pre-university) and tertiary educated (all with longer educations).[30]

About 63,000 employees with primary and short secondary degrees disappeared from the labour force between 2000 and 2002 (RAMS B 2000, 2002). Meanwhile, the number of employees with longer secondary education increased by about that figure. This is probably not only due to retirement, but also to the state-sponsored project

[30] This is a common division of education length, used by, inter alia, the OECD manual on measurement of scientific and technological activities, the Canberra manual (OECD 1995:20).

"kunskapslyftet". Thus, in the economy as a whole, in 2002, 17 per cent had only primary education, 51 per cent had secondary education and 30 per cent had tertiary education (RAMS B, 2000 and 2002).

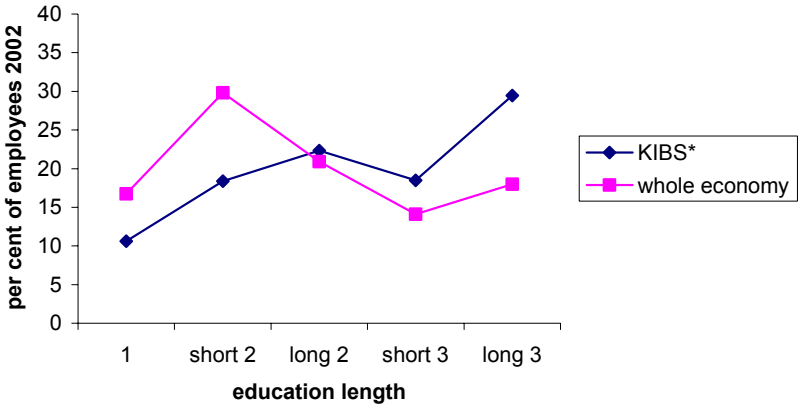

Figure 5-2. Distribution of (%) education length in KIBS compared to the whole economy 2002.*

Comment: education length. "1" stands for primary education, "2" stands for secondary education (divided into short for secondary education up to two years and long for secondary education exceeding two years) and "3" stands for tertiary education (divided into short for tertiary education shorter than three years and long for tertiary education three years and longer).
Source: RAMS B (2002).

Figure 5-2 demonstrates clearly how KIBS* have a higher educated labour force than the economy as a whole. In 2002, 11 per cent had only primary education, 41 per cent had secondary education and 48 per cent had tertiary education. If only length of education is considered, then KIBS are without doubt knowledge intensive.

Figure 5-3 builds on the same data as Figure 5-2, but separates men and women. The pattern is intriguing. Comparing the figures, we may make two observations. The first observation is that the KIBS* employees have a higher education level than employees in general. The trend lines of sectors are separate. But what is more interesting is how the trend lines of gender demonstrate the reverse pattern. Women have a higher educational level than men in the economy as a whole, but in KIBS* their education level is lower.

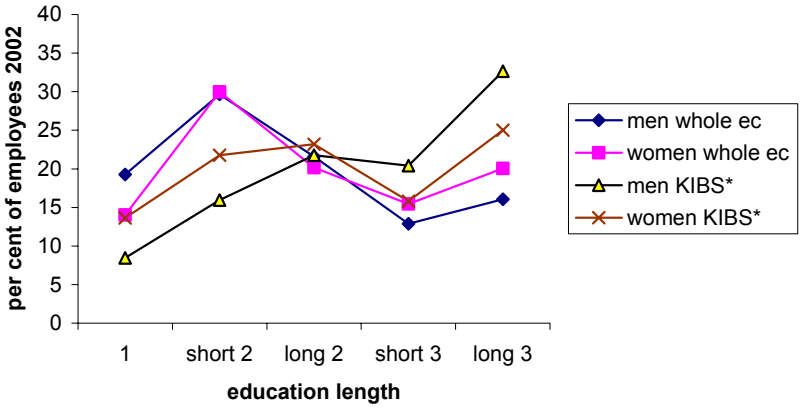

Figure 5-3. Distribution of (%) education length in KIBS compared to the whole economy. Men and women 2002.*

Comment: education length. "1" stands for primary education, "2" stands for secondary education (divided into short for secondary education up to two years and long for secondary education exceeding two years) and "3" stands for tertiary education (divided into short for tertiary education shorter than three years and long for tertiary education three years and longer).
Source: RAMS B (2002).

5.1.5 The young KIBS employees

KIBS employees are generally younger than employees in the labour market as a whole. In 2002, 31 per cent of the employees in the economy were below 35 years of age, while 19 per cent were older than 54 years old. In KIBS*, 38 per cent were younger than 35 years old whereas 16 per cent were older than 54. Comparing KIBS* age structure to the economy as a whole, it is clear that KIBS firms have an abundance of employees under 54 whereas the economy as a whole has more employees over 54.

The age structure changed in the economy as a whole and also in KIBS*. The share of employees aged 25-34 decreased, as did the cohort 45-54 whereas the cohorts over 55 all increased (RAMS C 2000, 2002).

The age structure is different in KIBS as we saw in Figure 5-4. The KIBS* age-curve lacks the high plateau made by employees 25 to 54 and may instead be characterised by a slope with its highest point at the cohort 25-34. The slope was even more pronounced in 2000 than in 2002, but for reasons of clarity, the 2000-figures are not presented in the figure. The 25-34 cohort is relatively smaller in 2002 than in 2000, whereas the cohort 35-44 is relatively larger. This may indicate either that the sector has substituted very young professionals with somewhat older professionals, or alternatively that the employees found in cohort 25-34 now, two years older, may be found in the next cohort (RAMS C 2000, 2002).

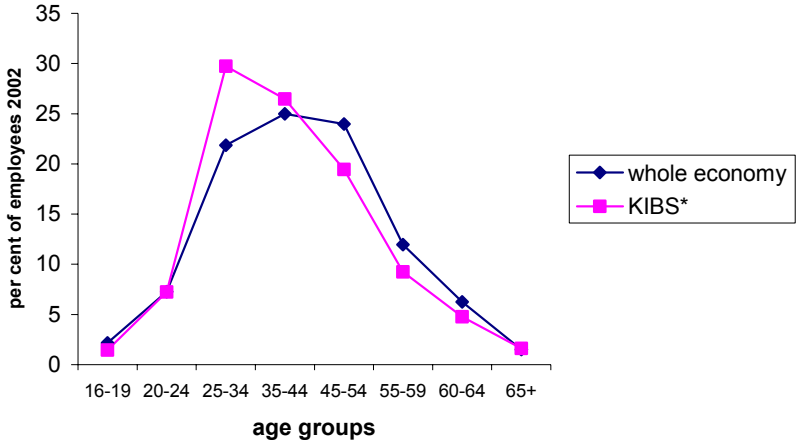

Figure 5-4. Distribution of (%) age structure in KIBS and the whole economy 2002.*

Source: RAMS C 2002.

The case of management consultancy illustrates one possibility. The crisis which struck the sector resulted in dismissals, most frequently of the young consultants (Ericson 2002b). The very young consultants seldom have previous, experience of the private sector (apart from working in the management consultancy firm) and are therefore sometimes less appreciated than more senior consultants. The sector has, according to the same source, a lack of middle-aged consultants (aged 35-45) with experience. In management consultancy, therefore, we are likely to see an age structure with more emphasis on older employees in 2002 than in 2000 due to the crisis.

5.1.6 Same number of employees, but different employees

So far, we have seen that the KIBS* sector shrunk very marginally - by 630 employees. This corresponds to 0.15 per cent of the KIBS* employees. However, it is plain to see in the last sections that the sector employed other persons in 2002 than in 2000.

R&D and business services moved toward further gender integration but the computer sector did not. Therefore we may also add that the KIBS* sectors, although sharing many features, also differ in others. Gender integration is important for the individual (who gets easier access to another labour market) but also for society, since a gender integrated labour market signals that employees have the opportunity to choose on the basis of ability rather than tradition (Roman 1994:19).

We also saw that KIBS employees were more highly educated than employees in general but women in KIBS had a lower education than men in KIBS. The KIBS employees are also younger than employees in other sectors. Young employees often have a longer formal education than older employees (Öberg 2002:14).

Chapter six will turn the perspective from the theoretical framework to more empirical analysis. It will thus investigate empirically, through a survey directed to KIBS firms, how employees are affected by innovation. It will not discuss different types of employees, i.e. what Pianta (2005:583) labels the quality of employment, but keeping this section in mind, we will have a better understanding of the results.

The sketch of employees in software consultancy firms which opened chapter 2 also finds some support in the statistical background sections. The employees are often young and, in computer sectors, male. The education level however, appears to be generally higher than in this particular firm.

5.2 One step further

Summing up, what makes KIBS special, from an empirical point of view, is that they are more innovative than other service sectors and the firms of the KIBS sector are rather small. Concerning the employees, we saw that the job growth has stagnated or even reversed. The recession has had a negative impact on employment and it is likely that the innovation pattern is affected. As we remember from chapter 3, firms tend to innovate for different reasons over the business cycle. We further noticed that the labour force is gender integrated (as a comparison it may be noted that service sectors in general tend to be feminised) and that the employees of the KIBS sector, as predicted from earlier empirical findings, often are well-educated and thus in some sense knowledge intensive. They are further rather young.

Important to remember is that KIBS are more innovative than the average service sector firms. Following the reasoning on T-KIBS and P-KIBS, we may also remember that innovations, at least in T-KIBS, are closer to manufacturing-type of innovations than in many other service sectors.

The fact that KIBS are innovative and knowledge intensive are important when taken together. The so-called skill biased technological change discussion foresees that skilled workers are favoured by innovation since they are qualified to implement the innovation (cf. Piva and Vivarelli 2002:348, more specifically on business related services: Kaiser 2002:104). Impact of innovation on different segments of the labour force is not considered in this thesis but it is important to keep in mind that there is a connection between knowledge-intensity in the labour force, age (since young employees often have a higher education than older employees) and innovativeness. What is important to remember is that KIBS are sectors which in many ways differ from the economy's average, and this will probably show up in the analysis in the form of high innovativeness.

So far the building blocks necessary for the empirical analysis have been gathered and we will see the result in the following chapters. At this point it may be fruitful to recapitulate the purposes and research questions in this empirical setting.

As concerns the first research question, the concept of KIBS, has been thoroughly scrutinised in chapter 4. KIBS as a concept is often vaguely defined, and the definitions given in the studies discussed do not always coincide. The conceptual distinction between KIBS sectors and KIBS features was also presented. In chapter 7

the IEK survey is used to get more information on KIBS firms and their relations to other firms. In some sense chapter 7 may be seen as a discussion of the extent to which KIBS firms have KIBS features and how well the stylised facts fit them.

The second research question, concerning what constitutes an innovation in services, was discussed in chapter 2. The most important tool for understanding the diversity of opinions on the concept of innovation in services is assimilationist-demarcationist-synthesis approach to innovation in services. The choice of approach will be very influential to our view of what should be considered an innovation in services and therefore much consideration has gone into the formulation of the innovation questions in the IEK survey, which will be discussed in section 6.4.1. It is also clear that it is difficult to define the exact borderline between innovative and non-innovative activities in knowledge based firms. It is now time to address the two purposes. The first purpose is to

> investigate whether KIBS firms are innovative, and, if so, what types of innovation they do.

We suspect from previous research that KIBS firms will be more innovative than service sector firms in general. We have also established that the extended taxonomy of process and product innovation is a good tool for identifying a wide array of innovations in KIBS. When the survey addresses the question of innovativeness, it will thus do so by asking the firms whether they have made GPIs, SPIs, Tπs and Oπs and a firm which has made one or more of these will be considered innovative. Oπs are thus ranked equal to the other innovations, and it is not assumed ex ante that KIBS firms do not make GPIs. In chapter 8 we will see to what extent KIBS firms are innovative and which of the four types of innovations they make.

The second purpose is to

> investigate whether and how process and product innovations affect the number of employees in the Swedish KIBS sectors.

The second purpose thus builds upon the first purpose. In section 2.2 the four types of innovations were presented, and in chapter 3 their impact on employment was discussed from a theoretical perspective. The second purpose may be specified and presented accordingly:

impact on innovation-induced employment change =	impact due to GPI	impact due to SPI	impact due to Oπ	impact due to Tπ
	+	+	+	

Where GPI and SPI are expected to have a positive impact on employment and Oπ and Tπ are expected to have a negative impact on employment. This will be tested and refined in a number of regressions in section 9.3 and 9.4.

It may be noted that this is a rather simple model which does not take confounding variables into consideration. This does not imply that the characteristic of product and process innovation alone explains employment change or even innovation-induced employment change. Other characteristics of the innovation, such as demand for

example, may also explain innovation-induced employment change. There are, as we saw in chapter 3, many characteristics and conditions other than type of innovation which influence innovation-induced employment change. Also, one important conclusion was that existing empirical evidence (that GPI and SPI have a positive impact and Oπ and Tπ have a negative impact) were for the most part based on the manufacturing sectors and to a very small extent on service sectors. That means that we should not expect to be able to explain all innovation-induced employment change with the four types of innovation: in the expression above a random term should also be included.

Purpose two clearly implies causality. It is assumed that it is innovation which affects employment, not vice versa. Bryman (1995:42-47) presents three conditions which must be fulfilled in order to assume causality. The *first* condition is that there is some type of relationship between the variables. We know from chapter 3 that there is a theoretical relationship between the variables (product innovation has a positive impact on employment, while process innovation has a negative impact on employment) and that there is also empirical support for the relationship in manufacturing. In chapter 9 we will see whether data from the IEK survey may verify the relationship. The *second* condition is that the relationship is not spurious, i.e. that other variables do not affect both the independent and the dependent variables. This may be counteracted by including all relevant variables which may be confounding. As we saw from Pianta's stylised facts, there are a number of confounding variables. The crux is to see which variables should be included as controlled variables and which to exclude.[31] The *third* condition is the time sequence, i.e. in this case that the innovation takes place prior to the employment change. As we will see later on, the questions are formulated in a way as to certify that only employment change caused by innovation is included. Still, and this will also be discussed further on, innovation and employment impact are intrinsically connected to each other.

The following chapter will discuss the methodological aspects of the empirical research. As mentioned in the introduction, a survey on innovation and employment in KIBS was launched and labelled IEK. In the following chapter it will be shown that there is no other available dataset suited for the pursuit. The survey was carefully designed to capture the phenomena discussed in this section.

[31] Footnote 56 and regression #6 (in Table 9-4) pursue this further.

6 Methodological considerations of the IEK survey

The last section of chapter 5 tied the threads from the theoretical chapters together. This chapter will function as a bridge to the empirical part. The IEK survey, tailor-made for this research project, has been mentioned in the previous chapters but in this chapter it will be properly presented and the rationale for such an extensive collection of primary data will also be justified. The purpose of the IEK is to collect data on innovation and employment in KIBS in Sweden, and, as will be shown, such data is not otherwise available.

In order to make the chapter less voluminous, the detailed technical description of the survey is presented in Appendix I and all the questions of the IEK are presented, in English and in Swedish, in Appendix II.

In this chapter the IEK survey will be presented and the reasons why it was launched, how it relates to previous surveys and what motivates the particular form of survey (computer-assisted telephone interviews). This chapter focuses on the empirical investigation, the computer-aided telephone interviews made with Swedish KIBS firms. It starts by arguing the need for a data collection, then present possible methods of data collection before settling on CATI (computer-aided telephone interviews). Thereafter the study is described in detail, including how the population in KIBS was defined and how the sample was drawn, and what methodological challenges were encountered.

6.1 In need of data collection? Relation to previous research

The data needed to address the purposes of the thesis were not readily available.[32] Hence, it was necessary to collect primary data. Therefore a tailor-made survey, the IEK, was launched as part of the PhD project. The IEK, archived on a CD-ROM, contains a quantitative dataset on KIBS firms which includes their innovativeness and information on their employees as well as information on the firm in order to distinguish whether they are firms with or without KIBS features. The great advantage with this tailor-made survey is that it can link innovations with their employment effect.

6.1.1 Two innovation studies: s-CIS2 and NUTEK

Before going into what the IEK can offer, it must be emphasised that the IEK is designed in relation to, and builds on, two large innovation studies which have been launched recently.

[32] There are (a) census studies from Statistics Sweden, (b) innovation surveys and (c) labour force surveys. It is difficult to combine these sources since they do not target the same firms. An inquest to Statistics Sweden also made it clear that it would not be possible to attain the information from already existing statistics. Statistics Sweden has been inquired about the possibility of obtaining information about the gender, occupation and education of the employees of the firms in the sample, but it is not possible presently to receive that type of information for specific firms (Hedin 2002).

The first was "the second community innovation survey - CIS II". CIS2 covers the period 1994-1996 and the service sector part of the survey (s-CIS2) was carried out in thirteen European countries. The purpose was to "measure the technological innovation activities in manufacturing and some service sectors". (Statistics Sweden 1998:5, my translation). The Swedish, as well as the Italian, version also included some questions on employment change. The s-CIS2 was unfortunately suffering from a number of insufficiencies, the most important were that the number of service sectors included was limited and service sector firms were not asked to distinguish between different types of innovations.

As a follow-up, Statistics Sweden (on commission by NUTEK) made the survey "*Innovationsverksamhet i företag i Sverige 1996-1998*" (Statistics Sweden and NUTEK 2000). This survey avoids the concept "technological innovation" and more service sectors were included.[33] The largest difference, however, was that the sample was three times larger while the response rate was merely 51 per cent. The survey used the same questions for service sector firms as for manufacturing sector firms but did not ask any questions on the employment effects.

From the point of view of the purposes and research questions in this thesis, the s-CIS2 has six major drawbacks. Below these six drawbacks are described and used to improve the design of the IEK survey.

(a) Small firms are omitted
The s-CIS2 included firms with more than ten employees and the NUTEK survey included firms with at least 20 employees: as we saw in section 5.1.1, this excludes many firms, not least in KIBS sectors: about 96 per cent of all firms in KIBS* have less than ten employees. Acknowledging this, the IEK includes firms with at least five employees since many of the knowledge intensive firms are allegedly very small (cf. Muller and Zenker 2001).

(b) Few KIBS firms are included
The Swedish CIS2 was primarily occupied with manufacturing industries. Despite this, 746 unweighted service sector firms were included, 140 of these were KIBS firms. This is a rather small sample and it also excludes large parts of the KIBS sector. Out of the 22 sectors covered in the operationalisation of KIBS sectors (presented in Table 4-4) only seven are included in the Swedish s-CIS2, all of which are T-KIBS sectors. All firms included in the KIBS sample in the s-CIS2 were T-KIBS, thus not providing the possibility to generalise to KIBS per se. The size and distribution of the sample in s-CIS2 is thus not suited for an in-depth analysis of KIBS. It would not be possible to generalise to the entire KIBS sector from the data provided by s-CIS2 and NUTEK. IEK includes all types of KIBS firms, also P-KIBS firms, as to avoid surveying only the part of KIBS which most resembles manufacturing.

[33] Tomlinson (2000:10) also suggests that "technological" is a problematic word to use, especially when surveying innovation in services.

(c) An assimilation approach to innovation
There are many ways to measure innovation. The CIS2 builds upon the *Oslo Manual* (OECD 1997) and its recommendations. The *Oslo Manual* has been published in two editions where one of the differences is that the second edition has included services to some extent. This is important, since it shows that service sectors have been included in the framework designed for manufacturing sectors. The same procedure may be noticed in, inter alia, the Swedish CIS2 (Statistics Sweden 1998:5). The natural consequence of this is that innovations and other key concepts are developed with manufacturing sectors and products in mind.

There are principally three ways to regard innovation in services according to Boden and Miles (2000b:248) and Coombs and Miles (1999) as we saw in section 2.1.2. The s-CIS2 belongs to an assimilationist view of innovation in services and thus captures innovations in services which resemble innovations in manufacturing. This gives rise to several observations. The first is that innovation (just like R&D) may appear differently in different sectors. If the question of innovation was to be formulated differently, or if the examples of the innovations referred to in the survey were different, then the rate of innovation would be different. More conceptual work in this field would give a clearer view of innovative activities not only in the service sectors but also in the manufacturing sectors. Hence more accurate policy recommendations could be drawn from such a survey.

Even though service firms are innovative, they often choose not to label these changes innovations. Therefore the questions in the IEK survey are designed to avoid the word "innovation" but the meaning of the concept is mirrored in the wording of the questions. This is a clear deviation from the assimilationist perspective. Still, it keeps clear from a demarcation approach, since it does not focus on "distinctive features of service innovation" (Drejer 2004:554).

(d) No differentiation between process and product innovation
The m-CIS2 (the manufacturing part of CIS2) differentiates between product and process innovation, but not the s-CIS2. This is most probably due to the opinion that the distinction between process and product innovation is not meaningful in service production. As we saw in section 2.2, this is not necessarily the case. The distinction is possible, and even necessary, if we have an ambition to perform a meaningful analysis of employment effects. Since product and process innovations - not counting substitution and compensation effects – may be expected to have the opposite effects on employment, not distinguishing between the two types of innovations would most probably lead to nonsensical responses. This is discussed in Nählinder and Hommen (2002:12).

The IEK survey analytically distinguishes between four types of innovations: SPI, GPI, Oπ and Tπ. The s-CIS2 aggregated the concepts of SPI and Tπ. The NUTEK survey on the other hand discussed product and process innovations separately.

The IEK survey further delimits the process innovation concept to innovations influencing *efficiency*. The survey uses a somewhat more narrow definition of process innovation than NUTEK does. This has been made in order to pinpoint what the

concept involves, rather than to use the concept of innovation that would have been the alternative.

(e) Internal dynamics
The s-CIS2, naturally, does not include data on the internal dynamics of KIBS firms. Overall, there is little research done on the internal dynamics of KIBS firms. The IEK survey is used to ask more questions about KIBS, for example concerning the origin of KIBS firms and in relation to the KIBS firms.

(f) Short surveying period.
The s-CIS2 has a short surveying period (1994-1996). The CIS2 was not designed primarily with employment issues in mind, and hence the surveying period was not adapted to investigate employment effects of innovation. Research building on this dataset (or the CIS3, used by Peters 2004) inherits this short time period and thus a methodological problem: only a minority of the impacts of innovation on employment is manifested in this rather short period. In order for an employment impact to occur, first the innovation must be made and then, within these years employment must be affected. We thus see that both Evangelista and Savona (2003) and Peters (2004) also analyse this short time period.

The IEK keeps a short surveying period for two reasons. The first is comparability to previous studies. A longer surveying period would make any comparisons difficult, both regarding rate of innovativeness and level of innovation-induced employment change. The second reason was availability and accuracy of information. How much does a firm remember about its past innovative behavior? This issue becomes increasingly problematic if we acknowledge that innovation may be a continuous as well as a discrete event. Hence, the IEK survey keeps the same length of time as the CIS2. This is a choice which is problematic and has grave consequences for the results obtainable. This is a very short time period and far from all impacts on employment can be manifested in that time.

Above six drawbacks of the s-CIS2 were identified and five of these were used to improve the design of the IEK survey. The IEK survey is a complement to s-CIS2 and, when possible, uses the same definitions. The survey will be described and presented in the remaining sections of this chapter, but before that the methodological approach of data collection will be discussed. Throughout this section surveys have been discussed and it may appear that the survey approach has been taken for granted. In the following section different methods for data collection are described and compared and it will be outlined how the decision was taken to collect data through computer-assisted telephone interviews and also what the alternatives were.

6.2 The choice of telephone interviews

There are several methods for gathering empirical non-experimental primary data. The choice of method is due to the type of data to be collected, economic constraints, sensitivity of the questions, among other things. Primary data may be collected through basically three methods: surveys, interviews and direct observation, where direct observation is of little relevance for collection of this type of data (Dahmström 2000:81-82).

There are four main types of surveys: postal surveys, web-based surveys, group surveys and face-to-face surveys. The most common survey is the postal survey. The Internet or web-based survey is distributed not via post but via computer. This has a technology-bias, since respondents with access and knowledge of computers are most likely to respond. There are also, according to Dahmström (2000:81-82) group surveys (when a survey is distributed to a specific group of present respondents) and face-to-face surveys (where the answering of the survey is tied to visiting a special place such as a polling station).

Interviews are of essentially two types: face-to-face interviews and telephone interviews. Face-to-face interviews are when the respondent meets the interviewer face-to-face to answer the questions. This is a regarded as a rather expensive method, especially if one wants to carry out a large number of interviews (Dahmström 2000:59-81).

Some of these methods are not applicable to collect data in this case. Group surveys are not a good option since it is difficult to find these firms gathered in such a way. Visiting surveys and visiting (face-to-face) interviews may also be excluded since it would be very costly to collect information from such a large number of respondents. The Internet survey also appears to be a troublesome alternative due to the technology-bias. Other reasons not to use Internet surveys are that it is more difficult to gain trust through an Internet survey and also more difficult to gain access to good e-mail addresses, not to mention that not all firms use e-mail.

There are thus mainly two viable alternatives remaining: telephone interviews and postal surveys (from here on referred to simply as "surveys"). The same type of information or data may be collected with either postal surveys or telephone interviews but the methods differ as regards (1) design of questions and responses, (2) methods of asking questions and registering responses and finally, (3) compilation of responses.

As regards (1), *design of questions and responses*, Salant and Dillman (1994:121-122) describe the telephone interview as "writing for the ear". It is not possible to use the same questions verbally as one would use in a written questionnaire. The questions must sound natural yet pointed without being too formal. Difficult words and clumsy sentence constructions should be avoided. Telephone questions must be shorter than written questions. The shortness of the questions may be counteracted with the help of help-screens and additional information that the interviewer may read in case the interviewee asks for more information. The questions should also entail few alternative responses.[34]

[34] This implies that questions may be two-step questions rather than entailing too much information. One example, taken from the IEK survey, is the question regarding the impact of innovation on employment; see question 8 and 9 in appendix II. In the written (postal survey) version, (see Nählinder 2003), the question was simply the magnitude of employment effects due to innovation. In the verbal version, this question was split up into two questions: first whether there were employment effects and then what their magnitude was. This leads to another difference between postal surveys and telephone interviews: skip-questions (as the one above) are easier to administrate in telephone interviews. As a consequence, we must

Having clarified that the design differs, it is now time to look at the next stage of data collection: (2) *methods of asking questions and registering responses*. The postal survey is distributed to the respondents who then fill in their responses. In the case of telephone interviews, there is an intermediary between the asking of questions and the filling in of responses: the interviewer. The interviewer is central in telephone interviews and has no equivalent in postal surveys. The interviewer may give rise to a number of methodological concerns, but may also be used to raise quality of data. A professional, motivated interviewer, as in the IEK survey, may raise the quality of data and the response rate since he or she may motivate the interviewee and provide additional understanding of the questions. It is therefore essential that the interviewer not only be motivated but also understands the questions and the responses to the questions. When several interviewers are engaged in the same project there is the risk of an interviewer effect: different interviewers may interpret the questions that may lead to differences in responses. The role of the interviewer should not be under-valued.

Another difference between postal surveys and telephone interviews concerns the extension in time. Postal surveys are typically sent out once (even though sending out reminders might be necessary later on) while telephone interviews are carried out over a period of time. Since interviews are carried out serially there is also a learning effect on the part of the interviewer. This learning effect may be divided into two major parts: the sample and the questions. Questions on which firms really are part of the sample always emerge. This kind of question always appears and must be handled consistently. More troublesome are issues regarding the wording of questions. It may be discovered, for example, that some questions could be formulated more adequately. The telephone survey runs a risk of time-bias which the postal survey does not and it is very tempting, but devastating for comparability, to change questions during the run-time.

As regarding the third stage, (3) *compilation of responses*, it is useful to differentiate between two types of telephone interviews: interviews that are computer-assisted and those that are not. In the following, computer-assisted interviews are discussed. When using computer-assisted telephone interview systems the interviewer codes the answers of the respondents immediately. Postal surveys, in contrast, must be coded afterwards and compiled into a database. Postal surveys also run a greater risk of being coded incorrectly since the automatic coding of computer-assisted telephone interviews is aided by logical constraints in the programme (the programmer may allow only a certain set of answers). That also means that partial non-response occurs less in computer-assisted telephone interviews than in postal surveys. This was obvious when data from the IEK were analysed. Some firms requested a postal survey instead of a computer-assisted telephone interview and they received a survey by postal mail. The few postal surveys had a much higher rate of non-response than the computer-assisted telephone interviews. Databases based on postal surveys and

---

be aware that the same information, entailed from a postal survey and a telephone interview, may actually not be equal since the questions (by necessity!) are asked in different ways.

telephone interviews alike must of course be reviewed critically prior to any analysis being made.

The postal survey and telephone interview are similar in many respects but give rise to different methodological concerns.

6.3 Realisation of the survey

The data of the survey was gathered through computer-assisted telephone interviews. NORSTAT AB Sverige in Linköping made the data collection during 17 January - 3 March 2003. Pilot interviews were also made prior to the data collection to try out the questions of the survey.

The original unweighted sample consists of 1013 firms taken from the population as is discussed below. The response rate was 69 per cent and measures were taken to avoid non-response.

The survey was carried out through computer-assisted phone-interviews made by professional interviewers with a university education. They received training prior to the interviews and I visited them every second day. The interviewers also had help-screens with further information and examples to be able to answer questions. Some help-screens were inspired by the *Oslo Manual* (OECD 1997). Measures were thus taken to ensure that the interviewers understood the questions and that the interviewers interpreted the responses in the same way. Thereby errors of measurement were minimized. A thorough account of the realization of the survey is found in Appendix I.

The population was KIBS firms which fulfilled three conditions:

1. The firm belonged to one of the KIBS sectors as specified in Table 4-4. They thus belonged to one of the following ISIC rev. 3 codes: 7210, 7220, 7230, 7240, 7290, 7310, 7320, 7411, 7412, 7413, 7414, 7421, 7422, 7430, 7491, and 7499. This also includes some public organisations. Despite this, I refer to all organisations in the survey as "firms".

2. The firm was established no later than January 1st, 2000 and was still active when the survey was conducted (January - March 2003).

3. The firm had not less than five employees on January 1st 2000.

It was not possible to draw the sample from one register only. Therefore, the sample was drawn from two registers, one for unlimited firms and the other for other types of firms. Neither register contains any serious systematic error. As seen in appendix I, problems of undercoverage and overcoverage have been investigated and are considered small and non-systematic.

The sample was stratified according to size (four strata) and sector (16 strata). The purpose of the stratification was to certify a high enough number of firms within each stratum in order to allow for generalisation. The stratified sample was then weighted

since the unweighted data is not representative (and thus not generalisable) to the KIBS population.

The sample was adjusted in two ways to omit misclassified firms. Firms which stated that they were misclassified (in response to question 14) and which, on further investigation (question 14a), did not belong to another KIBS sector, were omitted from the sample. Second, the articles of association of the very large firms (with 250 employees or more) were scrutinised. When the articles of association deviated substantially from the activities ascribed to KIBS firms, the firm was omitted. The adjustment of the sample excluded a total of 45 firms. The adjusted weighted sample thus consisted of 967 firms.

In sum, the IEK has an acceptable response rate and is not flawed by any larger systematic or unsystematic errors. The reliability must be considered high.

6.4 The questionnaire

How should a survey be designed with a synthesis approach, instead of an assimilationist approach, in mind? How should questions on innovation be designed to include service specific innovations and also test the extended taxonomy of process and product innovation? How should questions be designed to identify which firms within the sectoral definition of KIBS have KIBS features? These are some of the questions which guided the formulation of the questions of the IEK.

The survey has been designed as to gather information on (1) innovation patterns, (2, and 3) employment patterns and (4) the specific features of KIBS-firms, see Table 6-1. The survey is based upon a tradition of innovation surveys and has been modified to fulfil the specific needs of this project. This does not automatically imply comparability in all questions, which will be discussed later on.

Table 6-1. The questions in the IEK survey divided by topic

	topic	questions in the survey					
	general questions	1	2	3	13	18	38
(1)	innovation	4	5	6	7	11	12
(2)	employment pattern (general)	1b	1c	21	22	23	24
		25	26	27	28	29	30
		31	32				
(3)	employment pattern (innovation)	8	9	10			
(4)	KIBS firm related questions	14	15	16	17		

Comment: *N.B. not all questions are analysed in the thesis*
Source: *IEK database.*

Not all questions of the IEK questionnaire have been used in the thesis for various reasons, but all questions are found in appendix II. The questions are presented in context, (i.e. the first time they are analysed) but the questions on innovativeness are considered particularly important (since they also define what is understood by innovation in this context) and these questions are therefore presented below, in section 6.4.1.

The issues in section 6.2 have influenced the design of the IEK survey. More precisely, four circumstances are important to stress. **First** and most importantly,

much attention has been paid to the formulation of the questions in the survey. A clear and accurate formulation of a question also minimises measurement problems - the question measures what it is supposed to measure (cf. Kinnear and Taylor 1991:337). **Second,** the questions have been tested prior to the launching of the survey. Questions for a survey on KIBS cannot be designed without interaction with KIBS firms. **Third**, the questions have been "translated" into spoken language to make them understandable. The syntax has been simplified and the sentences have been shortened, all to guarantee improved understandability. **Fourth**, the complexity of the questions has also been limited through a reduced number of possible answers as well as many short questions instead of few long questions. Some firms preferred to answer the survey in writing instead of as an interview. A postal survey was mailed to them where the questions were slightly reformulated.

6.4.1 Questions on innovation in the IEK

The survey asked four questions to investigate whether or not the firm was innovative. Question 4 (see appendix II) targeted SPIs and GPIs. The firm was asked about

> the introduction of new or significantly improved goods or services to the market.

Question 5 asked whether the firm

> changed the organisation of work during the period with intent to more efficiently produce and deliver goods or services.

Question 6 asked whether the firm

> introduced technological equipment during the period with intent to more efficiently produce and deliver goods or services.

Question 7 aimed to include other potential innovations with the wording

> are there other essential changes your firm have undergone which are not captured by these questions?

The Swedish s-CIS2, by comparison, asked one question on innovation in service sector firms, namely

> Did your firm during the period 1994 - 1996 introduce any new or significantly improved services or methods to produce or deliver services?
>
> (Statistics Sweden 1998: questionnaire, my translation).

The wording of the questions is key to the definition of the concepts. Therefore the four IEK questions on innovativeness and the s-CIS2 question on innovativeness are compared. There are mainly four noteworthy differences (and one important similarity – see section 6.4.1.2) which may have bearing on how many and which innovations are included.

6.4.1.1 Innovation in IEK and s-CIS2 - four differences

The first difference concerns the (non-) use of the word innovation. This was mentioned in section 6.1. The operationalisation of the concept of "innovation" is

crucial to this study. The concept should include all relevant changes without being washed out of all meaning. Service sector firms are sometimes claimed to be innovative but they cannot always relate to the term of "innovation". Therefore the term "innovation" was not used in formulating the questions in IEK. Instead the questions were circumscribed to include the meaning of the word. The word innovation was not mentioned in the IEK-questions, nor was it mentioned in the s-CIS2-question itself. The word innovation, however, had a very prominent position in the help-text immediately above the question in the s-CIS2. This might have lowered the number of innovative firms found in the s-CIS2 as compared to the IEK since KIBS firms might be innovative without relating to the word "innovation".

The second difference lies in the explicitness of the question(s). In the s-CIS2-question, (a) services and (b) methods to produce or deliver services were included. In other words, SPIs and certain "methods" were included. According to the help-text of the question, these methods could be "associated with development of machines, production organisation or both".[35] The question included, in addition to SPIs, both Tπs and those Oπs that were introduced in order to produce or deliver services. However, when the results were discussed in the report (Statistics Sweden 1998:10), it was claimed that organisational changes were excluded. The IEK asked about changes in the organisation of work (not only production process) and the introduction of technological equipment. The IEK thus explicitly asked about organisation and equipment while the s-CIS2 asked about methods. Might this have had an impact on response, and if so, what kind of impact? The s-CIS2-question was rather extensive in its wording but was exemplified and specified in the (very small print) help-text. Either the respondents were more prone to consider themselves innovative when given a broad question or, alternatively did not think of innovations made as being innovations when not asked about them directly.

The third difference concerns which innovations are included. IEK included all four types of innovation while the s-CIS2 only included two (three if Oπs are included). When reading the help-text carefully, it is clear that the s-CIS2-question included both Tπs and some Oπs. It may, however, be questioned how many respondents had taken the time to go through the small print help-text. The s-CIS2-question positively excluded GPIs, taking for granted that service sector firms cannot produce goods, something that is not entirely correct which we will see later on. The IEK questionnaire included the introduction of goods and services and asked about organisational change (not only production process) and introduction of technology aiming at affecting *efficiency*. It further explicitly asked about changes in the organisation of work (not only production process) and the introduction of technological equipment. The s-CIS2 included SPI, (some) Oπ and Tπ. The IEK included those two or three forms of innovation but also GPI. The s-CIS2 included two (three, if we count Oπ) types of innovation in one question and made it impossible, in contrast to the IEK, to separate between them.

---

[35] Source: Statistics Sweden 1998: service sector questionnaire, my translation. The CIS2 questionnaire included help-texts. The IEK also was accompanied by a help-text, but it did not mention the term innovation. The help-text of the IEK may be found in appendix II.

The fourth difference concerns what is included in the concepts of Oπ and Tπ. The fourth difference actually consists of four minor differences. First, the IEK questions on process innovations were delimited to only include the measurements taken to affect efficiency intentionally. No such delimitation was included in the s-CIS2 question. That means that the IEK question excluded cases of process innovation that were not introduced in order to affect efficiency. Second, the s-CIS2 asked in a vague formulation about "methods". These methods turned out to include Tπs as well as some Oπs. The IEK more specifically asked about changes in organisation of work and introduction of technological equipment. Third, the scope of the innovations differs. The CIS asked about innovations that concern production or delivery of services, while the IEK asked about the changes that affect production or delivery of services or *goods*. The s-CIS2 ex ante excluded the delivery of goods. The fourth and final point concerns what is actually included in the concept of Tπ in IEK. The IEK question on technological innovation asked about the *introduction* of technological equipment which affected efficiency. It thus excluded the *production* of technological equipment which affected efficiency. This is an important delimitation since it presupposes that the service sector firm does not itself develop technological equipment for internal use with the aim to improve efficiency. The wording thus delimits the firm to being a technology user.

The s-CIS2-question and the IEK-questions hence have several differences which may have an impact on how many firms are considered to be innovative. It must be added, however, that many differences between the questions is likely to be purely academic, i.e. with minor implications on the results. Others may be more important. This is investigated in the following section.

6.4.1.2 The share of innovative firms compared to other studies

We may already reveal at this point that many firms - 81 per cent in the IEK-survey - are innovative. This share is higher than in other comparable innovation studies, even though the German CIS2-survey had a very high innovation-rate, of approximately three-fourth (Hipp et al. 2000:423).[36] The corresponding proportion for the service sector as a whole in various European countries (1996) was between 13 per cent (Belgium) and 58 per cent (Ireland) (Evangelista and Savona 2003:556-557). Muller and Zenker (2001:1511) found that between 62.3 and 73.1 per cent of the KIBS firms were innovative KIBS.[37]

Miles et al. (2000:106) investigated three different KIBS sectors (accountants, architects and environmental engineers) and reported innovation rates for firms with below and above 14 employees. The innovation rates varied between 61.5 per cent and 94.4 per cent as seen in Table 6-2.

---

[36] The German CIS2 had a response rate of 26 per cent, thus the researchers chose to do all analysis on an unweighted sample. The results of the study should therefore be considered with some caution.

[37] As many as 62.3 of the non-interacting KIBS were innovative while 73.1 of the interacting KIBS were innovative. Muller and Zenker (2001) thus observed a large difference which is interesting considering the results in section 7.3.

Table 6-2. Innovation rates (%) in three KIBS sectors.

no of employees	accountants	architects	environmental engineers
1-14	80.0	61.5	78.6
14-	73.2	72.0	94.4

Comment: innovation rates refers to per cent of firms which are innovative. For example 61.5 per cent of architect firms with less than 14 employees were innovative.
Source: simplification of table 4, Miles et al. (2000:106).

The three recent innovation surveys in Sweden report different innovation rates as seen in Table 6-3. The surveys include different sectors and different firm sizes and they also have different formulations of the innovation questions. Row (7) in Table 6-3 re-calculates the innovation rate to take only KIBS sectors into consideration and we may observe how the innovation rate for KIBS sectors are higher than for service sectors in general in all three surveys.

Table 6-3. Comparison of four innovation surveys.

		s-CIS2	NUTEK	s-CIS3	IEK
(1)	period of time	1994-1996	1996-1998	1998-2000	2000-2002
(2)	firm sizes	10--	20--	10--	5--
(3)	Innovations types covered	SPI+ Tπ+ (Oπ)	GPI+SPI	GPI+SPI	SPI, GPI, Tπ & Oπ
(4)	service sectors covered	51, 60, 61, 62, 63, 64, 65, 66, 67, 72, 74	516, 60, 61, 62, 63, 64, 65, 66, 67, 72, 74.	51, 60, 61, 62, 63, 64, 65, 66, 67, 72, 73, 74.2, 74.3	721, 722, 723, 724, 726, 73, 741, 742, 743, 7491, 7499
(5)	innovation rate (%)	30	63	46	81.2
(6)	KIBS sectors covered	72, 74	72, 74	72, 73, 74.2, 74.3	721, 722, 723, 724, 726, 73, 741, 742, 743, , 7491, 7499
(7)	adjusted innovation rate (%)	48	75.2	55.2	81.2

Comment: the table presents (1) time period the survey covers, (2) sizes of firm measured as number of employees, (3) types of innovation covered - this should be seen as a rough estimate since the wording of the questions made exact comparisons impossible, (4) service sectors in ISIC rev 3 covered in the survey, (5) share of innovative service firms in survey, (6) KIBS sectors covered and (7) share of innovative firms among the KIBS sectors included in the survey.
Example: the proportion of firms in all service sectors that were innovative included in the s-CIS2 is 30 per cent. When only KIBS-sectors are included, the share of innovative firms rose to 48 per cent.
Source: IEK database, Statistics Sweden (1998: table 1.1b), Statistics Sweden and NUTEK (2000:8, 12, table 1, table 5), Statistics Sweden (2002:9, 15).

Another approach is to calculate what the innovation rate of IEK would be if it had the same coverage of firm sizes and sectors as s-CIS2, NUTEK and s-CIS3. It turns out that if the IEK had the same firm size and sector coverage as the s-CIS2 it would have had an innovation rate of 81.4 per cent. If the IEK had the same firm size and sector coverage as NUTEK, 88.9 per cent of firms would be counted as innovative. If the IEK would have the same firm size and sector coverage as the s-CIS3, 83.8 per cent of the firms would be innovative. Hence, when firm size and sector affiliation are controlled for, the innovation rate is higher, not lower in the IEK as compared to the other innovation surveys. We may therefore conclude that, compared to these three innovation surveys, the IEK capture more innovations.

If we assume the same pattern among the KIBS-sectors which are not included in this comparison, then the share of innovative firms is higher in the IEK than in other

innovation surveys. The high share if innovative firms is with all likelihood due to what is included in the concept of innovation, even if time period probably has importance as well.

The IEK includes all four types of innovations: SPI, GPIs, Tπs and Oπs. The s-CIS2, on the other hand, includes only SPIs and Tπs (and to some extent Oπs as mentioned previously). The higher rate of innovative firms in IEK may thus be due to the fact that more activities of the firm are considered innovative, and, above all, that the concepts of innovation are more widely formulated than in the s-CIS2.

Lastly, and once more returning to the comparison with the s-CIS2, I would like to draw attention to an important similarity in the wording of the questions. Both the IEK and the s-CIS2 are concerned with the introduction of *new or significantly improved* product and processes. They thus ask the questions from a new to the firm perspective. That means that a new product or process introduced to a firm is regarded as an innovation to the firm regardless of whether it has already been introduced in other firms. The reason for choosing this level is that employment change assumingly takes place whether an innovation is new to the world or new to the firm.

Question 7 of the IEK aims to catch statistically significant changes not included in questions 4 to 6. It asks whether there are *significant changes not included in the questions*. Of all firms, 27.4 per cent claim to have made such changes. This is a rather high figure, even if we presume that not all these changes should be labelled innovations. Since the question is deliberately unspecific about the purpose or nature of the change, the share is not alarming.

However, most of the firms that claim to have made "significant changes not included in the questions" also made product or process innovations. Only 2.6 per cent did not make product or process innovations but only made "significant changes not included in the questions". In other words, even if all these firms were in fact innovative, it would not have a large impact on the share of innovative firms in the IEK. This means that the calculation of innovative firms is fairly accurate. The wording in the innovation questions thus helps us to identify most innovative firms but does not always help us to identify all types of innovations.

6.4.2 Employment is complex

The survey asked a number of questions concerning the employees of KIBS firms. The firms were asked to answer questions about all the employees that were employed between January 1st 2000 and January 1st 2002.

An employee is a person employed by a firm. This seemingly simple definition creates complications, above all of two types. The first complication is firms with many part-time employees. A part-time employee (especially one which only "fills in" on occasion) is intuitively not as important as a full-time employee. A choice has been made not to count so-called full-time equivalents (OECD 1995:37) but instead the crude number of employees, regardless of how many hours they work. A full-time equivalent count would weigh the employees according to hours of work. This choice of not counting full-time equivalents has been guided by two principles. **First**, the

employees working few hours are working in the firm and should not be automatically excluded. Since the firm was also requested to give additional information about the employees, it was considered too difficult to count full-time equivalents. The **second** complication concerns the employees of personal supply firms (also known as temp firms). These KIBS firms have a few in-house employees and many more "employees" working for other firms. It is difficult to give a correct answer to how many employees these firms actually have (Nählinder 1998). The personal supply firms are requested to report the total number of employees, since it would be incorrect not to include them in the survey. The question regarding who the employees of the personal supply sector really work for is difficult and lies beyond the scope of this study.

This chapter has been devoted to the IEK survey, its rationale and implementation. I have argued that although two innovation surveys were launched previously (and another one, the s-CIS3, during the execution of the IEK) there was a need for an innovation study which focused on the Swedish KIBS sectors, their characteristics, employment situation and relationship to innovation. The IEK differs from the CIS2 since it includes smaller firms (important in a sector with many small firms), firms from the full range of KIBS sectors and asks more questions on the internal dynamics and employment structure. It is also pivotal to remember, especially in chapters 8 and 9, that the view of innovation is different in the IEK than in the s-CIS2. The innovation questions of IEK and the CIS2 are compared and the innovation rate is critically assessed. The s-CIS2 builds on an assimilationist perspective to innovation. It includes only SPI and Tπ (and in part Oπs) as one indicator. Therefore the CIS2 is not suited to analyse the employment effects of innovation.

With computer-assisted telephone interviews carried out by highly skilled and highly educated interviewers, a rather large sample (967 weighted firms, when mis-classified firms are excluded) and a response rate of 69 per cent, the IEK must be considered a very good database for the analysis carried out in the chapters to come.

7 The KIBS firm's features and relations

This is the first of three chapters where the results of the IEK are presented and analysed. The previous chapter discussed potential methodological pitfalls and how these were avoided to the largest possible extent. The current chapter on KIBS firm's features and relations aims at research question number one, on how the concept of KIBS may be understood and defined. It functions as an empirical complement to chapter 4 which discussed KIBS from a theoretical perspective.

Next chapter (on the innovative KIBS firm) touches upon research question number two (what is an innovation in services and the limits of the concept) and it also addresses the first purpose: whether KIBS are innovative, and if so, what types of innovations they do. Chapter 8 is thus in many respects the empirical equivalent of chapter 2.

After the chapter on innovation follows the chapter on the consequences of innovation. Chapter 9 is thus the empirical equivalent to chapter 3 and addresses the second purpose. After these three empirical chapters we find the chapters on conclusions.

The current chapter: focuses on three issues. The first regards the degree to which KIBS firms have KIBS features (as discussed in chapter 4). The second concerns the relations of the KIBS firm to the economy and lastly, the third addresses how KIBS firms act as sources of innovations.

7.1 Do KIBS firms have KIBS features?

The reader is already familiar with the distinction between KIBS firms and KIBS features. The difference between them - and the importance of differentiating between them - was emphasised in Figure 4-3. The operationalisation of KIBS developed and used in this thesis is based on industrial classifications and not on KIBS features. There is thus a risk that the firms included in the IEK survey do not have the properties described throughout the thesis and, above all, in chapter 4.

Is there a way to measure whether the firms included in the survey have KIBS features? One way of investigating the firms in the sample is to investigate how they responded to questions designed to capture KIBS features.

The IEK survey includes seven questions which are designed in order to identify KIBS features in the KIBS firms. The seven questions, compiled into a KIBS index, regard (1) support in development, (2) frequency of contacts, (3) closeness of co-operation, (4) characteristics of the final product, (5) share of employees with tertiary education, (6) share of employees which received further training and finally (7) type of clients. The questions are presented in detail below.

KIBS-index 1: KIBS firms help develop products and routines for their clients

KIBS firms are often considered important sources of innovation as seen in section 4.1.3. This attribute is linked to the second KIBS feature since it is connected to

delivery of knowledge and information. Question 17a concerns helping clients to develop products or routines. One reason why KIBS are regarded as pivotal in the innovation system is that they enhance innovativeness in other firms (such as their clients). Question 17a asks on a Likert scale 1 (disagrees) to 4 (agrees) whether the firm often helps their clients to develop products or routines. Responses showed that 40.5 per cent of the firms agreed fully that they often helped their clients develop products and routines. It is thus relatively common that KIBS firms play this facilitating role in the innovation system as also discussed in section 4.1.3.

KIBS-index 2: KIBS have frequent contacts with their clients

A KIBS firm, being knowledge intensive, should have a rather large number of contacts with the client during a deal in order for supplier-user interaction to take place. It is thus connected to KIBS feature number two. The firm was asked in question 17b to estimate the frequency of contacts during a deal. The scale runs from 1 (agreement that the firm has a small number of contacts with the client during a deal) to 4 (disagreement that the firm has a small number of contacts with the client during a deal). Results showed 75.1 per cent had a high number of contacts with their clients during a deal. The firm had to estimate for themselves how often they had contacts and no definition was given as to what should be regarded as "often".

KIBS-index 3: KIBS firms work in close co-operation with their clients

As with the question above, a KIBS firm should work in close co-operation with its clients and as with the above, it should be connected to KIBS feature number two. This was the topic of question 17c. The scale runs from 1 (agreement that the firm works in close co-operation with its clients) to 4 (disagreement that the firm works in close co-operation with its clients). Findings showed 80.1 per cent regarded their contact to be very close.

KIBS-index 4: KIBS firms produce mainly non-standardised products

Theory claims that KIBS firms should not work with standardised products but rather with custom-made. This is not directly related to the KIBS features, but indirectly since it may be deduced that knowledge- and labour-intensive products which transmit knowledge should be bespoke to higher degree than other products. The firms had four alternatives to choose from (in question 16): (1) the products are usually standardised, (2) the products are usually standardised but are adapted to the needs of a client or (3) the products are usually tailor-made to the needs of the client. In this thesis the denomination "bespoke" is used for this category of products. The fourth alternative was "do not know". Results showed that 52.9 per cent of the firms produced bespoke products. This will be further discussed later.

KIBS-index 5: KIBS employees are highly educated

A knowledge intensive firm ought to have highly educated personnel. It was also seen in the discussion on KIBS features that KIBS were supposed to rely on professional knowledge. This was discussed in terms of knowledge workers in section 4.1.3 and in terms of education length in section 5.1.4. The IEK survey included questions on education level (question 10). Therefore also the share of tertiary educated employees (high educated employees) was included in the index. The median firm had 58 per cent tertiary educated.

KIBS-index 6: KIBS employees receive further training
The further education of employees is also important to keep knowledge up-to-date, important not least for firms in a dynamic sector. It is thus linked to the first KIBS feature, on the importance of professional knowledge. Therefore the survey included questions (33, 36, and 37) on the extent of further training. The share of personnel that received further training is also included in the index. The median firm had nine per cent of employees that had participated or were participating in further education. An interesting point is that among the firms which did offer further training, most firms trained all employees.

KIBS-index 7: KIBS firms supply business services
One very important characteristic for a KIBS firm is that it is a business service, targeted to other businesses (or the public sector) and not to households. It was also one of the two indicators Hipp (1999) used when identifying KIBS firms, even if she excluded the public sector. As seen in Figure 7-6, only 49 firms had households as their most important group of clients and these firms automatically received KIBS-index value zero.

Although KIBS firms are often described as innovative, this is not included in the KIBS-index. The seven questions above are assembled into a KIBS-index in this section. The problem with the index is that all the firms in the sample are firms within the sector grid (in Figure 4-3) and there is no comparison with non-KIBS firms (outside the sector grid).[38] In short, as we will see, it is difficult to draw the line between what should be regarded a hollow dot (non-KIBS firm) and a solid dot (KIBS firm) in Figure 4-3. This is also my main critique against using KIBS features as a method to identify KIBS firms.

The answers of these seven questions are assembled into an index that goes from "0" (no KIBS features) to "100" (measured all KIBS features).[39] The index is strict in its categorisation and all "do not know" answers are regarded as 0. The firm may get a maximum of three points on each question with the exception of question 7, which is a screening question. Any firm who has households as their most important clients does not fulfil the basic KIBS requirements and automatically receives 0 in the KIBS index. The final score is then multiplied by 5.55 so the index will go from 0 – 100 since this is more intuitive than an index from 0 to 18. Table 7-1 shows the details of the design.

[38] There is information on some firms that are "outside the sector grid", that is, the firms that were gravely misclassified and therefore omitted. These firms are not representative of the whole population of non-KIBS firms and therefore it is not meaningful to make a comparison with them.
[39] A composite index is always complicated to analyse. It always in some sense compares apples and bananas. One should also be careful with the weights attributed. Therefore I am very clear on the composition of the index and the weights.

Table 7-1. Composition of KIBS index.

	Description and question	Index value
1	17a. Is the statement a correct description of the relation to your clients? *Our firm often helps our clients to develop products or routines.* I ask you to state your answer on a scale from 1 "do not agree at all" to 4 "agree very much".	[4] agree very much: index value 3 [3] agree: index value 2 [2] agree somewhat: index value 1 [1] do not agree at all: index value 0
2	17b. Is the statement a correct description of the relation to your clients? *Our firm has a small number of contacts with the client during a deal.* I ask you to state your answer on a scale from 1 "do not agree at all" to 4 "agree very much".	[4] agree very much: index value 0 [3] agree: index value 1 [2] agree somewhat: index value 2 [1] do not agree at all: index value 3
3	17c. Is the statement a correct description of the relation to your clients? *Our firm often works in close co-operation with the client.* I ask you to state your answer on a scale from 1 "do not agree at all" to 4 "agree very much".	[4] agree very much: index value 3 [3] agree: index value 2 [2] agree somewhat: index value 1 [1] do not agree at all: index value 0
4	16. Are your products usually standardised or are they tailor-made for the need of the client?	[1] the products are usually standardised: index value 0 [2] the products are usually standardised but somewhat modified to the needs of the client: index value 2 [3] the products are usually tailor-made to the needs of the client: index value 3
5	Three questions from the survey were used in order to calculate the per cent of employees with higher education: 26. What per cent of your male employees have attended university/university college? 28. What per cent of your female employees have attended university/university college? 1b. How many employees did the firm have in 2002?	Each per cent of highly educated is multiplied by 0.03
6	What percentage of your employees took part in further training during the period 2000 - 2002?	Each per cent of further educated is multiplied by 0.03
7	I would now like to ask a couple of questions concerning the firm's relationship with its clients. Which types of clients do you usually have?	[1] service firms: index value 1 [2] manufacturing firms: index value 1 [3] public sector: index value 1 [4] households: index value 0

Comment: *the table shows the database values [within square brackets] and the corresponding KIBS-index values for the questions included in the KIBS index. All "do not know" answers are regarded as index value zero. Maximum value for each question is 3. Therefore each per cent of employees in question (5) and (6) is multiplied by 0.03. The index values of the first six components are added and multiplied by the seventh component. Then the total index value is multiplied by 5.55 to ensure the index goes from 0 - 100.*

Example: *a hypothetical firm answered "4" on question 17a, "3" on question 17b, "do not know" on question 17c, had standardised but adapted production, 52 per cent highly educated personnel, 30 per cent further educated personnel and had the public sector as most important client. The hypothetical firm thus had a KIBS-index of 46.9, calculated as follows: 3+1+0+2+ (52*0.03) + (30*0.03), all of which is multiplied by 1 (since households are not the most important clients). Lastly all is multiplied by 5.55 (to assure that the max score is 100). If, instead, the hypothetical firm had households as most important clients, then 3+1+0+2+ (52*0.03) + (30*0.03) would be multiplied with 0 and thus it would receive a KIBS-index of 0.*

Source: *own calculations based on questions 1b, 15, 16, 17a, 17b, 17c, 26 and 28 of the IEK database.*

7.1.1 Most firms have a high degree of KIBS features

All firms in IEK were given a KIBS-index value, i.e. a value of the degree to which they have KIBS features. Not surprisingly, most firms scored very high on the KIBS index. Figure 7-1 demonstrates the distribution of KIBS firms according to their "KIBS-ibility".

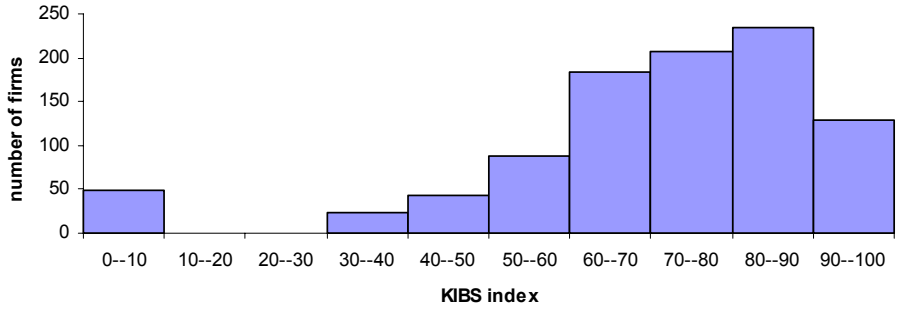

Figure 7-1. Number of firms according to KIBS-index value.

Source: own calculations based on questions 1b, 15, 16, 17a, 17b, 17c, 25 and 28 of the IEK database.

First and foremost we may note that 49 firms have 0-10 KIBS-index value, none have 10-20 and few have 20-30. This discontinuity mirrors that some firms have no KIBS features at all, and as soon as a firm has businesses or governmental organisations as their most important client, they are likely to have a KIBS-index value of at least 20. According to this index, KIBS firms generally have many KIBS features. This means that we are correct in our general picture of KIBS as being very important to the innovativeness of their clients, contact-intensive, closely co-operating with their clients, and to a small extent providing off-the-shelf products. To fulfil these functions they have a fairly well educated labour force. Most firms in the IEK have many KIBS features. We may therefore assert that in terms of Figure 4-3, most dots within the KIBS grid are solid dots.

Having said this, a number of issues arise. First: what does this tell us? Many firms agree to this description of themselves: what firm - knowledge intensive or not - would not want to describe its activity accordingly? We would expect that all, or at least most, firms which are within a KIBS sector would have a high level of "KIBS-ibility". Without firms from other sectors to compare with, it is difficult to say anything conclusive of what this really measures. In terms of Figure 4-3, we do not know how many dots outside the KIBS grid are solid dots. However, one indication that there is a higher concentration of solid dots within the KIBS grid than outside it is that the 45 firms which were excluded from the KIBS sample (since they did not belong to any KIBS sector) had a statistically significant lower KIBS-ibility. There may, however, be other differences between the firms as well, and therefore this should be seen as an indication only.

However, it is important to point out that KIBS firms tend to have KIBS features. Many of the features attributed to KIBS firms thus seem to hold true. The "KIBS-ibility" index does confirm (some) of the main theoretical facts about KIBS. This could also be seen as a confirmation of the data in the IEK database - if many KIBS firms lacked KIBS features, this could be the consequence of poor quality data.

The second issue is: where do we draw the line? Figure 7-1 gives us firms on a continuum; it does not give us the solid and hollow dots of Figure 4-3. It is difficult to make a distinction between KIBS firms and non-KIBS firms based on KIBS features which is less arbitrary than the one proposed by industrial classifications.

Although the notion that KIBS firms are innovative is often proposed, it was excluded from the KIBS-index so as not to make the argument circular. If the innovativeness of KIBS were part of the definition, then any discussion on innovation in KIBS would easily get out of hand. Instead the difference in KIBS-ibility between innovating and non-innovating firms was investigated.

It turned out (as seen in Figure 7-2) that there was a statistically significant (95 per cent level) difference in average KIBS-index between innovative and non-innovative firms. Innovative firms have a higher KIBS index, i.e. they have several KIBS features associated with them. This is interesting: the KIBS firms with a high share of KIBS features are more innovative. This does not imply, however, that this automatically is a good measurement of KIBS features but only that (some of) these indicators are important to explain activities we label innovations.

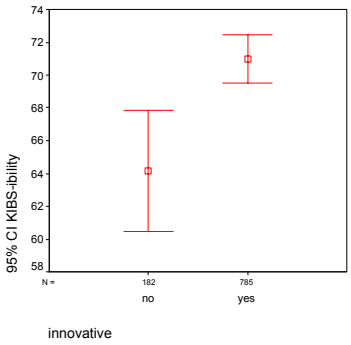

Figure 7-2. Average KIBS-index for innovative and non-innovative firms.

Comment: the diagram compares the mean KIBS-ibility for innovative (labelled yes) and non-innovative (labelled no) KIBS firms. The small squares indicate the mean KIBS-ibility (64.1 for non-innovative firms and 70.9 for innovative firms) and the error bars indicate the standard error at a 95 per cent confidence interval (abbreviated CI in figure). Expressed simply, it indicates that with 95 per cent probability, the true mean lies within the horizontal lines. It is thus highly unlikely that the mean of the population lies above or below the error bars.
Source: own calculations based on questions 1b, 4, 5, 6, 15, 16, 17a, 17b, 17c, 25 and 28 of the IEK database.

The KIBS firms do have KIBS features, although KIBS features are difficult to identify, even with tailor-made questions.

7.1.2 Using KIBS-ibility to sharpen the definition of KIBS

Chapter 4 discussed the inclusion of governmental organisations, advertising firms, labour recruitment firms and other business services firms in KIBS. It would be

interesting to test the importance of size and type of firm in general to KIBS-ibility, the degree to which these firms have KIBS features.

Chapter 4 discussed the inclusion of governmental organisations as KIBS and also the inclusion of advertising firms, labour recruitment firms and other business services firms. It would also be interesting to test the importance of size and type of firm in general to KIBS-ibility, the degree to which these firms have KIBS features.

In short, this section will investigate whether the KIBS-ibility index may sharpen the definition of KIBS. This will be done through investigating whether there are statistically significant differences in level of KIBS-ibility according to: (1) organisation of firm, (2) sector affiliation of firm and (3) size of firm.

7.1.2.1 It is unclear if organisation of firm matters for KIBS-ibility

There are no statistically significant differences in KIBS-ibility for governmental organisations as compared to private firms. That is seen in Figure 7-3. The most striking characteristic with Figure 7-3 is, however, that the standard error is very large for governmental organisation. This is in part due to the very low number of governmental organisations. This, in turn, is due to the fact that since the governmental organisations are so large, they have received a very low weight. Therefore the 15 unweighted governmental organisations are reduced to four weighted governmental organisations. In short, the number of governmental organisations is so small that it is literally impossible to draw any conclusions from them as a group. It is thus not possible to determine whether governmental organisations differ in terms of KIBS features and therefore it is not possible to determine whether or not governmental organisations should be included in a definition of KIBS.

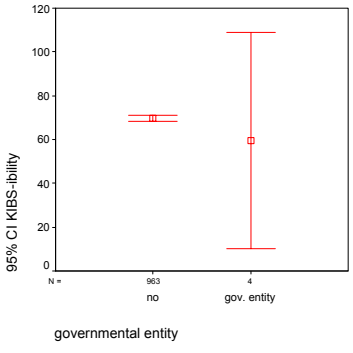

Figure 7-3. Average KIBS-index for governmental organisations and firms.

Comment: a governmental organisation (labelled gov. entity in the figure) is an organisation which has an organisational number which starts with "2". Firms are labelled "no" in the figure. Please see Figure 7-2 for details of how to read the figure. Source: own calculations based on questions 1b, 15, 16, 17a, 17b, 17c, 25 and 28 of the IEK database.

7.1.2.2 Sector affiliation of firm does not matter for KIBS-ibility

When the KIBS-index is applied to sector in exhibit A in Figure 7-4, we may note that there are few indications that one firm group or another would automatically have a higher KIBS index, i.e. have more KIBS features. Worth noting is however that some sectors have a very wide standard error. This indicates that the sectors are not homogeneous in this respect: whereas some firms within the sector have a high level of KIBS-ibility, others have a low level of KIBS-ibility. The three sectors with uncertain knowledge-intensity, advertising (743), labour recruitment (7491) and other business services (7499) do not stand out. Their mean and standard error are about the same as the other firms. Three sectors stand out among the KIBS sectors in terms of KIBS-ibility. Hardware consultancy (7210) has a rather large standard error. Database activities (7420) stand out with an exceptionally large standard error. Lastly, R&D in social sciences has a very low mean. It must however be remembered that since these differences are not statistically significant, no conclusions can be drawn. We may therefore conclude only that sector affiliation does not matter for level of KIBS-ibility.

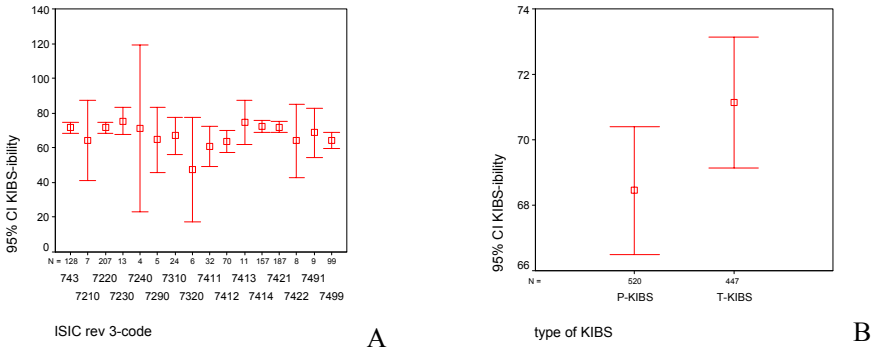

Figure 7-4. Average KIBS-index by (a) sector and by (b) T-KIBS and P-KIBS.

Comment: (a) covers average KIBS-index by four-digit ISIC rev. 3 sector and (b) covers average KIBS-index by T-KIBS and P-KIBS. Verbal descriptions of sectors and categorisation of T-KIBS and P-KIBS are presented in Table 4-4. Please see Figure 7-2 for details of how to read the figure.
Source: own calculations based questions 1b, 15, 16, 17a, 17b, 17c, 25 and 28 of the IEK database.

In Table 4-4 we also saw how the KIBS sectors may be divided into T-KIBS (technology based KIBS) and P-KIBS (professional KIBS). Is there a difference between levels of KIBS-ibility between these two groups of firms? There is a difference between T-KIBS and P-KIBS in level of KIBS-ibility as seen in exhibit B in Figure 7-4, but that difference is not statistically significant. We may therefore conclude that there is no difference in degree of KIBS features between T-KIBS and P-KIBS: based on the KIBS features (and how they are operationalised here) there is no reason to consider T-KIBS as more "KIBS" than P-KIBS. Both should be included in a definition of KIBS.

7.1.2.3 Size of firm matters little for KIBS-ibility

Figure 7-5 depicts the mean KIBS-ibility and standard error for KIBS firms according to size. The exceptionally large standard error for very large firms (250 employees and more) may be partly attributed to the limited number of firms in this category. There is one statistically significant difference in size: firms that had 5 to 19 employees in 2002 had a lower average KIBS-index than firms with 20 to 49 employees. However, there is no general difference in KIBS-ibility according to size and therefore it is difficult to analyse the meaning of this difference. The KIBS-index is, with one exception, size independent.

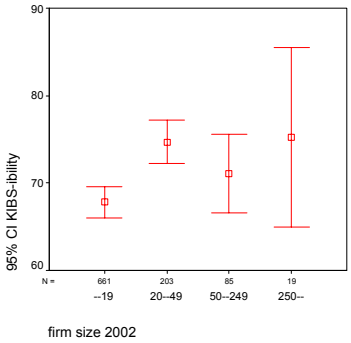

Figure 7-5. Average KIBS-index by firm size 2002.

Comment: population of KIBS firms divided into groups on the basis of size (number of employees). Please see Figure 7-2 for details of how to read the figure.
Source: own calculations based on Table 7-1 and question 1b, 4, 5 and 6 in the IEK database.

In this section we have shown that there are no statistically significant variations in the degree of KIBS features which might require a revision of the definition of KIBS which were developed in section 4.2 to 4.4 and presented in Table 4-4. The most important conclusion from the KIBS-index is however, how difficult and arbitrary it is to use the KIBS features to define a KIBS sector.

In this section, the question of operationalisation, discussed deductively in sections 4.2 and 4.3, was tested on the sample of KIBS firms in the IEK survey. We will now turn to an investigation of the relations of KIBS firms with the surrounding economy. The relations will be discussed in terms of the firms' number of client sectors and the character of the relations.

7.2 Firms well rooted in the innovation system

Most firms do not innovate in isolation. As Muller and Zenker (2001:1502) point out, since firms innovate in co-operation with other firms, "…the chain-linked model proposed by Kline and Rosenberg (1986) for one innovating firm is then to be expanded to several firms". Although the chain-linked model is a rigid and inaccurate

way to visualise the innovation process, the quote nicely illustrates how different parts of the innovation process may take place in different firms.[40]

KIBS are often thought to play an important role in innovation systems. Edquist (2005:191) places provision of consultancy services as one of the ten important activities in a system of innovation. Hauknes (1998:5) sees KIBS firms as bridges "between business expertise and localised knowledge and capabilities, becoming problem-solving actors specialised in the provision of the complementary knowledge inputs allowing the generation of innovations". Muller and Zenker (2001:1505-1510) see KIBS as important co-innovators of small and medium sized enterprises and also show that small and medium sized enterprises which interact with KIBS are more innovative. It is clear that KIBS firms may have a very central role in innovation systems.

The IEK survey posed a number of questions which may be utilised to explore the relation of KIBS firms to the innovation system. The KIBS firms were asked in question 15 of the IEK survey (see appendix II) to rank the importance of clients. The categories were service sector firms, manufacturing sector firms, public sector organisations and private sector (households).[41]

rank	S	M	P	H	nm	
1	448	293	177	49		total 967
	(110)	(75)	(28)	(12)		
2	219	296	179	48	225	
3	104	114	201	75	473	
4	7	10	32	130	315	

Figure 7-6. 967 firms' rankings of common client sectors.

Comment: S=service sector; M=manufacturing sector; P=public sector and H=households, nm= no more sectors chosen. Digits 1, 2, 3, 4 (to the left) indicate rank order. Numbers within parenthesis indicate how many of the above did not have a second important client sector.
Example: 448 KIBS firms out of 967 responded that the service sector was the most important client, while 219 claimed the service sectors was second most important, 104 that it was third. Of the 448 firms that ranked the service sector as their most common client, 110 declared not to have clients in other sectors. In total 225 firms had only one important client sector.
Source: own calculations based on question 15 of the IEK database.

Figure 7-6 illustrates the responses: 225 out of 967 firms (23.3 per cent) had clients in one sector only and 473 out of 967 firms (48.9 per cent) had clients in two sectors.

[40] In innovation studies, the unit of analysis has traditionally been the firm. The fluid borders of the firm makes the unit of analysis questionable. Tomlinson (2000:3-8) argues that networks is a better unit of analysis, however, unfeasible to sample.
[41] The respondents were requested to rank the sectors. The alternative "no more" sector clients was not presented and when the firms spontaneously responded that they had no more client sectors, the interviewer coded "no more" client sectors.

Thus the typical KIBS firm had clients in 2-3 sectors in the economy. What we see here is a group of firms that have contacts with several sectors of the economy. KIBS firms appear to be well integrated in the innovation system with a few exceptions.

Almost half of the firms, 448 of them, (46.3 per cent) had other service firms as their most important clients. It is often argued that the main role and rationale of the KIBS sector is to act as a supporting sector to manufacturing. We see here how that is only part of the truth. The main client sector is the service sector, but many KIBS firms (293 which equal 30.3 per cent) had manufacturing firms as their most important clients. We may also note that most firms (293+296+114+10, equals 72.3 per cent) include firms from the manufacturing sector as common clients. This fits nicely with the results of the survey by Muller and Zenker (2001:1510-1511) which showed that 86.1 per cent of KIBS firms *interacted* with manufacturing. This could also be seen in light of Tomlinson's (1999:446) study which found that knowledge intensive services absorb highly skilled knowledge workers from the manufacturing sector. The point is that "manufacturing sectors also receive substantial returns through the consumption of knowledge intensive services". Even if KIBS firms often have firms from the manufacturing sector as important clients, the service sector is the more common client.

Some firms (12.1 per cent) had the public sector as their most important client while a small minority: 49 firms (equals 5.1 per cent), had households as their most important clients. These firms were regarded as having no KIBS features in the KIBS-index above. Some of the KIBS firms provided services which may be utilised by households, above all legal activities and architects. Therefore it is not surprising that many firms have households as clients: what is interesting is why 12 of these 49 firms reported to have only households as clients.

Of the 23.3 per cent of KIBS firms mentioning contacts with only one sector of the economy, 48.9 per cent dealt exclusively with service sector firms, 33.3 per cent with manufacturing firms, 12.4 per cent with the public sector, and 5.3 per cent with households. The point of business services is that they are directed to other business firms. The point of business services is that they are directed to other business firms. Their product is thus not a consumer product (as discussed in section 2.2.3). However, some business services are directed to governmental organisations. It is obvious from the discussion that many firms provide both consumer products and intermediate/investment products and they are no doubt business services firms. Firms which only produce consumer products (i.e. the twelve firms in Figure 7-6 which only had the private sector as a client) hardly produce business services. It is therefore questionable whether these really are KIBS by feature, as discussed in section 4.1.2.

It is clear that the typical KIBS firm had clients in many sectors (although we do not know anything about the number of clients!) indicating that they are well rooted in the innovation system. The typical client is another firm and very few had households as

their usual client. All in all, the KIBS firms appear well integrated in the economy.[42] In the next section we will see how the KIBS firms often function as sources of innovation and how they are also likely to affect their clients further.

7.3 Important sources of innovation

The above section emphasised that KIBS firms have contacts with clients in more than one sector of the economy. The perception of service sector firms as help firms to manufacturing firms is not an accurate description of the KIBS firms in this sample. The most common client was another service sector firm. KIBS firms are firms in their own right and should not be reduced to support organisations.

This section will focus on KIBS firms as sources of innovations. We are here addressing how KIBS firms are assisting other firms in the innovation system, and not so much the innovativeness of the KIBS firms themselves. Three questions in the IEK are explicitly addressing the degree to which KIBS firms act as sources of innovations for their clients. These questions, which also are part of the KIBS index, are concerned with whether firms helped to develop products and routines for their clients if firms helped to develop products and routines for their clients (question 17a, see appendix II), worked in close co-operation with their clients (question 17c) and had frequent meetings with their clients (17b).

A crucial question is then: do frequent meetings, working in co-operation and developing products together with the clients have an impact on the final product? Meetings may take place for other reasons than developing products and co-operation does not always take the form of frequent meetings. The three questions thus target somewhat different aspects of supplier-user interaction and that is the reason why all three questions were considered important in the KIBS index.

Here a fourth question is introduced to investigate the impact of these three questions. The impact is investigated by cross-tabulating the results with where on the scale between production and innovation the product lies. In other words whether the product is standardised, customised or bespoke. The basic line of thought is that if a meeting, for example, functions as a source of innovation, then it must have affected the product and then the products should not be standardised. If the firms are to function as sources of innovation to their clients, their contribution should in some sense be unique or adapted to the firm.

Before introducing the distinctions between standardisation, customisation and bespoke production, the extent of development (supporting development of new products for their clients), contacts (frequency thereof) and co-operation (with their clients) are outlined in Table 7-2. Development differs substantially from the other two measurements of sources of innovation. The great majority of firms have a high or very high level of contacts and co-operation, while less (but still many!) have a very high share of development assistance.

[42] There are differences in client type between the KIBS sectors. Almost twenty per cent of legal services had households as most important clients. Firms which have households as most important clients tend to be less innovative than other firms.

Table 7-2. Level (no. and per cent) of development assistance, contacts with client and co-operation.

	development	(%)	contacts	(%)	co-operation	(%)
highest level	393	(40.9)	727	(75.6)	775	(80.6)
high level	222	(23.1)	114	(11.9)	148	(15.4)
low level	166	(17.3)	84	(8.7)	27	(2.8)
lowest level	180	(18.7)	37	(3.9)	12	(1.3)
total	960	(100)	961	(100)	961	(100)

Comment: *number and per cent (within brackets) of total firms. "development" stands for question 17a (our firm often helps our clients to develop products or routines), "contacts" for question 17b (our firm has a small number of contacts with the client during a deal. Please note that the data has been inverted so as to make a high level equal many contacts) and "co-operation" for question 17c (our firm often works in close co-operation with the client).*

Source: *own calculations based on questions 17a, 17b and 17c of the IEK database.*

Many, 80.6 per cent, of the firms in the IEK, responded that they work in close co-operation with their clients and 75.6 per cent responded that they had frequent contacts with them. It is also to a large extent the same firms that co-operate closely and have frequent contacts. When co-operation and contacts are cross-tabulated (not shown in table), 775 firms reported to work in very close co-operation, 727 firms reported to have very frequent meetings, and 625 firms reported to have both very close co-operation and very frequent meetings. The transfer of knowledge that knowledge intensive firms sell is facilitated by close and frequent contacts and the results therefore suit the idealised picture of KIBS firms nicely.

So far we have not discussed the impact of firm behaviour on the product. As argued above, if firm behaviour is associated with a role as sources of innovation, then it must have an impact on the product offered to the client. Hence if close or frequent meetings, co-operation or development support has had an impact on the product sold to the client by the KIBS firm, then this product cannot be standardised but has to be customised or bespoke (with the exception, of course, when the standardised product is developed for the very first time). In other words, if the products were standardised, the meetings, contacts and development assistance apparently affected the product little. The firm would thereby not be likely to have functioned as a source of innovation through the product sold.

Most products produced in KIBS firms are without doubt intangible. Therefore they are, hypothetically, more difficult to mass-produce and also require a different method of delivery. Knowledge intensive products, as for example selling "solutions to the problems of the clients" are more difficult to mass-produce (unless many clients have the same problem).[43] This brings us to the concept of standardisation as first discussed in section 2.1.3. A product - good or service - may be standardised, customised or bespoke. The degree to which a product belongs to one or another of these categories depends on, inter alia, whether it is a good or a service and its degree of knowledge intensity. A knowledge intensive problem-solving service firm would be more likely than a non-knowledge intensive firm to produce customised or bespoke products. This

[43] Here reference may be made to large management consultant firms which are said to sell the same solution to several clients (Ericson 2002a). These firms then sell standardised service products.

is also supported in the IEK where 86.9 per cent of the firms made predominantly non-standardised products.

If the reasoning above holds, then close and frequent meetings should have had an impact on the product. Firms with close and frequent contacts should thus not produce standardised products. Figure 7-7 presents the type of production cross-tabulated with development, frequency of contacts and co-operation.

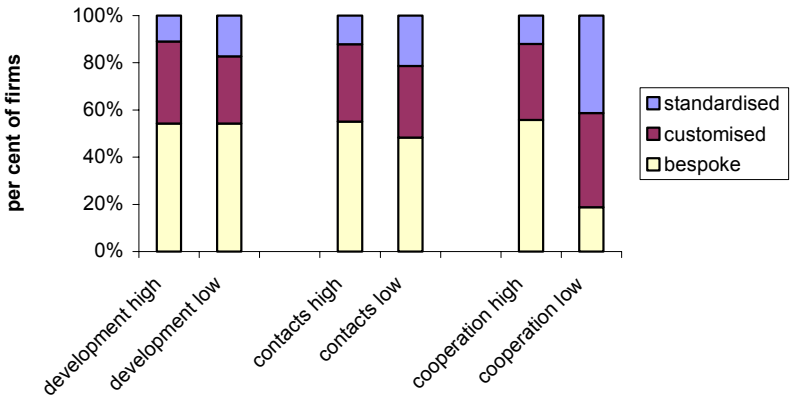

Figure 7-7. KIBS as sources of innovation measured by three questions (per cent).

Comment: three indicators are used to measure the degree to which KIBS firms acted as sources of innovations: propensity to develop products/routines for their clients (question 17a), the frequency of contacts (17b) and degree of co-operation (17c). Each question makes up two categories: one (high level) for firms with many contacts/high co-operation/many meetings and another (low level) for firms with a low level of development, few contacts and little co-operation. "High" is equivalent to Likert value 3-4 for question 17a and 17c and Likert value 1-2 for question 17b. The propensity to act as sources of innovation is then cross-tabulated with the propensity to produce standardised/customised/bespoke products.
Source: own calculations based on questions 16, 17a, 17b and 17c of the IEK database.

Figure 7-7 demonstrates that firms which helped other firms to develop products and routines were as unlikely to produce standardised products as firms which did not help other firms to develop products and routines. Likewise, firms that met with their clients often were as un-likely to produce standardised products as firms that did not meet their clients often. However, the propensity to produce standardised products increased dramatically for firms which co-operated little with their clients.

Although the three questions on relationship with the client might appear to measure the same phenomenon, this is not the case, as seen in Figure 7-7. Co-operation with the client clearly affected the product the KIBS firm sold. The contacts between the two firms served to specify the service sold, which is exactly what we would expect from a KIBS firm. It appears that Muller and Zenker (2001:1505) are correct when stating that

> Services provided by KIBS result from a highly interactive process in which KIBS perform a continuous adaptation to their clients´ needs.

The quote finds support from the IEK as long as the "highly interactive process" they refer to concerns co-operation or the development of products and routines.

Frequent contacts did not have the same impact on the final product. Firms with very frequent contacts were slightly more prone to produce bespoke products. Apparently frequent contacts take place for other reasons than determining the characteristics of the product. Frequent contacts have other rationales such as, for example, sales and delivery that do not affect characteristics.

It appears that frequent contacts do not affect the contents of the product nearly as much as co-operation. Just because a firm has frequent contacts with another firm does not imply that it works in close co-operation with the client. It would be interesting to know why many KIBS firms have frequent contacts with their clients and, more precisely, what is taking place during these meetings. It is also important to remember that although a firm claims that they help develop products and routines for their clients, it does not mean that they work in close co-operation with their clients.

KIBS firms appear to be important sources of innovation for their clients. This goes well in line with the findings of Muller and Zenker (2001) who found that small and medium sized enterprises interacting with KIBS were more innovative. At least from the KIBS firms' perspectives, it appears that they play a crucial role for their clients.

In sum, we may conclude that (a) co-operation had an impact on the characteristics of the product, (b) and that frequent meetings or development assistance did not. This merits further investigation. It is easy to assume that frequency of meetings do not necessarily have an impact on the product since meetings may also take place for other reasons, such as sales. It is more intriguing why co-development did not appear to have an impact on the product. One plausible reason may be that co-development had an impact on the product of the client, not on the KIBS firm. We will get back to this later on when we discuss sources of innovations and innovativeness.

The KIBS firm has been in focus in this chapter. We have seen some of the methodological problems related to using KIBS features (and not KIBS firms) as a basis for an investigation of KIBS. One important conclusion is that, contrary to the impression we might have gotten from Figure 4-3, the existence of KIBS features should not be represented as hollow and solid dots but rather as dots with different shades of grey; meaning that using KIBS features as a base of a definition of KIBS features is at best ambiguous. Another important conclusion is that the definition of KIBS, presented in Table 4-4, is rather successful in capturing firms with KIBS features: there is no apparent segment of KIBS firms which has a statistically significantly lower degree of KIBS-ibility. Section 7.1 thus contributes to a better understanding and conceptualisation of the concept of KIBS (which was the topic of research question two).

The rest of chapter 7 showed that KIBS firms appear to be firmly rooted in the innovation system, and this is also in agreement with previous research as we saw in

chapter 4. It scrutinised KIBS as sources of innovations, a role often discussed in association with KIBS and services in general. The following chapter will discuss the rate of innovative firms in the IEK survey.

8 The innovative KIBS firm

The previous chapter discussed how KIBS firms appear to be well integrated in the innovation system (as most of them have a variety of clients) and also that a very high share of KIBS firms function as sources of innovations for other firms. In this section we will investigate how innovative KIBS firms are. We have already revealed that 81 per cent of the KIBS firms are innovative, but that does not give the full picture, since it is also important to know what type of innovations they made and why they made them. Therefore a whole chapter is devoted to KIBS as innovative in their own right.

The difference between KIBS firms as being sources of innovation and being innovative in their own right may be illustrated by Figure 2-4. When KIBS firms function as *sources of innovations*, they help their clients (the right hand box) to be innovative. When they are *innovative in their own right* they help themselves (the middle box). KIBS firms may also, as will be discussed in this chapter, be *users of innovations* and then they support, through demand, the supplier to be innovative (left hand box).

It is important to distinguish between these three concepts. Previously, as was discussed in chapter 2, it was common to refer to services as predominantly technology users, and much discussion on KIBS today concerns KIBS as sources of innovations and thereby their role for other firms in the innovation system.

However, it appears as though it is the same KIBS firms which act as sources of innovations which are also innovative in their own right, as may be seen in Table 8-1. What is interesting in Table 8-1 is that there is a difference between non-innovative and innovative firms in their propensity to act as sources of innovations. Innovative firms are more prone to assist in development, more often have very frequent contacts with their clients and co-operate (slightly) more often with their clients. We could therefore declare that firms which are innovative in themselves more often function as sources of innovation. It is worth noting that the largest difference in propensity to function as sources of innovations is in development. Remembering how co-development only had a minor impact on the product, we might be surprised to find that innovative firms are co-developers to a much higher extent than non-innovative firms. The explanation suggested then was that co-development had an impact the product of the client, not on the product of the KIBS firm. If that explanation holds true, then the co-developers are particularly interesting since they are both innovative in themselves and have an impact on the product of the clients. We could also venture the suggestion that firms may act as sources of innovation without necessarily having an impact on the KIBS firms' product.

Table 8-1. No. and per cent of innovative and non-innovative firms that acted as sources of innovation.

	development	(%)	contacts	(%)	co-operation	(%)	no of firms
non-innovative firms	63	(34.6)	122	(67.0)	145	(79.7)	182
innovative firms	329	(41.9)	605	(77.1)	630	(80.3)	785
total	392	(40.5)	726	(75.1)	775	(80.1)	967

Comment: number and (per cent) of firms which responded "4", the highest value on the Likert scale ("1" on question 17b) divided into innovative and non-innovative firms on three different questions: firms which supported development (17a), had frequent contacts (17b) and co-operated closely with their clients (17c).
Source: own calculations of questions 4, 5, 6, 17a, 17b and 17c of the IEK database.

This chapter focuses on innovations in the KIBS firms themselves, not on the impact they have on employment. We save that for the next chapter. Before that, section 8.1 briefly discusses the relationship between size of firm, sector affiliation and innovativeness. The remainder of the chapter is focused on the twin concepts of product and process innovation.

8.1 Some KIBS sectors are more innovative than others

Before approaching the question of product and process innovativeness in KIBS, this section will be devoted to how firm size, sector and innovativeness are related in the firms of the IEK.

The proportion of innovative firms differs between sectors. When analysing the sample on a division level, it turns out that computer firms are statistically significantly more innovative than other business services. Sector affiliation thus matters for innovativeness. Computer related activities are closer, in many regards, to manufacturing sectors, than the other KIBS sectors. That may be a reason why these firms also are more innovative. We may however keep in mind that T-KIBS – to which computer services belong – do not have a higher share of KIBS features than P-KIBS.

The innovative firm in the IEK database had on average 44 employees and the non-innovative firm had 18 (2000). The difference in size is not, however, statistically significant and we cannot draw any conclusions concerning the propensity to innovate in small and large KIBS firms.

This section argued that innovations are more common in one sector (the computer sector) as opposed to others and that size of firm does not matter for innovativeness. We will now disaggregate the concept of innovation and discuss innovations as product and process innovations and further as types of innovations.

8.2 Half the KIBS firms are product innovators

Half of the firms, 50.4 per cent, of the KIBS firms are product innovators. The product innovation may be of two kinds: SPI or GPI and, interestingly, the KIBS firms have made both SPIs and GPIs, as seen in Figure 8-1. The KIBS firm "should", strictly theoretically, not make GPI and therefore it is easy to presume that they do not. Empirical evidence belies this theoretical assumption, however, as 17.4 per cent firms have made at least one GPI and this could be compared to SPIs, which were made by 42.7 per cent. The existence of GPIs in KIBS reminds us that firms are classified

according to their main product(s) and that the distinction between manufacturing sector and service sector is sometimes arbitrary. It also reflects how firms distinguish differently between goods and services. As Manninen (2002:158) finds, software firms sometimes consider their products as goods, sometimes as services.

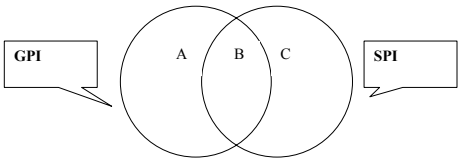

Figure 8-1. Venn diagram of product innovations.

Comment: A=74 firms, B=93 firms and C=320 firms. Please note that the size of the circles and intersections are not proportional.
Source: own calculations based on question 4 of the IEK database.

The service sector is an auxiliary category which (theoretically) contains sectors that do not produce goods as their main activity. The manufacturing sectors are recognised as goods as well as service producers. The same type of auxiliary reasoning is also present in the definition of services (as presented in section 2.1.1). As a consequence, services (the products and the sector) are not given the opportunity to form their own identity. This observation is often made among service researchers but the point must be made again here since the theoretical assumption that KIBS firms (or any other type of service sector firm) would not produce goods not only is incorrect, it also re-produces this false image. In this chapter, and the following chapter, reference is made to three other surveys of innovation in services, the Italian ISTAT (as analysed by Evangelista 2000a) and the German CIS2 (as analysed by Hipp et al. 2000 and Tether et al. 2001) and also occasionally the Swedish s-CIS2. All three surveys exclude GPIs a priori and this will have an impact on how innovation in services is viewed.

Then again it may be argued that a firm which makes a GPI cannot be a service sector firm. That line of reasoning is perilous, since it destabilises the understanding of sectors.

It is therefore important to include questions on GPI in future surveys on innovation in services. Service sector firms also make goods products, just as manufacturing sectors make service products as well as goods products. The precise division of a complex economy into manufacturing sectors and service sectors does not always give justice to the activities actually carried out in the specific firm. This will be discussed further later on. Despite the fact that KIBS firms make GPIs, the bulk of product innovation in this sector are SPIs: 42.7 per cent of the firms had made an SPI. Many firms had made both GPIs and SPIs and so 50.4 per cent of the firms in the weighted sample are product innovators.

8.2.1 Objectives to product innovate

The firms were asked to specify why they made the product innovation(s). In question 11, they were given nine propositions: five related to product innovation and four to process innovation.[44] For each proposition they were asked whether or not they agreed on a four-grade Likert scale. Some firms agreed to great extent on many of the propositions. Seventy-three firms answered "4" (the highest degree of agreement) on six or more of the propositions and six firms answered "4" on all nine propositions. It was thus rather common to have more than one objective to innovate.

The single most important reason to product innovate was to *improve* the quality of existing products, as seen in Figure 8-2. Among product innovators, 60 per cent regarded this as very important. Almost half of the firms, 48 per cent, innovated to create *new markets*. Fewer firms, 37 per cent, innovated in order to add *new products* to their portfolio (i.e. to diversify). Even less, 29 per cent product innovated in order to fulfil standards and *regulations* concerning a product. The least common objective, which nonetheless motivated 25 per cent to product innovate, was to *replace* existing products.

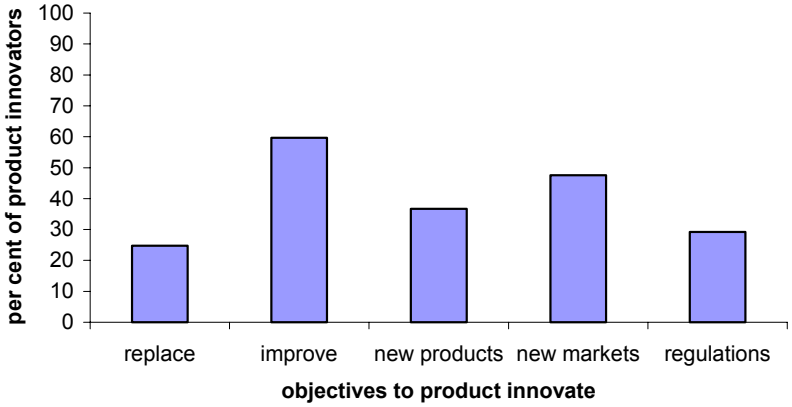

Figure 8-2. Objectives to product innovate.

Comment: share of product innovators (see definition in Table 8-5) which responded "very important" (the highest alternative) on five different objectives to innovate.
Source: own calculations based on question 11 of the IEK database.

There are at least two important observations to be made here. The first concerns the ranking of the reasons to innovate. It was less important for the firms to launch new products than to improve the quality of existing products.

The second observation is that some firms had more than one very important reason to product innovate. This has two possible explanations that are not mutually exclusive.

[44] The question was taken (and adapted) from the m-CIS2. The division into product innovation related objectives and process innovation-induced objectives mirror that of Larsson (2004:3).

One possibility is that the product innovator did more than one product innovation. We know already (see Figure 8-1) that 93 firms had made both SPIs and GPIs. But we may also assume that the 112 firms that regarded both quality improvement of existing products and launching new products as important reasons to innovate most probably made at least two different product innovations. Another example where it is obvious that the product innovator made more than one innovation is the 48 firms that regarded replacement and launching new products as very important reasons to innovate since the same product cannot both replace a product and add a product to the same market. Although it is hard to estimate how many firms made more than one product innovation, there is evidence that some did.

Another possibility is that the same innovation fulfils several objectives. A new product innovation may easily serve to diversify and to create new markets. Many firms of the surprisingly large share of firms (29 per cent) that regarded fulfilment of standards and regulations as very important reasons to innovate also had other very important reasons.

Theorising on product innovation often distinguishes between new products and significant changes to existing products. This is important, not least when analysing employment impact caused by innovation as we saw in section 3.4.1 when the study of Peters (2004) was discussed. Two of the objectives above focused directly on new products: diversification ("new products" in Figure 8-2) and replacement of existing products. Two other objectives, "new markets" and "regulations" are difficult to classify in this dimension) and another focused on significant changes (quality-improvement). Here we find support that both of these types of product innovations were important to the innovative KIBS firms.

8.2.1.1 Trivial change or non-trivial innovation?

Another relevant distinction is between trivial changes and non-trivial innovations. The concept of innovation will become washed out if trivial changes are considered innovations, as discussed in section 2.1.3.1. If all change in products and processes are innovations, then we have lost an important analytical tool. The question on product innovation in the IEK is purposely inclusive. This implies that there is a risk that trivial changes could pass for product innovation, even if the question in the survey is formulated in such a way as to only include non-trivial innovations.

There is one indication that the IEK includes some trivial changes as well as non-trivial innovations, and that is that the innovation rate is somewhat higher than in the comparable Swedish innovation surveys. In section 6.4.1.2, the topic was left with the comment that this probably is due to the formulation of the innovation question(s). It may however also be argued that the innovation questions in the other innovation surveys are may be too narrow in their formulation.

One may cast some light on this issue by comparing the *impact* on employment of innovations - products as well as process innovations. This proxy is problematic, since the importance of innovations is not only due to the impact they have on employment.

Innovations have effects on other variables as well, such as turn-over, economic growth etc.[45] Nevertheless, the share of firms which reported changes in number of employees due to innovation gives us an indication of how inclusive the concept of innovation is in the IEK survey although the comparison should be carried out with great caution.

Only one of the other surveys posed a question on employment impact due to innovation and that was the s-CIS2. Of the firms in ISIC rev. 3. sectors 72 and 74, 56 per cent had an innovation-induced employment change (Statistics Sweden 1998:tab 2.5). In the IEK-firms which (a) had ten employees or more as in the s-CIS2, and (b) belonged to sectors 72 and 74, 45 per cent had an innovation-induced employment change (see Table 8-2). The difference is over ten percentage points. The wording of the innovation question in s-CIS2 is narrower and it includes fewer types of innovation than the IEK. Although all conclusions regarding breadth of innovation concept should be drawn with great caution, this is an important indication that the innovations in the IEK also include more trivial changes with minor relevance to employment than the s-CIS2.

Table 8-2. Firms (per cent) with innovation-induced employment change in s-CIS2 and IEK.

	share (%) of innovative firms	share (%) of innovative firms with innovation-induced employment change	
		all types of innovations included	SPI and Tπ
s-CIS2	48	56	56
IEK	81.4	45.0	45.0

Comment: the first column presents share of innovative firms in s-CIS2 and IEK. The second and third column presents share of innovative firms that have an innovation-induced employment change. The difference between the second and third column is that the second column presents the share of all innovative firms with innovation-induced employment change and the third only the share of SPIs and Tπs with innovation-induced employment change. N.B. that there are instances when the s-CIS2 includes Oπs. Despite that, I have chosen to compare all the innovations of the s-CIS2 with the SPIs and the Tπs from the IEK, ignoring the cases where the s-CIS2 includes Oπs. The IEK has been recalculated to only include the firms with ten employees or more in sector 72 or 74, i.e. the coverage of s-CIS2.

Source: Statistics Sweden (1998: table 2.5), IEK database.

We may therefore conclude that the proportion of innovative firms is higher in IEK than in comparable studies and that this is with all likelihood related to the contents of the innovation concept used. We should keep in mind that this is not a coincidence, but rather an attempt to avoid an assimilationist perspective. Some innovations in the IEK are probably trivial changes from an employment perspective. We will now approach the question from another point of view.

8.2.2 Bespoke production is not always considered product innovation

The distinction between trivial and non-trivial innovation is vaguely reminiscent of the borderline between production and innovation. The difference between variations in production and innovation not only is small, but different firms make different distinctions. The firms in the sample were asked to specify if their typical product was standardised, customised or bespoke. These three alternatives also constitute different

[45] Firms may also have made more than one innovation where the innovation-induced employment changes are counteractive, thus resulting in little visible employment change.

degrees on the scale between production and innovation. A standardised product is mass-produced whereas a customised product is a variation of a product and on the scale closest to innovation we find the bespoke product.

The product innovation does not have clear boundaries towards product variation. This is expressed well by Hipp et al. (2000:428):

> The relationship between innovation and standardisation-particularisation is not simple. While it would [be] tempting to describe any firm which declared that less than all of its output to be standardised as an innovator, there is an important distinction between variety of output and innovation (…) Innovation requires more than the provision of variety, particularly if that variety is routine. Firms that customise their outputs, or even those that provide bespoke outputs, are not necessarily innovative.

A part of this quote was presented earlier as the attentive reader may have observed. It is impossible to clearly distinguish a product innovation from product variation, such as customised or bespoke products. By cross-tabulating the production-type and product innovation (see Table 8-3) we get a better understanding of the KIBS firms' view of the product innovation concept.

Table 8-3. Degree (per cent) of standardisation among product innovators and other firms.

	standardised	(%)	customised	(%)	bespoke	(%)	total	(%)
product innovators	66	(13.8)	181	(37.7)	233	(48.5)	480	(100)
other firms	60	(12.9)	127	(27.3)	278	(59.8)	465	(100)
total	126	(13.3)	308	(32.6)	511	(54.1)	945	(100)

Comment: product innovators are firms which have made at least one product innovation. Other firms are all firms other than product innovators. See Table 8-5 for definition of product innovator.
Source: own calculations based on question 4 and 16 of the IEK database.

Table 8-3 shows how there is a difference between firms which made product innovations and all other firms. One might have expected that firms which made bespoke production would perceive their production as innovation. What Table 8-3 shows is that this is not always the case. Surprisingly, we find that firms which did not make product innovations were the most frequent bespoke producers. Of all the firms that did not make product innovations, 59.8 per cent made predominantly bespoke products and this should be compared to 48.5 per cent of the product innovators. Not only did firms which did not make product innovations engage in bespoke production, they did so to a higher extent than product innovators.

Although it is not possible to exclude other explanations, this indicates that many KIBS firms distinguish between bespoke production and innovation, otherwise all bespoke firms which did not make product innovations would also claim to be innovators. The product innovation question was rather widely formulated and therefore it is important to have a deeper understanding of how the firms have understood the question on product innovation.

Another observation concerns the KIBS firms that did not made product innovations. These firms still change their products, but they do not consider these changes as innovations. Yet another interesting observation, not presented in Table 8-3, is that 46

per cent of the firms that made only GPIs were standard-oriented firms. It is (theoretically) easier to provide standardised goods than standardised services and that may account for the high share of GPIs making standardised products.

8.3 Process innovators are very common

Process innovation focuses on what goes on inside the firm. Process innovations as defined in this study are introduced to improve the efficiency of the firm. A process innovation is either an Oπ or a Tπ. Both Oπs and Tπs were very common among the KIBS firms of the IEK, as seen in Figure 8-3. Organisational process innovators comprised 530 firms. Tπs were almost as common: 493 firms were technological process innovators and 344 firms made both Oπs and Tπs. Even though Oπs are seldom introduced into innovation research, that is not due to scarcity of Oπs, but rather to methodological difficulties associated with identifying them.

KIBS firms were very concerned with efficiency-enhancing and the two types of process innovation appear in many firms to go hand in hand, which will be discussed later on.

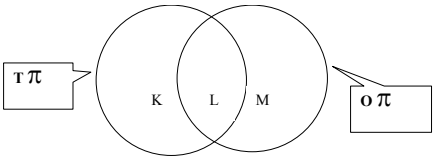

Figure 8-3. Venn diagram of process innovations.

Comment: K= 149 firms, L=344 firms and M= 186 firms. Please note that the size of the circles and intersections are not proportional.
Source: own calculations based on question 5 and 6 of the IEK database.

8.3.1 Objectives to process innovate

Process innovations were made for different reasons. In question 11 of the IEK, the firms were asked to consider nine propositions regarding their objectives to innovate. The five objectives which are related to product innovation were presented in Figure 8-2. Here we will discuss the objectives to process innovate. The first observation to make is one difference between Figure 8-2 and Figure 8-4. The product innovators were much more prone to consider the objectives as "very important" than the process innovators.

Among process innovators, the most common reason to innovate was to increase *production flexibility* (Figure 8-4). About thirty per cent of the process innovators considered this a very important reason to innovate. About thirty per cent of the firms found reducing *all production costs* very important. Disaggregating all production costs into labour costs and other production costs, we see how 22 per cent considered *labour costs* very important and 23 per cent considered *other production costs* as very important. Equally many considered *fulfilling regulations* very important. Fulfilment of standards and regulations (as for example work place regulations) is as important a reason to innovate as reducing other production costs. Institutions (in this case

standards and regulations) have a considerable impact on the firm's objective to innovate. Standards and regulations are to some extent dependent on the national context and therefore, it may be concluded, the institutional setting of the firm has a large impact on the innovation strategy of the KIBS firm.

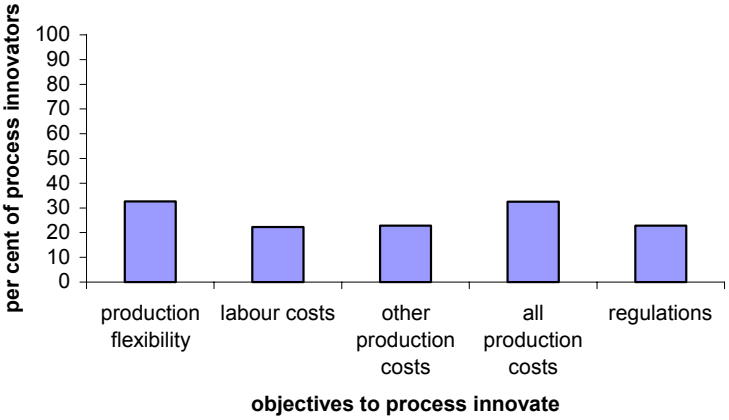

Figure 8-4. Objectives to process innovate.

Comment: share of process innovators which responded "very important" on four different objectives to innovate. All production costs are the aggregate of labour costs and other production costs. See Table 8-5 for definition of process innovator. Source: own calculations based on question 11 of the IEK database.

Process innovation in the questionnaire is limited to process innovations which concern efficiency. It is therefore surprising that so many firms considered fulfilment of standards and regulations so important. It is easier to understand that production costs and production flexibility are considered important for process innovation since these are both directly related to increased efficiency.

Production costs were split into labour costs and other production costs, and the latter were not specified. Reducing production costs was an important objective to innovate for many process innovators, but one could ponder why more firms did not consider it important. Given the prevailing economic hardship (which was discussed in section 5.1) it is interesting to note that more firms did not innovate in order to reduce production costs.

8.3.2 Process innovation and the investment product

Both Tπ and Oπ are (in the operationalisation of the IEK) introduced in order to improve efficiency, but they nevertheless differ much in character. As we recall from section 2.2.3, products may be divided into investment products, intermediate products and consumption products and one of the differences between Tπ and Oπ is that Tπ require an investment product.

This investment product could either be introduced to the firm or be developed inside it. The investment product that is introduced to the firm has been developed in another firm and used, in a second incarnation, as a process innovation in the KIBS firm (Edquist et al. 2001:14-15). This is also clear in Figure 2-4.

The Tπ (with an extramural investment product) also plays other roles in the innovation system: as *users of innovations*. The concept was first introduced in section 4.1.3. More than half of the KIBS firms are technology users, which makes them an important market for other (technology producing) firms.[46] Service sectors are important investors in ICT (cf. Evangelista 2000a:122, Boden and Miles 2000a:27) and thus function as supporters for technological development. They support innovation and production in other firms. This is supposedly an important support for other firms in the innovation system and also assists in the development of new technologies. It is not possible to draw any conclusions from the IEK regarding how large the investment in ICT is, but it is clear that KIBS firms are important technology users.

Concluding the process part on innovation, we saw that both Tπ and Oπ are very common among KIBS firms and that they were often made by the same firms. Most important reasons to process innovate were to increase production flexibility and decrease production costs. Acquisition of an investment product was a proxy for Tπ and therefore we may also confirm previous research (see chapter 2) which argues that KIBS are technology users.

8.4 Many firms are multi-innovative

In the two previous sections the number of product and process innovators were presented and discussed. We have also mentioned that some product innovators made both SPIs and GPIs and some process innovators made both Tπs and Oπs. What we have not discussed earlier is how the same firms have also made both product innovations and process innovations as seen in Figure 8-5 (and more in detail in Table 8-4). I have chosen the term **multi-innovative firm** to denote a firm which has made at least one product innovation and at least one process innovation over the period covered in the survey.[47] Some firms have made three or even all four types of innovations.

[46] It was claimed in section 4.1.3 that P-KIBS are predominantly technology users. The frequency of Tπs is a poor measurement of technology users in this context since only technology users which are also innovative in their own right are included. However, for what it is worth, analysis shows almost no difference between T-KIBS and P-KIBS in relation to Tπs. Of the P-KIBS, 50.8 per cent of the P-KIBS made Tπs whereas 51.3 per cent of the T-KIBS made Tπs.

[47] A multi-innovative firm is thus not a firm which makes two product innovations or two process innovations.

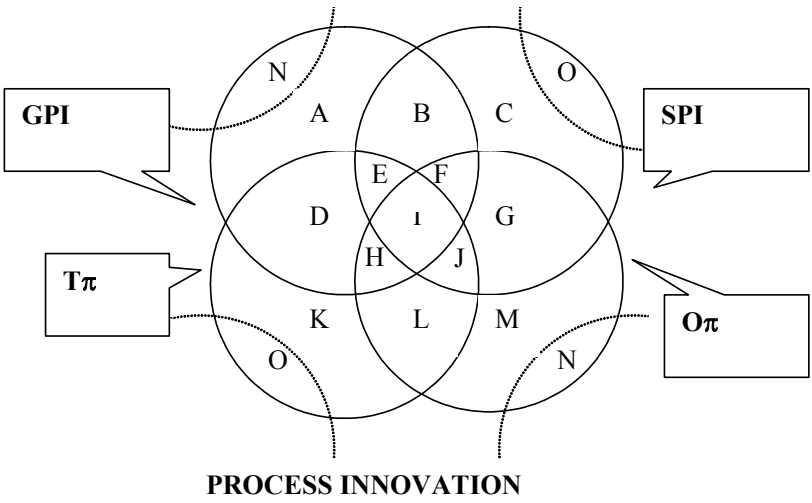

Figure 8-5. Venn diagram of combinations of innovations.

Comment: the four types of innovations: service product innovation, goods product innovation, technological process innovation and organisational process innovation give rise to 15 combinations of innovations (combinations A-O). The dotted fields (N and O) are not adjacent: GPI and Oπ do not meet when visualised in two dimensions, neither do SPI and Tπ. Please note that the size of the circles and intersections are not proportional.

The Venn diagram visualises how the four innovation types, GPI, SPI, Tπ and Oπ are not four separate circles but overlapping. This means that we may distinguish between 15 different combinations of innovations. I choose to label all 15 variants as combinations of innovations even if, in four cases, the variant only entails one type of innovation (A, C, K, and M).

Hence, another analytical step has been taken. Instead of discussing the impact of "innovation" as such, innovation was then discussed in terms of product and process innovation. Then we saw how the four different *types of* product and process *innovations* differ so the concept of innovation was discussed as GPIs, SPIs, Tπs and Oπs. Now I point at the relevance of focusing on 15 *combinations of innovations* (A-O) when, in a later chapter, we will analyse the impact on employment.

Although illustrative, the Venn diagram is not a practical way of presenting results. Table 8-4 shows the same information but systematised differently. The cells in Table 8-4 are labelled with the same letters as the fields of Figure 8-5. Each cell thus represents a specific combination of innovations. Table 8-4 summarises that many firms have made a specific combination of innovations and also specifies which combination of innovations they have made. It is thus clear from Table 8-4 that 785 firms are innovative (the sum of all fields), which adds up to 81 per cent of all firms.

Table 8-4. Combinations of innovations and number of firms with each combination.

		product innovation		
process innovation		GPI	SPI	GPI+SPI
		A: 12	C: 71	B: 21
Tπ	K: 94	D: 6	O: 29	E: 20
Oπ	M: 73	N: 20	G: 81	F: 15
Tπ+Oπ	L: 131	H: 35	J: 139	I: 38

Comment: the labels of the cells are presented in a different manner in Figure 8-5.
Source: own calculations based on question 4, 5 and 6 of the IEK database.

Table 8-5 defines a number of concepts occasionally used throughout the thesis. The concept of *multi-innovative firm* is especially important. Some firms made one type of innovation only. These may be labelled *pure innovators*. A second category of firm made two innovations and these may be referred to as *two-way combinations*. It is important to note how not all two-way combinations are multi-innovations since a two-way combination may consist of two process innovations (L) or two product innovations (B) and these are not multi-innovative since a multi-innovative firm, as it is discussed in this thesis, is a firm which made a process innovation and a product innovation. Similarly there are four *three-way combinations* and one *four-way combination*. These terms are important when the impact of the combinations of innovations on employment are discussed. Theory mainly predicts how product and process innovations affects employment. Multi-innovative firms will be discussed in sections 8.4.1 and 9.3.4.

Multi-innovation is a rather common phenomena (cf. Fritsch and Meschede 2001:344) which may also be shown empirically through analysing the manufacturing firms of the Swedish CIS2, i.e. m-CIS2.[48] Out of the 4,354 firms of the m-CIS2, 2,264 were innovative. Of the innovative manufacturing firms, 685 (30 per cent) were pure product innovators and 265 (11.7 per cent) of the innovative manufacturing firms were pure process innovators. From that follows that 1,314 (58 per cent) of the innovative manufacturing firms were multi-innovative. The German service sector CIS2 has, according to Hipp et al. (2000:424-425) 52 per cent multi-innovative firms. Another German survey (Falk 1999:20) had 62 per cent multi-innovative firms. A survey of Swedish mobile telecommunication firms detected 48 per cent multi-innovative firms (Manninen 2002:165). In the IEK, 48.8 per cent were multi-innovative.

[48] It is not clear in the s-CIS2 since no distinction is made between product and process innovations.

Table 8-5. Different categories of innovative firms and how they are specified.

	combinations	no of firms	(%)
innovator	ABCDEFGHIJKLMNO	785	(100)
multi-innovator	DEFGHIJNO	383	(48.8)
pure innovator	ACKM	250	(31.8)
two-way combinations	BDGLNO	288	(36.7)
three-way combinations	EFHJ	209	(26.6)
four-way combinations	I	38	(4.8)
product innovators	ABCDEFGHIJNO	487	(62.0)
process innovators	DEFGHIJKLMNO	681	(86.8)
GPI	ABDEFHIN	167	(21.3)
SPI	BCEFGIJO	413	(52.6)
Tπ	DEHIJKLO	493	(62.8)
Oπ	FGHIJLMN	530	(67.5)

Comment: the labels of the cells are presented in Figure 8-5. Within brackets the number is presented as a percentage of all innovative firms.
Source: own calculations based on question 4, 5 and 6 of the IEK database

We may first and foremost conclude that the share of multi-innovative firms is not higher in the IEK, quite the contrary, despite the fact that it contains more types of innovations. Multi-innovativeness is not unique to this survey. The share of multi-innovative firms turned out to be very high: between 48 and 62 per cent in different studies. This constitutes a methodological challenge, but it also has implications beyond methodology. Apparently, if product and process innovations are seen as different innovation strategies, these are complementary rather than substituting.

8.4.1 Multi-innovation as a methodological challenge with two solutions

However, multi-innovativeness also constitutes a methodological problem. How do we attribute the impact of product and process innovation if some firms have made both product and process innovations? The solution to the problem varies among researchers. There are two main approaches and they yield different results as we will see.

The *first* approach, as chosen by Falk (1999:20), distinguishes between three categories of innovative firms: "product innovation only", "product and process innovation" and "process innovation only". The three categories are mutually exclusive: the same firm is only counted in one of these three categories.

The *second* approach, as chosen by Evangelista and Savona (2003:463), distinguishes between two categories of innovative firms: "product innovation" and "process innovation". The two categories are not mutually exclusive and multi-innovative firms are counted in both these categories.

If the analysis is based upon mutually exclusive categories (as in the first approach), then the impact of a multi-innovative firm is not automatically assumed to be consistent with the impact of a product innovator plus the impact of a process innovator. If the analysis is based upon categories which are not mutually exclusive (as in the second approach) then multi-innovative firms will not be given specific attention: the impact of a multi-innovative firm is assumed to be consistent with the impact of a product innovator plus a process innovator. I therefore argue that the first

approach is a more viable instrument to handle multi-innovative firms and their employment impact than the second approach.

Why is it important how innovation is specified? It is important since it yields different results as we will see empirically in Table 9-4. Another reason is that several researchers (cf. Pianta 2005:576, Edquist et al. 2001:37) point to the combination of Tπ and Oπ as specific in its implication on employment and that combination will get special attention in the first approach but not in the second approach.

8.5 Concluding remarks

We have seen in chaper 8 that many KIBS firms are innovative and that they tend to make more than one kind of innovation. Product innovations and process innovations are not mutually exclusive. In order to emphasise that product and process innovations take place in the same firm, and are part of the same innovation strategy, a special term, multi-innovative, is used. Whereas 50.4 per cent of the firms were product innovative, 70.4 per cent were process innovative, and 44.8 per cent were multi-innovative.

This high share of multi-innovative firms – which nevertheless is rather low compared to other studies – entails some methodological problems which were discussed above. In this chapter, the relation between product innovators and product innovation objectives has been investigated and similarly the relation between process innovators and process innovation objectives. As we will see later on, product innovators are related to process innovation related objectives and vice versa.

Figure 8-5 also showed how the extended taxonomy of product and process innovation may be developed into 15 combinations of innovations. It will be an important challenge in the coming chapter to see if types of innovations, or combinations of innovations, will explain innovation-induced employment change.

In this chapter we have also seen how KIBS firms have made all four types of innovations: Close to one fifth of all KIBS firms made a GPI, indicating that it is crucial to investigate why KIBS firms produce goods and be aware that this is a possibility. Oπs were very common: 54.9 per cent of the firms made Oπs. Oπs are thus very common.

Given the harsh economic time period that the IEK surveys, it is interesting to notice how neither reducing production costs nor labour costs in particular, were very important objectives to innovate. We may notice, however, that the sector with the highest level of bankruptcies (in absolute numbers) – computer firms (Figure 5-1) was also the most innovative sector.

The innovation rate is higher in IEK than in comparable innovation surveys, even when firm size and sector affiliation is taken into consideration. The IEK also had a lower share of firms with innovation-induced employment change. This may be related to the fact that the IEK has broader innovation questions. Despite the breadth of the innovation question, not all bespoke producers consider themselves innovators. This will be discussed further in the concluding chapters.

9 Sorting out the innovation-induced employment change

The previous chapter presented the innovative pattern of the KIBS firms. We learned that KIBS firms are innovative to a very high extent and all four types of innovations are present in KIBS firms. In particular it is worth keeping in mind that Oπs were very frequent and that innovative KIBS firms tended to make more than one innovation. Many were also multi-innovative, that is, they made product innovations as well as process innovations. The concept of combinations of innovations was introduced in order to divide innovative firms into groups according to their innovation pattern.

Chapter 8 was a stepping stone to this chapter where the impact of types and combinations of innovations will be analysed and discussed. Prior to addressing the second purpose (i.e. the causal impact of innovation on employment) two other issues will be considered. The first is the relation between innovation-induced employment change and total employment change and the second is the degree to which innovations in KIBS had an impact on employment.

When analysing the impact of innovation on employment, one must keep in mind that firms grow and shrink for a number of reasons, i.e. total employment change may be due to several causes, as for example changes in production volume. Innovation is but one reason why a firm changes size. Since this thesis is concerned only with the change in employment that is caused by innovation, the change in number of employees which is due to innovation is separated from the change in number of employees which is due to other reasons.[49] I call the former innovation-induced employment change and the latter, consequently, other employment change. This is visualised in Figure 9-1. Although the following focuses largely around innovation-induced employment change, I am aware that the category of "other employment change" is large, heterogeneous and cannot be easily explained.

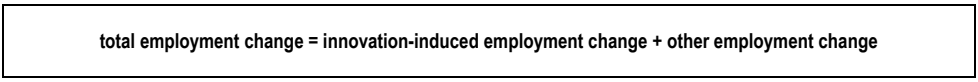

Figure 9-1. The composition of total employment change.

The structure of this chapter builds upon the distinction of innovation-induced employment change and other employment change. The first section, 9.1, presents the total employment change of the KIBS firms in the sample (and how the sample relates to the population). The second section, 9.2, presents the innovation-induced employment change. The third section 9.3 analyses innovation-induced employment change due to product and process innovations. Section 9.4, puts the results into perspective by discussing other factors (than the characteristic of product and process

[49] The survey included two questions, on innovation-induced employment change (numbers 8 and 9 in appendix II). There is thus no need to analyse whether or not innovation had an impact on employment: we have their word that they did. We may, however, question their estimation of how large a share of the total employment change consisted of innovation-induced employment change. Innovation-induced employment change explains almost half of the variation in total employment change, as seen in regression #1, footnote 50. There is thus no doubt that there is an innovation-induced employment change.

innovation) which may also have an impact on innovation-induced employment change.

9.1 Total employment change: analysing a sample of survivors

The firms in the sample as a whole have been job creating: the number of employees grew from approximately 37,600 in 2000 to 41,000 in 2002 which means that the surveyed KIBS firms created a total of 3,500 jobs as seen in Table 9-1.

Table 9-1. Size and growth of firms in the IEK 2000 - 2002.

	no of employees	mean	median
no of employees 2000	37,553	38.83	11
total employment change	3,494	3.61	0
no of employees 2002	41,047	42.45	12

Comment: 41,047 *divided by* 37,553 *equals an increase of nine per cent.*
Source: own calculations based on question 1b and 1c of the IEK database

The purpose of this chapter is to sort out the innovation-induced employment change. A section on total employment change may appear, in that light, superfluous, but total employment change is relevant here for two reasons. The first is that total employment change is sometimes used as a proxy for innovation-induced employment change since data on innovation-induced employment change is not always available or reliable (Peters 2004, 2005).

There is no clear empirical relation between other employment change and innovation-induced employment change in the IEK data. A firm with a positive other employment change may well have a negative innovation-induced employment change. There is thus no simple relationship between innovation-induced employment change and total employment change. This is also shown in a regression analysis, regression #1, which demonstrated that about half the variation in total employment change could be explained by innovation-induced employment change.[50] This implies that total employment change, at the very least in the IEK, is a poor proxy of innovation-induced employment change.

The second reason is that total employment change may tell us something about the sector - or rather about the sample. The surveyed time period, 2000 - 2002, was atypical for many KIBS firms. As we saw in sections 4.1.3 and 5.1, many parts of the sector underwent harsh restructuring after a long growth period. We would therefore expect to find that the sector has shrunk. Quite the contrary (see Table 9-1) we see that the number of employees in the surveyed firms have actually increased by nine per cent.

[50] An OLS regression (#1) reveals that innovation-induced employment change (as an independent variable) resulted in an adjusted R^2 of 0.437 where the dependent variable was total employment change. This only includes firms which had an innovation-induced employment change. (Details on regression #1: the regression was a univariate OLS regression with the dependent variable relative total employment change and the independent variable relative innovation-induced employment change. The value of the constant was 0.135*** and the beta value of relative innovation-induced employment change was 0.961***. Degrees of freedom: 1, no of cases: 337, standard error: 0.53047, R^2: 0.439, adjusted R^2: 0.437.

This may appear enigmatic, but the reason is clear. The firms in the sample have all survived. The sample does not include any firms which bankrupted during the period, for the simple reason that it is not possible to calculate the changes in employment if the firm was not active the entire period. The surveyed firms are thus not representative of all KIBS firms, only the ones that, in some sense, were winners since they survived. Many firms did not survive the recession, computer firms in particular, as we saw in Figure 5-1.

A picture of thriving survivors may have been created among some readers, but this picture must quickly be revised. If we study Table 9-1 more closely, we find that although the mean firm grew by 3.6 employees, the median firm did not change size. This means that whereas a few firms grew considerably, most experienced only modest changes in employment.

We may also note that innovation in itself was not a safe ticket to employment growth in this period. Innovative firms were not more likely to grow - or shrink - than non-innovative firms.[51]

9.2 Innovation-induced employment change is uneven

We have so far concluded that many KIBS firms in the sample grew. We will now turn to the innovation-induced employment change. First we will discuss innovative firms per se, and later (in section 9.3) we will distinguish between product innovative firms and process innovative firms.

Table 9-2. Direction of innovation-induced employment change: firms and employees.

Innovation-induced employment change	no of firms	no of employees
increase	215	2,648
unchanged	447	0
decrease	123	2,848
net change	+92	-200

Comment: all innovative firms are divided into three groups according to direction of innovation-induced employment change 2000 – 2002: increased, unchanged or decreased.
Source: own calculations based on question 9 of the IEK database

We find that innovation – as defined in our study – actually destroyed a few more jobs than it created among the KIBS firms. Table 9-2 shows how the net change in number of employees (increase due to innovation minus decreases due to innovation) was slightly negative. Innovation (product and process innovation taken together) thus turned out to be a net destroyer of jobs during this period in KIBS firms. Innovation indeed is a double-edged sword. On the other hand, the number of firms which grew due to innovation exceeds the number of firms which shrunk due to innovation. This only comes to show that a few firms shrunk considerably.[52]

[51] Although total employment change differs considerably between innovative and non-innovative firms, these differences were not statistically significant.
[52] The *size* of the innovation-induced employment change, and not only the *direction* of innovation-induced employment change is important. However, since the sizes of firms are not normally distributed it is difficult to compare and discuss magnitude of change.

9.2.1 Not all innovative firms have an innovation-induced employment change

Another important aspect is that far from all innovative firms had an innovation-induced employment change. Only in a minority of the innovative firms, 45 per cent, did the innovation(s) have an impact on employment. As we saw in Table 8-2, this is lower than other corresponding surveys. One reason for this may be that our concept of innovation is wider: it includes more types of innovations and probably smaller changes. The share of firms with innovation-induced employment change varies considerably between firms with different combinations of innovations.

Figure 9-2 demonstrates with clarity that few differences in innovation induced employment change between combinations of innovations are statistically significant. K-firms (pure Tπs) have a statistically significantly lower share of firms with innovation-induced employment change than CFGHIJLMNO-firms. J-firms have a statistically significantly higher share of firms with innovation-induced employment change than ABCDEL-firms, but for the most part the differences in share of firms with innovation-induced employment change is not statistically significant.

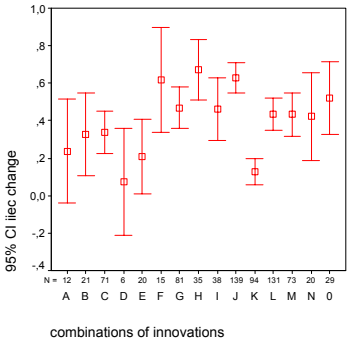

Figure 9-2. Per cent of innovative firms which had an innovation-induced employment change.

Comment: the letters (A-O) used refers to combinations of innovations presented in Figure 8-5. IIEC stands for innovation-induced employment change. Please see Figure 7-2 for details of how to read the figure.
Source: own calculations based on question 4, 5 and 6 of the IEK database.

We may draw two conclusions from this. The first concerns the innovations which are considered most central in innovation studies, GPI (combination A) and Tπ (combination K). Innovation-induced employment change is not more common among these firms than among other firms. Quite the contrary, KIBS firms which only made Tπs seldomly had an impact on employment.

The second conclusion concerns Oπs. From Figure 9-2 we may see that firms that made pure Oπs (combination M) are as likely to have an innovation-induced employment change as other innovative firms. This is an important lesson, which encourages inclusion of Oπs in further research on innovation and employment impact.

Having said this, two observations may be emphasised.

1. Firstly, firms were, by and large, capable of identifying innovation-induced employment change. The impact of innovations is complex, but firms still managed to separate between other employment change and innovation-induced employment change.

2. Secondly, the innovation-induced employment change is, after all, remarkably common. The innovation-induced employment change is only the net change of all innovation-induced employment change in a specific firm.[53] That means that the net change is only the tip of the iceberg of all impacts the innovation has on employment. Changes in work tasks, for example, are presumably much more common than the actual decision to employ or dismiss personnel. Innovations therefore have impact on employment beyond what this survey can show. It is therefore important to acknowledge that even though 45 per cent of innovative firms with innovation-induced employment change is less than the s-CIS2 with its 56 per cent, (as we learned in Table 8-2) it still represents a considerable number of firms that have changed their number of employees due to innovation.

Thus far, I have stated (in Table 9-2) that the net impact of innovation on employment in the KIBS firms has been negative but I have not attempted to explain why it is negative, which is the topic of the following section where innovation is divided into product innovation and process innovation.

9.3 Product and process innovation as explanatory factors

Theoretically, product and process innovations have reverse effects on employment as we saw in chapter 3. Therefore dividing innovative firms into product innovators and process innovators may provide further answers as to why some innovative firms have a positive impact on employment and others have a negative impact on employment due to innovation.

Table 9-3 shows that pure product innovative firms were slightly more likely to have a positive innovation-induced employment change than pure process innovative firms. It also shows that pure process innovative firms were slightly more prone to have a negative innovation-induced employment change than pure product innovative firms. We may therefore assert that for these firms, product innovation had a more favourable impact on employment than process innovation. The difference, however, is small. Table 9-3 gives a very rough estimate of the impact of product and process innovation since it only takes non-multi-innovative firms into consideration and it also considers direction, rather than magnitude. This is thus not a conclusive analysis of the impact of innovation on employment.

[53] "Net" implies that the firm may well have experienced a mobility of employees although the number of employees is constant. The net difference (job growth minus job loss) may therefore exclude employment change which has taken place in the firm.

Table 9-3. Product and process innovators after direction of innovation-induced employment change.

	direction of innovation-induced employment change							
	decrease	(%)	unchanged	(%)	increase	(%)	total	(%)
pure product innovative firms	7	(6.7)	70	(67.3)	27	(25.9)	104	(100)
pure process innovative firms	37	(12.4)	197	(66.1)	64	(21.5)	298	(100)
all innovative firms	124	(15.7)	447	(56.9)	215	(27.4)	785	(100)

Comment: *pure product innovators are firms that only made product innovations. This equals fields ABC in Figure 8-5. Pure process innovators are firms that only made process innovations. This equals fields KLM in Figure 8-5. The last row includes all innovative firms. The pure product innovators and the pure process innovators are cross-tabulated with direction (decreased/unchanged/increased) of innovation-induced employment change.*

Example: *there are 104 pure product innovators. Seven of these have had a negative impact on employment due to innovation. This equals 6.7 per cent of all the pure product innovators with innovation-induced employment change.*

Source: *own calculations based on questions 4, 5, 6 and 9 of the IEK database.*

9.3.1 Five regressions on impact of innovation on employment

A more sensitive method is regression analysis. Regression analysis is a suitable tool to determine the impact of innovation on the innovation-induced employment change.[54] Five regressions, presented in Table 9-4, are made in order to investigate possible explanations for the variation of the innovation-induced employment change. They build on the definitions (or rather operationalisations) of SPI, GPI, Tπ and Oπ which are given by questions 4-6 in the IEK survey (see appendix II) and discussed in section 6.4.1.[55] Although five regressions may seem superfluous and interpretation only departs from one of them, (#5), the other four are presented for reasons of comparison.[56]

---

[54] There are several types of regression analysis and selection among them depends on data. This regression analysis is multiple (i.e. includes several independent variables) and linear (i.e. a linear relationship between the dependent variable and the independent variables is assumed). It is further an OLS (ordinary least square) type of regression, which presupposes that the dependent and independent variables are on an interval/ratio scale (for an excellent discussion on scales, see Lindsay 1997:27-32) or, in the case of independent variables, dummy variables (see Kinnear and Taylor 1991:630). In cases where the dependent variable, and/or independent variable is on a lower scale (i.e. nominal or ordinal level) other regression techniques are available, such as log-linear, logit and probit regressions. Here, however, OLS-type regressions are used since the type of data allows it.

[55] Type of innovation and combination of innovation are treated as dummy variables, that is as dichotomous variables with two possible values: 1 (yes) and 0 (no). Unless the variables are transformed into dummy variables, they cannot be entered into the regression. See Kinnear and Taylor (1991:630) for further reference.

[56] A great number of regressions have been run in an earlier phase of the project, experimenting with different versions of the regression analysis. I will not tire the reader with a thorough account of them all, but only briefly report some main lines of thought. (The reported adjusted R^2 values below refers to variants of regression #5).

(1) A different sample of firms. The regressions of Table 9-4 are based only on firms that reported an innovation-induced employment change. The adjusted R^2 (0.058) was lower when all innovative firms were included into the analysis.

(2) A different dependent variable. The dependent variable of the regressions in Table 9-4 is relative innovation-induced employment change. A series of regressions were made with total

Regressions #2[57] and #3 are both based on the dual taxonomy of innovation (product innovation and product innovation). Regressions #4 and #5 are based on the extended taxonomy of innovation (GPI, SPI, Tπ, and Oπ). Regression #6 also includes two other variables, but that may be left aside for the moment. What is, then, the difference between regressions #2 and #3, and between regressions #4 and #5?

In order to understand the difference between them it is useful to remember the argument of section 8.4.1 where two ways to approach multi-innovative firms were compared. The first approach had three mutually exclusive categories ("product innovation only", "product and process innovation" and "process innovation only"). The second approach had two categories which were not mutually exclusive ("product innovation" and "process innovation").

Regressions #3 and #5 are based on mutually exclusive categories ("product innovation only", "product and process innovation" and "process innovation only" in #3 and the 15 combinations of innovations A-O in #5). The categories of regression #2 and #4, on the other hand, are not mutually exclusive ("product innovation" and "process innovation" in #2 and "GPI","SPI"," Tπ","Oπ" in #4). As we will see in Table 9-4, the level of the taxonomy (dual or extended) and the categorisation of innovation (mutually exclusive or not) matter.

It is now time to present regression #6 and the additional two variables. In order to investigate the impact of product and process innovation on employment, it is of outmost importance to identify other factors which may also have an impact on innovation-induced employment change. For example, Evangelista and Savona (2003:462) found that firm size, R&D and design expenditure, marketing expenditure, and sub-sectors all were more influential in determining the impact of innovation in service sectors than SPI and Tπ. The controlled variables are important since they (a) absorb explanations falsely attributed to the explanatory variables. But the case may also be that (b) adding a variable may actually unveil relationships otherwise obscured between the dependent variable and the set of explanatory variables.

---

employment change as a dependent variable. The adjusted R^2 was lower (-0.013) when total employment change was the dependent variable.

(3) Different form of the dependent variable. The dependent variable of the regressions in Table 9-4 is expressed in relative, normalised form. This means that, first, the number of employees affected by innovation-induced employment change is divided by number of employees in 2000. As a result, the distribution is closer to a normal distribution. The normalisation further makes data less vulnerable to outliers. The adjusted R^2 was lower when the absolute numbers, instead of the relative numbers, were included into the analysis.

(4) Other independent variables. A series of regressions were run with other independent variables. After the tests, it was clear that these additional variables did not increase the explanatory power of the innovation-variables and blurred the results. In an attempt to focus on the core, these other independent variables were ignored, with the exception of sector affiliation and size of firm, two reputed confounding variables, as well as objectives to innovate (regressions #7-#8 in Table 9-6).

The point is to demonstrate that the formulation of regressions #2-#5 is not haphazard but the result of careful attention.

[57] There is no regression #1 here, as not to confuse it with regression #1 in footnote 50.

Table 9-4. OLS regressions #2-#6: explaining innovation-induced employment change.

	#2	#3	#4	#5	#6
dependent variable	normalised relative innovation-induced employment change				
constant	0.325***	0.129***	0.154*	0.097**	0.084
product innovation	0.033	0.229**			
process innovation	-0.195**	reference			
multi-innovation		0.033			
types of innovations					
GPI			0.128*		
SPI			0.027		
Oπ			-0.078		
Tπ			0.057		
combinations of innovations					
A: GPI				-0.455*	-0.490*
B: SPI & GPI				0.059	0.049
C: SPI				0.407***	0.394***
D: GPI & Tπ				0.589	0.550
E: GPI, SPI & Tπ				-0.238	-0.260
F: GPI, SPI & Oπ				0.507***	0.484***
G: SPI & Oπ				-0.079	-0.069
H: GPI, Tπ & Oπ				0.382***	0.353***
I: GPI, SPI, Tπ & Oπ				0.212*	0.204*
J: SPI, Oπ & Tπ				reference	reference
K: Tπ				-0.182	-0.190
L: Tπ & Oπ				0.120	0.115
M: Oπ				-0.045	-0.045
N: GPI & Oπ				-0.366**	-0.377**
O: Tπ & SPI				0.186	0.187
no of employees in 2000					0.000
T- or P- KIBS					0.054
degrees of freedom	2	2	4	14	16
no of cases	337	337	335	337	337
standard error	0.48842	0.48842	0.48981	0.46027	0.45998
R^2	0.017	0.017	0.018	0.158	0.165
adjusted R^2	0.011	0.011	0.006	0.122	0.123

Comment: the denominations A-O were first encountered in Figure 8-5 and are combinations of SPI (service product innovation), GPI (goods product innovation), Tπ (technological process innovation) and Oπ (organisational process innovation). In regression #3, the three independent variables are mutually exclusive: i.e. product innovation refers to only product innovation and process innovation refers to only process innovation. T-KIBS and P-KIBS are aggregate categories of sectors, see further Table 4-4. The values given are unstandardised beta values. "J" is reference in regressions #5-#6, as is process innovation in regression #3. All variables with the exception of "no of employees" are dummy variables. The dependent variable is the normalised relative innovation-induced employment change (i.e. number of employees affected by innovation during 2000-2002 divided by number of employees in 2000) and it only includes firms which had an innovation-induced employment change.

** statistically significant on the ten per cent level; ** statistically significant on the five per cent level *** statistically significant on the one per cent level.*

Source: own calculations based on questions 1c, 4, 5 and 6 of the IEK database.

Adding variables could therefore potentially increase the explanatory power of the explanatory variables but due to the risk of over-fitting, it is crucial to keep the number of controlled variables to a minimum. Therefore, regression 6 includes the 15 combinations of innovative firms as well as two so-called controlled variables (Kish

1987:3-8); type of sector (T- or P-KIBS) and size of firm (number of employees in 2000).

Having discussed the design of the regressions, it is now time to discuss the results of the regressions presented in Table 9-4. A comparison of regressions #2, #3, #4, #5 and #6 provides interesting and surprising insights into how innovations affect employment.

9.3.2 Understanding the regressions

Three figures are particularly important when comparing the regressions in Table 9-4. The first is the *adjusted* R^2 which measures the share of variation in innovation-induced employment change that is explained by the independent variables (type or combination of innovation, employment and sector). The higher the adjusted R^2, the more of the variation is explained. The adjusted R^2 runs from 0 (in extreme cases it may also be negative) to 1, which means that it may be thought of as per cent of explained variation. If adjusted R^2 is, for example, 0.123, then the independent variables together explain 12.3 per cent of the variation in innovation-induced employment change.

The second important figure is the *level of significance*. The level of significance is marked with zero, one, two or three asterisks (*). The level of significance which is reported in the thesis in general is 95 per cent, i.e. two asterisks. The higher the number of asterisks, the more improbable it is that the result is a coincidence, a work of random. The independent variables values without asterisks are not statistically significant and those results are therefore highly insecure and no conclusions are based on these.

The third important figure is the *unstandardised beta value*, which represents the numbers given in the table for the dependent and independent variables. Most interesting about the unstandardised beta value at this point is that it may be used to calculate the *expected value*. Expected value is the constant plus the unstandardised beta value. The expected value indicates how the independent variable affects the value of the dependent variable. For example, in regression #2, the relative innovation-induced employment change is in the interval -1.32 to 1.54 (not given by Table). Process innovation has a (statistically significant) unstandardised beta value of -0.195 and the constant for regression #2 is 0.325. The expected value for process innovation in regression #2 is +0.13. This means that the impact of process innovation is positive, despite the fact that the unstandardised beta is negative. Hence, one cannot differentiate between positive and negative impact merely by looking at the unstandardised beta values.

Regression #2 shows how product and process innovation explain very little of the innovation-induced employment change. The adjusted R^2 is 0.011. This means that product and process innovation only explain 1.1 per cent of the variation in innovation-induced employment change. Regression #3 is almost identical. Regression #4 shows how, when divided into SPI, GPI, Oπ and Tπ, innovation explains even less of the innovation-induced employment change. In regression #5, the combinations of the SPI, GPI, Oπ and Tπ are also taken into consideration, thus

forming the 15 combinations of innovative firms which we first encountered in Figure 8-5. This means that in this case, the extended taxonomy explained variation in innovation-induced employment change more than the dual taxonomy and that mutually exclusive categories explained more than non-mutually exclusive categories for the extended taxonomy.

Regression #5, which will be discussed subsequently, explains considerably more than regressions #2 and #4 with an adjusted R^2 of 0.122. Regression #6, finally, builds on #5 but adds two controlled variables, none of which are statistically significant nor contribute much to the explanatory power. The adjusted R^2 is marginally higher in regression #6 than in regression #5.

The reason for the comparison of regressions is to show how powerful the 15-part division of the concept of innovation (in regressions #5 and #6) is in explaining innovation-induced employment change. As we are about to see, the interactions are important and peculiar. The following sections will discuss the results of regression #5 in detail. Reference is then at times made to the labels A - O of the combinations of innovations which were first presented in Figure 8-5.

9.3.3 Three main results

The previous section outlined how three key figures (adjusted R^2, level of significance, and unstandardised beta value) may be understood. This section will outline the main results of regression #5 prior to a detailed discussion concerning the results.

The **first** and most important result of regression #5 is that the direction of the expected values is hard to explain. From chapter 3, we would have expected that product innovations led to employment increase and process innovation led to employment decrease. In terms of the combinations of innovation, we would have expected that ABC had a positive impact on employment and KLM had a negative impact on employment (the multi-innovative combinations of DEFGHIJNO are more undetermined).

What we find is that many (8 out of 14) combinations of innovations are not statistically significant. This includes also some pure product innovators (ABC) and pure process innovators (KLM) since only pure GPIs and pure SPIs are statistically significant. To that, pure GPIs do not have the presumed direction of the expected value (according to theory GPIs should have a positive, not a negative impact on employment). Thus, regression #5 does not support (nor do regressions #2, #3 or #4) the direction of impact of product and process innovation on employment presumed by theory.

The **second** result is that combinations of innovations explain only a small part of variation in relative innovation-induced employment change. However, I do not consider the low level of adjusted R^2 unreasonably low.

It is futile to expect that type of innovation (or combination of innovation) would be the sole determinant of innovation-induced employment change. Several others

factors, among them number of innovations and magnitude of innovation, probably have an impact on innovation-induced employment change as we saw in section 3.1.[58] The IEK did not gather information on how many innovations of each type have been made, neither on the importance of these innovations: there is no indication in the survey if the innovation was radical or incremental, minor or major, new to the firm or new to the world. The information on the objectives to innovate, which provides indication of the degree of substitution and type of innovation (new/improved) is not gathered in a way that it is possible to categorise each single innovation. It may be that if this information was gathered and included into the analysis, the results would have been clearer. Another issue is that we cannot automatically presume that all innovations will have an impact on employment. The employment influence included here is only the part which has manifested itself within the same firm under a period of maximum two years. The comparably low adjusted R^2 value may be explained by the fact that other properties of the innovations also matter. There are also other factors which no doubt play a role. There is probably a large proportion of randomness as well.[59]

Theory predicts, indirect effects aside, that process and product innovations should have opposite effects on employment. The regressions #2 to #6 do not support that hypothesis. There are, however, several possibilities as to why the expected result was not attained and these will be discussed in the following sections. We will return to what this means - and not means - for the usefulness of the extended taxonomy of product and process innovation and about the value of this tool as an instrument to understand employment change in KIBS firms in section 10.2.4.

A **third** important conclusion may however be drawn from comparing regressions #2 to #5: the dual taxonomy of product and process innovation is too blunt and the more detailed extended taxonomy yields more explanatory power.

Almost all innovative firms made more than one type of innovation. Only 250 firms (ACKM) made only one type of innovation over the period. This multitude of innovations within the same firm contributes to making the disentanglement of the different innovations problematic. I will discuss the problem of disentanglement in section 9.3.4.2, but first I will discuss the impact on employment in firms which only made one type of innovation: the pure innovators.

---

[58] A negative or non-impact on employment due to innovation may be due to lack of demand of the new product but it may also be that the product innovation was a significantly improved product which required less resources, and a very important resource, in particular for service firms, is personnel. If that is the case then the product innovation will not result in an increased need for labour. Unfortunately no variables indicating economic performance are included in this survey, and it is for this reason not possible to do a more thorough test of this possibility.

[59] There are also methodological concerns which may have an impact on adjusted R^2. Among these is that the dependent variable is continuous and all innovation variables are dichotomous variables, since the dichotomous variables by nature explain less. A second methodological concern is that linear regression analysis is only adequate to analyse linear relationships and if the relationship is not linear the dependent and independent variables will appear unrelated.

9.3.4 Understanding the results

Before discussing the interpretation of the results, one crucial circumstance must be brought up – that of the length of the time period. The surveyed time period is very short as discussed previously. As a consequence, there is little time for the innovations to have had an impact on employment. This implies that most of the compensation mechanisms, for example, have not yet come into full effect. We must therefore underline that the innovation induced employment change is probably more extensive than what is shown here. On the other hand, it may be possible that some of the innovation induced employment change has already passed its peak. The product cycle of services is typically shorter than that of goods. As a consequence the innovation induced employment change of an innovation may be limited in time and there is a theoretical possibility that the innovation induced employment change of some innovations has come and gone 2000 to 2002.

Three circumstances complicate the analysis. The **first** is of a methodological nature and will be discussed now, whereas 9.3.4.1 deals with the atypicality of the surveyed period and 9.3.4.2 addresses the synergetic effects on employment.

In regression #5, "innovation" is measured as dichotomous dummy variables. That is, either the firm is innovative or not. No consideration is taken of innovation expenditure (as in the case of Evangelista and Savona 2003) or sales (as in the case of Peters 2004). In both these cases, these variables were important factors to explain impact on employment. This is, in a way, self-evident. These variables measure the *importance* of the innovations and an important innovation naturally has a greater impact on a number of factors, not only employment. This result was also reached in a study by Cainelli et al. (2004:128) which regarded the impact of innovation on several economic variables in services:

> firms economic performances in services do not only depend on the simple presence of innovation but also on the amount of financial resources devoted to innovation as well as on the type of innovation activity performed.

This is important, since it in part explains the comparably low adjusted R^2 value of regression #5: if a quantitative indicator of the importance of an innovation had been included as well, a larger share of employment would most probably have been explained.

This thesis did not aim at investigating the extent to which innovation-induced employment change could be explained, but rather to see how much of it was due to innovations being goods, services, technological or organisational. The size of adjusted R^2 is not central to that, but rather the direction of the expected values. It is apparent that product and process innovation alone cannot explain all variation attributed to innovation. Other factors are also crucial to explain the impact of innovation on employment. Two such factors, number of employees in 2000 and T/P - KIBS, were included in regression #6, but carried little or no importance. While other factors are important, they lie beyond the scope of this thesis. That is why the following discussion will focus on the direction of the expected values, rather than the size of adjusted R^2.

This also gives rise to the less pragmatic question of what, exactly, we are trying to measure. The type of innovation (or combination of innovation) is naturally associated with a number of other characteristics of the innovation, as for example the importance of it or the objectives underlying it. But how do we delineate the type of innovation from its other characteristics? This is important, and should be taken into consideration when indicators of process innovation and product innovation are designed or chosen.

9.3.4.1 Innovation as a response to economic hardship

In the paragraphs directly under heading 9.3.4 we saw that it is complicated to separate the impact of type of (or combination of) innovation from other characteristics of the innovation. In this section we will discuss how it is plausible that the survey mirrors conditions among firms struggling to survive during a recession which affected some KIBS sectors in particular as discussed in section 5.1.

The firms were surveyed during a period of economic hardship. This is also mirrored in the survey (questions 7 and 38), where several firms have chosen to comment upon the hardship of the economy. This implies that the innovative response may be atypical. As Rosenberg (1982:18) points out, innovation, and the direction of innovation, is a response to economic forces. Firms do not innovate without a cause and firms finding themselves in economic hardship are faced with an alternative: to innovate or not to innovate. Innovation is costly (even if service products require different investments than goods products, see Edquist et al. 2001:38) and is therefore not carried out without a reason.

I would suggest five different reasons why the recession might have had an impact on innovation in KIBS and its employment effects. The **first** is that innovative behaviour might be more common during a period of economic hardship and that would then be part of an explanation of why so many KIBS firms were innovative.

Another, **second** consequence of the recession is that the surviving firms have more ample access to qualified labour (since they may employ the ones the competitors were forced to dismiss) and these employees, in turn, may function as sources of innovation, thus rendering the surviving firms even more innovative.

Third, the recession may also have had an impact on the objectives the firms' had to innovate. How would a firm in a recession react? One reasonable solution would be to "save money". Many firms in the survey responded that (question 11) reducing labour costs and reducing other production costs were a very important objective to innovate. It is also interesting to note that both product innovators and process innovators found reducing labour costs and reducing other production costs were a very important objective to innovate.

Four, the recession may have an impact on the type of innovation made. Product innovation is a riskier strategy than process innovation (since it has to be introduced to

a market[60]). That may be one reason why the pure SPIs and pure GPIs are few (even fewer than the pure Tπs and pure Oπs, see Figure 8-1 and Figure 8-3. **Lastly**, the recession might have affected the impact the innovations had on employment. For example, it may be that innovations have made it possible not to dismiss employees, i.e. contributed to keeping labour already employed.

9.3.4.2 Cocktail innovations have synergetic impact on employment

Above we saw (first) that it is complicated to separate the impact of type or combination of innovation from other characteristics of innovation and (second) that the recession might have had an impact on innovativeness.

Here a third circumstance will be discussed which concerns the fact that most firms in the IEK made more than one type of innovation. Previously (section 8.4.1 and 9.3.1) I showed two different approaches to multi-innovative firms.[61] It distinguished between mutually exclusive categories (in the example, "product innovation only", "product and process innovation" and "process innovation only") and categories which were not mutually exclusive (in the example, "product innovation" and "process innovation"). Mutually exclusive categories allow firms that make more than one innovation to have an impact on employment which differs from the sum of the two innovations.

When looking at the expected values of regression #5, for example, we see that when more than one type of innovation was made by a firm, the effects on employment were not simply the aggregate of employment effects brought on by the two innovations.

There are cases when innovations, introduced together, have different impacts as compared to when they are introduced separately. One example is how labour saving Oπs, introduced with Tπs, lead to increased productivity (Edquist et al. 2001:37).[62] In other words, introduced together, Oπs and Tπs have a different impact than when introduced separately. Another effect, a synergetic *cocktail effect*, thus emerges. I here introduce the concept cocktail innovation to denote innovations that are introduced dependent on each other or in relation to each other and have different impacts on employment than innovations that are introduced separately from each other.

This is not to say that it is impossible to distinguish between product and process innovation in services. It is possible to a very high degree. But there are also cases where the will to distinguish between the two obstructs and blurs interesting results. Above I mentioned Hipp and how she had objectively reclassified the innovative

---

[60] If the product innovation was not a success it may have resulted not in an increase in number of employees needed (which was to be expected from theory), but a zero growth in demand of employees or even a decrease in demand of employees.

[61] Although not all firms that made more than one type of innovation are multi-innovative, the reasoning may be applied to all firms which made more than one type of innovation.

[62] The example presented is that of two different types of process innovations which, when introduced together, reinforces each other. Other examples would be a product innovation and and process innovation introduced together or two product innovations introduced together.

firms. The subjective and objective classifications differ substantially. For example, according to the subjective classification, 52 per cent of the firms made Oπs, but according to the objective classification only 16 per cent did. I quote Hipp et al. (2000:424, my italics): [63]

> This greater disagreement at the level of the individual types of innovation reflects difficulties Hipp encountered in differentiating between process and organisational innovations […] Many of the innovations classified by the firms as organisational innovations appeared to her to be, *or to also be*, process or procedural changes. Such innovations included new or improved intra-company communications network. These innovations could not be clearly differentiated from innovations identified by other respondents as process innovations

There are thus two main reasons why Hipp had difficulties with classification. The first reason is that some innovations appeared to be both Tπs and Oπs. The second is that innovations classified by one firm as Oπs were classified as Tπs in another. Here I will focus on the first reason. The solution Hipp et al. (2000) chose was to classify ambiguous cases as Tπs. The quote above also shows that at least some of these cases appeared to be both Oπs and Tπs. What we see here might be two innovations introduced together, i.e. the above discussed cocktail innovations. From the example they provide, it is also clear that these types of innovations are also made in manufacturing firms. This type of classification problem is thus not limited to service sectors.

These cocktail innovations (or rather the impact of these) may also be foretold in the IEK. This could be suspected already when the regressions were compared in Table 9-4. If there were not a synergetic effect in firms which made more than one type of innovation, then regression #4 would be as successful at estimating variation in innovation-induced employment change as regression #5. The expected values in regression #4 and regression #5 would be identical. This was, however, not the case. It is not possible to determine which firms here are cocktail-innovative and I may only note that some of the puzzling results are possibly due to cocktail innovation.

Some of the cocktail innovations in the IEK may also be of the type Hipp et al. (2000) describe in the quote. Expressed differently, some of the cocktail innovations in combination L are probably of the type Hipp et al. describe in the quote.

Previously, the concept of multi-innovative firms was introduced to denote firms which make both product and process innovations. These are theoretically assumed to have two counteractive employment changes. The (positive) impact of product innovation may be counteracted in part or totally by the (negative) impact of process innovation. Some multi-innovative firms may also be cocktail innovative and vice versa.

---

[63] What Hipp et al. (2000) label process innovation is here refered to as Tπ and what they label organisational innovation is here refered to as Oπs.

9.3.4.3 Pure innovators

The direction of some of the expected values of the pure combinations of innovations, ABC and KLM, were not as expected from theory. This section seeks to understand why. Section 9.3.3 showed that only two of the six pure combinations of innovations were statistically significant (pure GPIs and pure SPIs). That means that we cannot draw any conclusions at all concerning the innovation impact of the other pure combinations of innovations.

In Figure 9-2 we saw that GPIs seldom influence employment. Only three out of twelve of the pure GPI-firms had an impact on employment (in all cases a negative impact). Regression #5, as discussed, only included firms with an innovation-induced employment change. Many product innovations yield employment changes. This also points to the fact that the negative impact of GPI on employment is based on a very limited number of observations. The result, although statistically significant, should be regarded with caution.[64]

Tether et al. (2001:1119) suggest that SPIs, being relatively easy to copy, would rarely lead to firm growth. On the other hand, since we here have a new to the firm rather than a new to the world approach, this will have a minor impact. This is not supported by the results of regression #5, neither by Figure 8-2. Apparently, other factors, beside that of intellectual property protection, are important in influencing the employment impact of innovation at least in the short run.

Seen in the light of the economic hardship, the behaviour of the pure product innovators is complex. Product innovation could be a response to harsher conditions, although a riskier one than process innovation. One important conclusion here is that the two types of product innovations have different impacts on employment: pure GPIs (A) have a significant negative impact on employment and pure SPIs (C) have a significant positive impact on employment.[65] Thus, it cannot be taken for granted that different types of product innovations have the same impact on employment.

Just as pure SPIs and pure GPIs should, according to theory, have a positive impact on employment, so should the pure Tπs and the pure Oπs have a negative impact on employment. Both are negative but neither is statistically significant, indicating that the variety in innovation-induced employment change among these firms is great. It is not possible to draw any general conclusions concerning the impact on employment of these pure process innovations. The question is why the results are not statistically significant.

I have already mentioned the atypical time period as one possible reason why the innovation pattern is different and also possibly why the impact on employment is different. I would also like to suggest a complementary explanation, that of

---

[64] That the results of pure GPIs are not robust could also be suspected from comparing regression #4 and regression #5. The expected values of GPI and SPI are positive in regression #4, whereas pure GPI has a negative expected value in regression #5. This suggests that the results of pure GPIs are not robust.

[65] Neither pure Tπ (K), nor pure Oπ (M) is significant. It is therefore not possible to determine whether the impact on employment of a Tπ differs from that of a Oπ.

compensation via decrease in prices as to why the results are not robust. The five compensation mechanisms were presented in section 3.2.2. Most of them are not relevant to analyse the results of the survey but the compensation via decrease in prices may contribute to increase understanding. However, the surveyed time period is short and it may be that the time period is too short for this compensation mechanism to come into effect.

As the reader may recall, this compensation mechanism argues that lowered total cost may result in increase in demand. This in turn increase production and thereby employment. The reason why there are no statistically significant results for the pure process innovators (KLM) may be that some firms (not all - in that case the results would be statistically significantly positive!) which made a Tπ, an Oπ or both, succeeded in reducing the production costs. They were thereby able to lower the cost for their service or goods product gaining the market shares formerly held by competitors that had gone out of business. This increase in market shares (and thereby demand) resulted in increased production and thereby increased employment for the firm.

Unfortunately, the survey does not contain information on market shares, sales or other product oriented values which would have been necessary to closer scrutinise these possibilities. The point is that this helps explain why many process innovators actually increased their number of employees. It is particularly interesting due to the period of economic hardship, especially if kept in mind that the survey mirrors survivors in a sector under pressure. This compensation mechanism also helps us explain the behaviour of multi innovative firms. It is not unlikely that firms which gain market shares also choose to diversify production or improve existing products.

How could we then explain that GPIs, and not SPIs, have had a negative impact on employment? There are five possibilities why they have different impacts on employment. The **first** possibility is that the negative employment effect of pure GPIs is incorrect since it is based on only three observations. This is, in my understanding, the most probable reason. The **second** possibility is that, for some reason, SPIs have been more successful in the market and therefore have affected production more than GPIs. The **third** possibility is that GPIs are an anomaly for KIBS firms. It may be that it is either special firms, or special circumstances which make KIBS firms innovative in goods product. The **fourth** possibility is that service products are typically more labour intensive than goods products and that this also affects the number of employees involved in the new production. Therefore SPIs will have a larger impact on employment. A **fifth** possibility is that since services are produced while consumed (remember the Hermelin definition in section 2.1.1), they are harder to transport and also to export. Therefore, while the production of a goods product may well take place abroad (in which case the employment effects will not be included in this survey) or in a contracting firm, this is more seldom the case for knowledge intensive SPIs.

Before turning our attention to firms that made both product innovations and process innovations, we will first discuss the firms that made both GPIs and SPIs (B) and the firms that made both Tπ and Oπ (L). The product innovators should have a positive impact on employment and process innovators should have a negative impact on

employment. However, in both cases the direction of change is positive but neither is statistically significant. It is thus not possible to draw any conclusions concerning the impact on employment. It is odd that the impact on employment is not clear from these two combinations of innovations and a possible reason why will be discussed later on.

9.3.4.4 Multi-innovative firms

Only one group among the multi-innovative firms with two types of innovations is statistically significant, the combination of GPI and Oπ (N). This indicates that firms which made both GPIs and Oπs during the period had a loss of jobs due to innovation. This could simply be due to the (theoretically negative) employment effect of Oπs exceeding the (theoretically positive) employment effect of GPIs. This could also be a case of cocktail innovations, in which case GPIs in combination with Oπs would result in job loss.

Cocktail innovation may contribute to disentangle the effects of product and process innovation. There are six main groups of (two-way) cocktail innovation that need to be sorted out: the Tπ-GPI cocktail innovation, the Tπ-SPI cocktail innovation, the Tπ-Oπ cocktail innovation, the GPI-SPI cocktail innovation, the SPI-Oπ cocktail innovation and the GPI-Oπ cocktail innovation.

Having said this, it is important to point out that the same combination of innovations may be related to each other in different ways, thus resulting in different employment changes. Systematically identifying these cocktail innovations as well as their impact on employment is too wide a task for this thesis and will therefore have to be left aside. As the following section suggests, it may also be that the cocktail innovations cannot be collapsed into these six categories either.

I have now introduced the idea that cocktail innovation, the occurrence of two or more innovations dependent on or related to each other introduced in the same firm, is one possible reason why the impact on employment is not always as expected. I have also stated that the nature of different types of cocktail innovation and their possible effects on employment lies beyond the scope of the thesis. Turning now to the three-way interactive multi-innovators, the pattern becomes even more complicated.

9.3.4.5 Three-way interactive multi innovators and cocktail innovators

The challenge of analysing the three-way combinations is that they cannot be collapsed into two-way combinations. If a three-way combination could be simplified into a two-way combination, then the road to finding employment patterns would be easier to pursue.[66] When the four three-way combinations are tested, it is obvious that they may not be reduced to special cases of two-way combinations. The point with this argument is that since the three-way combinations cannot be logically reduced

[66] The idea is that a three-way interactive firm may be seen as a special case of a multi-innovative firm. The 20 firms which made GPI, SPI and Tπ (two type of product innovations and one type of process innovation) could then be seen as a special case of either GPI and Tπ (one product innovation and one process innovation) or SPI and Tπ and have the same direction of innovation-induced employment change.

into two-way combinations, then it is not possible to simply distinguish between product innovations and process innovations.

This conclusion is now drawn for the fourth time. The first time we encountered this result was in the comparison of the regressions in Table 9-4 where we saw that product and process innovation per se explained were little of the variation in innovation-induced employment change. The second time was when we saw how the impact on employment differed between pure GPI-firms (A) and pure SPI-firms (C). The third time was when we discussed the firms that did both types of product innovations (B) or both types of process innovations (L) did not have the expected impact on employment.

My main point is thus that GPIs and SPIs within the KIBS-sectors have different impacts on employment, and it is hard to refer to them as a common group of "product innovators" when it comes to the employment changes they cause. Neither pure Tπs, nor pure Oπs are statistically significant and therefore we do not know about their impact on employment. It is crucial to separate between all four types of innovations and consider the unique combinations of innovations in order to better understand the impact innovations have on employment.

The time period 2000-2002 has been a very specific period for many KIBS firms. This is mirrored in the IEK but the reflection is distorted. These firms have grown (on average) but innovations made in these firms have had a negative impact on employment (see Table 9-2). This net negative impact on employment may well be the reason why these firms have survived the recession. Before approaching the next section, some of the main findings in this section will be briefly summarised.

1. The innovative firm often makes more than one type of innovation. It is therefore fruitful to analyse the combinations between the four innovation types.

2. It should not be taken for granted that innovations (within the same firm) are made independent of each other. Cocktail innovative firms (firms where the innovations are dependent or related to each other) do not have the same impact on employment as other firms. This should be further investigated.

3. Reducing the four categories into product and process innovations also reduces the explanatory value. The two types of product innovations do not give rise to the same employment effects. Neither do the two types of process innovations.

4. All four types of innovations proved important to explain changes in innovation-induced employment change. Oπs are not neutral vis-à-vis employment even though pure Oπs have no statistically significant impact on employment as seen in Figure 9-2.

5. The time period is specific and the innovations made may to some degree be interpreted as a response to economic hardship. The time period has probably

had an impact on type and frequency of innovation as well as the consequences on employment of innovation.

9.4 Product and process innovation do not explain all

The last section discussed how GPIs, SPIs, Tπs and Oπs together may help us to explain innovation-induced employment change. But product and process innovation - even when divided into 15 combinations of innovations - only explain innovation-induced employment change in part. It is obvious that there are other explanations as well. This section will therefore critically assess why GPIs, SPIs, Tπs and Oπs do not explain more of the variation in innovation-induced employment change even though it is not realistic that the combinations of innovations should explain all variations as discussed in section 9.3.

As we will see in this section, objectives to innovate contribute to explaining innovation-induced employment change. The firms were asked to specify the importance of nine objectives to innovate. These were first discussed in association with Figure 8-2 and then Figure 8-4. The objectives were designed to be related either to product or to process innovation.[67] It must be emphasised, however, that this of course is an artificial distinction made upon theoretical assumptions. It is also possible to theoretically imagine cases where product innovations are associated with process innovation related objectives and vice versa. It is here useful to distinguish between the objectives (or motives) for the innovation made and the consequences of the innovation: for example, ideally a product innovation related objective will give rise to a product innovation but as a consequence, it may also give rise to a process innovation.

Table 9-5 shows how the objectives are not always related to the assumed type of innovation. The table distinguishes between product innovation related objectives and process innovation related objectives and between pure product innovators and pure process innovators. As a comparison, corresponding data from the m-CIS2 is also presented.

The point is that product innovators should not consider process innovation related objectives very important and vice versa. Nonetheless they do. For example, an innovation made in order to improve existing products should be a product innovation and not a process innovation. Despite this, 49.3 per cent of the pure process innovators in the IEK innovated in order to improve existing products. One possible explanation may be that they made also a product innovation but only reported the process innovation.

[67] The objectives are divided into product innovation related objectives and process innovation related objectives according to the original intent of the innovation. If the original intent of the innovation was to replace goods/services, then the objective is considered to be related to product innovation, for example. If the original intent was to improve the quality of a product, then it is a product innovation. It may also be that the firm had to make a process innovation as well in order to improve quality. In this case the firm would have made two innovations related to each other, i.e. a cocktail innovation.

This is not the case only when the objective is to improve existing products, although this circumstance provides the most confusing results. Of the pure process innovators, 16.4 per cent innovated in order to replace products, 22.1 per cent innovated to launch new products, 23.1 per cent innovated to enter new markets and 28.8 per cent innovated in order to fulfil standards and regulations of the product.

Pure product innovators of the IEK also considered process innovation related objectives very important: 23.4 per cent of the pure product innovators regarded increased production flexibility as very important, 12.8 per cent regarded reducing labour costs as a very important objective to product innovate and 6.5 per cent regarded other production costs as a very important objective to product innovate. As well, 22.1 per cent product innovated in order to fulfil standards and regulations of the work process.

In other words, the connection between objective to innovate and the type of innovation made was not always intuitive in the IEK. The results of the m-CIS2 are still not completely clear. There are pure process innovators which regard product innovation related objectives as very important. For example 40 per cent of the pure process innovators considered new markets as a very important objective to process innovate. Likewise, some product innovators regarded process innovation related objectives as very important objectives to innovate. Hence, as we clearly see this problem is not unique for this survey, nor for service firms. Table 9-5 thus shows that the objectives to innovate are not always in accordance with the type of innovation made.

It may also be that some firms did not consider only the present innovation (i.e. the innovation they had in mind when they responded to the questionnaire), but the innovation strategy at large. The question (number 11) was short and very much to the point but it is still possible that the firms were confused about the topic. They may also have answered according to expectations. It appears that the same firm may have found several objectives to innovate very important. This is important and should be investigated further. It may also be that although the firm reported itself to be a pure innovator, it may have made both a product innovation and a process innovation. Re-coding the dataset accordingly would make for an interesting analysis.

Returning to the IEK, not only did the pure product innovators also relate to the objectives to process innovate and vice versa but these objectives also appear to explain a share of innovation-induced employment change, as seen in regression #7 and #8 presented in Table 9-6. Regression #5 is included again to facilitate comparison.

Table 9-5. Objectives related to product and process innovation: no. and per cent. IEK and m-CIS2.

	IEK						m-CIS2					
	pure product		pure process		all innovators		pure product		pure process		all innovators	
product innovation related objectives												
replace products	29	(27.9)	49	(16.4)	169	(17.5)	297	(43.4)	65	(24.6)	894	(39.5)
improve products	49	(46.7)	147	(49.3)	437	(45.2)	349	(51.0)	105	(39.7)	1,267	(56.0)
new products	40	(38.3)	66	(22.1)	244	(25.3)	173	(25.3)	28	(10.6)	699	(30.9)
new markets	49	(47.5)	69	(23.1)	300	(31.1)	399	(58.3)	106	(40.0)	1,198	(52.9)
regulations	27	(26.3)	86	(28.8)	228	(23.6)						
process innovation related objectives												
prod. flexibility	24	(23.4)	92	(30.9)	246	(25.5)	141	(20.6)	103	(38.7)	554	(24.5)
labour costs	13	(12.8)	57	(19.1)	165	(17.0)	242	(35.3)	125	(47.3)	834	(36.8)
other prod. costs	7	(6.5)	61	(20.3)	162	(16.7)						
regulations	23	(22.1)	79	(26.5)	178	(18.4)						
total no of firms	104	(100)	298	(100)	967	(100)	685	(100)	265	(100)	2,264	(100)

Comment: *the table presents number (and per cent) of firms that responded with "very important" (Likert value=4 for IEK, Likert=3 for m-CIS2, thus, please keep in mind that the data are not comparable in detail) on the objectives. Only pure innovators (for the IEK: pure product innovators: fields ABC; pure process innovators: fields KLM in Figure 8-5) are included. The table presents nine objectives to innovate: replacing existing products that are phasing out, improving the quality of existing products, increasing the supply of products (i.e. adding new products to the portfolio), creating new markets, fulfilling regulations or standards of the product, fulfilling regulations or standards of the work process, improving production flexibility, reducing labour costs and reducing other production costs. The nine objectives are divided into objectives associated with product innovation and objectives associated with process innovation. The m-CIS2 contains also other objectives to innovate, but these were omitted since they did not serve as comparison.*

Example: *the objective to replace existing products was considered very important by 169 innovative IEK firms and 29+49=78 of these were pure innovators. Of the pure product innovators, 27.9 per cent considered replacing existing products a very important reason to innovate and 16.4 per cent of the pure process innovators considered replacing existing products a very important reason to innovate.*

Source: *own calculations based on questions 4, 5, 6 and 11 of the IEK database and own calculations based on m-CIS2 database.*

Regression #7 investigates how the nine objectives to innovate explain variety in innovation-induced employment change. Regression #8 is a combination of regression #5 and regression #7 since it includes all combinations of innovations, as well as all objectives as independent variables.

Table 9-6. OLS regressions #5, #7-#8: are objectives to innovate important?

	#5	#7	#8
dependent variable	normalised relative innovation-induced employment change		
constant	0.097**	0.013	-0.033
combinations of innovations			
A: GPI	-0.455*		-0.491*
B: SPI & GPI	0.059		0.093
C: SPI	0.407***		0.436***
D: GPI & Tπ	0.589		0.491
E: GPI, SPI & Tπ	-0.238		-0.057
F: GPI, SPI & Oπ	0.507***		0.398***
G: SPI & Oπ	-0.079		-0.054
H: GPI, Tπ & Oπ	0.382***		0.385***
I: GPI, SPI, Tπ & Oπ	0.212*		0.143
J: SPI, Oπ & Tπ	reference		reference
K: Tπ	-0.182		-0.313**
L: Tπ & Oπ	0.120		0.159**
M: Oπ	-0.045		-0.042
N: GPI & Oπ	-0.366**		-0.275
O: Tπ& SPI	0.186		0.081
objectives to innovate			
objective 1: replace		-0.020	0.011
objective 2: improve		0.137**	0.127*
objective 3: new products		0.108*	0.052
objective 4: new markets		0.117*	0.089
objective 5: regulations (processes)		0.137**	0.113*
objective 6: regulations (products)		-0.048	-0.022
objective 7: production flexibility		0.064	0.072
objective 8: labour costs		-0.280***	-0.257***
objective 9: other prod costs		-0.042	-0.039
degrees of freedom	14	9	23
no of cases	337	321	321
standard error	0.46027	0.45198	0.42190
R^2	0.158	0.187	0.323
adjusted R^2	0.122	0.163	0.271

*Comment: the denominations A-O were first encountered in Figure 8-5 and are combinations of SPI (service product innovations), GPI (goods product innovations, Tπ (technological process innovations) and Oπ (organisational process innovation). The values given are unstandardised beta values. "J" is reference in regression #6. The dependent variable is the normalised relative innovation-induced employment change (i.e. number of employees affected by innovation during 2000-2002 divided by number of employees in 2000) and it only includes firms which had an innovation-induced employment change. All variables are dummy variables. The objectives are transformed into dummy variables where "0" equals Likert value 1 and 2 and "1" equals Likert value 3 and 4 since such a compact Likert scale cannot be treated as a continuous variable. * statistically significant on the ten per cent level; ** statistically significant on the five per cent level *** statistically significant on the one per cent level.*

Source: own calculations based on questions 4, 5, 6, 11 of the IEK database.

Objectives to innovate were important to explain variation in innovation-induced employment change. The adjusted R^2 in #7 is 0.163, i.e. higher than in regression #5. It is even higher in regression #8 (0.271). We may also notice that, in most cases, the direction of the expected value is according to theory. Objectives 1-4 and 6 are, as recalled, associated with product innovation and objectives 5, 7-9 are associated with process innovation. Even if not all objectives are statistically significant, many are. We may therefore note that improving products has a positive impact on employment,

just as introducing new products and entering new markets. We may further notice that the objective to reduce labour costs also had a negative impact upon employment. The only confusing result is that regulations affecting processes had a positive impact upon employment.

Comparing regressions #5, #7 and #8 in Table 9-6, the first observation is that the adjusted R^2 is considerably higher in regression #7 and #8. Regression #8 explains twice as much as regression #5. Regression #8 thus presents a fuller reflection of the actual factors of influence than regression #5. This is interesting but hardly surprising as more independent variables are introduced and these are variables which more directly measure the intent with the innovation. The objectives to innovate present reasons to innovate, underlying causes which are partly related to product and process innovations. However, as discussed before, the purposes of the thesis is not to find factors influencing employment but to investigate the impact of four (15) particular factors on employment.

The second observation is that the objectives are complements rather than substitutes to the combinations of innovation (A-O). The relationship between the combinations of innovations and the innovation-induced employment change is not spurious with two exceptions. Two combinations of innovations, statistically significant in regression #5 are not statistically significant in regression #8: I (all four innovations) and N (GPI and Oπ). On the other hand, two other combinations of innovations are statistically significant: K (Tπ) and L (Tπ and Oπ). Combinations of innovations are on the whole not spurious, but important to explain innovation-induced employment change.

The third observation is that some objectives (regression #8) are important to understand innovation-induced employment change. In regression #8 it is apparent that two objectives have a positive (and statistically significant) impact on employment: the objective to improve existing products and fulfil standards and regulations concerning work process. Both these results are confusing: it is surprising that improving existing products, but not introducing new products, is statistically significant. From chapter 3 if would be expected that introducing new products would have greater (and more statistically significant) impacts on employment. Also: why do standards and regulations play this role? And why is the impact positive? It may be that firms keen on fulfilling standards and regulations are more often well-kept and more able to employ than other firms.

One objective has a statistically significant negative impact on employment, namely reduction of labour costs. Although self evident, it is important to point out that the intention to reduce labour costs also resulted in job loss. At the very least we may conclude that if the firms' answers were made with regard to the innovation strategy at large, this had an impact on innovation-induced employment change as well as product and process innovation.

10 Conclusions

Throughout this thesis, reference has been given to the purposes and research questions of this work, and here in chapter 10 we will get comprehensive answers to the questions posed. I will start by recapitulating the purposes and research questions and point to where in the thesis they have been addressed.

The first research question was:

> How may the concept of KIBS be understood and defined?

The first research question was approached from a theoretical and conceptual point of view in chapter 4 and then empirically revisited in chapter 7. I will draw some main conclusions regarding KIBS in section 10.1.

The second research question was:

> What is an innovation in services and what are the limits of the concept?

Some issues concerning "innovation in services" were presented in chapter 2. Some empirical results concerning innovation in services based on the IEK were discussed in chapter 8. Below, in section 10.2, the topic will be revisited again and some further conclusions will be drawn.

The first purpose was:

> … to investigate whether KIBS firms are innovative, and, if so, what types of innovation they do.

In order to address the first purpose, it was first necessary to define KIBS (as done as part of research question 1 in chapter 4) and have an understanding of innovation in services (which was done as part of research question 2 in chapter 2). In chapter 5 a background of KIBS firms, their size- and labour structure was presented and, building on that, the purpose was specified. It was concluded that we may expect KIBS firms to be more innovative than other firms and also that the extended taxonomy of product and process innovation, and more precisely the four types of innovations, would act as an instrument to identify innovation. This was then empirically investigated in chapter 8. In section 10.2.3 below, conclusions will be drawn concerning KIBS firms and innovativeness.

The second purpose was:

> … to investigate whether and how process and product innovations affect the number of employees in the Swedish KIBS sectors.

The second purpose builds directly on the first purpose and thus includes elements from the research questions as well. The research field of "innovation and employment" was presented in chapter 3 and in chapter 5, where a sketch of how I assumed innovation of different types affected employment was presented. Chapter 9

discussed the impact of innovation on employment in the short run. Purpose number two will be revisited in section 10.2.4 below.

10.1 KIBS firms have KIBS features and fit the stylised facts

Chapter 4 was devoted to KIBS, the concept of KIBS, KIBS features, common perceptions about KIBS firms and which firms should be considered KIBS firms. KIBS firms are commonly associated with great expectations and they are seldom associated with negative features. Yet, or even naturally, the concept is often not defined in such a way that it is possible to empirically investigate the sector. Chapter 4 argued for a definition of KIBS based on industrial classifications as an alternative to other methods to identify the sector. One of the pitfalls of such an operationalisation of the sector is the weakness of the industrial classification itself. Many KIBS-firms are mis-classified as are firms in other segments of the economy. However, most firms in the IEK that objected to the verbal industrial classification description appointed to them fitted the description of another KIBS sector. All in all, 45 firms (out of 1013) were omitted for being gravely mis-classified. Hence, the methodological difficulty of using industrial classifications is not large enough to discourage use of industrial classifications as a tool. However, the problem of misclassification increases with a finer level of classification. I would, based on the findings from the IEK, discourage use of levels finer than three digits.

The lesson learned was thus that although the industrial classification is not fully accurate, it is good enough to use as a basis for a sector study. The approach was taken to distinguish between KIBS features (an ephemeral set of features, described in section 4.1.2) and KIBS firms (firms belonging to a certain sector which is supposed to have many firms with KIBS features).

Data from the IEK were used to design a KIBS-index that measured some KIBS features. The KIBS-index measured the extent to which KIBS are sources of innovations, the degree of variation in products (standardised-customised-bespoke), and the share of employees with higher education and further training and, very important to remember, excluded all firms that had households as their main clients. A firm with a high KIBS-index is considered to better fit the KIBS features than a firm with a low KIBS index.

The KIBS index thus made it possible to question the effectiveness of the definition. The definition appears to include the firms with KIBS features. Hence, there is no need to adjust the definition of KIBS presented in Table 4-4. All included sectors have a similar level of "KIBS-ibility". Also small firms have a similar level of KIBS-ibility and, maybe most interesting, some governmental organisations have KIBS features and should be included. The number of governmental organisations included in the IEK, however, is very limited and further investigation should be made into this field.

The KIBS-index also gave us reason to reflect upon KIBS features as a definition in itself. One important objection to such an approach was presented, that of deciding when a firm had too few KIBS features to be considered a KIBS firm. There is no clear cut-off point between KIBS firms and non-KIBS firms. This shows how difficult it is to identify KIBS firms through a questionnaire, even though the questions were

tailor-made to catch KIBS features. One important lesson that deserves to be repeated is that KIBS features are not eternal and any definition of KIBS should be under constant revision.

There is also a point to the vagueness of the KIBS concept. If not properly identified, it is possible to associate these firms with all the desired features. These firms could then be bearers of the expectations of the new economy and only with difficulty could such an exaggerated image of KIBS be contradicted. I do not claim that the image of KIBS is invalid. On the contrary, as seen below, many of the six stylised facts presented in chapter 4 do find support from the IEK. I only wish to point out that these stylised facts commonly describe an ideal type of firm rather than a sector of firms.

Three of the six stylised facts presented in section 4.1.3 have been empirically investigated in the thesis and all three find support in the IEK.[68]

KIBS firms are innovative
The s-CIS2 showed that KIBS and financial services were significantly more innovative than other surveyed services. However, the IEK did not find any difference in innovativeness between T-KIBS and P-KIBS (see regression #6). We also saw that KIBS firms are innovative and tend to make more than one type of innovation. We will come back to the issue of innovations, types of innovations and combinations of innovations later on. We may also note, although this was not discussed in the empirical chapters, that a minority of all KIBS firms conducted R&D (39.4 per cent), although innovative firms were more likely to conduct R&D (44.0 per cent) than non-innovative firms (19.3 per cent). Since not even half the innovative KIBS firms conducted R&D, it would not have been an appropriate indicator of innovation in the IEK.

KIBS firms have a highly skilled labour force
Analysis of official statistics (RAMS B 2000, 2002) showed that KIBS*, as compared to the whole economy, had a higher percentage of employees with high education. Although the indicator was rather coarse, it is obvious that the labour force is highly skilled. This high education level may in part be related to the young age structure of KIBS. What was also interesting is that men in KIBS* had a higher level of education than women in KIBS*. This is contrary to the rest of the economy, where women tend to have higher education than men. The fact that men in KIBS have higher education than women may be a sign that men work in occupations requiring more extensive education than the occupations of women. If that is the case, an occupational segregation may be suspected. This is worrying, since recent media articles (Brundin 2004, Pröckl 2004, Nilsson 2004) emphasise that it is increasingly and particularly hard for female engineers to find work. These female engineers are in this case the

[68] The thesis has not discussed the creation and diffusion of knowledge by KIBS firms but focused on innovation. Therefore this statement has not been discussed. The growth of KIBS firms has already been addressed in section 4.1.3, therefore that particular statement is not discussed further here except to note that the number of bankruptcies have increased considerably in all KIBS* sectors, computer related activities in particular. The thesis has not focused on the ability of KIBS firms to link firms either, but it appears that KIBS firms have clients in 2-3 main sectors of the economy and that they are well integrated into systems of innovation.

persons who could lessen this occupational segregation (Brundin 2004, Pröckl 2004, and Nilsson 2004). On the other hand, with the exception of computer related activities, KIBS* was gender integrated in 2002.

KIBS firms help other firms to be innovative

The thesis has shown that KIBS firms, innovative as well as non-innovative, function as sources of innovation for their clients. This is a very important function, but must be discussed separately from the issue of innovativeness in the KIBS firm which we will come back to later on.

Having said this, I want to further emphasise how important it is to study, analyse and discuss the KIBS sectors. KIBS firms make up an important part of the economy and, since they are well integrated into the innovation system, they support other parts of the economy. These firms often facilitate innovation in other firms. These other firms are most commonly other service sector firms and this is important to repeat since it clearly shows how false the image is of services being merely a support system to the manufacturing sector.[69]

Summing up the first research question:

1. A definition of KIBS was developed in Table 4-4 and the definition was validated.

2. The investigated stylised facts on KIBS hold. KIBS firms are innovative to a high extent, they have a highly educated labour force, and they help other firms to be innovative.

Importantly, but not directly relevant to the first research question, is the issue of what a service is. Throughout the thesis we have seen that the ideal type of service, (exemplified by the quote in section 2.1.1 by Hermelin 1997), sometimes is an obstacle to analysing services and more specifically innovation in services.

We have seen that some services are tangible and others are not co-terminally consumed and produced. This implies that services today may be produced and consumed at different times and locations, allowing, in some circumstances, for exports. My point is that not all services are ideal type services but they should still be regarded as services as long as the content (the service) is more important than the package (the goods component). Consequently an investigation of services should not be a priori restricted by the characteristics of an ideal type of services. A similar argument concerns service firms. These should not be assumed to be ideal type service firms (i.e. pure service producers) but there must be possibilities to also catch other production and behaviour (i.e. goods products). This, naturally, also goes for manufacturing firms: it must be acknowledged that manufacturing firms also produce

[69] The KIBS firm in the sample is sometimes a spin-off (21.3 per cent) and it seldom has the firm it spun-off from as a very important client (3.2 per cent). The debate (c.f. Karaomerilioglu and Carlsson 1999) on service sector spin-off and outsourcing did not find much support in the IEK-survey.

service products: the division between goods production and service production is by no means as rigid as suggested by industrial classifications.

10.2 The understanding of innovation lies in the eye of the observer

One important lesson is that as soon as we leave the Schumpeterian concept of innovation and approach a view of innovation as a common, incremental activity, the boundaries of the concept weakens. This boundary-setting problem is apparent not least in services. Before going into a discussion on the boundaries of the innovation concept, the taxonomy of product and process innovation and its applicability will be discussed.

10.2.1 The extended taxonomy of product and process innovation

In this thesis I distinguish between four different types of innovations: the by now familiar GPIs, SPIs, Tπs and Oπs. These are either product innovations or process innovations. This does not mean that when reference is made in the literature to product and process innovation all four types are encompassed. On the contrary, it is highly unlikely. SPIs are not always included in discussions on innovation in manufacturing, despite the fact that many manufacturing firms also make innovation in services. The example of Six Sigma, discussed in section 2.2.3, may be brought up here. Six Sigma is clearly an SPI, but it was first developed by a manufacturing firm, Motorola. Likewise, GPIs are not included in investigations on innovation in services. The IEK showed that 167 KIBS firms made GPIs as well as SPIs, even though SPIs were much more common.

Tπs are very often included in discussions on innovation, in services as well as in manufacturing. Oπs, on the other hand, are seldomly included, and, furthermore, they are not even included in the main text of the *Oslo Manual* (OECD 1997) but placed in an appendix. It is controversial to include Oπs in a concept of innovations, and some prefer to discuss organisational change, rather than organisational innovation.[70] Here, however, Oπs are included and I have also shown that Oπs are both common, and have an impact on employment.

There is, however, another matter concerning the taxonomy of product and process innovation. The taxonomy was considered as an assimilationist tool for analysing innovation, implying that the tool would obstruct the view of many innovations in services. What we must recall then is how that statement refers to the simple taxonomy of product and process innovation, not the extended taxonomy of product and process innovation. The extended taxonomy of product and process innovation contains innovations otherwise omitted, and that was also shown to be a probable reason why Evangelista (2000a) found many innovative firms had made neither product innovations (SPIs) nor process innovations (Tπs).

[70] If Oπs were excluded from the concept of innovation in the IEK, the innovation rate would be lower. If only SPIs, GPIs and Tπs were included in the concept of innovation then the per cent of innovative KIBS firms would be 73.6 per cent, instead of 81.2 per cent.

I scrutinised the non-innovative KIBS firms which claimed to have made other important changes. These firms did not mention innovations that could not be categorised as GPIs, SPIs, Tπs or Oπs. This is crucial since evident that the extended taxonomy of product and process innovations is applicable to the innovative efforts of KIBS firms. It is important to remember that KIBS firms make all four types of innovations and also to include questions on all four types of innovations in innovation surveys and to ask for them separately.

We saw that KIBS firms could separate between GPIs, SPIs, Oπs, and Tπs. Hipp et al. (2000) found that the firms in the German CIS2 were not capable of differentiating between SPI, Tπ and Oπ. This result was attained by comparing the description the firms made of the innovations with the type of innovation. The questions in the IEK survey were formulated to make the difference between the types of innovations clear. It is important to remember that if the questions are posed carefully, it is possible to distinguish whether a specific innovation is a Tπ, an Oπ, a GPI or an SPI.

Another matter is how the objectives to innovate did not in all cases go hand in hand with the type of innovations they made. This is apparent when pure product and process innovators are cross-tabulated with objectives to innovate. We saw in Table 9-5 that a product-oriented objective did not always result in a product innovation. For example, the objective to replace existing products was considered very important by 169 innovative firms and 91 of these were multi-innovative. These 91 firms are difficult to investigate, since they have made several types of innovations. What is interesting is the remaining 78 firms and what type of innovation they made based on the objective to replace an existing product. Product innovations were made by 29 of them and 49 made a process innovation. That means there were actually more firms making (only) a process innovation to replace an existing product than making (only) a product innovation.

Leaving possible errors of measurements aside, we must question the relationship between objective, the type of innovation made and the direction of impact on employment: the stylised relation of Figure 10-1 does not work. This is an important reminder that it is easy to presume relations and rationales but important to test the assumptions. The type of innovation is not always a logical consequence of the objective to innovate.

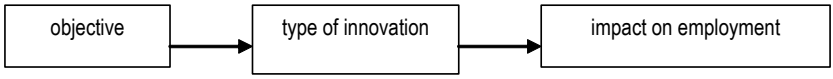

Figure 10-1. The stylised relation (1).

Comment: a stylised relationship of how objective to innovate impacts the type/combination of innovations made and how these, in turn, have an impact on innovation-induced employment change.

The lesson learned is that the objective to innovate is not inherent in the type of innovation. It would probably be very fruitful to investigate the relation between the objective to innovate, the type of innovation made and the consequences on

employment. This by no means suggests that the extended taxonomy does not hold, only that it does not always entail full information on *why* innovations are made.

10.2.2 Variation and breadth in innovation

After the conclusion of whether the extended taxonomy of process and product innovation is a valid and applicable tool to identify innovation in KIBS services, it is now time to discuss the innovation concept itself and what it contains. All changes are not innovations, as we use the concept, but the question of which changes are is problematic.

In this section we will see that there is not one, but several views of innovation in services and that the view on innovation affects what is considered an innovation.[71] We will now go on to discuss two other dimensions of innovation, breadth and variation.

The first dimension is that of breadth of innovation. Not all changes are innovations and the question is where to draw the line between trivial (change) and non-trivial (innovation). There is no distinction which is instrumental in directly separating between trivial changes and non-trivial innovation. A certain impact is a prerequisite of an innovation. In the IEK survey, this was specified through the use of the key words "significantly improved" product (for GPIs and SPIs) and "intent to more efficiently" perform a process (for Tπs and Oπs). The point is that these circumscriptions replaced the use of the word "innovation" as a division between change and innovation. When the word "innovation" is used it is easier to assume that only innovations are included than when the word "change" is used. One cannot assume that all changes are innovations when the word innovation is circumscribed. The meaning of innovation is circumscribed, we may recall, because the word innovation was excluded from the questionnaire so as not to discourage firms that made innovations but did not identify with the word as well as to slightly widen the innovation concept.

In the thesis, the breadth of the innovation concept was tested via comparison to innovation levels in other studies (in Table 6-3) and via comparison of impact on employment in other studies (in Table 8-2). The comparisons showed that the concept of innovation as used in the IEK not only included more types of innovations (GPI, SPI, Oπ and Tπ) but also a higher number of innovations and a lower rate of firms with innovation-induced employment change. That indicates the concept of innovation is broader in the IEK than in the s-CIS2.

Having stated that, the IEK's meaning of innovation must be clarified. Innovations in services potentially differ from innovations in manufacturing. First of all, the innovation concept is broadened here deliberately to avoid an assimilationist view on innovation which would only include innovations in services that resemble innovations in manufacturing. With the notion that the concept of innovation, as well

[71] We have already discussed how the inclusion of Oπs made the innovation concept used in this thesis differ from a more mainstream concept of innovation.

as the taxonomy of product and process innovation, was developed with innovation in manufacturing in mind, the questions on innovations were here broadly formulated.

Now we will turn to the second dimension, that of variation in products. We saw in the IEK that many firms made bespoke products and customised products and that makes the question of how innovation relates to variation in products crucial. Are innovations resulting in bespoke production innovations, or does the concept of innovation presume an element of reproducibility as expressed by Sundbo (1998:3)?

> It [the innovation] must be reproducible; a new service product must be sold in many copies, a process, organisational or market innovation must be introduced generally in a firm.

Objections to seeing one-off innovations (as discussed in section 2.1.3.1) as full-fledged innovations may also be traced in the quotes by Hipp et al. (2000:428) and Miles (2001a:37) both in section 2.1.3.1. Nevertheless, far from all production is standardised and limiting the concept of innovation to changes in standardised products threatens to exclude many innovations. I would consider the quote by Sundbo as mirroring a narrow view of innovation. Still, the high share of bespoke production begs the question of whether all bespoke production, all variation in products, is innovation. What should we make of firms that have *variety as routine*, as discussed in the quote by Hipp et al. (2000:428) in section 2.1.3.1? The 52.9 per cent of firms in the IEK which usually make bespoke production definitely have variety as routine and that is also true of the 31.8 per cent of firms with mainly customised products.

Parallels could here be drawn to another type of variation in products, that of *continuous change mode of innovation* as discussed by Tether (2004:5). The difference between a continuous change mode of innovation and a one-off innovation is that, crudely speaking, the former discusses improvements of existing products and the latter concerns a (more or less constant flow of) new innovations. That means a firm with a continuous change mode of innovation is not necessarily making bespoke production. Tether describes how different firms have different modes of innovation (contrasting the step-wise, reproducible innovation staircase to the continuous change mode of innovation). He concludes that the CIS favours the former mode of innovation. Even though the continuous change mode of innovation is not identical to bespoke production, it reminds us that just as production may be organised in different ways, innovation may be organised differently.

The crux is that there is nothing inherent in the operational definition of innovation in s-CIS2 nor the IEK which excludes one-off innovations. The circumscriptions of the IEK do not address the number of times a variation in products must occur in order to be considered an innovation. There is thus no stipulation of reproducibility in my definition of innovation (and neither is there one in Sundbo's (1998:3) definition which uses the circumscript of significant changes instead).

In the three quotes discussed above, there is an underlying assumption that one-off innovations are less important than innovations in standardised production. However, the impact of an innovation is an important facet of what makes it an innovation. In

contrast to an invention, an innovation must have influence on economic development, as for example Drejer (2004:557) points out. But this does not entail that one-off innovations would not have an economic impact. That is another issue which is related, but not identical, to that of reproducibility. A bespoke product which is a long-term commission definitely has an economic impact. My point is that it may not be the variation in products per se, but issues related to the variation in products, which makes the division of innovation and change fuzzy.

Taken to its extreme, what does this imply? First of all, remembering the example of the flight simulator which opened chapter 2, the flight simulator does not fulfil the prerequisite of reproducibility and that makes it, in the eyes of Sundbo (1998), something other than an innovation. Second, we saw in Table 8-3 that bespoke producers were underrepresented as innovators, drawing the conclusion that the firms were well equipped to distinguish between variation and change. In the light of Tether (2004), another conclusion may be drawn. Maybe these firms should also be considered innovative, but questions 4, 5 and 6 of the questionnaire are not equipped to appeal to their view of innovation. If all firms which mainly produce bespoke products were to be regarded as innovative, then 93.1 per cent of the firms in the IEK would be innovative.

Which variations in production we consider as innovations depends on how we view innovations. The continuous change mode of innovation is connected to the demarcation perspective and not convincingly incorporated into the assimilationist perspective of innovation. This is evident, among other things, in why these innovations are not included in the questions on innovation in innovation surveys. This is also due to the difficulty of measuring these innovations.

I have shown there are at least two innovation concepts and that the understanding we have of the innovation process has an impact on the number of innovations we perceive. Throughout the thesis, emphasis has layed with a step-wise view of innovation, although the steps are smaller, figuratively speaking, than in assimilationist research. Tether (2004:5) points to the existence of another dimension of innovation, and it is not clear to what extent the firms have reported this innovation in the IEK. The questions do not a priori exclude continuous change as innovative, but the fact that many bespoke firms do not see themselves as innovators is a clear indication of a narrower understanding of innovation among the KIBS firms. The point is not to argue one concept of innovation over another but to clarify that there are several modes of innovation and thereby several innovation concepts.

The last paragraphs have discussed to what extent variation in products is innovative. We have seen there is no common opinion in the matter. We may further make parallels to the continuous change mode of innovation where the products are continuously improved and that these are considered innovations by some but not by others. This entails that our standpoint of variation in products and innovation is related to our view of innovation in services in general, an obvious conclusion but it surely merits being spelled out clearly.

Three analytical perspectives on innovation in services were discussed in the beginning of the thesis: the division of research into assimilationist, demarcation and synthesis perspectives. To sketch the main points of the discussion, the assimilationist perspective merely adds services to the list of sectors investigated. The demarcationists focus on the peculiarities of services. The synthesis perspective recognises that innovation taking place in service sectors may differ from innovations taking place in manufacturing sectors and how findings on innovation in service sectors may enrich the concept of innovation in manufacturing.

There is no objective opinion on which changes should be considered innovations. There is a great division in this sense between assimilationist and synthesis/demarcation perspectives on innovation and it is important to keep in mind that if we embrace a continuous change mode of innovation into the innovation concept, the innovation concept will be able to better describe the innovative activities taking place in some service firms, but at the same time it will most probably dilute the concept of innovation.

As the synthesis approach points at, studies of innovation in services may feed back into studies of innovation in manufacturing. Remembering how service activities are carried out also in manufacturing, it is logical that further knowledge on innovation in services may result in increased knowledge on the manufacturing sector as well. I would like to point to two areas where knowledge of innovation in services may provide further insights into innovation in manufacturing.

First of all, we have seen that KIBS firms have made all four types of innovations, including Oπs and GPIs. We have also seen that other innovation surveys (i.e., Statistics Sweden and NUTEK 2000, Statistics Sweden 1998) do not include all types of innovations. It is a positive development that the m-CIS3 includes SPIs as product innovations, in contrast to m-CIS2 where it is unclear since reference is only made to "products" (Statistics Sweden 1998: question 1a in appendix; Statistics Sweden 2002: question 5 in appendix). However, it would be even more valuable to separate between all four types of innovations, as we have seen in the thesis that they have different impacts on employment. This would also provide a better understanding of what firms make which forms of innovations.

Second, far from all production in manufacturing is standardised. It would be valuable to question whether or not the concept of innovation in manufacturing includes reproducibility. Similarly, the continuous change mode of innovation is likely to occur in manufacturing and therefore should be investigated also there.

Summing up the second research question:

1. The extended taxonomy of product and process innovation is an adequate tool for identifying innovation in services.

2. An innovation should not be trivial. But what we consider trivial depends on the view we have of innovation (in services).

3. An innovation should include all innovations, independent of whether or not they are reproducible. This does not mean that all changes are innovations.

4. It is important to separate between two modes of innovation, the step-wise and the continuous change modes of innovation. The continuous change mode of innovation is harder to measure and eventually leads to another concept of innovation.

5. The discussion on innovation in services may feedback to innovation in manufacturing as well.

10.2.3 KIBS are innovative - and multi-innovative

The previous section (and thus research question 2) may have left some readers with a sense that all is in a state of flux: that the concept of innovation is fuzzy and unreliable. Research question 2 has shown that the concept of innovation - what should be considered new and important enough to be an innovation - is not an easy matter. It was also shown that the firms themselves identified certain changes as significantly important and causing changes in efficiency. We also saw that bespoke producers often did not perceive their production as one-off innovations: that these were not significant improvements. By applying another viewpoint of innovation, it could be argued that these changes too are innovations, but that is not the point of this section, which departs from the operational definition of innovation outlined in questions 4, 5 and 6.

Some key findings regarding innovation in KIBS are summarised in Table 10-1. More than eight out of ten, 81 per cent, of the Swedish KIBS firms innovated during the period 2000 to 2002. This is, as discussed, a rather high share.

The most common type of innovation was the Oπs. Of all KIBS firms questioned, 54.8 per cent had made Oπs. Oπ is a debated concept because the distinction between change and innovation appears to be particularly arbitrary in that case. Still, it is valuable to note that more than half the KIBS firms made changes to the organisation of work with the intent to more efficiently produce and deliver goods and services. It is also interesting to note that Oπs were as likely to have an innovation-induced employment change as any other type of innovation.

The second most common type of innovation was the Tπ which was made by about half of all KIBS firms. This is interesting since it shows that introducing technological equipment is an integral part of the activities of KIBS firms and it also gives us insight into KIBS as technology users. As we saw in Figure 2-4, purchase or development of technology is a precondition for Tπs and, since the question on Tπ in the survey addressed the introduction of technological equipment, question 6 may also be utilised to investigate KIBS as technology users. Now, not all introduction of technological equipment is a Tπ - it must be introduced with the intent to have an impact on efficiency. That means that there is probably a high level of undetected technology users among the KIBS firms where technological equipment were introduced but not with the explicit intent to affect efficiency. However, with certainty we may assert that

half the KIBS firms, during a two year period, were technology users, thereby supporting technology suppliers from other parts of the innovation system.

Table 10-1. Some key figures on innovation in KIBS.

	innovative		impact on employment	
	no of firms	(%)	no of firms	(%)
any type of innovation	785	(81.2)	338	(43.1)
product innovation	487	(50.4)	237	(48.7)
service product innovation	413	(42.8)	202	(48.8)
goods product innovation	167	(17.3)	73	(43.7)
process innovation	681	(70.5)	305	(44.7)
technological process innovation	493	(51.0)	218	(44.2)
organisational process innovation	530	(54.8)	273	(51.5)
more than one type of innovation	535	(55.3)	268	(50.1)
multi-innovative	383	(39.6)	204	(53.3)

Comment: *for operational definitions of product innovation and process innovation, please see Table 8-5. The first pair of columns refer to number (and per cent) of all firms that have made a particular innovation from 2000 to 2002. The second pair of columns refer to number (and per cent) of all firms that had an innovation-induced employment change due to the innovation in question.*
Example: *the case of "product innovation": 487 of 967 firms in the sample are product innovative. That makes 50.4 per cent product innovators. Of these product innovators, 237 had an impact on employment. That equals 48.7 per cent of all product innovators.*
Source: *own calculations based on questions 4, 5 and 6 of the IEK database.*

Not quite as many, 42.8 per cent, had made an SPI. There is not much to say about this figure, except that one might have suspected product innovations to be more common than process innovations in an expanding sector. On the other hand, the KIBS sector was not in an expansive phase during the surveyed period. It may be understandable that process innovation was a more common strategy than product innovation. On the other hand, the most common strategy was product *and* process innovation. That is apparent in Table 10-1 since the very high figure of 383 firms made product innovations as well as process innovations. However, the share of multi-innovative firms was higher in other studies. We may also note that more than half of all firms in the IEK, 55.3 per cent, made more than one type of innovation.

Lastly, and this is very important, a notable number of KIBS firms made GPIs. Other surveys of service sectors, discussed in the thesis, did not even include GPI as an option for service sector firms. Although "only" 17 per cent of the firms made GPIs, and most of them also made other types of innovations (see Table 8-4), this is worth noting. KIBS firms, and thereby also service sector firms, made GPIs and this must be acknowledged also in innovation surveys.

Having shown that KIBS firms are innovative, and that they make GPIs as well as Oπs (in addition to "merely" SPIs and Tπs) it is also important to point out that they are often multi-innovative, meaning that they have made product innovations as well as process innovations. What is important to remember is that product and process innovation may be understood as parts of the same strategy, and not different strategies.

Above I showed that at the very least half the KIBS firms were technology users. I also showed that over eighty per cent were innovative: i.e. innovative in their own right. Another aspect is that KIBS firms act as sources of innovation. Three different measurements of sources of innovation were applied in the thesis. Among the KIBS firms, 40.9 per cent helped their clients develop products and routines, 75.6 per cent stood in frequent contacts with their clients (even though this did not always have an impact on the product, as we saw) and 80.6 per cent co-operated closely with their clients. This reaffirms that KIBS firms have a positive impact on other firms in the innovation system.

What is furthermore interesting is that innovative firms more often functioned as sources of innovation. Table 8-1 showed that 34.6 per cent of the non-innovative firms acted as sources of innovations (i.e. helped develop products and routines for their clients) whereas 41.9 per cent of the innovative firms acted as sources of innovation. My conclusion is that these two activities are complementary. This is interesting, and the causality of this should be investigated. Are these KIBS firms more innovative because they co-develop or do they co-develop because they are innovative? The interesting point is, however, that supporting innovation in KIBS will also support innovation in other firms of the innovation system.

Summing up the first purpose:

1. Eighty-one per cent of the KIBS firms were innovative.
2. Oπ was the most common type of innovation and it also had an impact on employment.
3. GPIs were not common, but they existed.
4. Process innovations were more common than product innovations.
5. Many firms were multi-innovative.
6. Innovative KIBS firms also tended to function as sources of innovation to a higher extent than non-innovative KIBS firms.

10.2.4 Innovation has an impact on employment

The previous section showed beyond question that the KIBS firms are innovative and that innovativeness in the KIBS firm also was associated with a capacity to act as a source of innovation to client firms. In this section we will once more return to the issue of the impact on innovation-induced employment change. I previously discussed that it is important to separate between the impact on total employment and the impact on innovation-induced employment change. Innovation-induced employment change is only the change in employment which the firms allege is caused by innovation. In short, even though innovation-induced employment change is one part of total employment change, they do not always go hand in hand (as seen in footnote 50) and should be separated analytically.

There are many other reasons for employment change, not least change in demand. An important contribution would be to separate the impact of innovation and the impact of changes in demand. However, that has not been in focus here; demand has not been considered at all.

It is important to keep in mind that only about 43 per cent of innovative firms had an innovation-induced employment change. Innovations do not always have a (measurable) impact on employment. To that may be added that product innovations do not always have a positive impact on employment and process innovations do not always have a negative impact on employment as seen in Table 9-3 and also, for example, in Manninen (2002:176).

The extended taxonomy of product and process innovation was not very successful in explaining variation in innovation-induced employment change. The statistically significant results were difficult to explain and, overall, the four types of innovations explained little. The fifteen combinations of innovations explained considerably more, but still the results were difficult to explain.

Combination of innovations explains twelve per cent of the variation in innovation-induced employment change. Although this may appear futile, it is by no means a low share of the variation. One must remember that the regression did not take into account for example (1) the number of innovations made by the firm within each combination of innovations, (2) magnitude of innovation (radical/incremental), (3) objective of innovation apart from the fact that process innovations were described as improving efficiency, (4) whether the product innovation was new or improved, whether the product partly or totally substituted another product in the firm production portfolio and, (5) whether the innovation is new to the world or new to the firm. Lifting our gaze from the narrow perspectives of regressions, it must be remembered that an array of factors other than type of innovation are important and that was also clear from Pianta's accounts of stylised facts, discussed in chapter 3.

To that we must also add that there is evidence that the innovation concept used here is somewhat wider than the innovation concept used elsewhere. It is logical to assume that the "extra" innovations included in this investigation have had a smaller impact on employment. Pivotal is that combination of innovations is one important piece of the puzzle to explain the impact of innovations on employment in services.

Scrutinizing the firms which made more than one innovation, it was clear that the impact on employment was not always the expected. There appeared to be a *cocktail effect* where the total of the parts did not equal the sum of the individual components. The combined impact of, say, an organisational process innovation and a service product innovation is not simply the sum of the "impact of organisational process innovation" and the "impact of service product innovation".

This is an interesting result which deserves further attention, above all an answer to the question of how this cocktail effect works. Unfortunately, it is not possible to take the discussion of the cocktail effect of innovations very much further in this context; it should be investigated in case studies. Alternatively an additional question in an

innovation questionnaire, which asked whether the innovations were dependent of each other, could be tested. There is also the possibility that it is not the cocktail innovation per se, but the behaviour that gives rise to the cocktail innovation, which also causes these effects.

The unexpected cocktail effects were discovered only because the survey distinguished between all four types of innovations (in contrast to most innovation surveys) and that data was analysed as combinations of innovations. The results call out for further detailed investigation of the situation in which these innovations take place. It is clear that the combination of innovations undertaken within a firm has influence on the impact on employment. This is with all certainty also the case for manufacturing firms and should be kept in mind for further research also in that field.

In Figure 10-1 a stylised relationship between objective, combination of innovation and impact was outlined and it was shown that this stylised relationship did not hold. The rationale behind the innovation (as expressed by the objective to innovate) is not always mirrored in the type of innovation made and consequently, neither on the impact of innovation. To take but one example, if the objective behind the process innovation is to replace an existing product, should we then be surprised that the impact upon employment is not as expected?

Regressions #5, #7 and #8 are interesting in this light. Regression #5 (where the 15 combinations of innovation were independent variables) explained 12.2 per cent of variation in innovation-induced employment change, i.e. had an adjusted R^2 of 0.122. Regression #7 (where the nine objectives to innovate were independent variables) had an adjusted R^2 of 0.163. In short, the combinations of innovations explained almost as much as the objectives to innovate. The surprise comes in regression #8 which includes both the combinations of innovations and the objectives to innovate. If the stylised relationship objective, combination of innovation and direction of impact on employment (as outlined in Figure 10-2) was a correct representation of the line of events, then the objectives and the combinations would be alternative explanations and including both would not add much to explaining variation in innovation-induced employment change. Quite the contrary, it turned out in regression #8 that they were complementary explanations since the adjusted R^2 was as high as 0.271. My point is that the extended taxonomy of product and process innovation, together with objectives to innovate gives a rather good explanation of factors which influence innovation-induced employment change in KIBS.

The extended taxonomy of product and process innovation is one tool for understanding the employment impact of innovation. It is important especially when complemented with the objectives to innovate. The objectives to innovate resulted in the expected employment impact (i.e. in regression #7 and #8, the objectives associated with product innovation gave rise to employment increase and the objectives associated with process innovation gave rise to employment decrease). A plausible explanation as to why product and process innovations did not always give rise to the assumed impact on employment is that the underlying objective did not suggest the same assumed impact on employment. In short, the objective to innovate

did not always go hand in hand with the type of innovation and therefore it did not have the expected impact on employment.

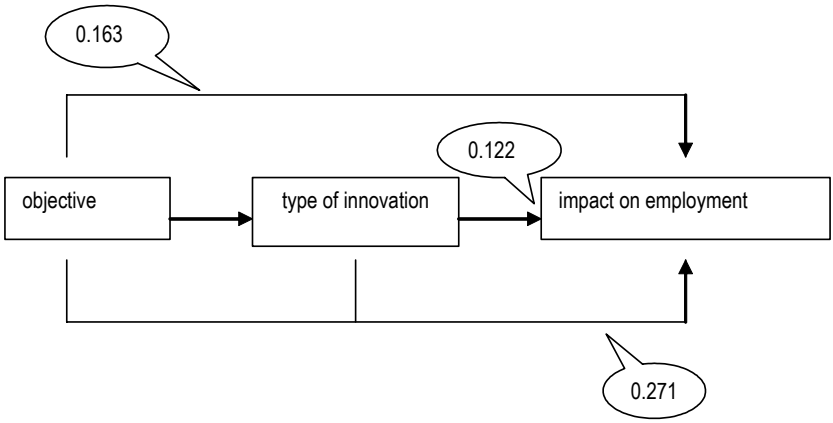

Figure 10-2. The stylised relation (2).

Comment: the figure represents the stylised relation between objective, type of innovation and impact on employment. The figure includes the adjusted R^2 values of regressions #5, regression #7 and lastly regression #8 (0.271, the explanatory value of objectives and combinations of innovations).
Source: Table 9-6.

The extended taxonomy of product and process innovation could be refined to better explain innovation-induced employment change. First of all, combinations of innovations explain more of variation in innovation-induced employment change than types of innovation. Combinations of innovations also allow for cocktail innovations to be detected. Second, not all process innovations are labour-saving. Clearly distinguishing between rationalising process innovations and other process innovations would probably improve the results (cf. Peters 2004). Third, it is important to analyse the impact of innovations on innovation-induced employment change and not on total employment change.

Summing up the second purpose:

1. Many product and process innovations have an impact on innovation-induced employment change.

2. Product innovations do not always have a positive impact on employment and process innovations do not always have a negative impact on employment.

3. Combinations of innovations explained more than types of innovations: still results are difficult to explain.

4. Firms which made more than one type of innovation had a different impact on innovation-induced employment change than firms which made one type of innovation only: there may be a cocktail effect of innovation which should be examined further.

5. It may be that GPIs do not have the same impact as SPIs on employment.[72]

6. The objective to innovate is not always mirrored in the type of innovation made. This may in part explain why the expected results were not always attained.

7. A broad concept of innovation is used in this thesis. Another conceptualisation of innovation, closer to that of the *Oslo Manual* (1997) might have been more successful at explaining the innovation-induced employment change.

10.3 One step further

This chapter has attempted to collect some of the red threads of this thesis. One important thread, which deserves further attention, is that of concepts and the treacherosity in concepts. Most concepts and divisions are artificial and serve the purpose of clarifying and simplifying the complicated. Over and over again, this thesis has stumbled on concepts which, on closer inspection, are intrinsically blurred. Here we have all the concepts (with family resemblance) surrounding KIBS, we have the industrial classifications, we have the taxonomy of product and process innovation. In all of these cases we showed how, when scrutinised, the concepts had flaws and overlaps. This observation merely mirrors the treacherous clarity of concepts: the phenomena mirrored are not as clear as the concepts may lead us to believe.

The dissipation of some central concepts has consequences which merit a further discussion and cannot be dismissed with the general comment above. This concerns in particular the division between goods and service products, the division between manufacturing and service sectors, and the division between innovation and change.

We have seen throughout the thesis that the concept of service products is broader than the ideal type service product. This suggests that there is a range of products that are in between (ideal type) services and (ideal type) goods. One example of these in between products is embedded services, such as books. The service content of a book (which is a good) is high and the same content may theoretically be found also in a pdf-file (which is not tangible and therefore a service). A similar example is music which may be embedded on a CD but also available in electronic form (for example mp3-files). Another example is goods and services sold together, as for example often mobile telephones.

The distinction between goods and services is evaporating for certain products. It may be questioned how meaningful the distinction is. These issues, let alone how to resolve them, lies beyond the scope of this thesis. It must however be pointed out that the distinction into goods and services sometimes is more hindrance than enlightment. When a service does not fulfil the ideal type characteristics, we run the risk of making assumptions about its use or properties. Rather than seeing goods and services as a dichotomy, maybe we should see production as a continuum where (ideal type) goods

[72] Although statistically significant, the number of pure GPI firms which had an innovation-induced employment change was very low. Therefore the result should be regarded with some caution.

and (ideal type) services are end points and products have both tangible and intangible properties.

The artificiality of the division between manufacturing and services is augmented by the dissipation of the division into goods and services. We may question what value the distinction into agriculture, manufacturing and services may have to analyse the economy given that the bases of the distinction (i.e. the dichotomy of goods and service products) is dissipating. Manufacturing firms often produce services and, as we have seen in the IEK survey, service firms also produce goods.

One important reason, however, not to abandon the trichotomy, is that it clearly indicates, if not the importance so at least the magnitude, of services in the economy. Abandoning the concept of services and manufacturing may lead to further focus on manufacturing and the importance of manufacturing. The trichotomy is useful as a figure of thought but less useful as a tool for analysing the economy in detail. It may also be added that the same type of flaws is also inherent in the industrial classification system.

We have so far focused on the withering differences between goods and services and, following that, manufacturing and services. This argumentation has implications for innovation as well and we will round of with that but before that we will discuss the division between innovation and production. Using the distinction into bespoke-customised-standardised production, we found that it was tricky to draw the line between innovation and production. Little production in KIBS is mass-produced (and thereby standardised) and as soon as a product is not mass produced, it is crucial to find an analytical division between change and innovation. An additional complication is that of the professional content of products of KIBS. If KIBS firms solve problems for their clients, this professional problem solving implies that, in the words of Hipp et al. (2000:428) "variety is routine". Unless we are willing to accept that all production of professional problem solving is innovation, we need to find an analytical tool to distinguish between the variety which is routine and the variety which is not.

Once more, it is crucial not to through out the baby with the bathwater. Knowledge intensive firms are innovative but not all they do is innovation. We must also keep in mind how KIBS employ approximately ten per cent of the Swedish labour force, and how the majority of the employees are fairly high educated. KIBS is thus an important labour market for high educated and if we were to assume that KIBS were not innovative by implication we would reach the conclusion that a large part of the high educated were not innovative and could not be innovate.

The drawback of concepts is that they have and must have borders. Drawing these borders is ambiguous and leads to borderline cases. This in itself is not specific to the discussion of innovation in services. What is peculiar and troubling is that we do not have to look closely to find a great number of ambiguities. This begs the question: how should we constructively relate to the concept of innovation in products with a high service content, the ones produced in manufacturing firms as well as the ones produced in service firms?

11 The empirical results and possible implications

The previous ten chapters have scrutinised the innovativeness of the sectors referred to as KIBS, containing service sector firms such as IT-firms, R&D firms, legal firms, consulting firms, marketing and advertising firms among others. The pragmatic reader might have wondered why this at all is important. What does it matter if firms in these sectors are innovative or not?

About two-thirds of the employees in Sweden work in services and roughly ten per cent units of these work in KIBS. Today only approximately 20 per cent of the employees work in manufacturing. The long term trend shows a decreasing number of employees in manufacturing and an increasing number of employees in service sectors (cf. Ingelstam 1997:139). The decreasing number of employees mirrors, inter alia, how process innovations have rationalised work. Labour productivity has increased so that the same number of employees now produces more, much more.

Very little research has been conducted on innovation in services. Even less on how the number of employees is affected by innovation in services despite how many the sectors employs. Here is where the thesis makes an important empirical contribution.

The thesis shows that the KIBS sector is innovative: as much as 81 per cent of the firms are innovative. This is important since some innovations have an impact on employment but it is also important since it emphasises that manufacturing does not hold the monopoly on innovation.

Not only are KIBS firms innovative to a very large extent, they are also important to innovativeness in other firms as well. We saw in the thesis that innovative firms more often helped their clients to be innovative. This implies that supporting innovative KIBS firms will also have positive effects on other firms in the economy as it helps them to be innovative as well. KIBS firms are in some regards supporting structures to other parts of the economy, but it is crucial to keep in mind that they are above all innovative in their own right.

The impact of innovation is complex. Innovation sometimes gives rise to job growth and sometimes to job loss and this implies that, in the short run, from an employment point of view, innovation is not always positive for the individual employee. On the other hand, job-reducing innovations are a prerequisite for economic growth and firm survival and, in the longer run, also a prerequisite for production of new products.

One important dimension is that innovation not only affects the number of employees required but also their characteristics. This has not been an issue in the thesis, but it is nevertheless important to be aware that innovation does not have a skill neutral or gender neutral impact on employment: low skilled employees are generally negatively affected by innovation and low skilled women in KIBS firms are more negatively affected by innovation than low skilled men.

This implies that innovation in KIBS generally benefits the high skilled. The KIBS sector is increasingly a labour market for the high skilled. If we believe that high-skilled jobs are instrumental for innovation and economic growth, then we may be aware that innovation in KIBS firms provides that, and more innovative KIBS firms reinforces the pattern.

Although the idealised picture of services presumes that production and consumption of a service must take place simultaneously and at the same location this is not always the case. Some services may be exported, in particular business services, according to Blind and Jungmittag (2004:205-206). New technologies, such as telecom, facilitate this development.

Sweden is a country with a high skilled labour force, language skills and a well-developed KIBS sector. This implies that Swedish KIBS firms may have a market beyond domestic borders. The Swedish economy may therefore also benefit from the globalisation of services by focusing on the high skilled, knowledge intensive segments of the economy. The KIBS sector could therefore have potential to grow even further and provide more high skilled jobs to the economy.

We may also keep in mind that KIBS firms have an impact on other firms in the innovation system. KIBS firms play an interesting role in the transition to the information society. ICT is a ubiquitous techno-economic paradigm and KIBS firms function as a catalyst in this paradigm shift. One concrete example of this abstract reasoning is how the products of IT-firms are used among their clients first to rationalise production, then, less importantly, to introduce new products. We have also seen that IT use today is very common in Swedish firms, and KIBS firms play a role in this. The point is that the products of KIBS firms are also used to rationalise activity in their client firms. This is important per se and it may also be important to ask oneself which type of labour benefits from the rationalisation.

One problem for KIBS is that it is difficult to identify which innovative firms will grow and which will shrink. The available tool for differentiating between job creating and job destroying innovation - the extended taxonomy of product and process innovation - was not successful overall in explaining changes in employment. Three empirical results are, however, important:

- Firms that made service product innovations had a positive impact on employment.
- Firms that made goods product innovations, or goods product innovations in combination with organisational process innovations, had a negative impact on employment.
- Firms that made goods product innovations and organisational process innovations in combination with technological process innovations or service product innovations had a positive impact on employment.

A more successful instrument to distinguish positive from negative impacts on employment was the objective(s) the firm had to innovate. If we want to support

growing innovative firms, close monitoring of *why* they innovate would probably be rewarding. Firms that innovated in order to improve existing products, launch new products and enter new markets all had a positive impact on employment. So did firms that innovated in order to comply with standards and regulations concerning the work process. This is a more viable indicator of growing innovative firms than the indicator of product innovation.

Nevertheless, as we saw above, supporting innovative KIBS firms overall will have a positive impact on other firms in the innovation system. If we are opting for an innovative country, we should support KIBS firms in general and innovative KIBS firms in particular.

Appendix I: Details on the IEK survey

The survey was carried out through computer-assisted phone-interviews (CATI) made by professional interviewers. The interviews were made with the managing director or with other members of management. Most interviews were carried out with another member of the management: 63.2 per cent of the interviews were made with the owner or executive director of the firm and 15.9 per cent were made with the finance, human resources or R&D manager of the firm (this was specified in question 39, see appendix II).

NORSTAT AB Sverige in Linköping made the data collection during January 17th - March 3rd 2003. Pilot interviews were also made prior to the data collection to try out the questions of the survey.

Ten interviewers carried out the survey. All were carefully selected on the basis of their university education. A project manager with a master's degree in statistics supervised them. Prior to data collection the interviewers were gathered for a briefing including the wider purpose of the project as well as a detailed review of all questions. They were encouraged to come with questions and suggestions for improvement and some changes to the survey were subsequently made. I stood in close contact throughout the whole period of data gathering, and at mid-point all interviewers were once more gathered for a meeting to discuss the survey and any possible ambiguities. These measures were carried out to motivate the interviewers, to make sure they fully understood the questions themselves and to avoid systematic mistakes such as two interviewers interpreting the same question or response differently.

The interviewers also had help-screens with further information and examples to be able to answer simple questions about innovations. These help-screens build on the *Oslo Manual* and are found in appendix II.

Population and sample

The survey targeted KIBS firms in Sweden. It further targeted firms, not employees. This is an important choice since it affects the type of information obtainable. As a consequence, focus is on innovation and not employees. The firms have been able to give more detailed information on innovation patterns than employee backgrounds. If the survey had targeted employees instead, more specific answers could have been given to questions regarding mobility, occupation, gender, education and further education.

One purpose of the survey was to study changes in employment. This had two implications on the population. First, firms with less than five employees were excluded. Pilot interviews revealed that very small firms did not relate well to some questions of the questionnaire. Second, only firms with activity from 1 January 2000 and on were included since it is difficult to value performance and changes in employment which took place during only part of the period, not to mention the

methodological problems involved. The survey was therefore targeted to firms in Sweden with the following properties:

1. The firm belonged to one of the KIBS sectors as specified in Table 4-4. They thus belonged to one of the following ISIC rev. 3 codes: 7210, 7220, 7230, 7240, 7290, 7310, 7320, 7411, 7412, 7413, 7414, 7421, 7422, 7430, 7491, and 7499.

2. The firm was established no later than January 1st, 2000 and was still active when the survey was conducted (January - February 2003).

3. The firm had not less than five employees on January 1st 2000.

A firm may have several entities on different locations. The population was however based on firms and not entities (aka working units). Since some public organisations, such as universities and other public research establishments, had the relevant ISIC-classification codes, these were also included in the population and thus in the sample. The survey included unlimited as well as limited firms.

The original unweighted sample consists of 1013 firms taken from the population. The sample was (a) taken from two different registers and (b) stratified according to size and sector. It was then (c) further adjusted to omit misclassified firms.

(a) two registers: UC-select and Dun & Bradstreet

The population consisted of both limited and unlimited firms. It was not possible to draw a sample of these types of firms from the same register. The sample of limited firms was taken from the Dun & Bradstreet register while the sample of unlimited firms was taken from the UC-select register. UC-select have been used to draw a sample of firms with other organisational forms that also have organisation number and fulfil the requirements cited above.

The largest part of the sample consisted of limited firms taken from the Dun & Bradstreet register. The Dun & Bradstreet register was from December 31st 2000, i.e. one year after the starting point of the investigated period. This conveyed two methodological problems: over-coverage and under-coverage of the population. The problem of over-coverage concerns the firms which fulfilled the requirements above on December 31st 2000 but not on January 1st 2000. Under-coverage then concerns the firms that fulfilled the requirements on January 1st 2000 but not on December 31st 2000. The problem of over-coverage was solved through screening all interviewed firms. During the screening, firms included in survey population but not in the target population were identified and excluded. The Dun & Bradstreet register was cleared of inactive firms (those that did not hand in an annual report). Despite this measure to minimise under-coverage, there are most probably firms that should have been included in the sample but were not. This is the case with firms that decreased their number of employees between January 1st 2000 and December 31st 2000 so that they had five employees or more in January but less than five employees in December. This error is regarded to be small and unsystematic.

The Dun & Bradstreet register has been adjusted for four types of errors: (a) in-active firms, (b) no telephone number stated, (c) no ISIC-code stated and (d) number of employees not stated. Inactive firms (firms which did not hand in the last annual report) were not to be included in the survey and therefore these firms were omitted. Firms without ISIC-codes were also omitted. Eighty-four firms did not state their number of employees. Inquiries into another database, "företagsfakta" (2003, 2004) were used to fill in the blanks. The organisational numbers of firms with 250 employees or more have then been compared with the organisational numbers of Dun & Bradstreet. No firms with 250 employees or more were found. That entails that no large firm which should have been included were involuntarily excluded. A possible, but limited, source of error would be whether any of these firms had less than 249 employees in spring 2003 but more than 249 employees on January 1st 2000. In that (improbable) case these firms have involuntarily been excluded.

A smaller part of the sample was taken from the UC-select register. The information in the UC-select register dates from the fourth quarter of 2002 (and not, ideally, from the 1st of January 2000). The register is thus more recent than the Dun & Bradstreet register which makes the problems of under-coverage and over-coverage larger. The problem of over-coverage was handled with screening in the same way as with the Dun & Bradstreet register. The problem of under-coverage is similar but is larger for the sample of unlimited firms. There is nothing to indicate that this error should in any way be systematic.

In some cases, UC-select did not have information on the number of employees. This leads to non-response. To investigate the nature of this non-response, a closer investigation of 100 limited firms were made. Of the 100 firms, 88 were closed, 1 was de-registered and 4 were started after January 1st 2000. In other words, out of the one hundred firms where information on number of employees was missing, only seven should have been included in the population. The assessment was then made that the number of firms that were wrongly excluded from the sample was very small.

(b) the sample was stratified according to size and sector

The sample was stratified according to size (4 strata) and sector (16 strata). The size of all 64 strata was calculated with "power"[73] to satisfy a 90 per cent confidence interval for as many sectors as possible. The purpose of the stratification was to certify a high enough number of firms within each strata in order to be able to generalise to the population. Some of the sectors are very small and therefore it is still not possible to draw conclusions on a sector-level from some of the sectors included in the sample.

The KIBS-sectors vary considerably in size. Size of firm is of vital importance in innovation surveys since large firms and small firms tend to have different innovation patterns. Therefore the sample was stratified according to size. The number of sector-stratas limited the possible number of size-stratas and the number of size-stratas was limited to four.

[73] "Power" is a statistical method which may be used to estimate needed size of sample (Keppel 1991:71-76).

One size-stratum contains small firms, between 5 and 19 employees. The population of this stratum is rather large. The following stratum contains firms with 20-249 employees. It was decided that all firms with 250 employees or more should be included in the survey it is customary to include very large firms in innovation surveys. Firms with at least 250 employees in 2000 were subject to a census study since the number of very large KIBS firms is small. If not all very large firms were included a large number of employees in the sector stood the risk of being excluded in the sample. Firms with less than 250 employees were divided into three strata: 5-19, 20-49 and 20-199 employees. A random independent sample selection was made in the three strata.

Since the sample is stratified it is not representative to the KIBS-population as such unless it is weighted to compensate for sector-size and firm-size. Weights are designed using the FDB A (2000)[74] register to determine size for each stratum.

(c) adjusted to omit misclassified firms

There are a number of misclassified KIBS firms, as also reported in the study of Hipp (1999). The firms in the sample were, in question 14 of the questionnaire (see appendix II), presented with a verbal description of their code and asked if they were correctly classified. Many, 31.5 per cent of the firms reported to be misclassified. These firms were also asked what business they were in and the 314 responses were estimated. In most cases the firms had minor objections to the description. Many firms would fit better into another KIBS code.[75] In 41 cases it was obvious that the firm was not a KIBS firm. The firms that were severely mis-classified were omitted from the sample.

The 19 largest firms (with 250 employees or more) were also scrutinised. The articles of association of these firms were read and four firms which articles of association deviated considerably from the activities ascribed to KIBS firms were omitted from the sample.[76] The two methods of verifying the sample, subjective (via response in survey) and objective (via estimation of the articles of association) excluded a total of 45 firms. The original weighted sample consisted of 1013 firms and the adjusted (weighted) sample consisted of 967 firms as shown in Table A-1. Hereafter all data refers to the weighted adjusted sample.

[74] The FDB register was then called "CFAR". Data is the same independent of denomination of database.
[75] This observation is also supported by the study of KIBS in Finland Toivonen made (see section 4.4) which indicated that the boundaries between KIBS sectors are vague and growing increasingly vaguer.
[76] Please note that it is the weighted numbers, not the unweighted numbers that are presented here.

Table A-1. Weighted adjusted sample of KIBS sector and size distribution.

		firm size (number of employees)				
		--19	20--49	50--249	250--	total
7210	hardware consultancy	6	2	0	0	7
7220	software consultancy and supply	140	54	8	5	207
7230	data processing	8	4	1	1	13
7240	database activities	3	1	0	0	4
7290	other computer related activities	4	1	0	0	5
7310	R&D in natural sciences and engineering	13	7	3	1	24
7320	R&D in social sciences and humanities	3	2	0	0	6
7411	legal activities	26	6	0	0	32
7412	accounting, bookkeeping and auditing activities; tax consultancy	64	5	0	1	70
7413	market research and public opinion polling	7	3	1	0	11
7414	business and management consultancy activities	121	31	4	1	157
7421	architectural and engineering activities and related technical consultancy	150	31	3	3	187
7422	technical testing and analysis	5	2	1	1	8
7430	advertising	107	21	0	0	128
7491	labour recruitment and provision of personnel	5	2	1	0	9
7499	other business activities n.e.c.	68	24	4	3	99
total		730	195	27	15	967

Comment: the verbal descriptions of the ISIC rev. 3 codes may be found in Table 4-4.
Source: own calculations of IEK database.

Reliability of the data

The response rate of the survey was 69 per cent. The response rate varied somewhat between different sectors and firms of different sizes.

Statistical sample surveys always suffer from two types of errors: random errors and systematic errors. The random error depends on distortions between the sample and the population. Random errors are handled with confidence intervals, which states the interval where the true value lies.

During the data collection period the interviewers discussed the sample on a number of occasions with the project manager and me. Inactive enterprises and firms with less than five employees on January 1st 2000, were initially screened. Some problems were encountered with certain types of firms. These problems were handled consistently (i.e. all other interviewers were informed of the problem and its solution) as they occurred in order to minimise measurement errors.

The systematic errors distort the result in a certain direction. They are usually the result of non-response and errors of measurement. Non-response is a consequence of firms included in the sample that choose not to take part in the survey. A number of measures were taken to avoid non-response.

1. The interviewers were given the possibility to ask different members of the managerial body of a specific firm for an interview. If one member declined an

interview, the interviewer had the possibility to ask another member of the managerial body. This reduces non-response.

2. The firms were promised the opportunity to take part in the results of the survey (question 40). Among the firms, 797 (78 unweighted per cent) requested the working paper. The working paper (Nählinder 2003) was sent out April - May 2003 by e-mail and, when requested, by postal mail.

3. The period of data collection was relatively long as to give the interviewers a possibility to return to interviewees with a shortage of time. This proved to be important, not least to auditing firms since the survey was launched during a period when auditing firms have a peak in workload.

4. The survey was delivered on paper for those firms who requested this. Eighteen firms (1.7 unweighted per cent) preferred to answer in a mail-survey rather than an interview (because, according to the interviewers, they wanted to have all paperwork in front of them when answering the survey in order to give accurate responses).

5. Lastly, the interviewees were informed in the beginning of the interview that data was collected on commission of Linköping University and was to be used for research purposes only. The interviewers estimate that this had a positive impact on the firms' decision to agree to an interview.

Misunderstandings of a question result in errors of measurement. The firm answers the question in a way not intended. The questionnaire was tested on a number of persons and later on actual firms in order to, as far as possible, identify in advance the questions with a risk of errors of measurement. The interviewers were trained and also provided with help-screens to be able to explain the questions of the questionnaire if necessary. I was in constant contact with the interviewers and the project manager throughout the whole period of data collection. Ambiguities concerning the questions have been discussed to avoid misunderstandings. However, the wordings of the questions have not been changed during the period of data collection. This means that the exact same questions were asked to the 995 firms who were interviewed. The wording in the mail-survey (answered by 18 firms) is by necessity slightly different.[77]

[77] It is not possible to simply provide a printout of the computer-assisted telephone interview to respondents requesting a mail survey since it is difficult to understand the questions without the context given by the interviewer. This will be obvious when reading the questions of the survey in appendix II. Therefore the questions were reformulated in the mail-survey. The mail survey questionnaire is included in Nählinder (2003:26).

Appendix II: Innovation and Employment in KIBS- survey

This appendix contains the questions of the IEK survey as well as the information provided by the help-screens, which the interviewers were asked to refer to when in doubt.

The questions (as read by the interviewers) are presented in Swedish and, under the subsequent headline, (translated) in English. Because the survey was carried out as computer-assistant telephone interviews (CATI). The questions were formulated to be straightforward and easily understood verbally. Therefore the following is close, but not identical to how the interviewers saw the information on screen. A postal survey was also designed and delivered to a few firms and it may be found in Nählinder (2003).

The interviewers were given more information than what is automatically given to the interviewee. This information is presented within parenthesis. The five help-screens[78] were developed to provide a background for some central questions of the survey. They were distributed as handouts to all interviewers and were a complement to a thorough discussion on the questions. The five help-screens are included in footnotes.

Not all firms had to answer all questions. Some firms answered all 47 questions, other firms considerably less. These logical constraints are presented in footnotes. In some cases, the firms had the possibility to answer in number of employees or in share of employees. Most questions are closed but some are open. When the questions were closed, all options (and their database code [x]) are presented.

The attentive reader will find that questions 19 and 20 are missing. The interviewing firm wanted to use them as screening questions, and therefore they were labelled 1b and 1c instead. The attentive reader will also note that not all questions are analysed in the thesis at this point. For further analysis of the results, I refer to Nählinder (2003).

The questionnaire in (original) Swedish

1.[79] Vi behöver först lite bakgrundsinformation om företaget. Vilket år började verksamhet bedrivas inom företaget? (ange årtal)
(OBS! Om IP svarar senare än år 2000 skriv 2001. Företaget ska alltså inte

---

[78] The first help screen (A) was a back-up to the introductory presentation of the survey, which is not included in this presentation of the questions.

HELP A in Swedish:
Tema Teknik och social förändring är en tvärvetenskaplig institution vid Linköpings universitet. Vid tema teknik och social förändring arbetar de bland annat, med forskning om ekonomiska aspekter på teknisk förändring. De studerar vad som driver fram nya produkter och vilka effekter det får på konkurrenskraft, sysselsättning och tillväxt.

HELP A in English:
The department of technology and social change is a multi disciplinary at Linköping University. At the department of technology and social change they work with, among other things, research concerning economic activities and technological change. They study the determinants of new products and the impact on competitiveness, employment and economic growth.

[79] Enbart företag som svarat 2000 eller senare inkluderas i undersökningen. Avsluta intervjun med övriga.

	svara på vilket år företaget registrerades, utan vilket år företaget började bedriva verksamhet. Företaget ska svara på förhållandena på företaget inte hela koncernen.)	
1b.	Nu kommer jag att ställa ett par frågor om företagets anställda. Hur många anställda hade företaget 2002? (Med 2002 menas 2002-01-01.)	
1c.[80]	Och hur många anställda hade företaget 2000? (Med 2000 menas 2000-01-01.)	
2.	Vilken juridisk form har företaget? (Läs upp alternativen om nödvändigt.)	[1] aktiebolag [2] handelsbolag [3] kommanditbolag [4] övriga [5] vet ej
3.[81]	Hur uppstod företaget? (Med avknoppning menas att företaget tidigare varit del i ett företag och sedan brutit sig ut och blivit ett oberoende företag. Ett industriföretag är ett företag som huvudsakligen producerar (materiella) varor. Läs upp alternativ om nödvändigt)	[1] företaget är en avknoppning från ett industriföretag [2] företaget är en avknoppning från ett företag som inte är ett industriföretag [3] företaget bildades av en eller flera personer som kom direkt från universitet/högskola [4] annan ursprungsmiljö [5] vet ej
3.	På vilket annat sätt?	
4.	Introducerade ert företag några nya eller väsentligt förbättrade varor eller tjänster på marknaden under perioden 2000-2002? (Små eller rutinmässiga förändringar ska inte räknas med, inte heller förändringar som endast är av estetisk art eller endast innebär nya sätt att presentera produkter för kunden. Se även HELP B[82]).	[1] nej [2] ja, nya eller väsentligt förbättrade tjänster [3] ja, nya eller väsentligt förbättrade varor [4] ja nya eller väsentligt förbättrade varor och tjänster [0] vet ej

[80] Enbart företag som svarat fem eller mer inkluderas i undersökningen. Avsluta intervjun med övriga.
[81] Intervjuade som svarat [4] fick också frågan [3a]. Andra intervjuade hoppar direkt till #4.

[82] HELP B: Varan eller tjänsten ska vara ny för företaget, men inte nödvändigtvis vara ny för marknaden.
Vad är en tjänst och vad är en vara?
Tjänster är immateriella produkter medan varor är materiella produkter. Det innebär att varor är konkreta eller påtagliga produkter. En vara, till skillnad från en tjänst, kan man alltså tappa på foten!
Exempel på tjänster är marknadsundersökning, datorprogram, juridisk rådgivning, revision eller forskning.
Exempel på varor är datorkomponenter (hårdvara).
Två kniviga exempel. Observera att datorprogram är en tjänst, även om den säljs på en CD-rom skiva. På samma sätt är en konsultrapport också en tjänst, även om den levereras tryckt på papper. Själva värdet i produkten ligger i innehållet, inte i förpackningen (CD-skivan eller rapporten).
Nya och väsentligt förbättrade tjänster/varor. Med nya tjänster menas tjänster vars egenskaper eller tilltänkta användningsområden skiljer sig från tidigare tjänster. Med väsentligt förbättrade tjänster menas tjänster vars kvalitet har förändrats avsevärt. Detsamma gäller för varor.
Exempel på nya eller väsentligt förbättrade varor och tjänster:
Ett företag utökar sitt tjänste-utbud eller varu-utbud. Exempelvis ett företag som tidigare erbjudit enbart datorprogramvara utökar sitt utbud till att omfatta även stöd till programanvändare.
Ett annat exempel är ett konsultföretag som tidigare erbjudit konsulttjänster inom marknadsföring men som diversifierar till konsultverksamhet inom etiskt företagande.
Ett företag erbjuder sina tjänster eller varor på ett nytt sätt, till exempel på CD-ROM eller via Internet.

5.	Har ert företag förändrat organisationen av arbetet under perioden 2000 - 2002 i avsikt att mer effektivt kunna producera eller leverera varor och tjänster? (Exempel: Företaget inför en ny produktionsorganisation. Se även HELP C[83]).	[1] ja [2] nej [0] vet ej
6.	Har ert företag introducerat teknisk utrustning under perioden 2000 - 2002 i avsikt att mer effektivt kunna producera eller leverera varor eller tjänster? (Med introducerat menas exempelvis utvecklat, köpt in eller börjat använda teknisk utrustning. Teknisk utrustning kan vara en ny maskin men också till exempel ett dataprogram. Observera att det ska leda till ökad effektivitet: ny version av Office-paketet räknas tex. inte som introduktion av teknisk utrustning. Se även HELP D.[84])	[1] ja [2] nej [0] vet ej
7.[85]	Finns det väsentliga förändringar ert företag genomgått som inte fångas av de här frågorna?	[1] ja [2] nej
7a.	Vilka förändringar då?	
8.[86]	Du har svarat att företaget har förändrat produktsortiment eller produktionsprocessen under perioden 2000 - 2002. Jag skulle nu vilja ställa ett par frågor i anslutning till detta. Har detta påverkat antalet anställda inom företaget? (Med anställda menas inte inhyrd personal. Företaget ska inte räkna om till "heltider" det vill säga att två stycken personer på halvtid ska inte räknas om till en heltidsanställd.)	[1] ja [2] nej
9.	Uppge förändringen i procent. Uppge även om det är en ökning (markera +) eller en minskning (markera -). (En ökning med 50% (+50%) anger alltså att om företaget har 10 anställda 2000, har de 15 anställda 2002. En minskning med 50% (-50%) anger att om företaget har 10 anställda 2000 har de 5 anställda 2002.)	
10.	Nu skulle jag vilja ställa en fråga om vilken typ av anställda som påverkats	

---

[83] HELP C: Definitioner:
En organisatorisk förändring är en ny eller förbättrad organisation av arbetet inom företaget som påverkar hur effektivt varan eller tjänsten produceras eller levereras.
Metoderna ska vara nya för företaget, men behöver inte nödvändigtvis vara nya för andra företag.
Exempel på organisatoriska förändringar:
Företaget inför självstyrande grupper
Företaget inför en ny produktionsorganisation
Företaget inför Just-In-Time
Företaget förändrar arbetsorganisationen inom företaget

[84] HELP D: Definitioner:
En teknologisk förändring är när ny teknik införs eller skapas inom företaget för att påverka hur effektivt varan eller tjänsten produceras eller levereras.
Metoderna ska vara nya för företaget, men behöver inte nödvändigtvis vara nya för andra företag.
Exempel på teknologiska förändringar:
Företaget investerar i informations- kommunikationsteknik som avsevärt förenklar arbetsrutinerna. Exempelvis genom att köpa in programvara som leder till att vissa arbetsmoment kan utföras snabbare eller mer effektivt.
En människa ersätts av en maskin i produktionen, eller omvänt
Inköp av ny teknik leder till att företaget mer effektivt kan producera varor och tjänster.
Inköp av ny teknik leder till att företaget kan erbjuda nya typer av varor eller tjänster till sina kunder.

[85] Intervjuade som svarat [1] fick också frågan 7a. Företag som uppfyllde följande villkor hoppar till fråga #8: svarat [2], [3] eller [4] på #4, svarat [1] på #5, svarat [1] på #6. Alla andra intervjuade hoppar direkt till #13.

[86] Intervjuade som svarat [1] fick också frågan 9, 10a, 10b, 10c och 10d. Andra intervjuade hoppar direkt till #11.

av förändringen.

10a.	Hur har gruppen högskoleutbildade kvinnor påverkats?	[1] de har blivit fler [2] de har blivit färre [3] har inte påverkats [0] vet ej
10b.	Hur har gruppen högskoleutbildade män påverkats?	[1] de har blivit fler [2] de har blivit färre [3] har inte påverkats [0] vet ej
10c.	Hur har gruppen kvinnor utan högskoleutbildning påverkats?	[1] de har blivit fler [2] de har blivit färre [3] har inte påverkats [0] vet ej
10d.	Hur har gruppen män utan högskoleutbildning påverkats?	[1] de har blivit fler [2] de har blivit färre [3] har inte påverkats [0] vet ej
11.	Du har angett att företaget förändrat produktsortimentet eller produktionsprocessen under perioden 2000 - 2002. jag skulle nu vilja veta varför ert företag valde att genomföra de förändringarna. jag ber dig nu uppskatta betydelsen för följande faktorer på en skala från 1 till 4, där 1 indikerar "inte viktigt" och 4 indikerar "mycket viktigt". Om du inte tycker att frågan är relevant för ert företag, vill jag att du svarar "1". a. att ersätta varor/tjänster som håller på att fasas ut b. att förbättra kvalitén på varor/tjänster c. att utöka utbudet på varor/tjänster d. att skapa nya marknader e. att uppfylla föreskrifter eller standarder som påverkar arbetsprocessen f. att uppfylla föreskrifter eller standarder som påverkar slutprodukten g. att förbättra produktionsflexibiliteten h. att sänka arbetskraftskostnaderna i. Att sänka andra produktionskostnader comments. Var det något annat som var särskilt viktigt?	
12.	Har ert företag sökt patent på något ni utvecklat under perioden 2000-2002?	[1] ja [2] nej
13.	Bedrev företaget forskning och utveckling under perioden 2000-2002? (Forskning och utveckling (FoU) är en systematisk verksamhet som (1) har till syfte att öka den samlade kunskapen eller (2) har till syfte att utnyttja denna för nya eller förbättrade produkter och processer. Exempel på FoU är konstruktion, design och utprovning av prototyp. Det kan även vara dataprogramutveckling om dataprogramutvecklingen innebär ett vetenskapligt eller tekniskt framåtskridande. FoU är inte samma sak som förändringar i produktsortimentet och produktionsprocessen. Skillnaden är att FoU genom ny kunskap påverkar förutsättningen för förändringar i produktsortiment eller produktionsprocessen. FoU kan därför fungera som en första steg för att genomföra förändringar i produktsortiment eller produktionsprocessen.)	[1] ja [2] nej [0]vet ej
14.[87]	Enligt Patent och Registreringsverket (PRV) är ert företag registrerat som {sni}. Tycker du det stämmer med den huvudsakliga verksamhet som företaget bedriver? (Istället för att läsa upp sifferkoden (SNI-koden), läs upp motsvarande SNI-koder.) 72.1 Ett maskinvarukonsultföretag 72.2 Ett system- och programvarukonsultföretag 72.3 En dataservicebyrå	[1] ja [2] nej

[87] Intervjuade som svarat [2] fick också frågan 14a. Andra intervjuade hoppar direkt till #15.

	72.4 Ett företag som bedriver databasverksamhet 72.6 Ett datorföretag av annat slag 73.1 Ett företag som bedriver naturvetenskaplig och teknisk forskning och utveckling 73.2 Ett företag som bedriver samhällsvetenskaplig och humanistisk forskning och utveckling 74.11 Ett företag som bedriver juridisk verksamhet, till exempel advokat- eller patentbyrå 74.12 Ett företag som sysslar med redovisning, bokföring, revision eller skatterådgivning 74.13 Ett företag som sysslar med marknads- och opinionsundersökning 74.14 Ett konsultföretag inriktat på företagsorganisation och information 74.15 Ett holdningbolag 74.2 Ett arkitektkontor eller teknisk konsultbyrå 74.3 Ett tekniskt provnings- och analysföretag 74.4 En reklambyrå eller annat marknadsföringsföretag 74.5 En arbetsförmedling eller ett rekryteringsföretag 74.83 En kontorsservice- och översättningsbyrå 74.84 En företagsservicefirma av annat slag)	
14a.	Vilken verksamhet bedriver företaget? (Andra verksamheter är också tillåtna än de som står ovan, exempelvis kan ett företag ha möbeltillverkning som verksamhet)	
15.	jag skulle nu vilja ställa ett par frågor om företagets relation till era kunder. Vilka typer av kunder har ni vanligtvis? Rangordna följande alternativ:	
15a.	nämnd nr 1: (Alla företag har inte samtliga typer av kunder. Det är alltså inte nödvändigt att rangordna samtliga 4 alternativ. Ett industriföretag är ett företag som huvudsakligen producerar (materiella) varor).	[1] tjänsteföretag [2] industriföretag [3] offentlig sektor [4] privatpersoner
15b.[88]	nämnd nr 2:	[1] tjänsteföretag [2] industriföretag [3] offentlig sektor [4] privatpersoner ([0] inga fler)
15c.[89]	nämnd nr 3:	[1] tjänsteföretag [2] industriföretag [3] offentlig sektor [4] privatpersoner ([0] inga fler)
15d.	nämnd nr 4:	[1] tjänsteföretag [2] industriföretag [3] offentlig sektor [4] privatpersoner ([0] inga fler)
16.	Är era produkter vanligtvis standardiserade eller är de skräddarsydda för kundens räkning? (En standardiserad produkt är en produkt som är likadan oberoende av vem den säljs till. Den är alltså inte modifierad för kundens behov. Office-paketet är ett exempel på en standardiserad produkt. En skräddarsydd produkt utgår helt från kundens behov. Standardiserade anpassade datorprogram utgår från redan färdiga datorprogram, men man har ändrat i programkoden för en specifik kunds behov.)	[1]produkterna är vanligtvis standardiserade [2] produkterna är vanligtvis standardiserade men anpassas något efter kundens behov [3] produkterna är vanligtvis skräddarsydda för kundens behov

[88] Intervjuade som svarat [1], [2], [3] eller [4] fick också frågan 15c. Andra intervjuade hoppar direkt till #16.

[89] Intervjuade som svarat [1], [2], [3] eller [4] fick också frågan 15d. Andra intervjuade hoppar direkt till #16.

		[4]vet ej
17.	Jag kommer nu att läsa upp ett antal påståenden för dig. Stämmer påståendena in på er relation till era kunder? Jag ber dig ange ditt svar på en skala från 1 "stämmer inte alls" till 4 "stämmer mycket väl". a. vårt företag hjälper ofta våra kunder att utveckla produkter eller rutiner. b. vårt företag har ett litet antal kontakter med kunden under en affär c. vårt företag arbetar ofta i nära samarbete med kunden d. vår främsta kund är det företag vi avknoppats från (Exempel mittersta påståendet: vid vissa typer av verksamhet träffar man kunden vid ett flertal tillfällen. Ett exempel på det är verksamheter som kräver fler kontakter mellan köpare och säljare, exempelvis utformning av mjukvara så det passar kundens behov. Vid andra typer av verksamheter som inköp av enklare varor görs hela affären görs upp och avslutas vid ett enda tillfälle. Kommentar näst sista påståendet: Vissa företag arbetar mycket nära och samarbete med kunden för att producera den tjänst eller vara kunden vill köpa. OBS! Alternativet "vet ej" gavs också.)	
18.	Hur länge säljer ert företag i genomsnitt samma produkt innan den fasas ut ur sortimentet?	[1] kortare än ett år [2] 1-3 år [3] 4-6 år [4] 7-9 år [5] längre än nio år [6] vet ej [7] frågan är inte relevant för vårt företag
21.[90]	Har ert företag haft svårigheter att finna anställda med lämplig utbildning?	ja [1] nej [2] vet ej [3]
21a.	På vilket sätt?	
22.[91]	Har detta negativt påverkat företagets möjligheter att expandera?	[1] ja [2] nej [3]vet ej
22a.	På vilket sätt?	
23.[92]	Har företaget haft omsättning på anställda mellan 2000 - 2002? (Företaget ska enbart svara "nej" på denna fråga om de inte har anställt eller avskedat någon under perioden 2000-2002. Har de anställt eller avskedat någon har de haft omsättning på personal. I det här avseendet räknas pensionering också som avskedande.)	[1] nej, vi har haft exakt samma anställda under hela perioden [2] ja, vi har haft viss omsättning på personal [3] ja, vi har haft stor omsättning på personal
24.	Hur många procent av era anställda är män? Detta gäller anställda år 2002. (Med 2002 menas 2002-01-01.)	
25.	Har andelen män ökat eller minskat under perioden 2000 - 2002?	[1] ökat [2] minskat [3] har inte ändrats [4] vet ej
26.	Hur många procent av era manliga anställda har studerat vid universitet/högskola? (Summan av män som har studerat vid universitet/högskola och de män som inte har studerat vid universitet/högskola är 100%.)	
27.	Har den andelen ökat eller minskat under perioden 2000 - 2002?	[1] ökat [2] minskat

[90] Intervjuade som svarat [1] fick också frågan 21a och 22. Andra intervjuade hoppar direkt till #23.
[91] Intervjuade som svarat [1] fick också frågan 22a. Andra intervjuade hoppar direkt till #23.
[92] Intervjuade som svarat [2] eller [3] fick också frågorna 25, 27, 29, 31.

		[3] har inte ändrats [4] vet ej
28.	Hur många procent av era kvinnliga anställda har studerat vid universitet/högskola? (Summan av kvinnor som har studerat vid universitet/högskola och de kvinnor som inte har studerat vid universitet/högskola är 100%. Detta gäller anställda år 2002. Med 2002 menas 2002-01-01.)	
29.	Har den andelen ökat eller minskat under perioden 2000 - 2002?	[1] ökat [2] minskat [3] har inte ändrats [4] vet ej
30.	Jag kommer nu att räkna upp fyra yrkeskategorier. Den första kategorin är civilingenjörer & dataspecialister. Den andra kategorin är övriga med teoretisk specialkompetens. Dit räknas alla andra yrkesgrupper med en lång högskoleutbildning som till exempel läkare, samhällsvetare, jurister eller ekonomer. Den tredje kategorin är kontors- och kundservicearbete. Den fjärde kategorin är övriga och dit räknas alla andra yrkesgrupper, till exempel säljare. Nu skulle jag vilja veta vilka typer av yrken era anställda har. Ange ungefärlig andel i procent. jag ber dig alltså att svara på vilka yrken de har, inte vilken utbildning. En civilingenjör som arbetar som säljare faller alltså in under kategorin "övriga" här. civilingenjörer & dataspecialister. övriga med teoretisk specialkompetens. kontors- och kundservicearbete. övriga och dit räknas alla andra yrkesgrupper, till exempel säljare.	
31.[93]	Har sammansättningen av personal med olika yrken förändrats under perioden 2000 - 2002?	[1] ja [2] nej [3] vet ej
32.	Har andelen… …"civilingenjörer och/eller dataspecialister": …"övriga med teoretisk specialkompetens": …"kontors- och kundservicearbete" …"övriga": (Skilj på andel (alltså antal procent av de anställda) och antal (alltså hur många anställda)!)	[1] ökat [2] minskat [3]oförändrat …under perioden 2000 - 2002?
33.[94]	Vi närmar oss nu slutet på intervjun. Nu ska jag ställa ett antal frågor om vidareutbildning inom ert företag. Vidareutbildade ert företag delar av eller hela er personal under perioden 2000-2002?	[1] ja [2] nej [3] vet ej
34.[95]	Vilken eller vilka former tog vidareutbildningen?	[1] kurser eller konferenser [2] internutbildning [3] självstudier [4] annat
34a.	Vilket annat utbildningssätt?	
35.	Uppskatta hur mycket ert företag spenderade på vidareutbildning under 2002 i antal kronor. Inkludera både kurskostnader och personalkostnader. (Med 2002 menas 2002-01-01.)	
36.	Hur många procent av era anställda genomgick vidareutbildning under perioden 2000 - 2002?	
37.	Hur stor andel av de som genomgick vidareutbildning var...? ...universitetsutbildade män... ...universitetsutbildade kvinnor... ... icke universitetsutbildade män...	

[93] Intervjuade som svarat [1] fick också frågan 32. Andra intervjuade hoppar direkt till #33.
[94] Intervjuade som svarat [1] fick också frågorna 34, 35, 36 och 37. Andra intervjuade hoppar direkt till #8.
[95] Flera alternativ möjliga. Intervjuade som svarat [4] fick också frågan 34a. Andra intervjuade hoppar direkt till #35.

... icke universitetsutbildade kvinnor...
... (vet ej män)...
... (vet ej kvinnor)...

38. Har ni ytterligare några kommentarer?
(Om IP undrar: undersökningen är beställd av professor Charles Edquist genom doktorand Johanna Nählinder. Ansvarig för denna forskning är professor Charles Edquist.Vid eventuella frågor, kontakta gärna Johanna Nählinder på telefon 013-28 22 29 alternativt johna@tema.liu.se) Se även HELP E. [96]

39. Vi skulle också behöva veta er position i företaget?

40. Vill ni ta del av undersökningens resultat? Uppge då en e-post adress dit forskningsrapporten skickas.
(Fråga efter e-postadress i första hand; anger de istället en postadress går även detta bra.)

The questionnaire in (translated) English

1.[97] First we need some background information. Which year did the firm start conducting business? (state year)
(N.B! If firm answer later than year 2000, enter 2001. The firm should thus not respond which year the firm was registered, but the year the firm started conducting business. The firm's response should mirror circumstances in the firm, not the group of firms, if applicable.)

1b. Now I will ask a couple of questions concerning the employees of the firm. How many employees did the firm have in 2002?
(2002 means January 1st 2002)

1c.[98] And how many employees did the firm have 2000?
(2000 means January 1st 2000)

2. What is the business enterprise of the firm?
(Read the alternatives if necessary.)
[1] limited firm
[2] trading partnership
[3] limited partnership
[4] others
[5] do not know

3.[99] How did the firm originate?
(A spin-off is a firm that previously was a part of a firm and then broke loose to become an independent firm. A manufacturing firm is mainly concerned with producing (material) goods). Read the alternatives if necessary.)
[1] the firm is a spin-off from a manufacturing firm
[2] the firm is a spin-off from a non-manufacturing firm
[3] the firm was constituted by one or more persons who came directly from university/university college

[96] HELP E: Vad ska resultatet av undersökningen användas till?
Ungefär 1000 kunskapsintensiva tjänsteföretag har i den här undersökningen fått svara på frågor om sina sysselsatta och sin innovationsverksamhet. Resultatet kommer att ligga till grund för en doktorsavhandling inom innovationsstudier. Ansvarig för forskningen är professor Charles Edquist vid Linköpings universitet. I avhandlingen undersöks vilka effekter olika typer av innovationer har på sysselsättningen i kunskapsintensiva tjänsteföretag i Sverige. Avhandlingen beräknas vara klar under våren 2005.
För mer information kan man kontakta doktorand Johanna Nählinder (013-282229) eller på e-post johna@tema.liu.se. Mer information finns också tillgänglig på Internet under adressen http://www.tema.liu.se/tema-t/sirp/johna.htm.

[97] Only firms that answered 2000 or later are included in the survey. Close the interview with other interviewees.

[98] Only firms that answered five or more are included in the survey. Close the interview with other interviewees.

		[4] other origin [5] do not know
3a.	What other way?	
4.	Did your firm introduce any new or significantly improved goods or services to the market during the period 2000 - 2002? (Small or routine changes should not be included, neither changes which are solely aesthetic nor only include new ways of presenting products to the customer. See also HELP B.[100])	[1] no [2] yes, new or significantly improved services [3] yes, new or significantly improved goods [4] yes, new or significantly improved goods and services [0] do not know
5.	Has your firm changed the organisation of work during the period 2000 - 2002 with the intent to more efficiently produce and deliver goods and services? (Example: The firm introduces a new production organisation. See also HELP C.[101])	[1] yes [2] no [0] do not know
6.	Has your firm introduced technological equipment during the period 2000 - 2002 with the intent to more efficiently produce and deliver goods or services? (With introduced is intended, for example, the development, purchase or	[1] yes [2] no [0] do not know

[99] Interviewees who responded [4] were also asked question 3a. Other interviewees were directed to #4.

[100] HELP B: The good or service must be new to the firm, but not necessarily new to the market.
What is a service and what is a good?
Services are immaterial products whereas goods are material products. It entails that goods are concrete or tangible products. A good, in distinction to a service, may thus be dropped on ones foot!
Example of services are market research, computer programs, legal counseling, auditing or research. Example of goods are computer components (hardware).
Two tricky examples. Please note how computer programs are services, even if they are sold on CD-ROMs. Correspondingly a consultancy report is also a service, even if it is delivered printed on paper. The value of the product resides in the content, not in the embodiment (the CD-ROM or the report).
New and significantly improved services/goods. With new services is intended services whose properties or intended fields of application detaches from previous services. With significantly improved services is intended services whose quality has improved significantly. The same reasoning is applicable to goods.
Examples of new or significantly improved goods and services:
A firm increases its range of services or range of products. For example a firm which previously offered only computer programs increases its range of products to also including support to users.
Another example is a consultancy firm which earlier offered marketing consultancy services but which diversifies into consultancy ethical enterprising.
A firm offers services or goods in a new way, for example on CD-ROM or via the Internet.

[101] HELP C: Definitions:
An organisational change is a new or improved organisation of work within the firm which affects how effectively the good or service is produced or delivered.
The methods must be new to the firm, but not necessarily new to other firms.
Examples of organisational changes:
The firm introduces self-governing groups
The firm introduces a new production organisation
The firm introduces Just-In-Time
The firm changes the organisation of work within the firm

	initial use of technological equipment. Technological equipment may be a new machine but also for example a computer program. Please note that it must lead to increased efficiency: a new version of Office for example does not count as introduction of technological equipment. See also HELP D.[102])	
7.[103]	Are there other essential changes your firm have undergone which are not captured by these questions?	[1] yes [2] no
7a.	What changes?	
8.[104]	You have responded that the firm has changed the line of production or the production process during the period 2000-2002. I would like to ask a few questions concerning this. Did it affect the number of employees within the firm? (Temp labour is not included as employees. The firms should not recalculate the number of employees into full-time equivalents - that is two persons working half time should not be counted as a full-time employee.)	[1] yes [2] no
9.	State the change in per cent. Also state if it is an increase (mark +) or a decrease (mark-). (A 50% increase (+50%) thus indicates that if a firm had 10 employees in 2000, they had 15 employees 2002. A 50% decrease (-50%) indicates that if a firm had 10 employees in 2000, they had 5 employees 2002.)	
10.	Now I would like to ask a question regarding which category of employees have been affected by the change.	
10a.	How has the group of university educated women been affected?	[1] they have increased [2] they have decreased [3] they have not been affected [0] do not know
10b.	How has the group of university educated men been affected?	[1] they have increased [2] they have decreased [3] they have not been affected [0] do not know
10c.	How has the group of non-university educated women been affected?	[1] they have increased [2] they have decreased [3] they have not been affected [0] do not know
10d.	How has the group of non-university educated men been affected?	[1] they have increased [2] they have decreased

---

[102] HELP D: Definitions:
A technological change is when new technology is introduced or created within the firm in order to influence how effectively the good or service is produced or delivered.
The methods must be new to the firm, but do not necessarily have to be new to other firms.
Examples of technological changes:
The firm invests in information and communication technologies which significantly simplifies routines of work. For example through the purchase of software leading to the speeding up or efficiency-increase of certain sub-operations.
An employee is replaced by a machine in production or the opposite
Purchase of new technology results in the firm's more efficient production of goods and services.
Purchase of new technology leads to the firm being able to offer new types of goods or services to its customers.

[103] Interviewees who responded [1] were also asked question 7a. Firms which fulfilled the following criteria were directed to #8: #4, responded [2], [3] or [4] or #5, responded [1] or #6, responded [1]. All other firms were directed to #13.

[104] Interviewees who responded responded [1] were also asked question 9, 10a, 10b, 10c and 10d. Other interviewees were directed to #11.

[3] they have not been affected
[0] do not know

11. You have stated that the firm has changed the line of production or the production process during the period 2000-2002. I would now like to know why your firm chose to implement the change. I ask you to estimate the importance of the following objectives on a scale from 1 to 4 where 1 indicates "not important" and 4 indicates "very important". If you do not consider the question relevant for your firm, I want you to respond "1".
a. replace goods/services which are phasing out
b. improve quality of goods/services
c. increase supply of goods/services
d. create new markets
e. fulfil regulations or standards of the work process
f. fulfil regulations or standards of the product
g. improve production flexibility
h. reduce labour costs
i reduce production costs
comments. was there anything else which was particularly important?

12. Did your firm apply for a patent on anything developed during the period 2000-2002?
[1] yes
[2] no

13. Did your firm conduct research and development during the period 2000-2002?
(Research and development (R&D) is a systematic activity which has the purpose to (1) increase accumulated knowledge or (2) use knowledge for new or improved products and processes. Example of R&D is construction, design and testing of prototype. It may also be developing a computer program if the development entails scientific or technological progress. R&D is not identical to changes in product portfolio or production processes. The difference is that R&D through new knowledge may function as a first step to implement change in product portfolio and production process.)
[1]yes
[2] no
[0]do not know

14.[105] According to (PRV) - the Swedish Patent and Registration office, your firm is registered as {the registred SE-SIC92 code. } Do you think that is in accordance with the main activity of the firm?
(Instead of reading the numerical SE-SIC92 code, read the verbal description.)
[1] yes
[2] no

72.1 a hardware consultancy firm
72.2 a supply- and software consultancy firm
72.3 a data processing firm
72.4 a firm conducting database activities
72.6 another type of computer firm
73.1 a firm conducting research and experimental development in natural sciences and engineering
73.2 a firm conducting research and experimental development in social sciences and humanities
74.11 a firm conducting legal activities, for example, a lawyer's office or patent agency
74.12 a firm conducting accounting, bookkeeping, auditing activities or tax

[105] Interviewees who responded responded [2] were also asked question 14a. Other interviewees were directed to #15.

	consultancy 74.13 a firm conducting market research and public opinion polling 74.14 a consultancy firm directed at business and management consultancy activities 74.15 a holding company 74.2 an architect's office or a technical consultancy 74.3 a firm conducting technical testing and analysis 74.4 an advertising agency or other type of marketing firm 74.5 a firm conducting labour recruitment or provision of personnel 74.83 a firm providing office assistance or a translation agency 74.84 other type of business services firm	
14a.	What business does the firm conduct? (Businesses other than the above SE-SIC92 codes are also permitted, for example a firm may have furniture manufacturing as a business)	
15.	I would now like to ask a couple of questions concerning the firm's relationship with its clients. which types of clients do you usually have? Rank the following alternatives.	
15a.	mentioned no 1: (All firms do not have all types of clients. It is thus not necessary to rank all four alternatives. A manufacturing firm is a firm mainly producing (material) goods.)	[1] service firms [2] manufacturing firms [3] public sector [4] households
15b.[106]	mentioned no 2:	[1] service firms [2] manufacturing firms [3] public sector [4] households ([0] no more)
15c.[107]	mentioned no 3:	[1] service firms [2] manufacturing firms [3] public sector [4] households ([0] no more)
15d.	mentioned no 4:	[1] service firms [2] manufacturing firms [3] public sector [4] households ([0] no more)
16.	Are your products usually standardised or are they tailor-made for the client? (A standardised product is a product which is the same independent of who it is sold to. It is thus not modified to the needs of the client. "Office" is an example of a standardised product. A tailor-made product takes its point of departure from the need of the client. standardised modified computer programs takes their point of departure from already developed computer programs, but the program code has been altered to the needs of a specific client.)	[1] the products are usually standardised [2] the products are usually standardised but somewhat modified to the needs of the client [3] the products are usually tailor-made to the needs of the client [4]do not know
17.	I will now read you a number of statements. Are the statements a correct description of the relation to your clients? I ask you to state your answer on a scale from 1 "do not agree at all" to 4 "agree very much". a. our firm often helps our clients to develop products or routines b. our firm has a small number of contacts with the client during a deal c. our firm often works in close co-operation with the client	

[106] Interviewees who responded responded [1], [2], [3] and [4] were also asked question 15c. Other interviewees were directed to #16.

[107] Interviewees who responded responded [1], [2], [3] and [4] were also asked question 15d. Other interviewees were directed to #16.

d. our main client is the firm we spun-off from

(Example second statement: in some types of activities you meet the client at a number of times. One example is activities which demand several contacts between buyer and seller, as required when shaping software to fit the needs of the client. With other types of activities the whole deal is executed at one time only. Comment second last statement: some firms work in close co-operation with the client in order to produce the service or good the firm wants to purchase. N.B! The alternative "do not know" was also given.)

18. How long does your firm on average sell the same product before it is phased out?
[1] less than one year
[2] 1-3 years
[3] 4-6 years
[4] 7-9 years
[5] longer than 9 years
[6] do not know
[7] the question is not relevant to our firm

21.[108] Has your firm encountered difficulties in finding employees with an adequate education?
[1] yes
[2] no
[3] do not know

21a. In what ways?

22.[109] Has this had a negative impact on the firm's possibilities to expand?
[1]yes
[2]no
[3]do not know

22a. In what ways?

23.[110] did your firm have an employee turn-over during 2000-2002?
(The firm is only supposed to respond "no" if they have not employed or dismissed any employees during 2000-2002. If they employed or dismissed anyone then they have had an employee turn-over. In this context retirement counts as dismissal.)
[1]no, we have had exactly the same employees during the whole period
[2]yes, we have had some employment turn-over
[3]yes, we have had extensive employment turn-over

24. What percentage of the employees are men? This concerns employees in 2002.
(2002 means January 1st 2002)

25. Has the share of men increased or decreased during 2000-2002?
[1] increased
[2] decreased
[3] no change
[4] do not know

26. What percentage of your male employees have attended university/university college?
(The sum of men who attended university/university college and the men who have not equals 100%.)

27. Has that share increased or decreased during 2000-2002?
[1] increased
[2] decreased
[3] no change
[4] do not know

28. What per cent of your female employees have attended

---

[108] Interviewees who responded [1] were also asked question 21_a and 22. Other interviewees were directed to #23.
[109] Interviewees who responded [1] were also asked question 22a. Other interviewees were directed to #23.
[110] Interviewees who responded [2] or [3] were also asked questions 25, 27, 29, 31.

university/university college?
(The sum of women which attended university/university college and the men that has not equals 100%)
(2002 means January 1st 2002)

29. Has that share increased or decreased 2000-2002?
[1] increased
[2] decreased
[3] no change
[4] do not know

30. I will now present four occupational categories. The first category is engineers and computer specialists. The second category is others with special theoretical competencies. This incudes occupational groups with extensive university/university college education as for example physicians, social scientists, lawyers and economists/business administrators. The third category is office and customer support. The fourth category is "others" and other occupational groups, as for example salesmen. Now I would like to know which types of occupations your employees have. State approximate share in per cent. I ask you to respond which occupations they have, not their educational background. An engineer working as a salesman thus belong to the category "others".
engineers & computer specialists
others with special theoretical competencies
office and customer support
others and here is included all other occupational groups, for example salesmen.

31.[111] Has the composition of employees with different occupations changed during the period 2000-2002?
[1] yes
[2] no
[3] do not know

32. Has the share of….
… engineers & computer specialists
…others with special theoretical competencies
…office and customer support
…others
increased [1]
decreased [2]
no change [3] during the period 2000-2002?

(Differentiate between share (that is % of employees) and number (that is number of employees)!)

33.[112] We are approaching the end of this interview. I will now ask a number of questions on further training within your firm. Did your firm provide further training for part of or all your employees during the period 2000-2002?
[1] yes
[2] no
[3] do not know

34.[113] What form(s) did the further training take?
[1] courses or conferences
[2] internally organised professional training (on the job training)
[3] self studies
[4] other

34a. What other form of further training?

35. Estimate how much your firm spent on further training during 2002 in Swedish crowns. Include both expenses on courses and personnel.
(2002 means January 1st 2002)

---

[111] Interviewees who responded [1] were also asked question 32. Other interviewees were directed to #33.
[112] Interviewees who responded [1] were also asked questions 34, 35, 36, 37. Other interviewees were directed to #38.
[113] Multiple responses possible. Interviewees who responded [4] were also asked question 34_a. Other interviewees were directed to #35.

36. What percentage of your employees took part in further training during the period 2000 - 2002?
37. How large a share of the employees who participated in further training were….?
…university-educated men…
…university-educated women…
…non-university-educated men…
…non-university-educated women…
… (men, education unknown)…
…(women, education unknown) …

38. Do you have any further comments?
(If the interviewer asks: the survey is ordered by Professor Charles Edquist through PhD-student Johanna Nählinder. Responsible for this research is Professor Charles Edquist. For questions, please contact Johanna Nählinder (013-282229) alternatively on e-mail johna@tema.liu.se. See also HELP E.[114])
39. We would also need to know your position within the firm?
40. Do you want to take part in the results of the investigation?
(Ask for e-mail address first. If they give postal address instead that is OK)

114

HELP E: How will the result of the survey be used?
About 1000 knowledge intensive business services have responded in this survey to questions on their employees and their innovative activities. The result will constitute the basis for a PhD thesis within innovation studies. Responsible for the research is Professor Charles Edquist at Linköping University.
In the thesis the impact of different types of innovations have on employment in knowledge intensive business services in Sweden will be investigated. The thesis is estimated to be completed spring 2005.
For more information, please contact Ph.D-student Johanna Nählinder (013-282229) alternatively on e-mail johna@tema.liu.se

References

Databases

CIS2 database (1998). *The second Swedish Community Innovation Survey database*. Statistics Sweden.

FDB A (2000, 2002). *Företag (FDB) efter näringsgren SNI92, storleksklass och tid* [Downloaded from Statistics Sweden homepage http://www.ssd.scb.se/databaser/makro/start.asp February 2003, October 2004 and February 2005.]

FDB B (1993-2002). *Anställda i företag (FDB) efter näringsgren SNI92 och tid.* [Downloaded from Statistics Sweden homepage http://www.ssd.scb.se/databaser/makro/start.asp October 2004.]

Företagsfakta (2003, 2004). [Downloaded from Affärsdatabasen homepage http://www.ad.se on numerous occasions 2003-2004.]

IEK database (2003). *Innovation and Employment in KIBS database*. Linköping University.

RAMS A (2000). *Förvärvsarbetande 16+ år med arbetsplats i regionen (RAMS) efter näringsgren SNI92 och tid.* [Downloaded from Statistics Sweden homepage http://www.ssd.scb.se/databaser/makro/start.asp October 2004.]

RAMS C (2000, 2002). *Förvärvsarbetande 16+ år med bostad i regionen (RAMS) efter ålder och tid.* [Downloaded from Statistics Sweden homepage http://www.ssd.scb.se/databaser/makro/start.asp October 2004.]

RAMS B (2000, 2002). *Förvärvsarbetande 16+ år med arbetsplats i regionen (RAMS) efter utbildningsnivå, kön och tid.* [Downloaded from Statistics Sweden homepage http://www.ssd.scb.se/databaser/makro/start.asp October 2004.]

Statistics Sweden/ITPS (1994-2002). *Konkurser i riket efter näringsgren SNI 2002, storleksklass och företagsform. Månad 1994M01-2002M12.* [Downloaded from Statistics Sweden homepage http://www.ssd.scb.se/databaser/makro/start.asp October 2004.]

Personal communications

Hambraeus Björling, Y. (2004). Seminar 11 March 2004 at Swedish Institute for Growth Policy Studies (ITPS), Stockholm. Name of seminar: på spaning efter tillväxt. Name of session: växer IT-sektorn?

Hedin, G. (2002). E-mail correspondence with Gunnar Hedin, SCB Registerbaserad arbetsmarknadsstatistik, 27 November 2002.

Maskell, P. (2001). E-mail correspondence with Peter Maskell 25 September 2001.

Tängerud, B. (2004). Telephone conversation with Bengt Tängerud, SCB företagsregistret, 26 April 2004.

Toivonen, M. (2001c). E-mail correspondence with Marja Toivonen 30 May 2001.

Peters, B. (2005). E-mail correspondence with Betina Peters 11 May 2005.

Zenker, A. (2004). E-mail correspondence with Andrea Zenker 26 October 2004.

Literature and written sources

Acs, Z. & Audretsch, D. (1987). "Innovation, Market Structure, and Firm Size." *The Review of Economics and Statistics*. 69(4), pp. 567-574.

Ahrens, T. (2003). "Det gör ont när knoppar brister" *Computer Sweden* 1 December 2003.

Alm, H. (2004). *External Relations in the Product Development Process. A study of Biotechnology Firms in Sweden.* Dissertation. Linköping: Linköping University.

Ambramowitz, M. (1989). *Thinking About Growth and Other Essays on Economic Growth and Welfare*. Cambridge: Cambridge University Press.

Appelbaum, E. & Albin, P. (1990). "Shifts in Employment, Occupational Structure, and Educational Attainment" in: T. Noyelle (Ed.), *Skills, Wages and Productivity in the Service Sector*. Boulder, Colorado: Westview Press.

Barras, R. (1986). "Towards a Theory of Innovation in Services." *Research Policy*. 15(4), pp. 161-173.

Bhattacharya, M. & Bloch, H. (2004). "Determinants of Innovation." *Small Business Economics*. 22(2), pp. 155-162.

Blind, K. & Jungmittag, A. (2004). "Foreign Direct Investment, Imports and Innovations in the Service Industry." *Review of Industrial Organization*. 25(2), pp. 205-227.

Blomqvist, M. (1994). *Könshierarkier i gungning: kvinnor i kunskapsföretag*. Dissertation. Stockholm: Almqvist & Wiksell International.

Boden, M. & Miles, I. (2000a). "Introduction. Are services special" in: M. Boden & I. Miles (Eds.), *Services and the Knowledge Based Economy*. London & New York: Continuum.
Boden, M. & Miles, I. (2000b). "Conclusions. Beyond the Service Economy" in: M. Boden & I. Miles (Eds.), *Services and the Knowledge Based Economy*. London & New York: Continuum.
Brundin, S. (2004). "Rekordtungt för IT-utbildade" *Computer Sweden* 18 October 2004.
Bryman, A. (1995). *Kvantitet och kvalitet i samhällsvetenskaplig forskning*. Lund: Studentlitteratur.
Cainelli, G., Evangelista, R. & Savona, M. (2004). "The Impact of Innovation on Economic Performance in Services." *The Service Industries Journal*. 24(1), pp. 116-130.
Castellacci, F. (2004). "How does Innovation Differ Across Sectors in Europe? Evidence from the CIS-SIEPI database" *Working paper 04/04*. Oslo: TIK.
Coombs, R. & Miles, I. (1999). "Innovation, Measurement and Services: The New Problematique" in: J.S. Metcalfe & I. Miles (Eds.), *Innovation Systems in the Service Economy*. Norwell, Massachusetts: Kluwer Academic Publishers.
Cowan, R., Soete, L. & Tchervonnaya, O. (2001). "Knowledge Transfer and the Services Sector in the Context of the New Economy" *MERIT-Infonomics Memorandum series 2001-021*. Maastricht: MERIT.
Cyert, R. M. & Mowery, D. (1988). *The Impact of Technological Change on Employment and Economic Growth*. Cambridge, Massachusetts: Ballinger.
Dahles, H. (1999). "Producer Services and Urban Restructuring" Paper presented at the seminar *Brokers of Capital and Knowledge: Producer Services and Social Mobility in Provincial Asia 1960-2000*, 15 March 1999.
Dahlström, M. (1995). "Tjänsteproduktionens anatomi och geografi" in: S. Berger (Ed.), *Samhällets geografi*. Uppsala: Nordisk Samhällsgeografisk Tidskrift.
Dahmström, K. (2000). *Från datainsamling till rapport. Att göra en statistisk undersökning*. Lund: Studentlitteratur.
Danielsson, R. (1995). *Tjänstekvalitetens hörnstenar*. Lund: Studentlitteratur.
Dathe, D. & Schmid, G. (2000). "Determinants of Business and Personal Services. Evidence from West-German Regions" *Discussion Paper FS I 00-202*. Berlin: WZB.
Den Hertog, P. & Bilderbeek, R. (1998). "Conceptualizing (Service) Innovation and the Knowledge-Flow Between KIBS and Their Clients", *SI4S Topical Paper 11*. Oslo: STEP.
Den Hertog, P. (2000) "Knowledge-Intensive Business Services as Co-producers of Innovation" *International Journal of Innovation Management* 4(4), pp. 491-528.
Drejer, I. (2004). "Identifying Innovation in Surveys of Services. A Schumpeterian Perspective." *Research Policy*. 33(3), pp. 551-562.
Edling, L. (2003). "Special konsultguiden. Managementkonsulterna smakar sin egen medicin" *Affärsvärlden* 15 October 2003.
Edquist, C. & Texier, F. (1996). "The Growth Pattern of Swedish Industry 1975-1991" in: O. Kuusi (Ed.), *Innovation Systems and Competitiveness*. Helsinki, Taloustieto Oy in collaboration with ETLA (The Research Institute of the Finnish Economy) & VATT (The Government Institute for Economic Research).
Edquist, C. (1997). "Systems of Innovation Approaches. Their Emergence and Characteristics" in: C. Edquist (Ed.), *Systems of Innovation. Technologies, Institutions and Organizations*. London: Pinter Publishers/Cassell Academic.
Edquist, C. (2005). "Systems of Innovation - Perspectives and Challenges" in: J. Fagerberg, D. Mowery, & R. Nelson (Eds.), *The Oxford Handbook of Innovation*. Oxford: Oxford University Press.
Edquist, C., Hommen, L. & McKelvey, M. (2001). *Innovation and Employment. Process versus Product Innovation*. Cheltenham: Edward Elgar.
Ericson, B. (2002a). "Special: managementkonsulter. Illusionist eller frälsare" *Veckans affärer* 13 May 2002.
Ericson, B. (2002b). "Management. Blodbad på konsulter" *Veckans affärer* 11 November 2002.
Eriksson, M-L. 2005). *Innovation Policy in Learning Regions: The Development of Regional Development Coalitions*. Dissertation. Linköping: Linköping University.
European Commission. (1999). *The Contribution of Business Services to Industrial Performance. A Common Policy Framework*. Luxembourg: Office for Official Publications of the European Communities.
Evangelista, R. & Savona, M. (2002). "The Impact on Employment in Services. Evidence from Italy." *International Review of Applied Economics*. 16(3), pp. 309-318.
Evangelista, R. & Savona, M. (2003). "Innovation, Employment and Skills in Services. Firm and Sectoral Evidence." *Structural Change and Economic Dynamics*. 14(4), pp. 449-474.
Evangelista, R. & Sirilli, G. (1995). "Measuring Innovation in Services." *Research Evaluation*. 5(3), pp. 207-215.

Evangelista, R. (2000a). "Innovation and Employment in Services. Results from the Italian Innovation survey" in: M. Vivarelli & M. Pianta (Eds.), *The Employment Impact of Innovation. Evidence and Policy*. New York: Routledge.
Evangelista, R. (2000b). "Sectoral Patterns of Technological Change." *Economics of Innovation & New Technology*. 9(3), pp. 183-221.
Falk, M. (1999). "Technological Innovations and the Expected Demand for Skilled Labour at the Firm Level" *ZEW discussion paper 99-59*. Mannheim: ZEW.
Farina, C. & Preissl, B. (2000). "Research and Technology Organisations in National Systems of Innovation" *DIW Discussion Papers 221*. Berlin: DIW.
Flanagan, K. (1999). *Innovation Networks and New Media Development in Europe and the UK*. Dissertation. Manchester: University of Manchester.
Fritsch, M. & Meschede, M. (2001). "Product Innovation, Process Innovation, and Size." *Review of Industrial Organization*. 19(3), pp. 335-350.
Gallouj, F. & Weinstein, O. (1997). "Innovation in Services." *Research Policy*. 26(4/5), pp. 537-556.
Hales, M. (1998). "A Tale of Two Sectors. Issues in the Mapping of Knowledge-Intensive Business Services" *SI4S Topical paper 13*. Oslo: STEP.
Hauknes, J. (1994). "Tjenesteyende näringer - Ökonomi og Teknologi" *STEP report 13* Oslo: STEP. [Cited in Edquist, C., Hommen, L. & McKelvey, M. (2001). *Innovation and employment. Process versus product innovation*. Cheltenham: Edward Elgar]
Hauknes, J. (1998). "Services in Innovation - Innovation in Services" *S14S synthesis papers S1*. Oslo: STEP.
Hauknes, J. (1999). "Knowledge Intensive Services - What is Their Role" *The OECD business and industry policy forum on realising the potential of the service economy. Facilitating growth, innovation and competition,* Paris 28 February 1999.
Hermelin, B. (1997). *Professional Business Services. Conceptual Framework and a Swedish Case Study*. Dissertation. Uppsala: Uppsala University.
Hipp, C. (1999). "Information Flows and Knowledge Creation in Knowledge-Intensive Business Services: Scheme for a Conceptualization" in: J. S. Metcalfe & I. Miles (Eds.), *Innovation Systems in the Service Economy*. Norwell, Massachusetts: Kluwer Academic Publishers.
Hipp, C., Tether, B. S., & Miles, I. (2000). "The Incidence and Effects of Innovation in Services. Evidence from Germany." *International Journal of Innovation Management*. 4(4), pp. 417-453.
Howells, J. & Roberts, J. (2000). "Global Knowledge Systems in a Service Economy" in: B. Andersen, J. Howells, R. Hull, I. Miles & J. Roberts (Eds.), *Knowledge and Innovation in the New Service Economy*. Cheltenham: Edward Elgar.
Howells, J. (2000). "Innovation & Services. New Conceptual Frameworks" *CRIC Discussion Paper 38*. Manchester: CRIC.
Hughes, A. & Wood, E. (1999). "Rethinking Innovation Comparisons Between Manufacturing and Services. The Experience of the CBR SME Surveys in the UK." *Working paper 140*. Cambridge: ESRC Centre for Business Research.
Illeris, S. & Plougmann, P. (2001). "Arbejde og kvalifikationer i service" *Report 8*. Roskilde: RUC.
Ingelstam, L. (1997). *Ekonomi för en ny tid*. Stockholm: Carlssons.
Jacobsson, C. (2002). "Ojämlika löner i IT-branschen" *Dagens Nyheter* 27 October 2002.
Jaumandreu, J. (2003). Does Innovation Spur Employment? A Firm-level Analysis using Spanish CIS data. *Mimeo*.
Kaiser, U. (2002). *Innovation, Employment, and Firm Performance in the German Service Sector*. Dissertation. Heidelberg: Physica.
Kaldor, N. (1961). "Capital Accumulation and Economic Growth" in F. Lutz & D. Hagur (Eds.) *The Theory of Capital*. New York: St. Martin Press.
Karaomerlioglu, D. C. & Carlsson, V. (1999). "Manufacturing in Decline? A Matter of Definition." *Economics of Innovation and New Technology*. 8(3), pp. 175-196.
Keppel, G. (1991). *Design and Analysis. A Researcher's Handbook*. Upper Saddle River: Prentice Hall.
Kinnear, T. & Taylor, J. (1991). *Marketing Research. An Applied Approach*. New York: McGraw-Hill.
Kish, L. (1987). *Statistical Design for Research*. New York: Wiley.
Kline, S. & Rosenberg, N. (1986). "An Overview of Innovation". in: R. Landau & N. Rosenberg. (Eds.). *The Positive Sum Strategy: Harnessing Technology for Economic Growth*., Washington DC: National academy press.
Kraft, K. (1990). "Are Product and Process Innovations Independent of Each Other?" *Applied Economics*. 22(8), pp. 1029-1038.

Larsen, J. (1998). "Knowledge-intensive Business Services in the Danish Economy" *Working paper 4*. Roskilde: RUC.
Larsen, J. (2000). "Supplier-user Interaction in Knowledge-Intensive Business Services. Types of Expertise and Modes of Organization" in: M. Boden & I. Miles (Eds.), *Services and the Knowledge Based Economy*. London & New York: Continuum.
Larsson, A. (2004). "Innovation output and barriers to innovation" *Statistics in focus. Theme 9*. (1), pp. 1-7.
Laestadius. S. (2005 forthcoming). "The Rise and Fall of Management of Innovation. The Transformation of a Concept and of Management Practice in the Knowledge Economy" in J. Sundbo et al (Eds.) *Innovation - are we looking at the right things?* Palgrave.
Licht, G., Ebling, G., Janz, N. & Niggemann, H. (1999). "Innovation in the Service Sector. Selected Facts and Some Policy Conclusions". Paper prepared as part of the project "*Innovation Policy in a Knowledge-Based Economy*" commissioned by the European Commission.
Linderman, K., Schroder, R. Zaheer, S. & Choo, A. (2003). "Six Sigma. A Goal-Theoretic Perspective." *Journal of Operations Management*. 21(2), pp. 193-203.
Lindsay, J. (1997). *Techniques in Human Geography*. London: Routledge.
Lundquist, L. (1992). *Förvaltning, stat och samhälle*. Lund: Studentlitteratur.
Lundvall, B-Å. & Borrás, S. (1997). *The Globalising Learning Economy. Implications for Innovation Policy*. Brussels: European Commission.
Magnusson, K., Kroslid, D. & Bergman, B. (2000). *Six Sigma. The Pragmatic Approach*. Lund: Studentlitteratur.
Malerba, F. (2005). "Sectoral Systems. How and Why Innovation Differs Across Sectors" in: J. Fagerberg, D. Mowery, & R. Nelson (Eds.), *The Oxford Handbook of Innovation*. Oxford: Oxford University Press.
Managementkonsulter - En tillväxtbransch för kunskapsspridning och strukturomvandling. En beskrivning av managementkonsultsektorn i Sverige. (2002). Stockholm: Svenskt näringsliv/Sveriges managementkonsulter [report on line retrieved 27 October 2004 available from http://www.samc.se/bransch.htm.]
Manninen, E. (2002). *New Technology - New Jobs? The Case of Mobile Telecommunications in Sweden*. Dissertation. Linköping: Linköping University.
Maskell, P. & Törnqvist, G. (1999). *Building a Cross-border Region*. Copenhagen: Copenhagen Business school press.
Mastrostefano, V. & Pianta, M. (2004). "The Dynamics of Innovation and its Employment Effects. An Analysis of Innovation Surveys in European Industries" Paper presented at the *Schumpeter society conference*, Milan, Italy: 9-12 January 2004.
Miles, I. (2001a). "Knowledge-Intensive Business Services Revisited" *Nijemegen lectures in Innovation Management 8*. Nijmegen: Katholiecke Universiteit Nijmegen.
Miles, I. (2001b). "Services Innovation. A Reconfiguration of Innovation Studies". *PREST discussion paper DP01-05*. Manchester: PREST.
Miles, I. (2005). "Innovation in Services" in: J. Fagerberg, D. Mowery, & R. Nelson (Eds.), *The Oxford Handbook of Innovation*. Oxford: Oxford University Press.
Miles, I., Andersen, B., Boden, M. & Howells, J. (2000). "Service Production and Intellectual Property." *International Journal of Technology Management*. 20(1/2), pp. 95-115.
Miles, I., Kastrinos, N., Flanagan, K., Bilderbeek, R., den Hertog, P., Huntink, W. & Bouman, M. (1995). "Knowledge-Intensive Business Services. Users, Carriers and Sources of Innovation" *EIMS publication 15*. Luxembourg: European Innovation Monitoring Service.
Ministry of Industry & Ministry of Education (2004). "Innovativa Sverige. En strategi för tillväxt genom förnyelse" *departementsserien 2004: 36*. Stockholm: Fritzes.
Muller, E. & Zenker, A. (2001). "Business Services as Actors of Knowledge Transformation: the Role of KIBS in Regional and National Innovation Systems." *Research Policy*. 30(9), pp. 1501-1516.
Muller, E. (2001). *Innovation Interactions Between Knowledge Intensive Business Services and Small and Medium-sized Enterprises*. Dissertation. Heidelberg: Physica.
Myren, K. (2003). "Vart tionde jobb borta i IT-branschen" *Computer Sweden* 5 February 2003.
Nachum, L. (1998). "Danish Professional Service Firms. Why are They Not Competitive Internationally? A Comparative Analysis Between Danish and U.K. Management Consulting Firms." *Scandinavian Journal of Management*. 14(1/2), pp. 37-51.
Nählinder, J. & Hommen, L. (2002). "Employment and Innovation in Services. Knowledge Intensive Business Services in Sweden" Paper presented at *the final meeting and conference of AITEG*, London: 18-19 April 2002.

Nählinder, J. (1998). *Personaluthyrning. Studie av lokaliseringsmönstret hos en bransch i snabb förändring*. Masters Dissertation. Uppsala: Uppsala University.
Nählinder, J. (2001a). "Innovation related changes in employment structure. The case of knowledge-intensive business services" Paper presented at *DRUID winter conference*, Korsör, Denmark: 18-29 January 2001.
Nählinder, J. (2001b). "Innovation and Employment in KIBS. Skills and Gender" Paper presented at *the NECSTS workshop on Technological Practices and Innovation in Services*, Toruplund, Denmark: 3-5 May 2001.
Nählinder, J. (2002). "Innovation in Knowledge Intensive Business Services. State of the Art and Conceptualisations" *working paper 244*. Linköping: Tema T.
Nählinder, J. (2003). "Sysselsättningseffekter av innovationer i kunskapsintensiva tjänsteföretag" *working paper 266*. Linköping: Tema T.
Nilsson, G. (2004). "Fler arbetslösa bland unga kvinnor" *Sydsvenska dagbladet* 7 October 2004.
Öberg, P. (2002). "Utbildningsval. Kvinnor bryter mönster." *Välfärdsbulletinen.* (1), pp. 14-15.
OECD (1995). *Canberra manual. The Measurements of Scientific and Technological Activities. Manual on the Measurement of Human Resources Devoted to S&T*. Paris: OECD.
OECD (1997). *Oslo Manual. Proposed Guidelines for Collecting and Interpreting Technological Innovation Data. Committee for Scientific and Technology Policy*. Paris: OECD.
OECD (1999a). *Strategic Business Services*. Paris: OECD.
OECD (1999b). *Science, Technology and Industry Scoreboard 1999. Benchmarking Knowledge Based Economies*. Paris: OECD.
Parker, R. (2004). "Explaining Variations in the Knowledge Economy in Three Small Wealthy Countries." *Technology Analysis & Strategic Management.* 16(3), pp. 343-366.
Parkin, M. (1994). *Economics*. Reading, Massachusetts: Addison-Wesley.
Pedersen, M. K. (1999). "Professional Business Service Innovation" *Working papers 11*. Roskilde: RUC.
Peters, B. (2004). "Employment Effects of Different Innovation Activities. Microeconometric Evidence" *ZEW discussion paper 04-73*. Mannheim: ZEW.
Peterson, O. & Söderlind, D. (1992). *Förvaltningspolitik*. Stockholm: Publica.
Pettersson, L. (1996). *Ny organisation, ny teknik - nya genusrelationer? En studie av omförhandling av genuskontrakt på två industriarbetsplatser*. Dissertation. Linköping: Linköping University.
Pianta, M. (2000). "The Employment Impact of Process and Product Innovations" in: M. Vivarelli & M. Pianta (Eds.), *The Employment Impact of Innovation. Evidence and Policy*. New York: Routledge.
Pianta, M. (2005). "Innovation and Employment" in: J. Fagerberg, D. Mowery, & R. Nelson (Eds.), *The Oxford Handbook of Innovation*. Oxford: Oxford University Press.
Piva, M. & Vivarelli, M. (2002). "The Skill Bias. Comparative Evidence and an Econometric Test." *International Review of Applied Economics.* 16(3), pp. 347-356.
Preissl, B. (1997). "Services in Europe. Patterns of Growth and Development" *SI4S survey paper 2*. Oslo: STEP.
Preissl, B. (2000) "Service Innovation. What Makes it Different? Empirical Evidence from Germany". In: Metcalfe, J.S. Miles, I. (Eds.), *Innovation Systems in the Service Economy. Measurement and Case Study Analysis*. Boston: Kluwer Academic Publishers. [cited in Drejer, I. (2004). "Identifying Innovation in Surveys of Services. A Schumpeterian Perspective." *Research Policy.* 33(3), pp. 551-562.]
Pröckl, E. (2004). "Nybakad manlig ingenjör gynnad på arbetsmarknaden" *Ny Teknik* 13 October 2004.
Reiten, M. (2000*). Leadership in the New Economy*. Masters Dissertation. Oslo: University of Oslo.
Roman, C. (1994). *Lika på olika villkor. Könssegregering i kunskapsföretag*. Dissertation. Uppsala: Uppsala University.
Rosenberg, N. (1982). *Inside the Black Box. Technology and Economics*. Cambridge: Cambridge University Press.
Sakurai, N. (1995). "Structural Change and Employment. Empirical Evidence for 8 OECD Countries." *STI Review*. 15, pp. 133-175.
Salant, P. & Dillman, D. (1994). *How to Conduct Your Own Survey*. New York: Wiley.
Sandström, O. (2004). "Sökes: 150 kvinnliga konsulter" *Dagens Nyheter* 20 June 2004.
Schienstock, G. (2001). "Social Exclusion in the Learning Economy" in: D. Archibugi & B-Å. Lundvall (Eds.), *The Globalizing Learning Economy*. Oxford: Oxford University Press.
Schumpeter, J. A. (1934/1983). *The Theory of Economic Development* New Brunswick: Transaction Publishers (reprint. originally published: Cambridge: Harvard University Press.
Schumpeter, J. (1942). *Capitalism, Socialism and Democracy*. New York: Harper & brothers publishers.
Sellenthin, M. & Hommen, L. (2002). "How Innovative is Swedish Industry? A Factor and Cluster Analysis of CIS II." *International Review of Applied Economics.* 16(3), pp. 319-331.

Simonetti, R., Archibugi, D. & Evangelista, R. (1995). "Product and Process Innovations. How are They Defined. How are They Quantified." *Scientometics*. 32(1), pp. 77-89.
Skogli, E. (1998). "Knowledge-Intensive Business Services. A Second National Knowledge Infrastructure?" *STEP working paper A-03*. Oslo: STEP.
Smith, K. (2005). "Measuring Innovation" in: J. Fagerberg, D. Mowery, & R. Nelson (Eds.), *The Oxford Handbook of Innovation*. Oxford: Oxford University Press.
Soete, L. & M. Miozzo (1989). "Trade and Development in Services. A Technological Perspective." *Working paper No. 89-031*. Maastricht: MERIT.
Spezia, V & Vivarelli, M. (2000). "The Analysis of Technological Change and Employment" in: M. Vivarelli & M. Pianta (Eds.), *The Employment Impact of Innovation. Evidence and Policy*. New York: Routledge.
Statistics Sweden & NUTEK (2000). *Innovationsverksamhet i företag i Sverige 1996-1998*. Stockholm: Statistics Sweden.
Statistics Sweden (1998). *Företagens innovationsverksamhet. The second Community Innovation Survey - CIS II*. Stockholm: Statistics Sweden.
Statistics Sweden (2002). *Företagens innovationsverksamhet 1998-2000. The third Community Innovation Survey - CIS III*. Örebro: Statistics Sweden.
Statistics Sweden (2004). *Företagens användning av datorer och Internet*. Stockholm: Statistics Sweden.
Storey, J., Quintas, P., Taylor, P. & Fowle, W. (2002). "Flexible Employment Contracts and Their Implications for Product and Process Innovation." *International Journal of Human Resource Management*. 13(1), pp. 1-18.
Sundbo, J. (1998). "Standardisation vs. Costumisation in Service Innovations*" SI4S topical paper 3*. Oslo: STEP.
Svensson, D. (2002). "Börs & finans: konsultmörkret fortsätter. Förlust för åtta av nio bolag" *Dagens industri* 26 April 2002.
Tether, B. S. (2003). "The Sources and Aims of Innovation in Services: Variety Between and Within Sectors." *Economics of Innovation & New Technology*. 12(6), pp. 481-505.
Tether, B. S. (2004). "Do Services Innovate (Differently)?" *CRIC discussion paper 66*. Manchester: CRIC.
Tether, B. S., Hipp, C. & Miles, I. (2001). "Standardisation and Particularisation in Services. Evidence from Germany." *Research Policy*. 30(7), pp. 1115-1138.
Toivonen, M. (2001a). "Main development characteristics of knowledge intensive business services" in: M. Toivonen (Ed.), *Growth and Significance of Knowledge Intensive Business Services (KIBS)*. Helsinki: Employment and Economic Development centre of Uusimaa.
Toivonen, M. (2001b). "Development trends in Different branches of Knowledge Intensive Business Services" in: M. Toivonen (Ed.), *Growth and Significance of Knowledge Intensive Business Services (KIBS)*. Helsinki: Employment and Economic Development centre of Uusimaa.
Toivonen, M. (2004). *Expertise as Business. Long-term Development and Future Prospects of Knowledge-intensive Business Services (KIBS)*. Dissertation. Helsinki: Helsinki University of Technology.
Tomlinson, M. & Miles, I. (1999). "The Career Trajectories of Knowledge Workers" Paper presented at *OECD workshop on S&T labour markets*, Paris, France: 17 May 1999.
Tomlinson, M. (1999). "The Learning Economy and Embodied Knowledge Flows in Great Britain." *Journal of Evolutionary Economics*. 9(4), pp. 431-451.
Tomlinson, M. (2000). "Innovation surveys. A researcher's perspective" *DRUID working paper 00-9*. Aalborg: DRUID.
Tordoir, P. (1994). "Transactions of Professional Business Services and Spatial Systems." *Tijdschrift voor Economiische en Sociale Geografie*. 85(4), pp. 322-332.
UNSD (2000). "United Nations Statistics Division Homepage UNSD" [at http://esa.un.org/unsd/cr/family2.asp?Cl=2 visited on numerous occasions in 2000].
UNSD (2004). "United Nations Statistics Division Homepage UNSD" [at http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=2&Lg=1 visited on numerous occasions in 2002].
Utterback, J. & Abernathy, W. (1975). "A Dynamic Model of Process and Product Innovation." *Omega* 3(6), pp. 639-656.
Van Reenen (1997). "Employment and Technological Innovation. Evidence from U.K. Manufacturing Firms." *Journal of Labor Economics* 15(2), pp. 225-284.
Varian, H. R. (1993). *Intermediate Microeconomics. A Modern Approach*. New York & London: W.W. Norton & Company.
Vivarelli, M. (1995). *The Economics of Technology and Employment. Theory and Empirical Evidence*. Cheltenham: Edward Elgar.

Webster, J. (1996). *Shaping Women's Work. Gender, Employment and Information Technology*. London & New York: Longman.
Werner, R. (2001). "Knowledge-Intensive Business Services in the Oulu Region. Business Development and Geographical Linkage" in: M. Toivonen (Ed.), *Growth and Significance of Knowledge Intensive Business Services (KIBS)*. Helsinki: Employment and Economic Development centre of Uusimaa.
Windrum, P. & Tomlinson, M. (1998). "The Impact of KIBS on International Competitiveness. A UK-Netherlands comparison" *SI4S Topical papers 10*. Oslo: STEP.
Windrum, P. (2000). "Knowledge Pools and Innovation Networks in E-commerce. The Integrating Role of Knowledge-Intensive Services" Paper presented at *SEIN workshop: Innovation Networks. Theory and Policy*. 14 January 2000.
Wong, K. & He, Z. (2005). "A Comparative Study of Innovation Behavior in Singapore's KIBS and Manufacturing Firms." *The Service Industries Journal*. 25(1), pp. 23-42.
Yin, R. (1994). *Case Study Research. Design and Methods*. London: Sage.
Zackrisson, M. (2003). Financial Systems and the Financing of High-technology Small Firms. The Cases of Sweden, Linköping, and Santa Clara County. Dissertation. Linköping: Linköping University.