Fraunhofer Institute Systems and Innovation Research

Patterns of Organisational Change in European Industry (PORCH)

Ways to Strengthen the Empirical Basis of Research and Policy

DG Enterprise and Industry: Innovation Policy Unit

Final Report

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1 Executive Summary

Non-technological innovation, particularly organisational innovation, is playing an increasingly important role in better understanding innovation and its impact on the competitiveness of enterprises and countries. Organisational innovations are changes in structure and processes of an organisation by implementing new managerial and working concepts and practices, such as the implementation of team work in production, performance-based wage systems or just-in-time concepts. The increasing relevance of organisational innovations in research and management practice is due to the following reasons (see e.g. Damanpour et al., 1989; Greenan, 2003; Womack et al., 1990; Hammer and Champy, 1993):

- *Organisational innovations as enablers and facilitators for technological innovations*:
  The full exploitation of technological innovations in companies often needs or is entangled with organisational change.
- *Organisational innovations as immediate source of competitive advantage:* New organisational solutions and management methods improve company performance with regard to productivity, lead times, quality and flexibility and thus constitute a dimension of innovation of its own right.
- *Organisational innovations as prerequisites of knowledge development in companies*:
  A company's competence to create, acquire and make best use of knowledge and skills is largely grounded in its organisational and managerial practices.

Although there is an increasing awareness of the importance of organisational innovation for the competitiveness of enterprises, the empirical basis for measuring organisational innovations is still weak and scattered. The PORCH project aimed at identifying Patterns of ORganisational CHange in European Industry and at exploring and developing ways to strengthen the empirical basis of research and policy in this context. The project was issued by DG Enterprise and Industry and has been carried out by an expert team led by the Fraunhofer Institute for Systems and Innovation Research in Germany involving researchers from France (Centre de Recherche en Economie Industrielle Internationale), Italy (Lunaria), the United Kingdom (University of Cranfield) and Slovenia (Evrocenter for Management and Development). The project had three objectives:

1. Objective: Analyse the importance of organisational innovations across industry sectors
2. Objective: Formulate recommendations for surveying organisational innovation in large scale surveys

3. Objective: Formulate recommendations for improving the concept and methodology of the European Innovation Scoreboard (EIS) with respect to organisational innovation

Following the **first objective** of this project, 100 interviews have been conducted with experts, both industry practitioners (72 interviews) and research representatives (28 interviews) on the importance of organisational innovations in different industry sectors. The sectoral coverage included the aerospace, automotive, biotechnology/biopharmaceuticals, chemical, electronics, food, machinery, medical devices and textile industry. Interviews have been conducted partially face-to-face and partially by telephone with experts from 12 different countries. In these expert interviews a questionnaire including 21 organisational innovations has been applied. The organisational innovations surveyed belonged to the categories: decentralisation, cooperation, outsourcing/relocation, quality management, human resource management, knowledge management and production management.

The interviewees were asked to assess the importance of each organisational innovation for the industry sector they were familiar with and experts in. The assessment of importance has been based on the estimation of impact (low, moderate, strong) of these 21 organisational innovations on the output dimensions quality, flexibility, costs and innovation ability (see Figure 1).

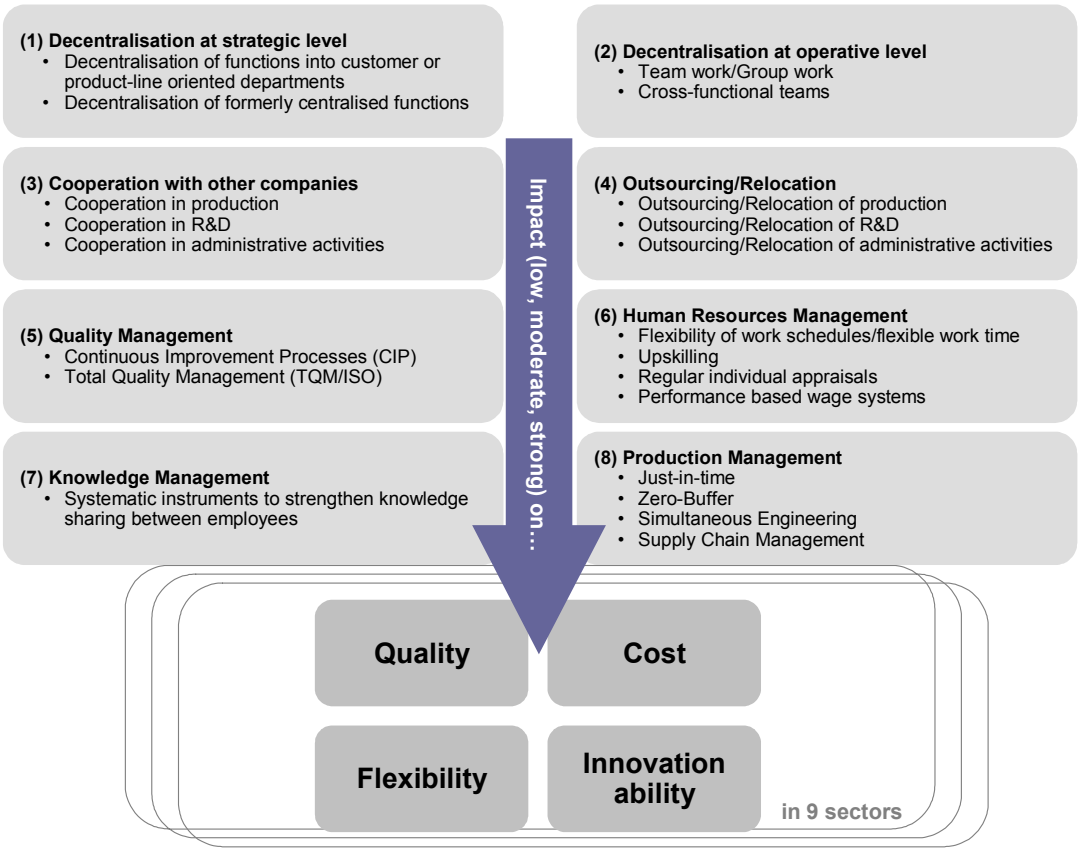

Figure 1: Surveyed organisational innovations in the research and industry interviews.

The analysis of the interviews revealed that the importance of organisational innovations differs strongly according to different output dimensions (Figure 2). Most of the organisational innovations are clearly targeted either towards quality increase, flexibility increase and increase of innovation ability or cost decrease. For instance, supply chain management is important for achieving cost savings, irrespective whether supply chain management is applied in the automotive industry or in the food sector. Total quality management is important for increasing product and process quality rather than for gaining flexibility, whereas flexible working schedules clearly aim at increasing flexibility but do not predominantly intend to decrease costs, again, independent of the sector.

However, few organisational innovations, that is simultaneous engineering, zero-buffer and just-in-time are highly important in certain sectors like automotive or machinery but not in others. These results are plausible since some organisational innovations are by nature more sector-specific, especially if related to particular production structures. Despite the sector-specific importance of zero-buffer and just-in-time they are also as-

sessed to vary in their importance across the output dimensions, mainly reducing costs.

The results show that for the majority of organisational innovations surveyed there is no sector-specific importance but a different impact on output dimensions. Organisational innovations are directly targeted towards specific outputs; therefore, their importance is strongly related to the respective aim and does (almost) not differ across sectors. This implies the necessity of a close connection between the input and the output side of organisational innovations. Measuring organisational innovations should therefore always take into account the specific target of the organisational innovation. It is not advisable to consider organisational innovations as a homogenous phenomenon being measured with one item only. The various effects of organisational innovations on company's structure and processes have to be also taken into consideration when measuring organisational innovation.

Organisational innovation*	**Predominantly important for specific output dimension**	**Predominantly important for specific sectors**
Team work/Group work	Flexibility, quality	all sectors
Outsourcing/Relocation of production	Costs	all sectors
Outsourcing/Relocation of administrative activities	Costs	all sectors
Continuous Improvement Processes (CIP)	Quality, innovation ability	all sectors
Total Quality Management (TQM/ISO)	Quality	all sectors
Upskilling	Quality, innovation ability	all sectors
Regular individual appraisals	Quality	all sectors
Supply Chain Management	Costs	all sectors
Flexibility of work schedules/flexible work time	Flexibility	all sectors
Simultaneous Engineering	Not important for one specific output dimension	Automotive, electronics, machinery
Just-in-time	Costs	Automotive, machinery, electronics
Zero-Buffer	Costs	Automotive

* Results are t-tested. No significant results have been found for the remaining organisational innovations.

Figure 2: Output dimension-specific importance or sector-specific importance of organisational innovations

Based on the results of the stakeholder interviews as well as on desk research, four recommendations for surveying organisational innovation in large scale surveys have been identified, thus the **second objective** of the project has been achieved. At first, it is necessary to differentiate between different concepts of organisational innovations. It is not sufficient to ask only one comprehensive question about the existence of organisational innovation as such. Furthermore, it is not sufficient to only ask if organisational concepts have been implemented lately, but it is also necessary to ask if they are implemented at all, since organisational innovations are not as strongly subject to life cycle changes as product innovations are. When surveying organisational innovation, it seems to be advisable to gather information about the extent of use of organisational concepts, not only about use or non-use, because organisational concepts are sometimes implemented only in isolated units or partially in enterprises. Finally, it is not sufficient to ask only for general labels of organisational innovations like *teamwork* or *task integration*, but it is crucial to define the exact meaning of these labels in different cases of adoption.

(1) Complexity of organisational innovation (aggregation level) It is not sufficient to only ask for "organisational innovation" in general. It is necessary to differentiate between several concepts of organisational innovation.
(2) Life cycle of organisational innovation (use or change) It is not sufficient to only ask if organisational concepts have been changed in the last xy years. It is important to collect data on which organisational concepts are implemented at all.
(3) Scope of organisational innovation (use or extent of use) It is not sufficient to only ask for "use" or "non-use" of organisational innovations. It is necessary to gather information on the extent of "use".
(4) Quality of organisational innovation (labels or features) It is not sufficient to only ask for labels of organisational innovations like "teamwork" or "task integration". It is crucial to know the individual meaning of these labels in the different cases of adoption.

Figure 3: Recommendations for the measurement of organisational innovation in large scale surveys

Taking these results and the **third objective** of the project into consideration, two recommendations for the EIS in respect of indicators for organisational innovations have been formulated (Figure 4). The *first recommendation* applies to the present focus of the EIS' output indicators on product innovation. Assuming that the EIS will maintain its focus on product innovation, three new input indicators for organisational innovation

(cross-functional teams, continuous improvement processes and cooperation in R&D) are proposed. These organisational concepts are clearly related to product innovation processes which means that their impact can be measured by existing output indicators in the EIS. The *second recommendation* applies in case the focus of the EIS should change and be widened in the future, including also non-technological output indicators. Should the EIS adopt a holistic focus, it is proposed to include seven new input indicators for organisational innovation (among them total quality management, team work and decentralisation) and, at the same time, supplement the present product related output indicators by three new non-technological output indicators measuring quality, flexibility and cost reduction. The enlargement of the EIS in this way would make it possible to measure adequately organisational innovation both on the input and on the output side.

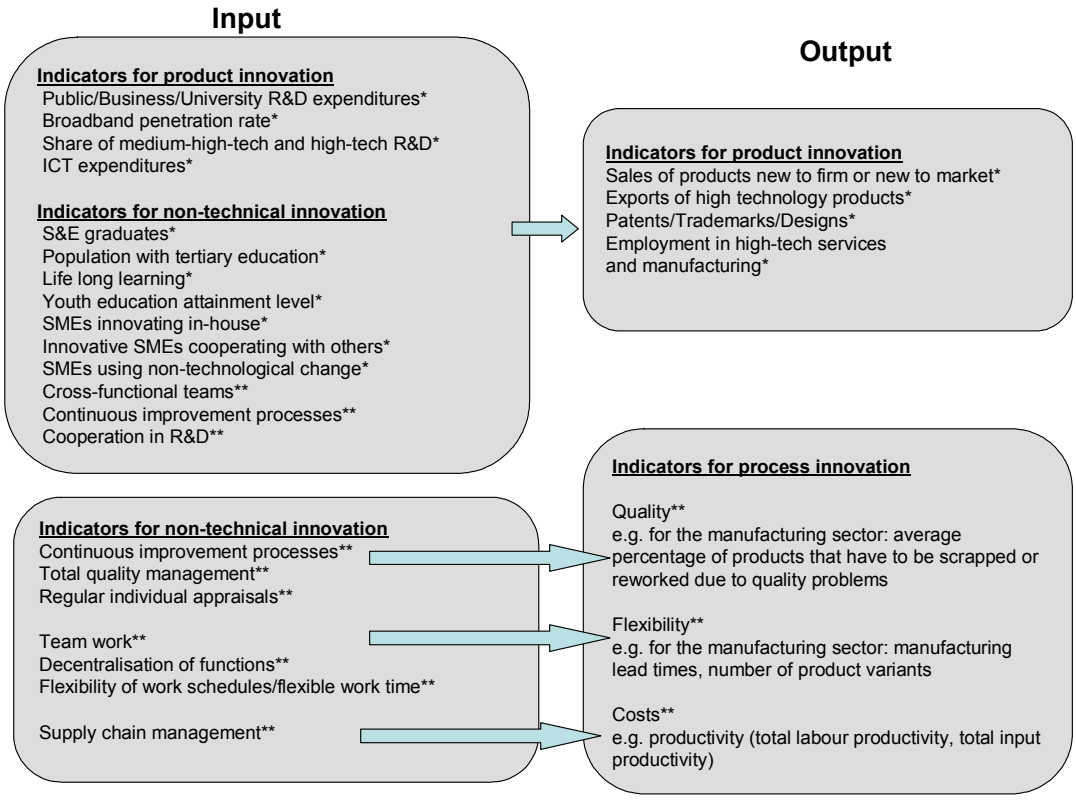

Figure 4: Recommendations for the integration of organisational innovation indicators in the EIS

2 Introduction

This document is the final report of PORCH, a project to identify Patterns of ORganisational CHange in European industry and to explore and develop ways to strengthen the empirical basis of research and policy in this context. The project was issued by DG enterprise and industry following the Call for Tender: Studies on Innovation Matters No ENTR/03/24, Lot 4. The project was carried out by an expert team led by the Fraunhofer Institute for Systems and Innovation Research in Germany and involving researchers from France (Centre de Recherche en Economie Industrielle Internationale), Italy (Lunaria), the United Kingdom (University of Cranfield) and Slovenia (Evrocenter for Management and Development). In addition, the project team draws on a wide network of co-operating researchers in Europe as well as overseas based on parallel project engagements and institutional relations. Based on this network of researchers an advisory board has been established to assist and support the work of the PORCH project team and to participate in the project workshops.

Non-technological innovation, particularly organisational innovation, is playing an increasingly important role in better understanding innovation and its impact on the competitiveness of enterprises and countries. This increasing relevance of organisational innovations in research and management practice is due to the following reasons (see e.g. Damanpour et al., 1989; Greenan, 2003; Womack et al., 1990; Hammer and Champy, 1993):

- *Organisational innovations as enablers and facilitators for technological innovations*:
  The full exploitation of technological innovations in companies often needs or is entangled with organisational change.
- *Organisational innovations as immediate source of competitive advantage:* New organisational solutions and management methods improve company performance with regard to productivity, lead times, quality and flexibility and thus constitute a dimension of innovation of its own right.
- *Organisational innovations as prerequisites of knowledge development in companies*:
  A company's competence to create, acquire and make best use of knowledge and skills is largely grounded in its organisational and managerial practices.

Despite this growing interest in organisational innovation the empirical basis of organisational innovations is still weak and scattered. A commonly shared definition of organisational innovations is still lacking. This might be partly due to the fact that organisational innovation is addressed by a large number of different disciplines using different indicators and a wide range of empirical instruments from case studies to large scale

written surveys. While in the late 80s and early 90s the lean production model was in the focus of attention today there is no single outstanding paradigm. Moreover, different approaches and more targeted, industry- or company-specific solutions are discussed. In addition, in the knowledge society organisational innovation is seen as a major factor for creation and acquisition of knowledge (and competencies) which again is a key factor of European industries' competitiveness.

However, over the past years, several steps have been undertaken in order to improve and develop the definition and measurement of organisational innovations. Organisational innovation has been considered in the revision of the Oslo manual: *"An organisational innovation is the implementation of a significant change in business practices, workplace organisation or external relations, intended to improve the firm's innovative capacity or performance characteristics, such as the quality and efficiency of work flows.*" Following this definition, a comprehensive question on organisational innovation has been added to the questionnaire for the fourth Community Innovation Survey while keeping the main focus on technological product and process innovation when defining an "innovative firm". Moreover, the European Innovation Scoreboard (EIS) and the Summary Innovation Index (SII) as important instruments of the European Commission have raised awareness towards organisational innovation and made use of available data on organisational innovation of the third Community Innovation Survey.

2.1 Aim of PORCH study

Hence, there is an increasing awareness of the importance of organisational innovation for companies' competitiveness which results in initial efforts to improve the definition and measurement of organisational innovations. Despite these activities, the empirical basis of organisational innovations in terms of definition and measurement is still not satisfactory. There is a need to better measure and integrate organisational aspects in indicators measuring innovation performance and taking into account sectoral specificities.

Therefore, the overall goal of this project is to provide suggestions for surveying organisational innovation at a European level including a special focus on different industry sectors. More specifically, the project has three objectives:

1. Objective: Analyse the importance of organisational innovations across industry sectors
2. Objective: Formulate recommendations for surveying organisational innovation in large scale surveys

3. Objective: Formulate recommendations for improving the concept and methodology of the European Innovation Scoreboard (EIS) with respect to organisational innovation.

2.2 Approach of PORCH study

This final report of PORCH provides results on the above mentioned three objectives of PORCH. In order to achieve the above aims the following four work packages have been defined:

- Work package 1: *Analytical overview* aimed at providing a state of the art in theory and empirical research of organisational innovation
- Work package 2: *Stakeholder interviews* aimed at gathering views of research and industry representatives in terms of the importance of different organisational innovations across industry sectors
- Work package 3: *Tool development and pilot application* aimed at developing recommendations for the measurement of organisational innovation and providing approaches to improve the concept and methodology of the European Innovation Scoreboard (EIS).
- Work package 4: *Management and communication* aimed at managing the project, including the set-up of the advisory panel, organisation of team meetings and panel workshops as well as preparation, communication and presentation of three interim reports and the final report.

Desk research on organisational innovation in different scientific disciplines and analyses of the conducted *stakeholder interviews* provide the basis for recommendations on the measurement of organisational innovations in CIS and for the improvement of the concept and methodology of the European Innovation Scoreboard (EIS). These recommendations include sector-specific considerations.

The final report is structured as follows:

Following this introduction (*chapter 1*), *chapter 2* is based on results of work package 1 *(Analytical overview)* and provides an overview of different theoretical and disciplinary views on organisational innovation (see annex for detailed papers on specific disciplines). *Chapter 2* concludes with a definition on organisational innovations which serves as a basis for the following considerations and analyses in this report.

Chapter 3 provides an outline of existing surveys and statistical instruments that have included organisational innovation in their surveys. The main focus of this chapter is on

the Community Innovation Survey (CIS) and the European Innovation Scoreboard (EIS).

Chapter 4 deals with methodological aspects of the measurement of organisational innovation discussing possibilities and challenges of quantitative survey approaches. It uses empirical data on organisational innovation from Fraunhofer ISI's *German Manufacturing Survey* to substantiate the issues in question.

Chapter 5 is based on the efforts of work package two (*Stakeholder interviews*) and provides the results of 100 stakeholder interviews in 12 European countries. Interviews have been conducted with representatives of companies and research institutions working in or having specific knowledge of nine sectors currently in the main focus of the European Commission. The surveyed sectors are automotive, aerospace, biotechnology, chemicals, electronics, food industry, machinery, medical devices and textile. This chapter shows how experts on organisational innovation in research institutes as well as in industry estimate the importance of organisational innovation in different industry sectors. Importance of organisational innovations has been measured by increased quality (product and process quality), flexibility (product, lead time and batch size flexibility), innovation ability (product and process innovation) and decreased costs (personnel and capital costs).

Recommendations for the measurement of organisational innovations and for the improvement of the concept and methodology of the European Innovation Scoreboard are provided in *chapter 6*. This chapter is based on the efforts of work package 3 (*Tool development and pilot application*) and concludes with an outlook.

3 Theoretical overview on organisational innovation

After a long period of theorising focussed solely on technical innovation, the developments in organisation theory opened the way to the concept of organisational innovation. The attention thus turned to the "intangible" factors that account for firms' competence and performance. Some basic works like Chandler's (1992) regarding firms' structures, Penrose's (1959) work on resource-based theory of the firm, or March and Simon's (1958) seminal book on "organisations", have been revisited and have often led to major developments. More particularly, the theory of organisations has revealed the existence of specific organisational capabilities and, in order to do so, has developed a series of tools that are often quite refined. According to this line of reasoning, the revival of the "resource-based theory" of the firm (Wenerfeld, 1984; Conner and Pralahad, 1996; Foss, 1997a and 1997b) evolved significantly with behavioural theory of the firm (Cyert and March (1963). At the heart of this reflection the joint notions of organisational competences and organisational learning around which some evolutionist authors as Nelson and Winter (1982), Dosi and Marengo (1994) or else Teece and Pisano (1994) focussed their attention, have enabled the renewal of the classical visions of firms' behaviours and performances. On that ground, the evolutionary approach to the firm has given the notion of organisational innovation its "lettres de noblesse" (see among a large and diversified body of contributions: Nelson and Winter, 1982; Nelson, 1991; Chandler, 1992; Dosi and Marengo, 1994; Dosi and Teece, 1998; Prahalad and Hamel, 1990; Dosi, Nelson and Winter, 2000).

3.1 Evolutionary approaches: Theoretical basis of organisational innovation

The evolutionary approach to organisations is considered by many theorists a fruitful theoretical basis for the analysis of organisational change respectively organisational innovation. The evolutionary approach to economics is rooted in the view that firms are complex learning organisations that develop different ways to solve similar problems and eventually are selected by the environment through competition mechanisms. The concept of heterogeneity is deeply related with that of bounded rationality: different agents with different degrees of rationality behave differently and develop rules of actions, i.e. routines, to simplify decision making and the interaction with their environment. In this perspective, the structure of organisations, the way they operate and evolve becomes a key element in the understanding of firms' behaviour and performance.

With regard to the notion of organisational innovation, evolutionary approaches can be associated with a series of basic ideas and assumptions allowing for apprehending and understanding the meaning and implications of the notion of organisational innovation.

(1) Organisations with specific intangible ("non-technical") capabilities and competencies

Evolutionary approaches stress the fact that firms' (differing) capacity for drawing on appropriate protocols to co-ordinate the information and knowledge distributed between the individuals belonging to the organisation is one of the key elements allowing the firm to establish persistent relative advantage[1]. It has to be noticed here that unlike prevailing approaches, such as Porter's, that lay the emphasis on firms' positions on markets and on the ways they use their market power, these analyses focus on firms' specificities and the internal elements accounting for their performances (more on this, especially to distinguish evolutionary approaches from "agency" theory and transitions costs theory, see: Dosi, G. and L. Marengo, 1999). One of the basic features of these evolutionary approaches is their insistence on the fact that "the resources" created inside the firms cannot be acquired on the market: the firm must create them by itself, or assimilate them after a period of learning. As Teece, Pisano and Shuen (1997) put it, "the very essence of most [organisational] capabilities/competencies is that they cannot be readily assembled through markets". According to this line of reasoning (which follows Penrose's basic intuitions), a firm's growth and success is supposed to rely essentially on an *internal* and *endogenous* creation of specific resources, characterised as organisational capabilities/competencies. Furthermore, distinctive organisational competences/capabilities bear importance insofar as they can be shown to persistently shape the destiny of individual firms - in terms of probability of survival, performances, profitability, growth, etc. (Nelson, 1991).

(2) Organisational Competencies/Capabilities as "Routines"

A key feature of the evolutionary approaches is their highlighting fact that these organisational capabilities become efficient only when they are "routinised", i.e. when they are turned into "repeated actions" between individual agents. Routines may be defined and analysed as a group of protocols relative to the division of labour and to the coordination of tasks (inside the firm or in the inter-firm coordination); protocols which are relatively stabilised and which can henceforth develop with a certain amount of automaticity. Finally, according to evolutionary theorists routines in organisations are the

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[1] To a certain extent this recent theorising has given new strength and relevance to the "X efficiency" hypothesis, first formulated in the seminal paper by Leibenstein, 1982.

equivalent of skills in individuals: "individual skills are the analogue of organisational routines" (Nelson and Winter, 1982, p.73). Moreover, the term routines - like skills - is broadly defined: "We use the term 'routines' in an extremely flexible way, in the same way as 'programme' (or 'routine') is used to discuss the programming of a computer". In both cases (entire organisation or individual skill) the concept of routine refers to a model of repetitive activity.

It should be noted that the element of "repetitivity" is essential. The existence of individual skills as well as organisational routines necessarily implies some automaticity in their implementation and diffusion, since it is only on this condition that routines are economically efficient. Once they have been adopted, they may be applied smoothly and easily, without delay and at no additional cost. Routines are all the more efficient as they permit to "economise" the costs for exchanging information between agents prior to actions. Routines thus economise "deliberation". They accelerate the decision making process (for an assessment see Cohen et al., 1995).

(3) The dynamics of organisational innovations

The issue here is whether organisations gradually adapt, having their own internal engine of change, or if organisational innovation is rather the result of a discontinuous process involving the selection of those firms or institutions that are better at increasing their competitive advantage. It is possible to distinguish three views in the literature. Firstly, evolutionary theories of the firms have stressed the role of inertia, whereby organisations are very slow at responding to changes in their environment, that tend more to select them than to spur them to change. Secondly, the punctuated equilibrium model argues that organisations go through long periods of gradual evolution, interrupted at some stage by short periods of revolutionary and discontinuous change that is not said to cause their disappearance. Finally, the strategic adaptation theory argues that there exists a dialectic interaction between organisations and their environment: organisations are not only affected by their environment but they are also able to counter-affect it, especially when moving at the competitive edge thanks to practices of continuous learning and adaptation (Lewin and Volberda, 1999).

(4) Organisational innovation and technological innovation

The interaction between technological and organisational change and the effects on economic activities and employment is a further issue addressed by the evolutionary-type literature. Several European studies (Caroli and Van Reenen, 2001 on France and Britain; Greenan, 2003 on France; Piva and Vivarelli, 2002 on Italy) have shown that organisational innovation is more important than technological innovation in shaping changes in occupational structure and skills. The rather fragmented evidence so far

available on organisational innovation suggests that it plays a crucial role alongside technological innovation in shaping productivity and employment outcomes. The two can have a complementary relationship (especially when a virtuous circle of growth is in place) leading to a combined effect on performance and upskilling that can be greater than their mere sum. On the other hand, changes in organisations or in technologies may be pursued as alternative paths in contexts of restructuring and job losses. It has been argued that technological innovation without the related organisational innovations could hinder (in spite of bettering) economic performances. In the case of Europe, organisational innovations were thus analysed as the "missing link" in European competitiveness (Andreassen et al., 1995).

3.2 Definition of innovation in a business context

The definition of innovation is disparate, with little consensus among researchers (for examples see Rickards and Moger, 1991; Nystrom, 1990; Vrakking, 1990; West and Farr, 1990; Goffin and Pfeiffer, 1999). There is no commonly accepted understanding of what innovation means, especially within a business context. Historically, academics have made a distinction between invention and innovation, with innovation normally being couched in terms of commercial success (Trotterdell et al., 2002).

However, West and Anderson (1996, p. 681) propose a definition of innovation as one that involves "intentional attempts to derive anticipated benefits from change", therefore the actual benefits remain to be determined after an innovation has been implemented (Trotterdell et al., 2002). Other definitions of innovation try to adapt an all encompassing approach, such as the definition of innovation proposed by Nohria and Gulati (1996) including "any policy, structure, method, or process, product or market opportunity that the manager of the innovating unit perceived to be new". This is similar to Zaltman et al. (1973) who say that innovation is "an idea, practice, or material artefact perceived to be new by the relevant adoption unit".

The above definitions show that the term "innovation" is an umbrella for at least four different types of innovation, of which organisational innovation is one aspect (see Figure 5). Companies can innovate by developing *new services* (which can help to differentiate products and also earn additional revenues) or *new products* and by improving manufacturing or service delivery processes. In addition, companies can innovate by optimising *business processes* that make it easier for customers to do business with the organisation (Goffin and Szwejczewski, 2001).

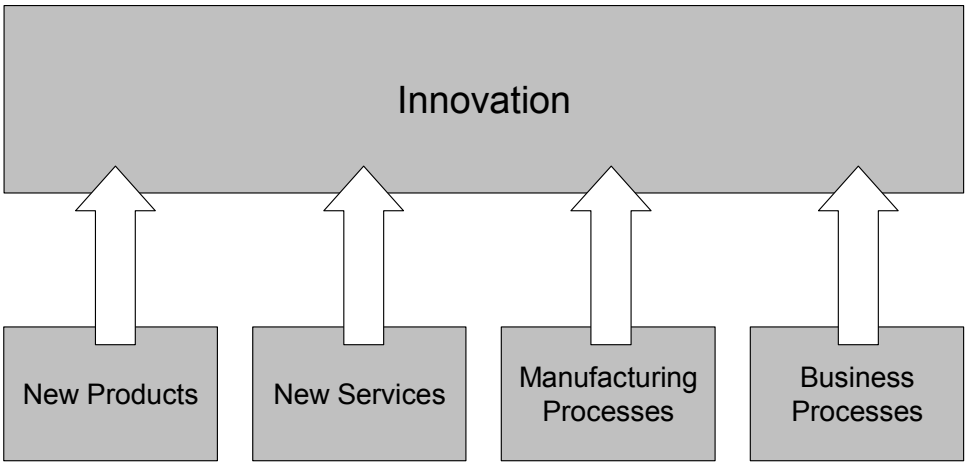

Figure 5: Four types of innovation (based on Goffin and Szwejczewski, 2001)

A similar distinction is that of product or process innovation, respectively technical and non-technical innovation (see Figure 6). While product and process innovations represent technical innovations, product-service and organisational innovations are affiliated to non-technical innovations (e.g. Schumpeter, 1934; Boer and During 2001; Damanpour and Evan 1984; Totterdell et al. 2002). *Product innovation* is defined as the development of new products or technologies supported by research and development activities of the companies. *Service-product innovation* is aimed at offering the customers new services which may stay alone or which might go along with a physical product, such as maintenance or operating services. *Process innovation* aims at finding new process technologies in order to produce more cheaply, faster and in higher quality. Finally, *organisational innovation* comprises the development and implementation of new organisational structures and processes to offer customers more flexibility and efficiency. Organisational innovations include for example the implementation of team work in manufacturing, the decentralisation of central departments into divisions or just-in-time concepts. Furthermore, the Oslo manual and the CIS IV have added a further category, i.e. marketing innovation (see chapter 4).

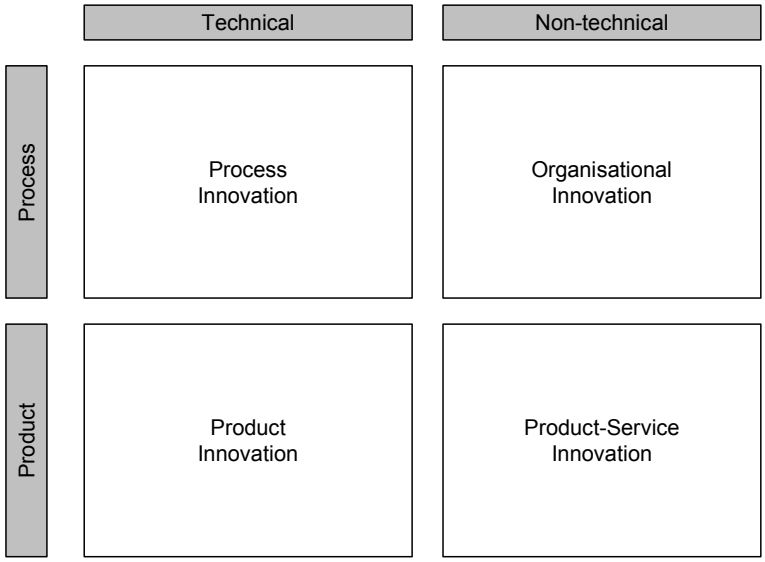

Figure 6: Different types of innovations (based on Kinkel, Lay and Wengel, 2004)

3.3 Definition of organisational innovation

Organisational innovation can be differentiated into *structural organisational innovations* and *procedural organisational innovations* (Figure 7). *Structural organisational innovations* influence, change and improve responsibilities, accountability, command lines and information flows as well as the number of hierarchical levels, the divisional structure of functions, or the separation between line and support functions. Such structural organisational innovations are for instance the implementation of (cross-functional) teams or the change from an organisational structure of functions (product development, production, human resources etc.) into one of product- or customer-oriented lines, segments, divisions, or business units.

On the other hand, *procedural organisational innovations* affect the routines, processes and operations of a company. Thus, these innovations change or implement new procedures and processes within the company, such as simultaneous engineering or zero-buffer-rules. They may influence the speed and flexibility of production (e.g. just-in-time concepts) or the quality of production (e.g. continuous improvement process, quality circles).

Organisational innovation can be further differentiated into an *intra-organisational* and *inter-organisational* dimension. While intra-organisational innovations occur within an organisation or company, inter-organisational innovations include new organisational

structures or procedures beyond a company's border. This comprises new organisational structures in an organisation's environment, such as R&D cooperation with customers or other forms, just-in-time processes with suppliers or customers, or supply chain management practices with suppliers.

Intra-organisational innovations may concern particular departments respectively functions or may affect the overall structure and strategy of the company as a whole. Examples for intra-organisational innovations are the implementation of team work, quality circles, continuous improvement processes or the certification of a company according to ISO 9000.

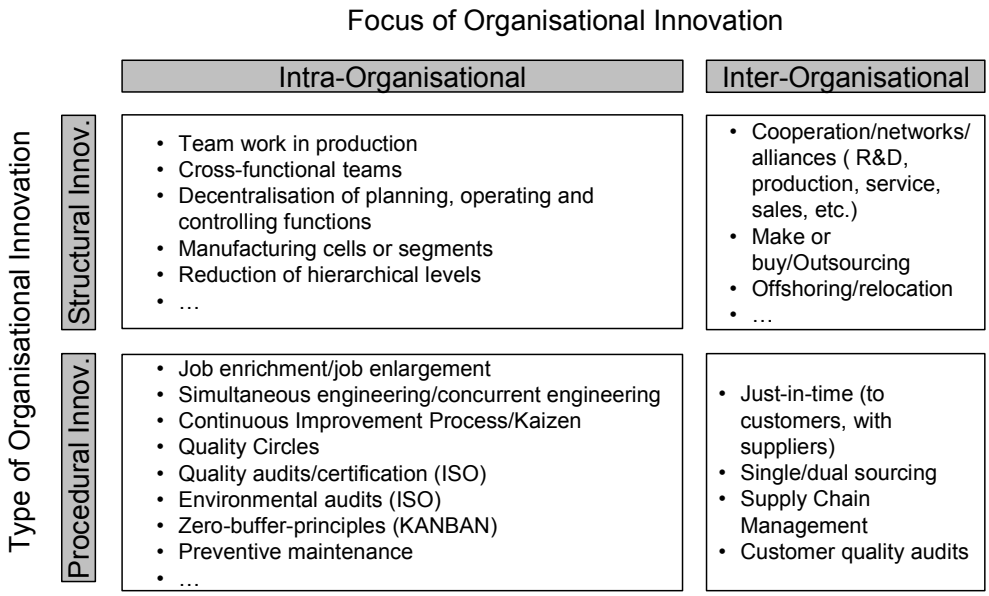

Figure 7: Classification of organisational innovations

It is obvious that there is a vast variety of organisational innovations differing in terms of type and focus of these concepts. Based on the examples provided in Figure 7 it becomes clear that the proposed categorisation is of analytical nature. In reality, most innovative organisational concepts address different aspects of business performance at the same time. They may contribute to several business strategies, requiring the use of specific performance indicators to analyse their impacts (see chapter 5).

4 Surveys on organisational innovation

The following chapter aims at providing an overview of surveys having included organisational innovation in the questionnaire. This chapter mainly focuses on the Community Innovation Survey (CIS) and the European Innovation Scoreboard (EIS) which represent the main statistical instruments of the European Union to receive information on the innovation performance of companies and countries in Europe.

4.1 Community Innovation Survey (CIS)

The lack of reliable and statistically representative data on innovation has for a long time severely hampered both empirical research and technology policies. Over the last decade, these data constraints have been substantially released, especially after the first Community Innovation Survey (CIS I) was launched by Eurostat and the EU Commission in the early 1990s. Since then other three rounds of CIS have been carried out (CIS II – CIS IV). These surveys have provided a unique set of data able to shed new light on the variety of forms in which innovation takes place within firms and across countries, industries and typologies of firms.

Both the OECD Oslo manual which provides the methodological basis of CIS and the first round of CIS were strongly focussed on technological innovation taking place in the manufacturing sector. Over the last few years, an effort has been made to broaden the concept of innovation as well as the sectoral coverage of CIS. In fact, CIS II covered for the first time a selected number of service industries, while in the following surveys, the definition of innovation adopted has been progressively broadened in order to accommodate innovation items, activities and assets which go beyond the technological domain.

Organisational change respectively organisational innovation is the most important form of non-technological innovation. This explains why there has been an increasing pressure for its inclusion in CIS and in the Oslo Manual. However, the measurement of organisational innovation is a very difficult task. This is because of the multidimensional nature of "organisations" and the associated difficulty of finding unambiguous concepts, clear-cut definitions of such a phenomenon. Organisational innovation is approached from scholars belonging to different disciplines such as sociology, management and business studies, labour and evolutionary economics. The issue regarding if, and how, organisational changes should be included in the concept of innovation and eventually covered by CIS is at the core of a lively debate and is heavily discussed in the ongoing revision process of the Oslo Manual. Given the difficulties mentioned above, the strategy chosen by Eurostat has been a rather conservative one, it consisted in including

some basic questions on the organisational changes introduced by firms in the periods covered by the surveys in the CIS III and CIS IV questionnaires.

The question on organisational change respectively organisational innovation in CIS III was as follows: "Did your enterprise during the period 1998-2000 undertake any of the following activities: implementation of advanced management techniques within your enterprise, implementation of new or significantly changed organisational structures." Possible answers for both aspects were "yes" or "no" (European Community, 2004). The results collected by this question show great variations at cross-country comparison. The share of enterprises which had implemented advanced management techniques during the period 1998-2000 ranged from 7 or 8 % (Denmark and Sweden) up to 31 % (UK and Austria), 36 % (Germany) and even 57 % (Luxemburg). The share of enterprises which had implemented changes in their organisational structures during the same time frame were at minimum 7 % (France) and at maximum 49 % (Germany) respectively 57 % (Luxemburg) (EU Innovation Scoreboard, 2004).

CIS IV has made a step forward in the measurement of organisational innovation. The definitions used to identify the different types of organisational changes introduced by firms in the period 2002-2004 have been more clear-cut. The questions on organisational innovation in the CIS IV are as follows: "Did your enterprise during the three years 2002 – 2004 implement new or significantly improved management systems to better use or exchange information, knowledge and skills within your enterprise?" The organisational question reads as follows: "Did your enterprise during the three years 2002 – 2004 make a major change to the organization of work within your enterprise, such as changes in the management structure or integrating different departments or activities?" Additionally the questionnaire asked: "Did your enterprise during the three years 2002 – 2004 introduce new or significant changes in your relations with other firms, such as alliances, partnerships, outsourcing and sub-contracting?" These modifications intended to specify the questions by explanatory amendments and to give the innovations in inter-firm relations an independent role in the questionnaire.

Summarising, the CIS survey was basically designed to cover technical aspects of innovation as defined by the Oslo Manual. Organisational and managerial innovations are an amendment being approached in general terms and at an aggregated level. The options to answer regarding organisational innovation are limited (yes/no). Furthermore, organisational innovation is treated as change process by asking for organisational changes in a time period. This allows for distinguishing between firms with or without organisational change processes.

4.2 Other surveys on organisational innovation

If and how organisational innovation is monitored on a quantitative empirical basis depends on the scientific or political interest in the kind of innovation. Many approaches are rooted in human resource management and sociological perspectives. They focus on procedural (managerial) innovations dealing with the way the work and the workers are managed or examine the consequences of new forms of organising on working conditions and qualification requirements. Another research line is concerned with the interaction of new technologies (particularly IT) and organisational innovation. In the service sector in particular, organisational innovation – again often together with IT – plays an important role in the establishment of new (innovative) service products. In addition, new successful corporate strategies such as lean production have raised interest in the monitoring of organisational change (as one element of industrial innovation). Therefore, organisational innovation is also increasingly recognised in surveys of specific industry groups such as SMEs or certain sectors. However, a sole focus on organisational innovations in a survey is rare.

Figure 8 shows a list of surveys which include a significant share of questions on organisational innovation in a wide scope, or which (only) touch upon it, however, cover at least several European countries. The table below contains information on the *institution* that conducts the survey, the *countries* where the surveys have been carried out, the *sector* coverage, the *years* in which the survey was conducted so far and the *sample size*. In addition, the table gives information on the *content* of the survey - whether it has a single focus mainly on one issue (e.g. working conditions) or rather a multi focus where organisational innovation is only one subject. The category *depth* of survey shows how detailed the questions have been, whether they are at a rather general level or whether they have been asked in detail. Finally, the column *impact indicators* details if impact indicators such as performance measures have been monitored on an objective and factual basis (e.g. manufacturing lead time, productivity, etc.) or if they are based on perceptions and estimations of the interviewees. The table below has been updated on the basis of the work in CIS project No.8 "Analysis of Empirical Surveys on Organisational innovation and Lessons for Future Community Innovation Surveys" of the European Commission (Wengel et al., 2000).

Survey	Institution	Countries	Sectors	Year	Sample	Content	Depth	Impact indica-tors
CIS	Statistical Offices, different research institutes	EU plus several OECD countries	private sector	1997 (UK) 2001 2005	> 15000	multi focus	general	objective and per-ceived
European Sur-vey on Working Conditions	European Founda-tion	EU 15 EU 25	all	1990 1995 2000 2005		single focus on working condi-tions	general	none
European Re-structuring Monitor	European Founda-tion	EU 15	private sector	con-tinu-ous	ca. 2500	job reduction or crea-tion	(news-paper, business reports)	objective
European Sur-vey on Working Time and Work-life Balance	European Founda-tion, In-fratest	EU 15	all	2004	>16000	working time	general	none
Statistical Indi-cators Bench-marking the Information Society	EU, INRA	GER, Fi, F, Gre, UK, It, Es	all (deci-sion ma-kers, IT respon-sibles)	2002	3139	IT use	general	?
Observatory of European SMEs	European Commis-sion	EU15 plus Lie, CH, N, Ice	private sector	1992-today	7800 SMEs	multi focus	very detailed	almost none
German Manu-facturing Sur-vey, European Manufacturing Survey	Fraun-hofer ISI	Germany GER, CH GER, CH, A, UK, F, Slo, CR, Tur, It	invest-ment goods, chem./ plastics since 2001	1995, 1997, 1999, 2001, 2003	1305 1329 1442 ca 1950 >2500	multi focus	very differen-tiated	per-ceived and objective
International Manufacturing Strategy Survey (IMSS)	IMSS consor-tium (mainly universi-ties)	14 coun-tries (>20)	me-chanical engineeri ng/asse mbly (ISIC 38)	92-94 96-98 2002	? ? 474 (600)	Manufac-turing strategies	detailed (scales)	per-ceived
Employee Par-ticipation in Organisational Change*	EPOC research group	Europe	all	1996	5786	single focus on participa-tion	very differen-tiated	per-ceived
The Collaborat-ing Firm* (DISKO module 2, OECD/NIS project)*	University of Aalborg (DRUID research group)	Denmark parallel surveys in F, A, E, It, Swe, Fi, N	manu-facturing sector	1997/ 8	1022 (324)	single focus on collabo-ration in product design	very differen-tiated	objective

INNFORM*	Oxford University et al	UK, US, NL, F, J, E, SE, CH	large, medium industry	1997	ca. 450	multi focus	very differen-tiated	objective (relative)
Flex-2: Change in Enterprise*	Nutek	Sweden	all	1998	3360	multi focus	very differen-tiated	per-ceived and objective
Enterprises as Employers*	Statistical Office	Finland	private sector	1996	2110	multi focus	very differen-tiated	per-ceived and objective
Flexibility in Working Life*	Institute for Social Research/ Statistical Office	Norway	all	1997	2130	multi focus	very differen-tiated	no im-pact indica-tors
Workplaces in Sweden*	National Institute for Work-ing Life	Sweden	all	1991/ 2	2135	multi focus	very differen-tiated	no in-forma-tion
IAB Establish-ment Panel	Institute for Em-ployment Research (IAB)	Germany (similar surveys in other EU countries)	all	1993 -2003	15856	multi focus	very differen-tiated	
The Flexible Firm (DISKO module 1)*	University of Aalborg (DRUID research group)	Denmark	private sector	1996	1900	single focus on organ-isational flexibility	very differen-tiated	objective
Workplace Employee Rela-tion Survey	Advisory Conciliа-tion and Arbitrary Service	United Kingdom	all (ex-cept agricul-ture, mining)	1990-1998	2188	multi focus	partly differen-tiated	per-ceived and objective
Georgia Manu-facturing Sur-veys	Georgia Tech University	USA (Georgia)	manu-facturers	1994 1996 1999 2002 2005	1700, 1002, 778, 635 >1300	multi focus	partly differen-tiated	objective
Organisational Changes and Computerisation	Statistical Office (SESSI), DARES	France	industry	1998 2005 (plan ned)	N/A	multi focus	very differen-tiated	almost no
Computerisation and Company Respondence to Social Change	Japan Institute of Labour	Japan	private sector	1996 ?	558	multi focus	very differen-tiated	no in-forma-tion
Survey on Per-sonnel Policy Systems	Japan Institute of Labour	Japan	private sector	1998 ?	N/A	Changes in corpo-rate/work organi-sation	varied	no in-forma-tion

* This survey is a one time activity or unlikely to be continued.

Figure 8: Overview of surveys covering organisational innovation

4.3 European Innovation Scoreboard (EIS)

The European Innovation Scoreboard (EIS) is the instrument of the European Commission to analyse and compare the innovation performance of the European Member States. For all 25 European countries as well as for Bulgaria, Romania, Turkey, Iceland, Norway, Switzerland, the USA and Japan, the EIS provides data on the innovation performance of these countries (European Innovation Scoreboard, 2005).

EIS 2005 contains 26 indicators which are assigned to five categories and grouped in two main groups, i.e. input and output indicators. Sources of these innovation indicators are statistics of Eurostat and the OECD as well as parts of CIS (see Figure 9).

These 26 innovation indicators are merged into one composite index, the Summary Innovation Index (SII), providing an overview of the innovation performance of every European country.

	INPUT – Innovation drivers	
1.1	S&E graduates per 1000 population aged 20-29	EUROSTAT
1.2	Population with tertiary education per 100 population aged 25-64	EUROSTAT, OECD
1.3 NEW	Broadband penetration rate (number of broadband lines per 100 population)	EUROSTAT
1.4	Participation in life-long learning per 100 population aged 25-64	EUROSTAT
1.5 NEW	Youth education attainment level (% of population aged 20-24 having completed at least upper secondary education)	EUROSTAT
	INPUT – Knowledge creation	
2.1	Public R&D expenditures (% of GDP)	EUROSTAT, OECD
2.2	Business R&D expenditures (% of GDP)	EUROSTAT, OECD
2.3 NEW	Share of medium-high-tech and high-tech R&D (% of manufacturing R&D expenditures)	EUROSTAT, OECD
2.4 NEW	Share of enterprises receiving public funding for innovation	EUROSTAT (CIS)
2.5 NEW	Share of university R&D expenditures financed by business sector	EUROSTAT, OECD
	INPUT – Innovation & entrepreneurship	
3.1	SMEs innovating in-house (% of all SMEs)	EUROSTAT (CIS)
3.2	Innovating SMEs co-operating with others (% of all SMEs)	EUROSTAT (CIS)
3.3	Innovation expenditures (% of total turnover)	EUROSTAT (CIS)
3.4	Early-stage venture capital (% of GDP)	EUROSTAT
3.5	ICT expenditures (% of GDP)	EUROSTAT
3.6	SMEs using non-technological change (% of all SMEs)	EUROSTAT (CIS)

	OUTPUT - Application	
4.1	Employment in high-tech services (% of total workforce)	EUROSTAT
4.2 NEW	Exports of high technology products as a share of total exports	EUROSTAT
4.3	Sales of new-to-market products (% of total turnover)	EUROSTAT (CIS)
4.4	Sales of new-to-firm not new-to-market products (% of total turnover)	EUROSTAT (CIS)
4.5	Employment in medium-high and high-tech manufacturing (% of total work-force)	EUROSTAT
	OUTPUT – Intellectual property	
5.1	EPO patents per million population	EUROSTAT
5.2	USPTO patents per million population	EUROSTAT
5.3 NEW	Triadic patent families per million population	EUROSTAT, OECD
5.4 NEW	New community trademarks per million population	OHIM
5.5 NEW	New community designs per million population	OHIM

Figure 9: Indicators of the European Innovation Scoreboard 2005

5 Methodological challenges in measuring organisational innovations

As organisational innovations are important for firms' competitiveness, the collection and comparison of data on organisational innovations is of particular interest. However, the measurement of organisational innovation raises several challenges. The following chapter aims at showing how different indicators and ways of asking for organisational innovation lead to different conclusions concerning the organisational innovativeness of a firm. We use the *German Manufacturing Survey* of the Fraunhofer ISI and present four challenges for the measurement of organisational innovation. The objective of this questionnaire-based, mailed German Manufacturing Survey is to gather data on the implementation of innovative technical production concepts, on performance indicators, product innovations, service innovations, inter-firm cooperation, relocation of parts of the company, as well as general data on the company and data on the implementation of innovative organisational concepts, thus organisational innovations. In 2003, we asked 13,259 companies to fill in the questionnaire whereupon 1,450 companies returned an utilisable questionnaire, which makes a response rate of 11 percent. These companies constitute a representative sample of the investment goods industry, chemical industry and rubber and plastic industry. The survey was first launched in 1993 and is conducted every two years (Lay and Maloca, 2004).

5.1 Challenge 1: Complexity of organisational innovations (aggregation level)

As illustrated in chapter 3, the term organisational innovation may include (many) different concepts of how to change traditional organisational structures. Organisational

innovations can affect business processes (e.g. continuous improvement processes) as well as organisational structures (e.g. team work). Organisational innovations may occur in an enterprise itself (intra-organisational perspective, e.g. simultaneous engineering), but may also concern relationships to other companies (inter-organisational perspective, e.g. R&D cooperation).

The diversity of organisational innovations implies that they might be an element of (many) different business strategies:

- Implementing decentralised product- or customer-oriented organisational structures to replace traditional centralised tayloristic-type of organisational structures aims at improving companies' flexibility.
- Implementing quality circles, total quality management or continuous improvement processes contributes to improved quality.
- Implementing simultaneous engineering or cross-functional teams is to shorten the product development processes in the companies.
- Implementing concepts of just-in-time and supply chain management aims at increasing productivity by minimising storage costs.

These various business strategies are fostered and triggered by different innovative organisational concepts. Therefore, an indicator that merely states whether a company has implemented organisational innovation or not while disregarding the kind of organisational innovation may only have limited explanatory power. An overall indicator of organisational innovation may merge various business activities in the field of organisational innovation which are targeted towards different objectives like flexibility, productivity, etc. and thus might not be able to explain specific performance differences.

An analysis using such an overall indicator of organisational innovation supports this assumption. In a regression model which aimed at identifying variables that have an influence on productivity, an overall indicator of organisational innovation was introduced (index of implementation of organisational innovation). This indicator was composed of 13 organisational concepts covered in the *German Manufacturing Survey 2003*. This index comprise the implementation of team work in production, simultaneous engineering, continuous improvement processes, decentralisation, quality circles, kanban, balanced score card, regular individual consultation, quality management according to EFQM, cross-departmental temporary development teams, segmentation of production, integration of tasks and customer or product-line-oriented segmentation of central departments.

	Dependent variable: Productivity	
	Coeff.	t
Outsourcing ratio (1 – [turnover minus inputs per turnover])	-.274	-6.91***
Firm size (number of employees)	.008	0.18
East Germany (establishment located in East Germany, yes = 1 / no = 0)	-.309	-7.12***
Manufacture and assembling staff (staff occupied with manufacture or assembly as share of all employees)	-.196	-3.86***
Index of IT application	.149	3.10**
Qualification of workforce (share of employees with university or college degrees, masters or technicians on all employees)	.131	2.59**
Rate of export	.097	2.03**
Share of turnover with new products	-.090	-2.14**
Degree of capacity utilisation	.097	2,37**
Product quality (share of products re-worked or scrapped)	-.038	-0.95
Supplier to automotive sector (establishment predominantly supplies to automotive industry, yes = 1 / no = 0)	.029	0.66
Index of implementation of organisational innovation	.038	0.83
Constant	1.958	23.42***
8 Sector dummies and production structure	yes	
Observations	417	
corr. R^2	.38	
F-test	13.360***	

*** Significance level <.001 ** Significance level <.05 * Significance level <.10.

Figure 10: Results of a multiple regression analysis using a composite index for organisational innovation

Apart from the overall index on organisational innovation, a multiple regression analysis (see Figure 10) tested various other independent variables. The R^2 value indicates that the model explains 38 percent of the variance of the dependent variable “productivity”. The coefficient of the variable “index of implementation of organisational innovation”, however, was not statistically significant (coeff. .038). Thus, we can not conclude that there are significant differences in productivity based on the extent of implementation of organisational innovation in general represented in one index.

An in-depth analysis with single organisational innovations instead of an overall indicator introduced in the regression model depicted a different picture: some organisational concepts proved to have a significant influence on productivity while others do not significantly affect productivity. Figure 11 gives an overview of the results. These first results clearly point out the necessity to explore the impact of different organisational innovations on company performance separately. As assumed in the introduction to

this chapter, some organisational innovations might have an impact on performance in terms of flexibility, while others entail improved quality and others again account for better productivity. In order to explain and perhaps to predict a superior performance in specific fields like flexibility, quality, cost reduction or innovation ability it is crucial to not only inquire whether companies have implemented organisational concepts at all, but to ask which particular kind of organisational innovation has been implemented. It is probable that the effects of overall organizational innovations concerning productivity, flexibility and quality on performance indicators overlap and indicate no significant impact on performance.

	Dependent variable: Productivity			
Models 1-13[+]	Coeff.	Sign.	F-test	corr. R^2
Model 1: Customer or product-line-oriented segmentation of central departments	.029	n.s.	14.164***	.054
Model 2: Decentralisation of planning, operating and controlling functions	.069	*	14.547***	.361
Model 3: Balanced scorecard	.046	n.s.	14.094***	.363
Model 4: Regular individual consultation	.069	*	14.454***	.358
Model 5: Quality Circle	.048	n.s.	14.127***	.354
Model 6: CIP Continuous Improvement Process	.050	n.s.	14.556***	.361
Model 7: Quality management according to EFQM	.033	n.s.	13.854***	.360
Model 8: Simultaneous Engineering	.018	n.s.	14.052***	.352
Model 9: Cross-departmental temporary development teams	.023	n.s.	13.636***	.345
Model 10: Segmentation of production	- .021	n.s.	14.190***	.352
Model 11: Integration of tasks	- .016	n.s.	14.162***	.353
Model 12: Internal zero-buffer-principle (kanban)	.071	*	14.834***	.365
Model 13: Team work in production	.024	n.s.	14.046***	.350

*** Significance level <.001 ** Significance level <.05 * Significance level <.10.

[+] All regression models 1-13 are conducted with the following control variables: outsourcing ratio, firm size, East Germany, manufacturing and assembling staff, index of IT application, qualification of workforce, rate of export, share of turnover with new products, degree of capacity utilization, product quality and supplier to automotive sector.

Figure 11: Results of 13 multiple regression analyses

Therefore, in the stakeholder interviews which have been conducted in the frame of this project (see chapter 6), interviewees had to estimate the impact (low, medium, high) of different organisational innovations on quality, flexibility, costs and innovation

ability. These estimations might provide evidence for different impacts on specific performance indicators such as increased quality, flexibility and innovations as well as decreased costs.

5.2 Challenge 2: Life cycle of organisational innovations (use or change)

As previously outlined, organisational innovations are changes to the structure and processes of enterprises that result from a new understanding of the adequate organisation for the current market situation. In former times stable markets and homogenous customer demands required organisational structures that benefited from the advantages of specialisation, labour division and centralisation ("economies of scale"). However, this has changed. Turbulent and dynamic markets as well as heterogeneous customer demands together with greater market power of the customers require more flexible structures and less hierarchy levels in enterprises in order to promote more decision power in places where the relevant information is directly available.

The implemented organisational innovations as a response to the changes in the organisational environment (particularly the market situation) give the companies the ability to increase their performance as long as the market situation does not change. This implies that organisational innovations, as opposed to products, are not subject to an aging process per se. For example, enterprises will gain advantages from concepts like total quality management, supply chain management or just-in-time for more than 3 years after their first implementation. The concept of the "innovative firm" is to be questioned with respect to organisational innovation. At least, other reference periods or "life cycles" may be considered.

Therefore, in order to empirically measure organisational innovations, it seems necessary to apply a different approach than the one applied when measuring product innovations. Product innovations age because of the fast technological progress, therefore the return on these innovations is earned during the first three years after their introduction. In the case of organisational innovations, however, the fact of the innovation being implemented at all rather than the point of time when the innovation is introduced is important.

The following example illustrates this through a comparison between the implementation of organisational innovations in total versus the implementation of organisational innovations within the last three years. The data are taken from the *German Manufacturing Survey 2003* (see Figure 12). The survey showed that 62% of all firms have im-

plemented team work in production, 59% task integration, 37% decentralisation, 69% continuous improvement processes and 46% a product or customer-oriented organisational structure (segmentation of production).

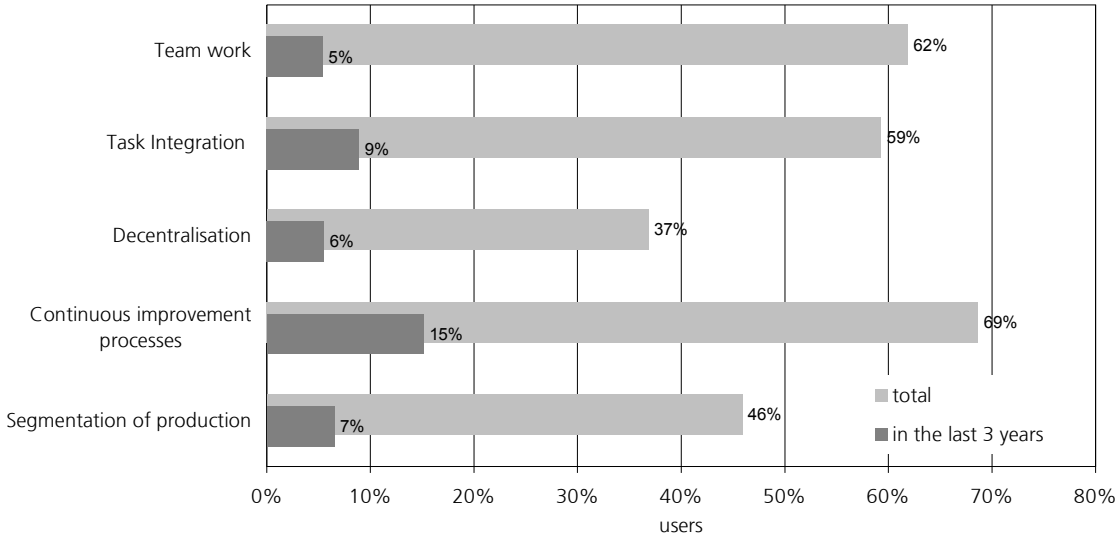

Figure 12: Implementation of organisational concepts in total vs. within the last three years

Since the year of introduction of the particular organisational innovation was recorded as well, the results to the possible question "Have you implemented team work, task integration, decentralisation, continuous improvement process, or product- or customer-oriented structures in the last three years?" can be reconstructed. This would have led to the following results:

- In the case of team work, 5% of all firms would have stated that they have introduced this organisational innovation during the last three years. 57% of all firms that introduced team work would have been considered as not innovative even though they use team work, a concept still regarded as innovative. In a comparison between innovative and non-innovative enterprises, the previously named 5% where team work has been introduced in the last 3 years would have been compared to a group consisting of 57% that have used team work for a long time already and to a group of 38% without any implementation of team work so far.
- Considering task integration, 9% of all companies would have been regarded as innovative, although this innovation has actually been implemented by 59% of all companies.
- 6% of all firms would have introduced decentralisation, even though 37% of all firms have already launched this process
- Instead of 69% in reality, only 15% would have introduced continuous improvement process

- As to the introduction of product and customer-oriented structures (segmentation of production), with the 3-year-rule only 7% of the companies would have been registered in comparison to 46%.

The percentages above illustrate that the group of non-innovative firms is not described correctly at all when asking for the innovations of the last three years. A comparison of the performance of firms characterised as innovative and non-innovative (based on the three years question) might lead to the following: The group of non-innovative firms might perform better because of the high amount of enterprises that have already used the innovations on a long term (more than three years).

To conclude, when measuring organisational innovations, all firms that use organisational innovations have to be included in the set of innovative firms. This is only guaranteed when all firms that implemented organisational innovations at all are included. A limitation to the companies that have introduced innovations in the last three years incorrectly characterises the latecomers (who are the least innovative of the group of the innovative firms) as innovative.

5.3 Challenge 3: Scope of organisational innovations (use or extent of use)

The extent to which innovation characterises a company is crucial. When product innovations are offered on the market most of the innovation process and effort has already been accomplished. Insofar, there is no interim solution between market offering and non-offering. Therefore, to capture the proportion of innovative firms with regard to product innovations, it is appropriate to examine a firm on whether it has launched a product innovation on the market or not. Such a question will identify innovative firms and give hints for policy-makers. Nevertheless it has to be taken into consideration that economic success is only achieved through significant sales.

However, this is not valid in the case of organisational innovations. For example, if an organisational innovation is put into practice as a pilot project in a very small area of the enterprise, only a small part of the work is done and there might not be any impact on the performance of the business at all. Yet, if the organisational innovation is realised in highly relevant departments of the business, but an overall implementation is still missing, limited effects might occur. Ultimately, an organisational innovation can be implemented throughout all departments of the firm, so the impact on the performance of the business is maximal and no unutilised potential remains.

This shows that asking for the extent of use in a firm is crucial when investigating and measuring organisational innovation. Only with this knowledge it is possible to estimate

the effects of organisational innovation and furthermore to quantify the unutilised potential for non-users and part-users of these organisational innovations.

The analysis of the *German Manufacturing Survey 2003* shows that only a small proportion of the companies that make use of a certain organisational innovation have fully implemented this organisational innovation in all business areas (see: Figure 13):

- More than 60% of all firms claim to have implemented team work; however, only 10% say that they have fully exploited the potential of this organisational innovation.
- Task integration has been realised by more than 60%, but only 7% have implemented this innovation throughout the whole corporation.
- 37% of all enterprises use decentralisation, yet only 6% indicate that they have completed the process of decentralization.
- Almost 70% of the companies stated that they use continuous improvement processes, but only 5% indicate that they have completely implemented this organisational concept.
- A total of 46% have begun with the segmentation of production, however just 13% state that the potential of this innovation has been fully exploited.

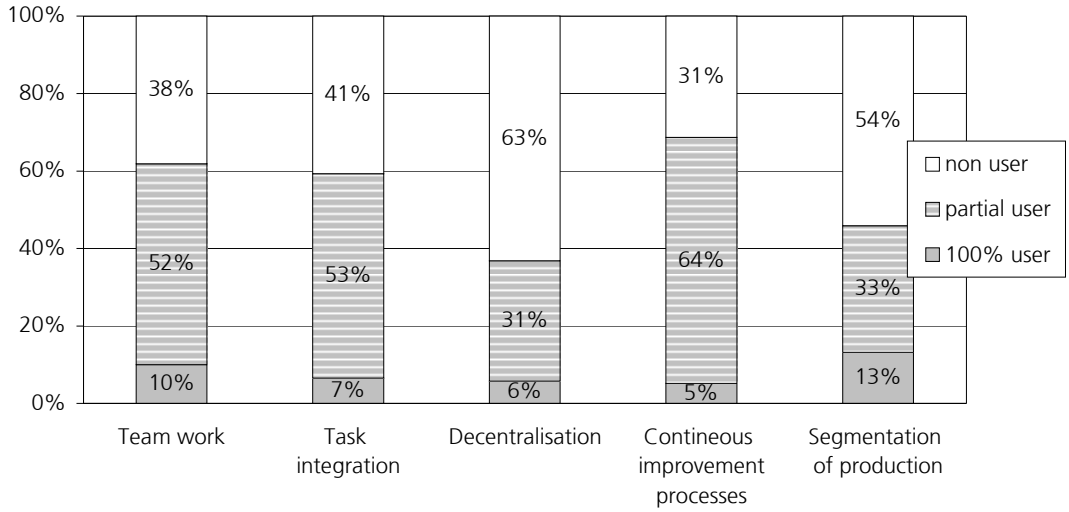

Figure 13: Diffusion of organisational innovations between 'use' and 'non-use'

Considering a comparison between innovative and non-innovative firms where the extent of use of an organisational innovation is not regarded, it would be difficult to estimate the impact of this organisational innovation on performance indicators. If for instance the group of innovative firms contains a high percentage of businesses that have only partially implemented various organisational innovations without having increased their performance so far, this group of organisationally innovative firms will not stand out with a superior performance.

5.4 Challenge 4: Quality of organisational innovation (labels or features)

Most organisational innovations are not linked to clearly defined measures for changing organisational structures and processes. They are rather basic concepts and their actual implementation depends on the company's management. Except for ISO 9000 (quality assurance) and ISO 14000 (environment protection), there are no standards for these organisational innovations.

Particularly when organisational innovations are very new and are yet not to be assessed as established concepts, companies tend to label their small realization efforts as a successful implementation of the organisational innovation. An example on team work which is integrated in the *German Manufacturing Survey 2003* (see Figure 14) proves this assumption.

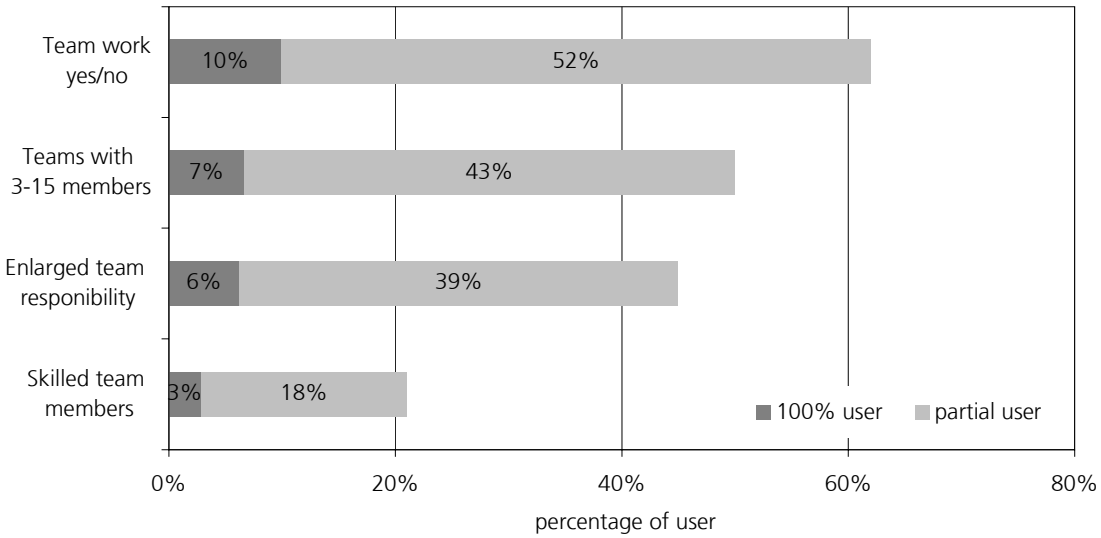

Figure 14: Diffusion of 'team work'

62% of the firms answered with "yes" when asked if they had realised team work (10% are users with fully exploited potential and 52% partial users). This result suggests that team work is used by a relevant part of the economy. However, when asking if team work was realised with a team size of 3 to 15 members the share decreased to 50% (of which 43% are partial users). This indicates that 12% of the enterprises realise team work with a group size of 1 to 2 or more than 15 members which does not comply with the basic idea of team work and therefore will not lead to the positive effects that are intended.

When restricting team work to those models that have teams consisting of 3 to 15 members and that assign an enlarged responsibility to the team, the share drops to

45% (of which 39% are partial users). Moreover, when adding the requirement that all team members are qualified for all up-coming tasks within the team, only 21% of all firms comply with these requirements (of which 18% are partial users).

As depicted above, the measurement of organisational innovations by using no more than a term like "team work" will lead to results that are highly questionable. The quoted example leads to the assumption that two thirds of all firms are profiting from all possible advantages of team work. In fact, this is only true for less than a quarter of the firms, since only this proportion has yet realised the concept of team work in a proper sense. Moreover, the percentage of all firms that are utilizing the entire potential of team work in all parts of the business is only 3%.

This accentuates the need for additionally characterizing organisational innovations in such a way that –beyond the mere term - their characteristic features within companies can be recorded.

6 Stakeholder interviews

6.1 Aim and scope of stakeholder interviews

Stakeholder interviews have been conducted to understand the importance of different innovative organisational concepts across sectors. Therefore, interviews were accomplished with representatives of universities, intermediaries or policy makers (*research interviews)* and with practitioners in different companies (*industry interviews*).[2] In total, 100 interviews[3] - 28 research interviews and 72 industry interviews - have been accomplished. Both research and industry interview partners are distributed across nine different sectors which have been selected as target sectors for the PORCH project.

The sectoral coverage of this study included the aerospace, automotive, biotechnology/bio-pharmaceuticals, chemical, electronics, food, machinery, medical devices and textile industry. Face-to-face and telephone interviews have been conducted by the project team with stakeholders from 12 different European countries (see figure 15)[4].

No. of interviews	Sector	Country
10	Aerospace	UK, France, Germany
18	Automobile	France, Germany, Italy, Slovenia
9	Biotechnology	UK, France, Germany, Spain
7	Chemical	UK, France, Germany, Italy, Slovenia
13	Electronics	UK, France, Germany, Italy, Slovenia, Ireland
9	Food	UK, France, Italy, Slovenia, Czech Republic
15	Machinery	UK, France, Germany, Italy, Slovenia, Bulgaria, Croatia, Sweden
9	Medical Devices	UK, France, Germany, Slovenia
10	Textile	UK, France, Germany, Italy, Poland
∑ = 100		

Figure 15: Stakeholder interviews across sectors and countries

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[2] It was attempted to choose interview partners in the sector according to the sectoral structure. E.g. in the machinery sector, machine manufacturers and component manufactures are the most important actors in this sector. Therefore, machine manufacturers and component manufacturers have been interviewed. Concerning the country coverage, due to the relatively small number of interviews, it was not possible to cover all European countries in every sector. However, we tried to cover the most important European countries for every surveyed sector.

[3] In addition, nine interviews with research representatives, who cannot be affiliated to a specific sector, have been conducted. Therefore, these additional nine research interviews have not been considered in the further data analysis of the stakeholder interviews.

[4] See appendix for a detailed table of all conducted interviews.

The following 21 organisational innovations[5] – affiliated to 8 thematic categories - have been selected in order to be evaluated by the stakeholder interviewees.

Decentralisation at a strategic level of the company

1. Decentralisation of functions into customer or product-line oriented departments
2. Decentralisation of formerly centralised functions

Decentralisation at an operative level of the company

3. Team work/Group work
4. Cross-functional teams

Cooperation with other companies

5. Cooperation in production
6. Cooperation in R&D
7. Cooperation in administrative activities

Outsourcing/Relocation

8. Outsourcing/Relocation of production
9. Outsourcing/Relocation of R&D
10. Outsourcing/Relocation of administrative activities

Quality Management

11. Continuous Improvement Processes (CIP)
12. Total Quality Management (TQM/ISO)

Human Resources Management

13. Flexibility of work schedules/flexible work time
14. Upskilling
15. Regular individual appraisals
16. Performance based wage systems

Knowledge Management

17. Systematic instruments to strengthen knowledge sharing between employees

[5] See appendix for definitions of every *organisational innovation*.

Production Management

18. Just-in-time
19. Zero-Buffer
20. Simultaneous Engineering
21. Supply Chain Management

Figure 16: 21 surveyed organisational innovations

Drawing on these organisational innovations, the following items were asked in the stakeholder interviews[6]:

- Assessment of the *relevance* of organisational innovations in every industry sector (yes/no).
- Assessment of the *intensity of impact* (low, moderate, strong) of 21 innovative organisational concepts on quality, flexibility, costs and innovation ability for the specific sector the interviewee is familiar with. The impact assessment measures how important different organisational innovations are for the output dimensions quality, flexibility, costs and innovation ability.
- Intensity of impact on quality, flexibility, costs and innovation ability of *additional organisational innovations* named by the interviewee.

In a first step, interview partners have been asked for the assessment of the overall relevance of every single organisational innovation in the sector they are experts of. In case of existing relevance of the respective organisational innovation, further questions have been asked assessing the impact of each organisational innovation on the four different output dimensions quality, flexibility, costs and innovation ability. Not only the relevance for each of the 21 organisational innovations has been assessed by the stakeholders but also the impact of each organisational innovation on different output dimensions. This allows a more differentiated analysis of the importance of organisational innovations. Experts have been further asked about other organisational innovations they can think of which have not been part of the questionnaire. However, the great majority of experts have considered the list of 21 organisational innovations to be complete.

6 See appendix for entire interview guidelines.

6.2 Interview data

As 100 stakeholders in nine sectors across twelve countries have evaluated the (low, moderate, strong) impact of 21 organisational innovations on quality, flexibility, costs and innovation ability, the data set is rather complex.

Therefore, data has been analysed in three steps (see Figure 17). In a *first* step, the interview data has been analysed for each of the nine surveyed sectors separately. The *second* step was to analyse the importance of organisational innovation independently from sectors but according to the output dimensions. The *third* step was to compare the importance assessments for organisational innovations between the output dimensions as well as between the sectors. The aim of this comparison was to understand if the stakeholder assessments of the importance of organisational innovations differ according to the output dimensions or/and according to the sectors. It has been analysed if organisational innovations are differently important across sectors or if their importance is different across the four output dimensions quality, flexibility, costs and innovation ability.

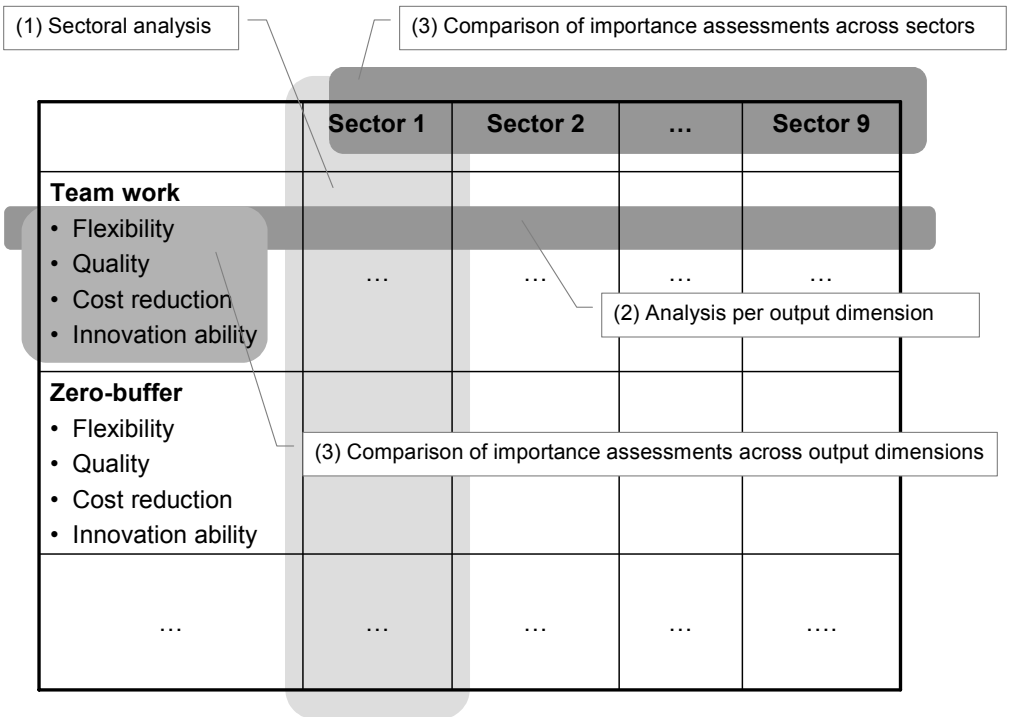

Figure 17: Data analyses of stakeholder interviews

The results of the analyses that have been conducted in the second and third step will be presented in chapter 6.4. The detailed studies for the sectors (sectoral studies) for the aerospace, automotive, biotechnology/bio-pharmaceuticals, chemical, electronics, food, machinery, medical devices and textile industry can be found in the appendix of this report.

6.3 Data analysis

The importance of organisational innovation has been measured as follows: the interviewed persons were asked to first assess the relevance of the specific organisational innovation (yes or no). In the case of relevance, the impact on increased quality, increased flexibility, reduced costs and increased innovation capability were estimated by the experts on a scale of low (=1), medium (=2) or high impact (=3). In the case of no relevance of the organisational innovation the value is zero, indicating that there is no impact on the four dimensions.

Means of the answers have been calculated in three different ways (see Figure 18):

(1) Means for every output dimension in each sector which represents the importance of every organisational innovation on flexibility, quality, innovation ability and costs per sector;

(2) Means for every output dimension across all sectors which describes the importance of every organisational innovation on flexibility, quality, innovation ability across all sectors; and

(3) Means across all output dimensions for each sector indicating the overall importance of every organisational innovation on flexibility, quality, innovation ability per sector.

	Automotive	Machinery	…	Across all sectors
Team work				
• Flexibility	2.83	2.5		2.23
• Quality	2.72	2.29		2.23
• Cost reduction	2.69	1.57		1.83
• Innovation ability	2.29	2.07		2.01
Average across all output dimensions	*2.63*	*2.11*		
Zero-buffer				
• Flexibility				
• Quality				
• Cost reduction				
• Innovation ability				
Average across all output dimensions				
…	…		…	…

(1) Means for every output dimension per sector

(2) Means for every output dimension across all sectors

(3) Means across all output dimensions per sector

Figure 18: Extract from data sheet of PORCH interviews

6.4 Results of stakeholder interviews

Results of the stakeholder interviews are presented in a twofold way. First, chapter 6.4.1 describes the results of the stakeholder interviews as regards the importance of organisational innovations for the four output dimension quality, flexibility, innovation ability and costs. Second, chapter 6.4.2 presents results of a comparison of the importance assessments of organisational innovations between the nine sectors as well as between the four output dimensions.

6.4.1 Importance of organisational innovations for quality, flexibility, costs and innovation ability

Figure 19 to 22 show the results of the stakeholder interviews according to the estimated importance of every organisational innovation in the four output dimensions (quality, flexibility, cost reduction and innovation ability).

These importance rankings show that for every output dimension different organisational innovations are the most important ones. According to the experts' opinion, the most important organisational innovations for quality, i.e. the organisational innovations that have the strongest positive impact on quality improvement are continuous improvement processes and total quality management. This is not surprising since these two organisational innovations explicitly aim at the improvement of quality in enter-

prises and are therefore expected to display the strongest effect on quality. Contrarily, outsourcing of R&D and of administrative tasks as well as cooperation in administrative activities and also zero-buffer and just-in-time are not supposed to have a strong impact on quality improvement and rank low in this list (see Figure 19).

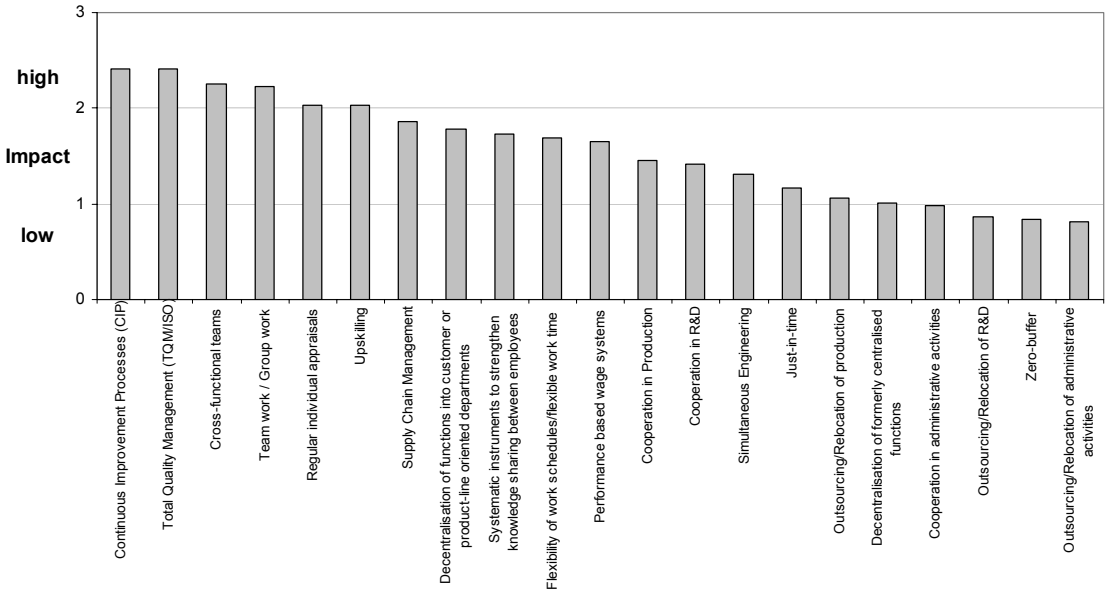

Figure 19: Ranking of importance of organisational innovations for increasing quality

Looking at the importance of organisational innovations for increasing flexibility (Figure 20), experts think that flexibility of work schedules, cross-functional teams or team work have the strongest impact on flexibility. This is not surprising as these organisational innovations attempt to increase product and process flexibility within a company. In case of cross-functional teams not only flexibility, but also innovative ability is a reason for implementation (see Figure 22). In the light of increase of flexibility of an enterprise, outsourcing, cooperation in administration and zero-buffer do not seem to be of great importance.

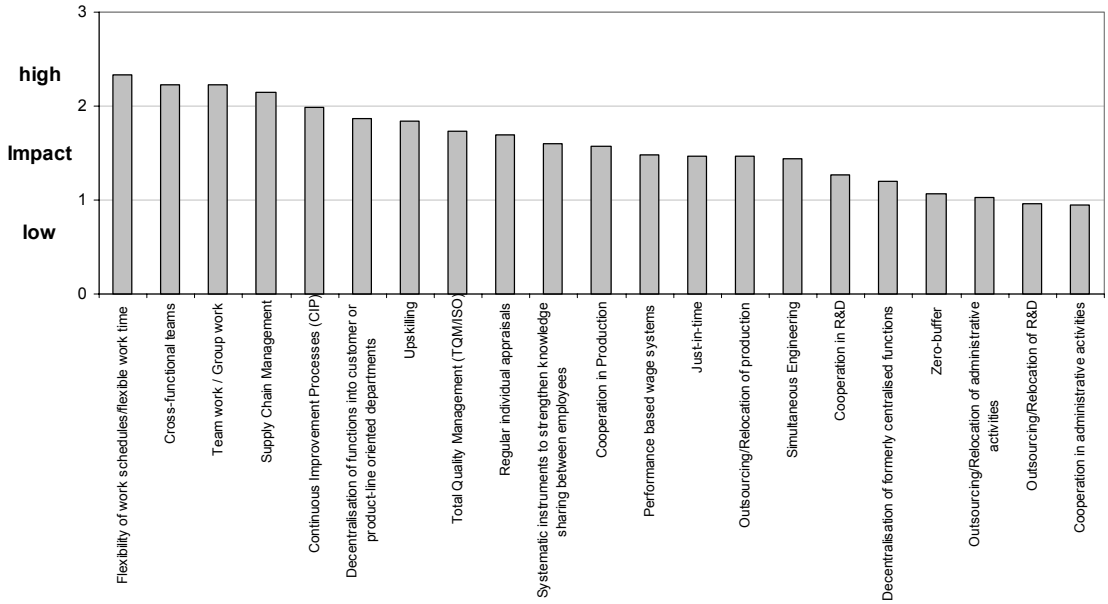

Figure 20: Ranking of importance of organisational innovations for increasing flexibility

Considering the aspect of cost reduction, again different organisational innovations seem to be important according to the experts' assessments (see Figure 21). Supply chain management is the organisational innovation with the highest impact on cost reduction but continuous improvement processes which are mainly directed towards quality improvement also seem to have an effect on costs. The interviewed experts think that outsourcing of R&D and of administrative tasks, cooperation and decentralisation are organisational innovations which influence costs the least.

Concerning the innovation ability, experts think that cross-functional teams, continuous improvement processes, team work and total quality management have the strongest impact on a company's ability to innovate (see Figure 22). It becomes clear that these organisational innovations do not only increase the innovation ability but also increase product and process flexibility and quality. The organisational innovations being the least important for innovation ability are similar to those already seen related to increased quality and cost reduction. Zero-buffer, outsourcing and decentralisation have not been considered important for improving the ability to innovate.

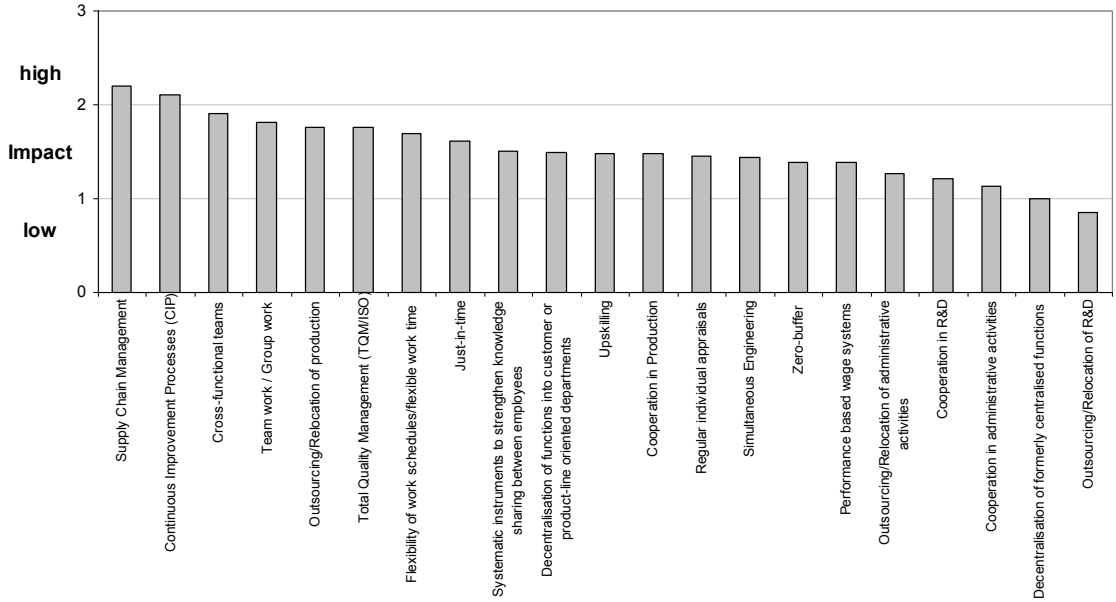

Figure 21: Ranking of importance of organisational innovations for reducing costs

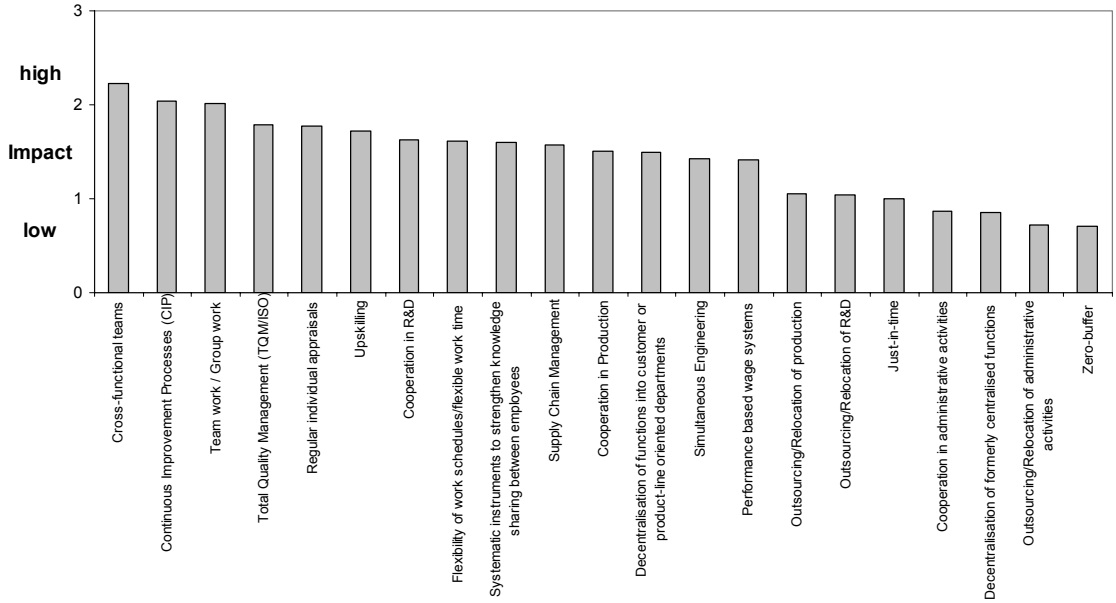

Figure 22: Ranking of importance of organisational innovations for increasing innovation ability

To sum up, the results of the stakeholder interviews show that depending on the output dimension, different organisational innovations are the most important ones. There are organisational innovations that are clearly targeted either towards quality increase, flexibility increase, innovation ability increase or cost decrease. Thus, every organisational innovation aims at a specific goal or strategy which is mirrored in the varying impact on outputs.

6.4.2 Differences in the importance of organisational innovations across sectors

The above presented results do not consider possible sector-specificities of organisational innovations. One might think that some organisational innovations are particularly important in one sector but not in another one. For instance, the analysis of simultaneous engineering across the nine surveyed sectors indeed reveals that the importance - measured by the average value across flexibility, quality, innovation ability and costs – strongly differs across the sectors. The experts think that simultaneous engineering plays a particularly important role in the automotive and machinery industry but a minor role in textile and food industry (see Figure 23).

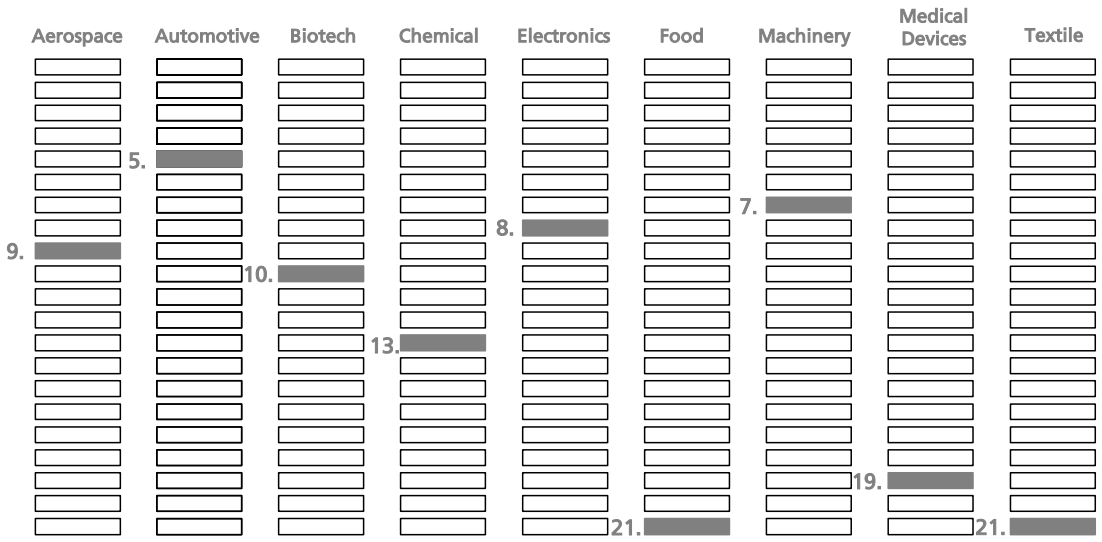

Figure 23: Importance ranking of simultaneous engineering across sectors

In order to reveal if there are differences in the importance assessment across the sectors as well as to understand if the above mentioned differences in the impact of organisational innovations on the output dimensions (see chapter 6.4.1) differ in a statistically significant manner, the stakeholders' assessments have been compared and t-tested in two ways. First, the answers about the importance of every organisational innovation (means of four output dimensions) have been compared across the nine sectors. This reveals if the answers significantly differ from one sector to another, thus showing that organisational innovations are differently important throughout the sectors. Second, the impact assessments for the four output dimensions have also been compared. This shows if the importance assessments of the organisational innovations on flexibility, quality, costs and innovation ability (means across all answers) are significantly different from each other. The figures 19 to 22 already demonstrate that there are differ-

ences, however, without t-testing if the means in the four different output categories are statistically distinct from each other.

Organisational innovation	**Importance for specific output dimension**	**Sector-specific importance**	**Organisational innovation**	**Importance for specific output dimension**	**Sector-specific importance**
Decentralisation of functions into customer or product-line oriented departments	n.s.	n.s.	Continuous Improvement Processes (CIP)	*	n.s.
Decentralisation of formerly centralised functions	n.s.	n.s.	Total Quality Management (TQM/ISO)	**	n.s.
Team work/Group work	*	n.s.	Flexibility of work schedules/flexible work time	**	n.s.
Cross-functional teams	n.s.	n.s.	Upskilling	*	n.s.
Cooperation in production	n.s.	n.s.	Regular individual appraisals	**	n.s.
Cooperation in R&D	n.s.	n.s.	Performance based wage systems	n.s.	n.s.
Cooperation in administrative activities	n.s.	n.s.	Systematic instruments to strengthen knowledge sharing between employees	n.s.	n.s.
Outsourcing/Relocation of production	**	n.s.	Just-in-time	**	**
Outsourcing/Relocation of R&D	n.s.	n.s.	Zero-Buffer	**	*
Outsourcing/Relocation of administrative activities	*	n.s.	Simultaneous Engineering	n.s.	*
			Supply Chain Management	**	n.s.

* significant at 5% level
** significant at 1% level

Figure 24: Results of t-tests

Figure 24 shows the results of the t-tests. The comparisons reveal that for most of the organisational innovations the assessments on the importance significantly differ across the four output dimensions. For instance, stakeholders' estimations on the importance of supply chain management significantly differ in the four output dimensions. Analysing supply chain management more in detail, this organisational concept is seen to be most important for the reduction of cost but rather unimportant for innovation ability. Team work, outsourcing/relocation of production and of administrative activities, continuous improvement processes, total quality management, flexibility of work schedules, upskilling, regular individual appraisals, just-in-time and zero-buffer are also considered to be more important for one output dimension than for another. It is only for simultaneous engineering, zero-buffer and just-in-time that the importance of these

organisational innovations is considered to be differently across sectors. For instance, simultaneous engineering is more important in the automotive and machinery industry than in textile or food. Zero-buffer and just-in-time are important concepts in the automotive industry but rather unimportant in the chemical industry. However, just-in-time and zero-buffer are also supposed to be more important for one output dimension than for other.

To conclude, the results show that the majority of organisational innovations are differently important for the four output dimensions. They are predominantly targeted either towards quality increase, flexibility increase, innovation ability increase or cost decrease. The importance of organisational innovations does not – except for simultaneous engineering, zero-buffer and just-in-time – differ across sectors. For instance, supply chain management is important for achieving cost savings, irrespective whether supply chain management is applied in the automotive industry or in the food sector. Total quality management is more important for increasing product and process quality than for gaining flexibility, whereas flexible working schedules clearly aim at increasing flexibility but do not predominantly intend to decrease costs, independently of the sector. Measuring organisational innovations should therefore always take into account the specific target of the organisational innovation. It is not advisable to consider organisational innovations as a homogenous phenomenon being measured with one item only. The various effects of organisational innovation on company's structure and processes have to be considered when measuring organisational innovation.

7 Conclusions: Recommendations

The recommendations which are derived of the PORCH study are twofold. In the first part, recommendations for the improvement of the methodology and concept of the European Innovation Scoreboard (EIS) will be provided by suggesting organisational innovation indicators to include in the scoreboard. These suggestions are based on desk research and on the results of the stakeholder interviews. In the second part of the conclusions, several recommendations for the improvement of the measurement of organisational innovation for large scale surveys are presented.

7.1 Recommendations for the European Innovation Scoreboard

The innovation indicators used in the EIS are predominantly focused on product innovations both at the national economy and at the company level (see chapter 4.3). Indicators such as "public R&D spending in % of GDP" for a national economy indicator or "innovation expenditures in % of total turnover" for an indicator at company level shows that the underlying definition of innovation in the EIS is mainly based on a technological understanding of innovation which manifests itself in new products or services.

However, two innovation indicators in the group of input indicators also touch the non-technological side of innovation. These are the input indicators "innovative SMEs co-operating with others in % of all SMEs" and "SMEs using non-technological change in % of all SMEs". These two organisational innovations are a good starting point to enlarge the EIS from a solely technologically focused instrument to a scoreboard that covers both technological and non-technological innovation indicators. Yet, these two organisational innovation indicators in the EIS are very much aggregated and selective by including "non-technological changes" in general and consider only those changes which have been taking place in SMEs. We therefore propose to improve the measurement of these organisational innovation indicators by including more concrete ones (recommendation 1.1).

Moreover, the conducted stakeholder interviews and methodological considerations of organisational innovations in chapter 5 showed that organisational innovations not only have an influence on a company's ability to innovate and thus to strengthen product innovations. Certain organisational innovations also have an influence on flexibility, quality and costs. Thus, if those organisational innovations are considered to be included into the EIS that predominately influence flexibility, quality and costs and do not mainly influence product innovations, the EIS output indicators should then be enlarged by these indicators flexibility, quality and costs. The current output indicators of the EIS

point to an underlying understanding according to which the development of new products and services is the main indicator of a company's and country's competitiveness. Output indicators at the company level such as "sales of new-to-market products in % of total turnover" or "sales of new-to-firm not new-to-market products in % of total turnover" only consider company's performance in terms of product innovation. It is, however, evidenced that not only new products or services account for competitive advantage but also the implementation of new manufacturing or organisational processes. In other words, the overall performance and competitiveness of the firm can not only be improved by the development of new products or services, but also by the improvement of the internal processes. Indicators such as flexibility or quality can measure the outputs of these process innovations which are not yet considered in the EIS. The suggestion for such process-oriented output indicators and organisational innovations that influence process innovations will be presented in recommendation 1.2.

To summarise, two recommendations for the EIS are derived. The first recommendation (recommendation 1.1.) is based on the current understanding of innovation in the EIS, this is that innovation output indicators and therefore company's competitiveness are mainly based on product innovations. It is recommended to include those organisational innovations that specifically positively influence product innovations in order to have a clear link between input and output indicators. It is therefore suggested to improve already existing non-technological indicators in the EIS. The second recommendation (recommendation 1.2) is based on an enlarged understanding of innovation. Company's competitiveness is not only based on product innovations but also on process innovations. Proposed output indicators for process innovations are flexibility, quality and costs. In the following, it is therefore recommended to include those organisational innovations as new input indicators into the EIS that influence process innovation output indicators such as flexibility, quality and costs.

Recommendation 1.1:

Desk research and the results of the stakeholder interviews showed that several innovative organisational concepts affect various output indicators (flexibility, quality, costs and innovation ability) in a different way. For instance, according to the interviewed academics and industry representatives outsourcing and relocation of production predominantly reduces the costs but does hardly affect quality or flexibility aspects or company's innovation ability. On the contrary, cooperation between companies in the field of R&D is mainly focused on increasing company's innovation ability (mainly understood as the ability to develop new products) whereas supply chain management

aims at reducing costs and increasing flexibility. Thus, the implementation of different organisational innovations leads to different outputs as they are targeted towards different aims.

As the EIS currently clearly focuses on output innovation indicators that comprise only those indicators measuring product innovation, it is recommended to include for the input innovation indicators only those organisational innovations that – based on the stakeholder interviews and theoretical considerations – presumably positively influences product innovations. Other organisational innovations affecting mainly those output dimensions that are not considered in the EIS, such as quality, flexibility and cost reduction are not to be included as they cannot predict the innovation return measured by the existing output indicators. In this way, there is a consistency between the target of the proposed new input indicators and the already existing output indicators.

Considering the experts' estimations of the impact of the surveyed organisational innovations on company's innovation ability and enriching these assessments with research on the different organisational concepts, the following organisational innovations are assumed to have the strongest impact on product innovations:

- *Cross-functional teams:* The aim of cross-functional teams is to bring together people with different educational background and from different functions and parts of the company to increase creativity for better coping with complex and multi-faced tasks and to find innovative solutions. In addition, experts assume that cross-functional teams have the strongest impact on innovation ability among all surveyed organisational innovations. Thus, it is assumed that cross-functional teams positively affect product innovations. It is therefore recommended to include cross-functional teams as a new input innovation indicator into the EIS.
- *Continuous improvement processes*: The main focus of continuous improvement processes is to enhance processes and products by making incremental and continuous changes. The concept of continuous improvement processes therefore supports – besides the improvement of quality - product innovations even though those product innovations are rather incremental ones than radical new ones. On the same lines, the majority of the interviewed experts from academia and industry think that the innovative organisational concept continuous improvement processes strengthens and positively influences product innovations. It is therefore recommended to include continuous improvement processes as a new input innovation indicator into the EIS.
- *Cooperation in R&D:* The argumentation for inclusion of cooperation in R&D goes into a similar direction than that of cross-functional teams. Cooperation with other companies in R&D not only involves different people within the same company as it is the case in cross-functional teams, but also includes people from other compa-

nies. This provides additional know-how and approaches and leads to higher probability of developing new products. The estimations of the experts support the above postulated relation between cooperation in R&D and product innovations. Most of the experts think that cooperation in R&D positively influences company's ability to innovate. It is therefore recommended to include R&D cooperation as a new input innovation indicator into the EIS.

Simultaneous Engineering is also considered as very supportive for product innovations as it implies a specific approach towards technical developments. The basic idea of simultaneous engineering is to shorten the time to market of new products by simultaneously working on product developments. However, the interviewed experts think that simultaneous engineering indeed effects product innovations but not in a significant manner. The sectoral analyses on simultaneous engineering reveal a strong variance of estimations across sectors. Simultaneous Engineering plays an important role in the automotive, electronics or machinery sector while this organisational concept is almost not relevant in the food and textile industry (see chapter 6.4.2). Thus, simultaneous engineering is assumed to affect product innovations only in some sectors. As the EIS covers the entire manufacturing industry as well as the service sector an inclusion of simultaneous engineering into the EIS is not recommended.

To conclude, in case the EIS continues to focus mainly on product innovation performance, it is recommended to include only those innovative organisational concepts that are predominantly strengthening product innovation, namely cross-functional teams, continuous improvement processes and cooperation in R&D. This is to build a clear link between input innovation indicators and output innovation indicators in EIS.

Recommendation 1.2:

As it has already been outlined in the previous chapters, the implementation of different innovative organisational concepts is targeted to the improvement of different performance indicators such as the raise of quality, flexibility and innovation ability and the reduction of costs. In recommendation 1.1., innovative organisational concepts have been selected that presumably influence company's ability to innovate, thus to develop new products which is up to now the main output innovation indicator of the EIS. In this second recommendation, a wider view on innovation is adopted. Based on a holistic approach to innovation, the innovativeness of an enterprise does not only consist in new products and services, but also in innovative manufacturing and organisational processes. Thus, following this holistic view of innovation, it is not sufficient to measure product innovation, but it is recommended to include both new input and new output indicators which measure also process innovation additionally.

It is therefore recommended to include those innovative organisational concepts as input innovation indicators into the EIS that mainly influence quality, flexibility and costs. Quality, flexibility and costs are proposed to be included as new output indicators in order to have a clear link between input and output indicators. The selection of organisational innovations to be included into the EIS is based on theoretical considerations as well as on the interviews with academics and industry representatives.

Increasing quality:

Results of the stakeholder interviews as well as desk research show that continuous improvement processes, total quality management and regular individual appraisals have a strong presumed influence on quality. It is therefore recommended to include these organisational innovations as new input innovation indicators into the EIS:

- *Continuous improvement processes:* This organisational concept not only has a positive influence on the innovation ability of a company but helps to increase the product and process quality. The majority of experts think that continuous improvement process positively affects quality. It is therefore recommended - as has been already recommended above - to include continuous improvement processes as a new input innovation indicator into the EIS.
- *Total quality management:* Total quality management is a set of systematic activities carried out by the entire company to provide products with a level of quality that satisfies customers at the appropriate time and price. Most of the interviewed experts from academia and industry also state that total quality management increases product and process quality. It is therefore recommended to include this organisational concept as a new input innovation indicator into the EIS.
- *Regular individual appraisals:* Appraisal interviews are regular face-to-face meetings between employees and their managers and are one part of a human resources development concept. The main intentions of appraisal interviews are to review employees' performance, to assess their potential by identifying strengths and weaknesses, to identify training needs and to deal with career planning. As the individual performance is reviewed, rewarded or presumably enhanced through trainings high performance standards are ensured having an effect on the quality standards of the product and processes within a company. The experts confirm this positive relation between regular individual appraisals and quality improvements. It is therefore recommended to include regular individual appraisals as a new input innovation indicator into the EIS.

The above mentioned organisational innovations all have a positive influence on quality. As quality as a process innovation oriented indicator yet has not been considered as an output innovation indicator in the EIS we propose to include this innovation performance indicator. Quality at a company level might be measured, e.g. in the context

of the manufacturing industry by the average percentage of products that have to be scrapped or reworked due to quality problems.

Increasing flexibility:

Theoretical considerations and the results of the conducted interviews show that team work, decentralisation of functions into product- or customer-oriented departments and flexibility of work schedules positively affect product and process flexibility. Hence, it is recommended to include these innovative organisational concepts into the EIS:

- *Team work:* One important aim of team work is to increase product and process flexibility. Team workers have a high variety of skills and responsibilities allowing for job rotation within the team so that they can fill in for one another which increases flexibility. The assessments of the interviewed stakeholder also show that team work positively influences product and process flexibility. It is therefore proposed to include team work as a new input innovation indicator in the EIS.
- *Decentralisation of functions into product- or customer-oriented departments*: Decentralisation into product-oriented departments increases the product and process flexibility as it brings decision-making closer to the point of actions. Companies with decentralised structures are better able to faster react to the customer or market and can therefore increase their flexibility in terms of business and manufacturing processes as well as of products. Interview results show a similar picture. Industry and research experts also think that decentralised departments that are structured along products or customers positively affect product and process flexibility. It is therefore proposed to include decentralisation of functions into product- or customer-oriented departments as a new input innovation indicator in the EIS.
- *Flexibility of work schedules/flexible work time:* The idea of this concept is to let employees take part in the decision process of when to work. This concept aims at absorbing times of work overload and under load and therefore increases mainly business or manufacturing process flexibility. The interviewed experts confirm this positive relationship between concepts of flexible working time and flexibility. It is therefore recommended to include flexibility of work schedules/flexible work time as a new input innovation indicator into the EIS.

Flexibility as a performance indicator has not yet been considered in the EIS. It is therefore proposed to include flexibility as an additional output innovation indicator for process innovation. Examples for the measurement of flexibility are manufacturing lead time for flexibility in terms of velocity, or for product flexibility, the number of different product versions or variants which can be produced economically.

Decreasing costs:

According to the consulted experts and based on the relevant literature, supply chain management most strongly decreases personnel and capital costs. We recommend to insert this organisational innovation into the EIS:

- *Supply Chain Management:* Supply chain management is a co-ordinated set of techniques to plan and execute all steps in the global network used to acquire raw materials from vendors, transform them into finished goods, and deliver both goods and services to customers. It includes chain-wide information sharing, planning, resource synchronization and global performance measurements. Through an effective supply chain management costs can be significantly reduced. The interviewed experts are also convinced that supply chain management reduces costs. It is therefore recommended to include supply chain management as a new input indicator into the EIS.

An output indicator which comprises costs has not yet been included into the EIS. It is proposed to measure this aspect through productivity (e.g. total labour productivity or total input productivity). In this way, the efficiency of business processes in total can be indicated.

Figure 25 shows the proposed recommendations for the EIS: On the one hand, the existing focus of EIS on product innovation is maintained, where according to the first recommendation (1.1) three new non-technical input indicators for product innovation are proposed. On the other hand, based on a wider view of innovation, both new non-technical input and new output indicators for process innovation are proposed, following the second recommendation (1.2).

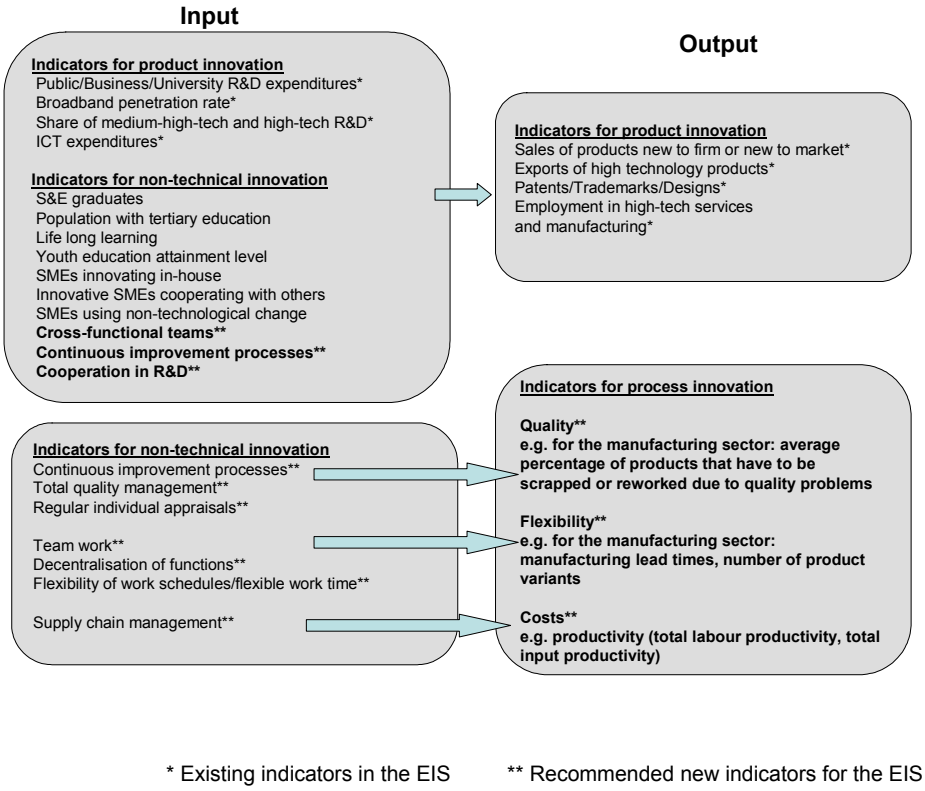

Figure 25: Recommendations for new organisational innovation indicators to be included in the EIS

7.2 Recommendations for the measurement of organisational innovations in large scale surveys

Based on chapter 5, considering a comparison of different approaches for measuring organisational innovation by modelling these organisational innovation indicators in the *German Manufacturing Survey* 2003 leads to four main recommendations for measuring organisational innovation in large scale surveys:

Recommendation 2:

Complexity of organisational innovation (aggregation level): It is not sufficient to only ask for "organisational innovation" in general. Questions like "changes in the organisation of work" or "changes in your relation with other firms" are too general. It is necessary to enquire for specific innovative organisational concepts separately. For instance, for the general question on "changes to the organisation of work" one might specify the concrete organisational concept that implies a change of the work organisation, such as team work, decentralisation of functions into customer or product-related departments or creating customer or product-related lines/cells in the factory instead of shop floors. Specifications for the question "changes in your relation with other firm such as through alliances, partnerships, outsourcing or sub-contracting" are cooperation in R&D, cooperation in production, cooperation in administrative activities, outsourcing of production, outsourcing of R&D or outsourcing of administrative activities. The specification on individual organisational concepts is important because different organisational innovations have different effects on performance indicators and are of different importance for different sectors. An organisational innovation indicator based on a very general question on organisational innovations only has limited explanatory power.

Recommendation 3:

Life cycle of organisational innovation (use or change): It is not sufficient to simply ask whether organisational concepts have been changed over the past years. In contrast, it is important to determine the proportion of firms that has generally implemented an organisational innovation at all. This is crucial because organisational innovations do not age as fast as product innovations do. Thus, applying questions like "During the years 2002 and 2004 did your company introduce a major change to the organisation of work within your company" incorrectly only classifies latecomers as innovative. Those companies that have introduced changes in the work organisation before 2002 are ignored and therefore considered as not innovative. This is misleading as companies having implemented changes more than three years ago are not necessarily less innovative than companies having reorganised their work organisation two years ago. Therefore, it is recommended that questions on organisational innovation should also include the year in which the organisational concept was used for the first in time in the company.

Recommendation 4:

Scope of organisational innovation (use or extent of use): It is not sufficient to only ask for "use" or "non-use" of organisational innovations. It is, however, necessary to identify the extent to which organisational innovations have been implemented into business processes. Questions on "changes of work organisation" with the limited options of "yes" and "no" are misleading. Companies answering "yes" to this question might have implemented changes in work organisation (e.g. the implementation of team work in manufacturing and assembly) only in one small part of production as a pilot, for the assembly of one product or for all manufacturing processes in the company. In order to generate viable estimations on the performance effects of organisational concepts, the extent of use of organisational innovations has to be taken into consideration. Organisational innovations being only implemented in single parts of the companies probably do not have any effect on performance indicators, however, these companies are considered as innovators.

Recommendation 5:

Quality of organisational innovation: It is not sufficient to only ask for labels of organisational innovations like team work or task integration as in every company organisational concepts are defined and shaped differently and answers of the respondents vary according to their own definition. It is crucial to know how terms like team work are used in the respective company. Merely using labels or catchwords when inquiring about organisational innovations, biases the diffusion of organisational innovations across companies. It is recommended to include definitions about the specific organisational innovations that are surveyed in order to be sure that every respondent understands the innovative organisational concept in the same way.

7.3 Summary of recommendations

Figure 26 summarises the above recommendations and shows the selected organisational innovations and output indicators to be included into the EIS as well as the estimated impact of the selected organisational innovations on output innovation indicators.

In total, nine organisational innovations as new organisational innovation input indicators have been selected to be included into the EIS assuming that the focus of the EIS is to enlarge its scope to not only product but also process innovations. In this case,

three new output indicators (flexibility, quality and costs) are also proposed to be included. If the EIS will keep its focus on product innovations three organisational innovations are proposed to be included, namely cross-functional teams, continuous improvement processes and cooperation in R&D. They have been selected as they are presumed to influence product innovations. In terms of the operationalisation of different organisational innovations it is recommended to include "extent of use" as well as "year of first use" for all nine selected organisational innovations. Moreover, precise definitions of organisational innovations are recommended to be included for all selected organisational innovations.

	Predominant impact on …				**Recommendations for the measurement of organisational innovations**		
Recommended organisational innovation input indicators to include in EIS	Innovation ability	Quality	Flexibility	Costs	Include "extent of use"	Include "year of first use"	Include definition
Cross-functional teams	x				x	x	x
Continuous improvement processes (CIP)	x	x			x	x	x
Cooperation in R&D	x				x	x	x
Total Quality Management (TQM/ISO)		x			x	x	x
Regular individual appraisal		x			x	x	x
Flexibility of work schedules			x		x	x	x
Team work/Group work		x	x		x	x	x
Decentralization of functions into customer or product-line oriented departments			x		x	x	x
Supply Chain Management				x	x	x	x

Figure 26: Overview of recommendations for large scale surveys and for the EIS

7.4 Outlook

The above presented recommendations for the EIS offer first approaches of how to improve the European Innovation Scoreboard in terms of organisational innovation indicators.

The described relation between organisational innovation input indicators and output indicators is based on 100 stakeholder interviews as well as on desk research. This correlation between the suggested organisational innovation input indicators and the output indicators, however, has not been tested with large scale data. In order to gather an in-depth understanding of the impacts of input indicators on output indicators, further data analyses with European large scale data sets have to be undertaken. One precondition for this data analysis is the existence of the proposed organisational innovation indicators. Based on CIS, for instance, some of the proposed organisational innovation indicators might be extractable, some others are not available. Therefore, it might be advisable to co-operate with other institutions having European data with respect to organisational innovations at a concept level (e.g. European Manufacturing Survey, DISKO, etc.).

Another approach is to use three of the proposed organisational innovations that presumably have a positive impact on product innovation for a pilot survey. Questions on whether companies have implemented the concept of continuous improvement processes, whether they co-operate in R&D with other institutions and whether they have introduced cross-functional teams might be included as pilot questions into the CIS. Based on the pilot data further statistical analyses on the relation between organisational innovation input indicators and output indicators could then be conducted. Depending on the results of the pilot study, further steps for the improvement of the EIS in terms of coverage of organisational innovation might be undertaken, e.g. the implementation of questions about the use of organisational innovations that are important for product innovation into the core of CIS; or the enlargement of the EIS to process innovation and therefore the implementation of various new organisational innovation input indicators and new output indicators.

More research is needed in the field of theoretical conceptualisation of organisational innovations when assuming that a better understanding of the compounding concepts will be helpful in order to develop an adequate monitoring system. For instance, an interesting task for research might also be to investigate the life cycle of an organisational innovation. Getting insights into the question after what time of use an organisational innovation is more or less effective in terms of positively influencing performance indicators might help to develop future indicators. Research might tackle this issue by

analysing the influence of different organisational innovations on different performance indicators in longitudinal studies.

The approach of PORCH was to focus on organisational innovations as one important type of innovation besides product innovation and technical process innovation. However, when considering a holistic approach towards innovation in the EIS, the implementation of indicators as regards service innovations should also be considered. Studies similar to PORCH have to be undertaken in order to understand and learn about service innovations in different industry sectors and to derive concepts for the measurement of service innovations in large scale surveys.

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