Patterns of Organisational Change
in European Industry (PORCH)

Ways to Strengthen the Empirical Basis of Research and Policy

While awareness of the importance of innovative organisational concepts to enhance the competitiveness of European enterprises has increased, the empirical basis for measuring organisational innovations remains underdeveloped. *Patterns of Organisational Change in European Industry* aims to remedy this situation. Based on 100 interviews with research and industry representatives across 10 sectors, this publication formulates recommendations on large scale surveys to measure organisational innovations. A key recommendation is the inclusion in the European Innovation Scoreboard of the organisational innovations that predominantly strengthen product innovation, thus obtaining a direct link between input and output indicators.

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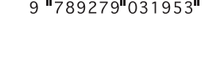

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Fraunhofer
Institute Systems and Innovation Research

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:

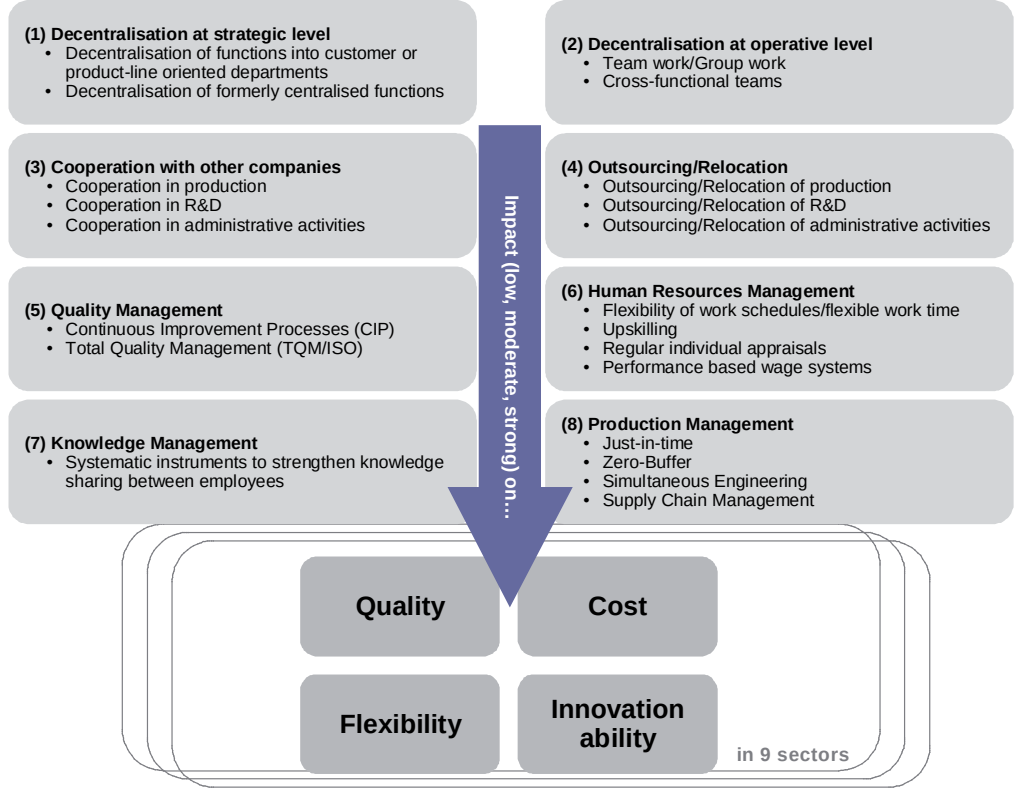
1. Objective: Analyse the importance of organisational innovations across industry sectors
2. Objective: Formulate recommendations for surveying organisational innovation in large scale surveys
3. Objective: Formulate recommendations for improving the concept and methodology of the European Innovation 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/bio-pharmaceuticals, 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).

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 in-

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



novation 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 assessed 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.

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

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.

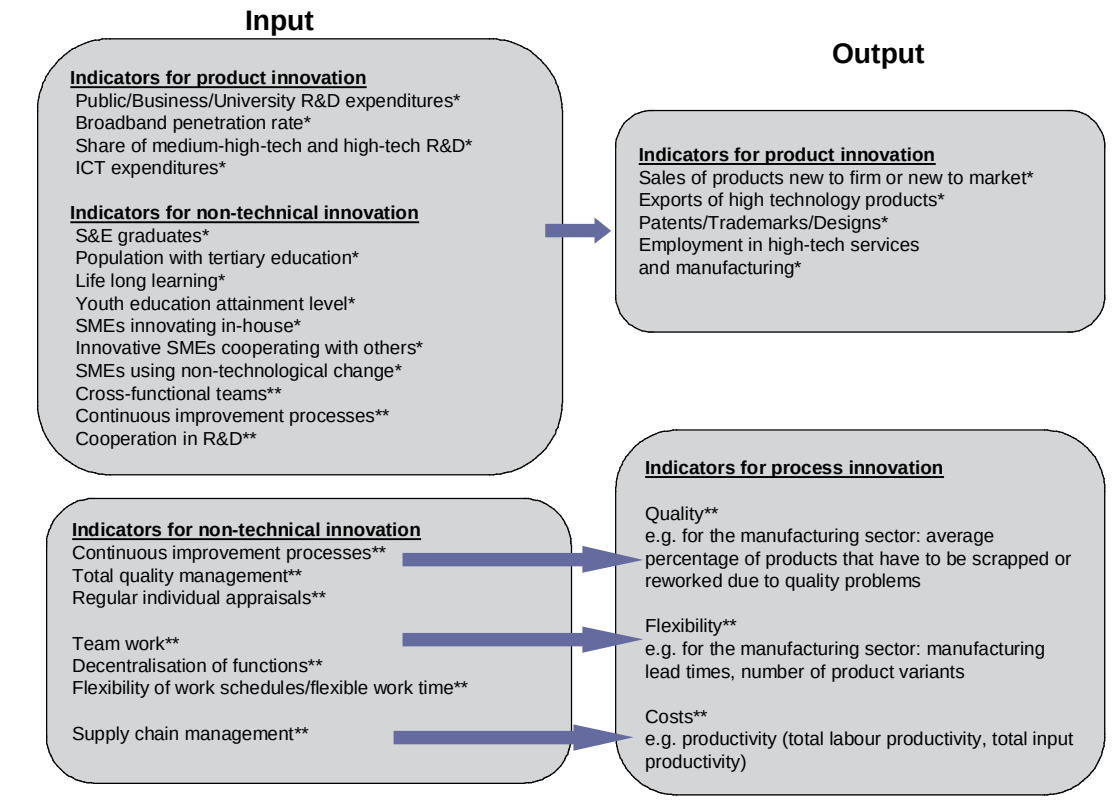
Based on the results of the stakeholder interviews as well as on desk research, four recommendations for surveying organisational innovation in large scale surveys have been identified, thus the **second objective** of the project has been achieved. At first, it is necessary to differentiate between 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.

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

(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.

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



* Existing indicators in the EIS ** Recommended new indicators for 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 cooperating 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 stud-

ies 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 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

([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.

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

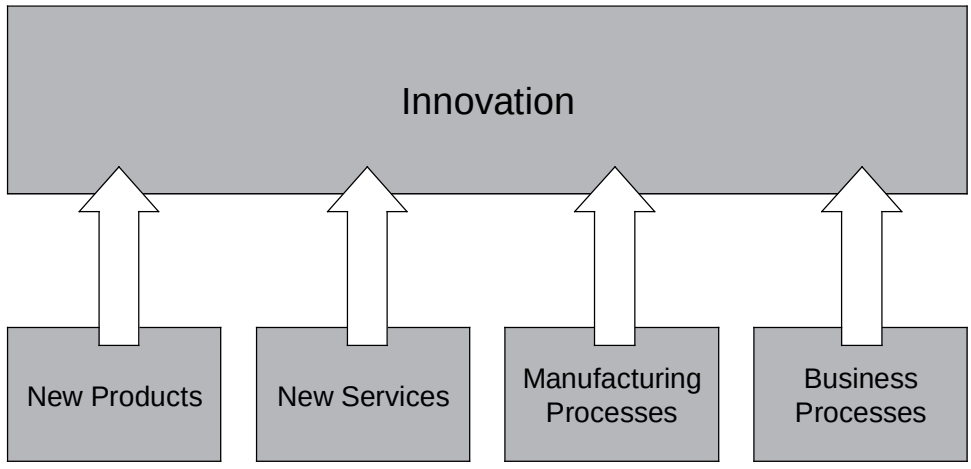
The definition of innovation is disparate, with little consensus among researchers (for examples see Rickards and Moger, 1991; Nystrom, 1990; Vrakking, 1990; West and Farr, 1990; Goffin and Pfeiffer, 1999). There is no commonly accepted understanding of what innovation means, especially within a business 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).

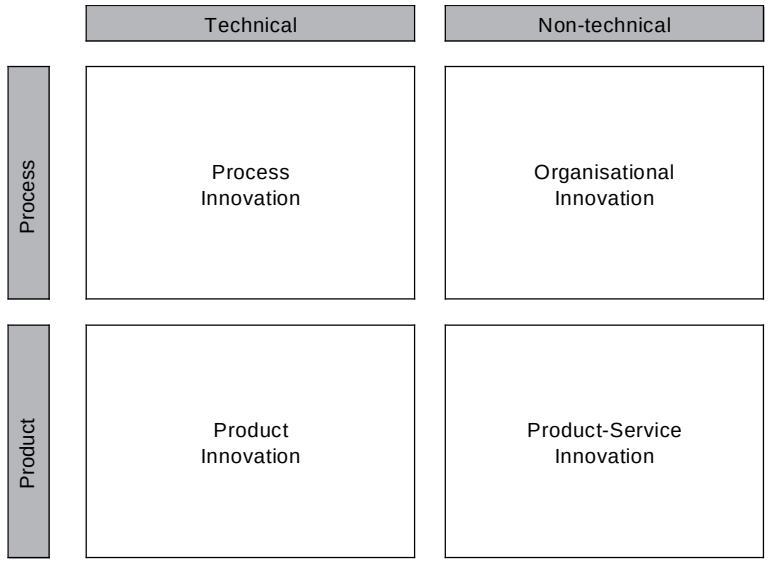
A similar distinction is that of product or process innovation, respectively technical and non-technical innovation (see Figure 6). While product and process innovations represent technical innovations, product-service and organisational innovations are affiliated to non-technical innovations (e.g. Schumpeter, 1934;

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



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.

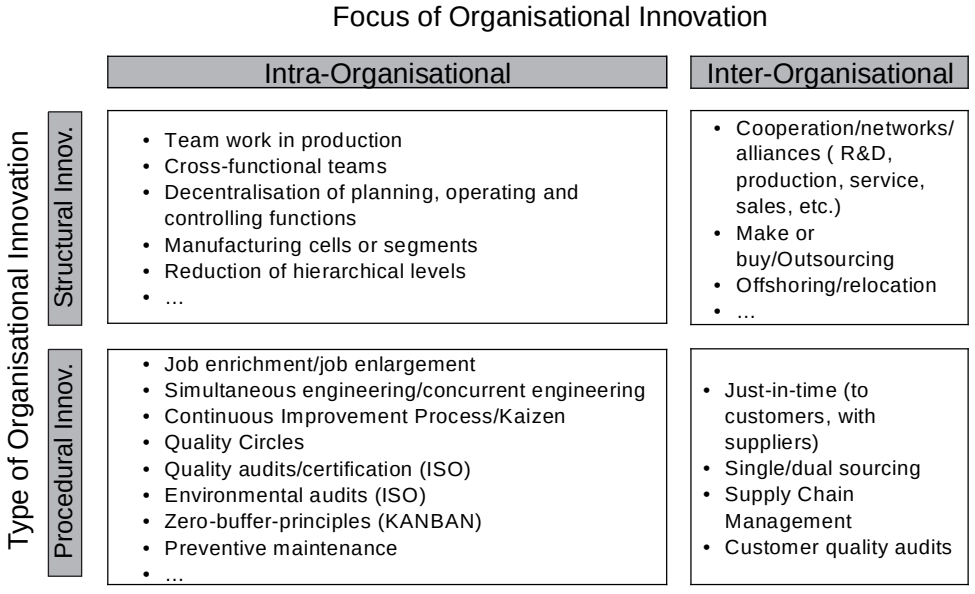
On the other hand, *procedural organisational innovations* affect the routines, processes and operations of a company. Thus, these innovations change or implement new procedures and processes within the company, such as simultaneous engineering or zero-buffer-rules. They may influence the speed and flexibility 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.

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).

Figure 7: Classification of organisational innovations



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 subcontracting?" 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).

Figure 8: Overview of surveys covering organisational innovation

Survey	Institution	Countries	Sectors	Year	Sample	Content	Depth	Impact indicators
CIS	Statistical Offices, different research institutes	EU plus several OECD countries	private sector	1997 (UK) 2001 2005	> 15000	multi focus	general	objective and perceived
European Survey on Working Conditions	European Foundation	EU 15 EU 25	all	1990 1995 2000 2005		single focus on working conditions	general	none
European Restructuring Monitor	European Foundation	EU 15	private sector	continuous	ca. 2500	job reduction or creation	(newspaper, business reports)	objective
European Survey on Working Time and Work-life Balance	European Foundation, Infratest	EU 15	all	2004	>16000	working time	general	none
Statistical Indicators Benchmarking the Information Society	EU, INRA	GER, Fi, F, Gre, UK, It, Es	all (decision makers, IT responsibles)	2002	3139	IT use	general	?
Observatory of European SMEs	European Commission	EU15 plus Lie, CH, N, Ice	private sector	1992-today	7800 SMEs	multi focus	very detailed	almost none
German Manufacturing Survey, European Manufacturing Survey	Fraunhofer ISI	Germany GER, CH GER, CH, A, UK, F, Slo, CR, Tur, It	investment goods, chem./ plastics since 2001	1995, 1997, 1999, 2001, 2003	1305 1329 1442 ca 1950 >2500	multi focus	very differentiated	perceived and objective
International Manufacturing Strategy Survey (IMSS)	IMSS consortium (mainly universities)	14 countries (>20)	mechanical engineering/assembly (ISIC 38)	92-94 96-98 2002	? ? 474 (600)	Manufacturing strategies	detailed (scales)	perceived
Employee Participation in Organisational Change*	EPOC research group	Europe	all	1996	5786	single focus on participation	very differentiated	perceived

Survey	Institution	Countries	Sectors	Year	Sample	Content	Depth	Impact indicators
The Collaborating Firm* (DISKO module 2, OECD/NIS project)*	University of Aalborg (DRUID research group)	Denmark parallel surveys in F, A, E, It, Swe, Fi, N	manufacturing sector	1997/8	1022 (324)	single focus on collaboration in product design	very differentiated	objective
INNFORM*	Oxford University et al	UK, US, NL, F, J, E, SE, CH	large, medium industry	1997	ca. 450	multi focus	very differentiated	objective (relative)
Flex-2: Change in Enterprise*	Nutek	Sweden	all	1998	3360	multi focus	very differentiated	perceived and objective
Enterprises as Employers*	Statistical Office	Finland	private sector	1996	2110	multi focus	very differentiated	perceived and objective
Flexibility in Working Life*	Institute for Social Research/ Statistical Office	Norway	all	1997	2130	multi focus	very differentiated	no impact indicators
Workplaces in Sweden*	National Institute for Working Life	Sweden	all	1991/2	2135	multi focus	very differentiated	no information
IAB Establishment Panel	Institute for Employment Research (IAB)	Germany (similar surveys in other EU countries)	all	1993 -2003	15856	multi focus	very differentiated	
The Flexible Firm (DISKO module 1)*	University of Aalborg (DRUID research group)	Denmark	private sector	1996	1900	single focus on organisational flexibility	very differentiated	objective
Workplace Employee Relation Survey	Advisory Conciliation and Arbitrary Service	United Kingdom	all (except agriculture, mining)	1990-1998	2188	multi focus	partly differentiated	perceived and objective
Georgia Manufacturing Surveys	Georgia Tech University	USA (Georgia)	manufacturers	1994 1996 1999 2002 2005	1700, 1002, 778, 635 >1300	multi focus	partly differentiated	objective
Organisational Changes and Computerisation	Statistical Office (SESSI), DARES	France	industry	1998 2005 (planned)	N/A	multi focus	very differentiated	almost no
Computerisation and Company Respondence to Social Change	Japan Institute of Labour	Japan	private sector	1996 ?	558	multi focus	very differentiated	no information
Survey on Personnel Policy Systems	Japan Institute of Labour	Japan	private sector	1998 ?	N/A	Changes in corporate/ work organisation	varied	no information

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

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.

Figure 9: Indicators of the European Innovation Scoreboard 2005

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 workforce)	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

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.

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

	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.

- 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.

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

Figure 11: Results of 13 multiple regression analyses

	Dependent variable: Productivity			
	Coeff.	Sign.	F-test	corr. R2
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.

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.

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.

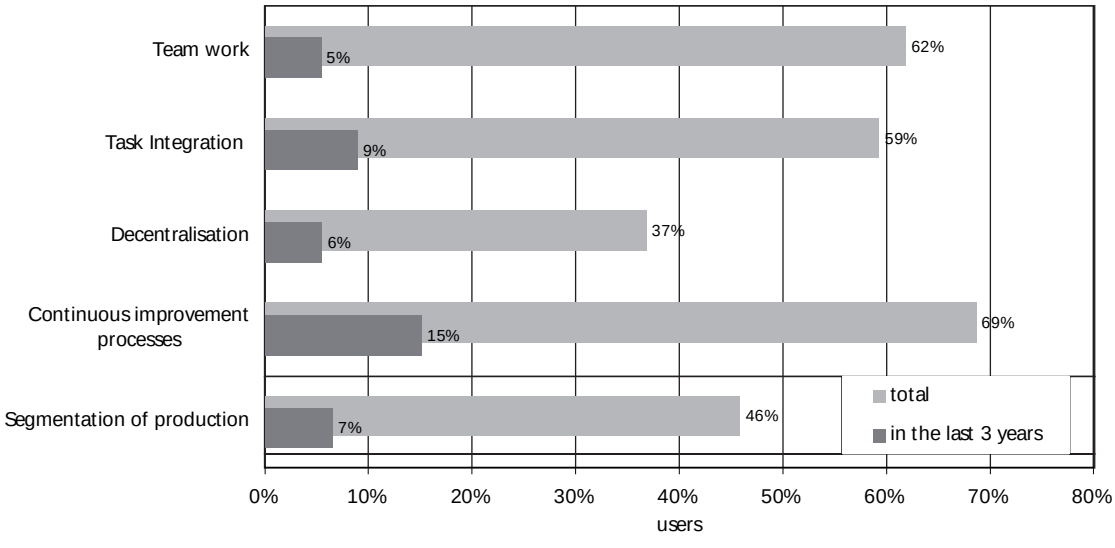
5.2 Challenge 2: Life cycle of organisational innovations (use or change)

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

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



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 implemented 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).

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.

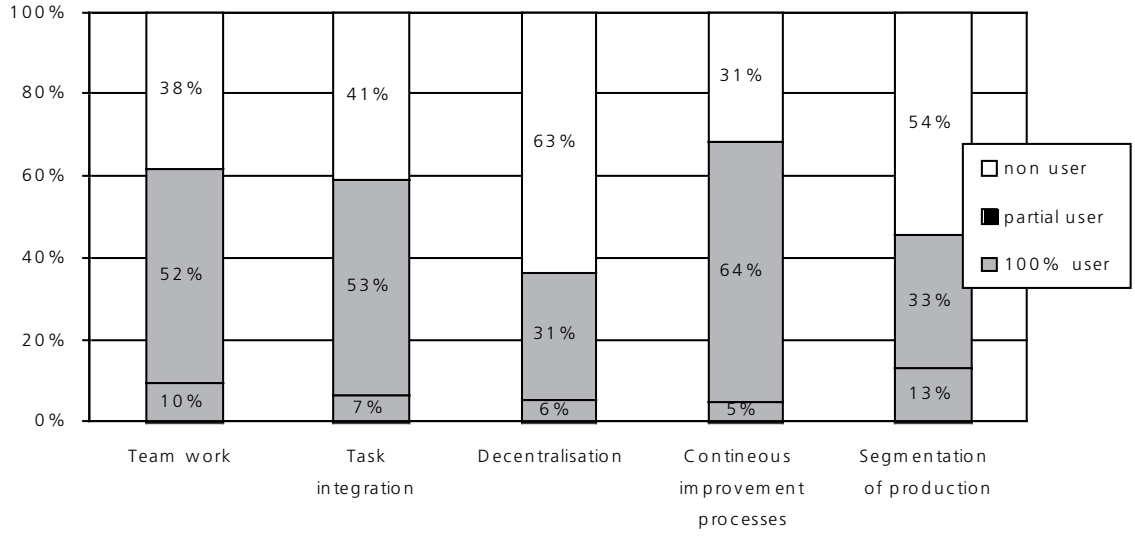
This shows that asking for the extent of use in a firm is crucial when investigating and measuring organisational innovation. Only with this knowledge it is possible to estimate the effects of organisational innovation and furthermore to quantify the unutilised potential for non-users and part-users 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.

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

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



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.

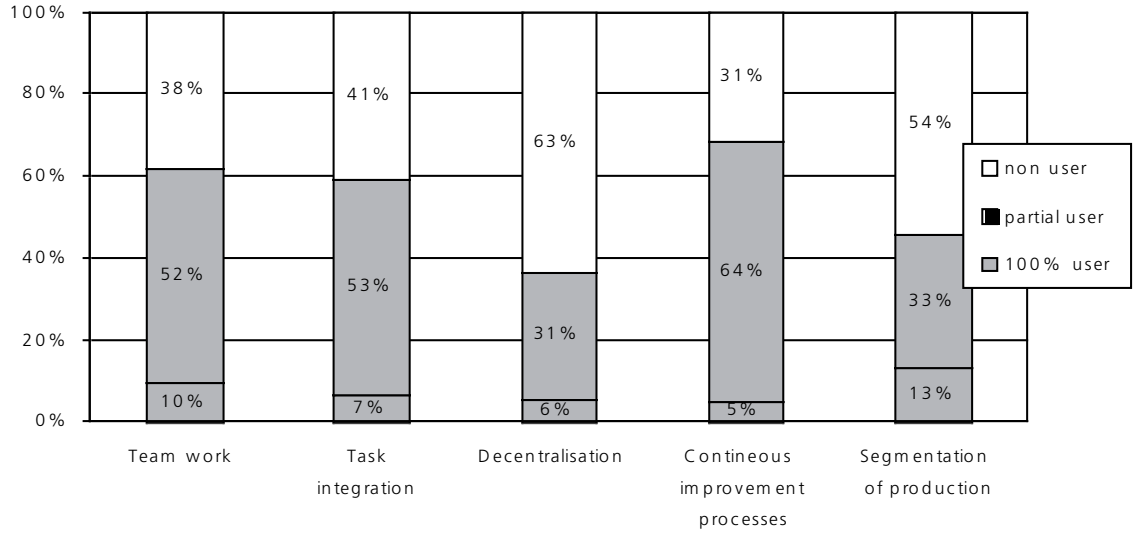
Particularly when organisational innovations are very new and are yet not to be assessed as established concepts, companies tend to label their small realization efforts as a successful implementation of the organisational innovation. An example on team work which is integrated in the *German Manufacturing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

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

Figure 14: Diffusion of 'team work'



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].

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

Figure 16: 21 surveyed organisational innovations

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

(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.

(5) See appendix for definitions of every *organisational innovation*.

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

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 organisa-

(6) See appendix for entire interview guidelines.

Figure 15: Stakeholder interviews across sectors and countries

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
$\sum = 100$		

tional 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.

6.2 Interview data

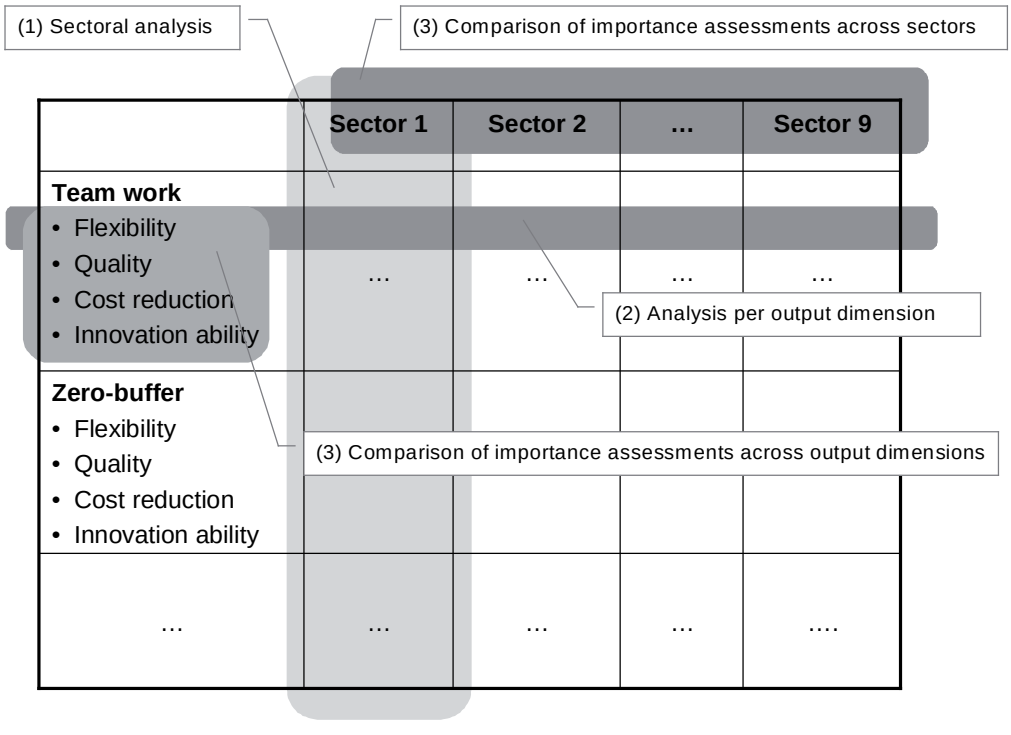
As 100 stakeholders in nine sectors across twelve countries have evaluated the (low, moderate, strong) impact of 21 organisational innovations on quality, flexibility, costs and innovation ability, the data set is rather complex.

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.

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.

Figure 17: Data analyses of stakeholder interviews



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.

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

Figure 18: Extract from data sheet of PORCH interviews

	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

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 enterprises 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

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

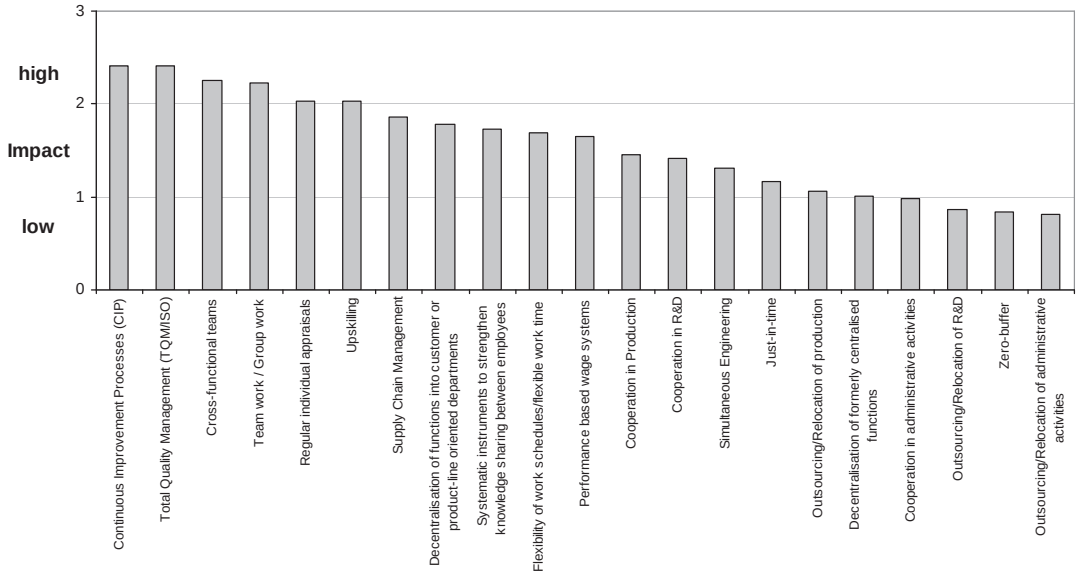
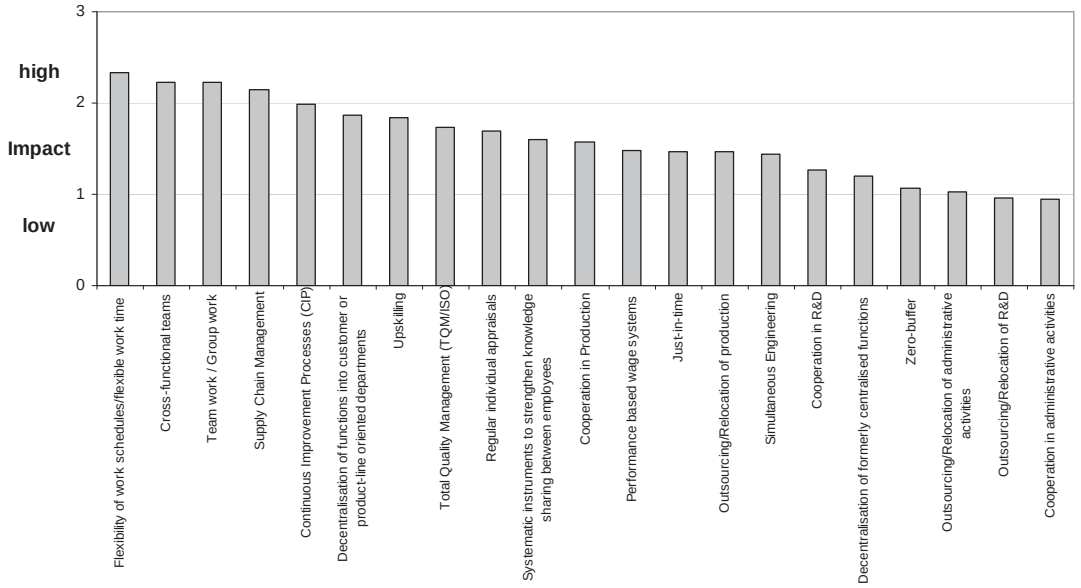


Figure 20: Ranking of importance of organisational innovations for increasing flexibility



just-in-time are not supposed to have a strong impact on quality improvement and rank low in this list (see Figure 19).

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.

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.

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

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

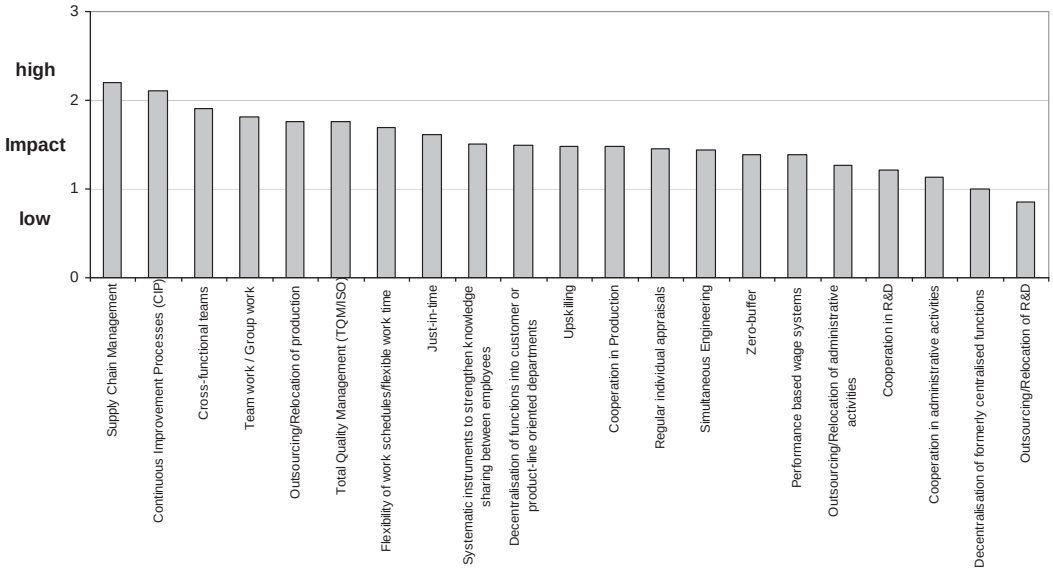


Figure 22: Ranking of importance of organisational innovations for increasing innovation ability

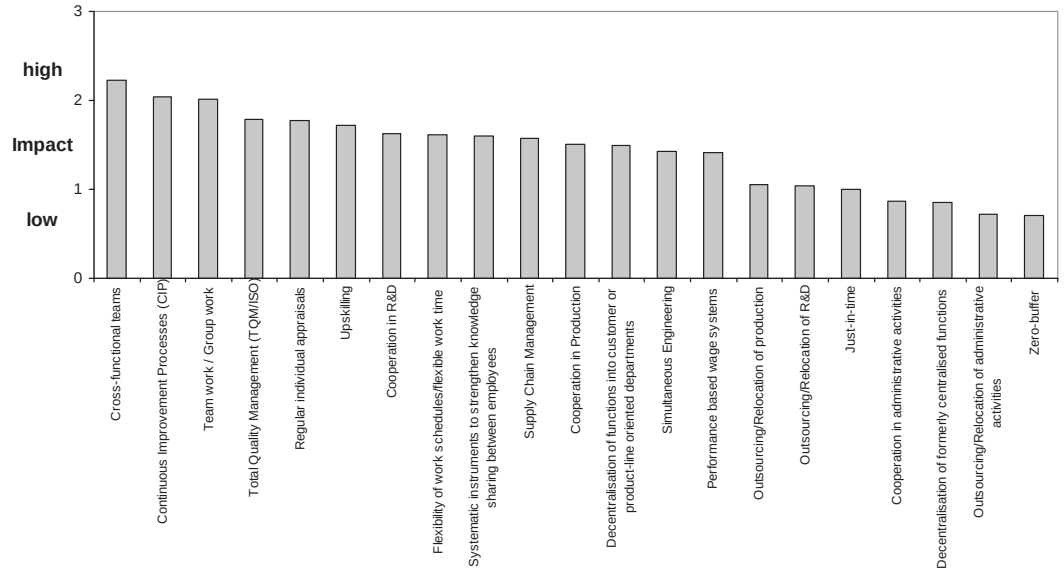
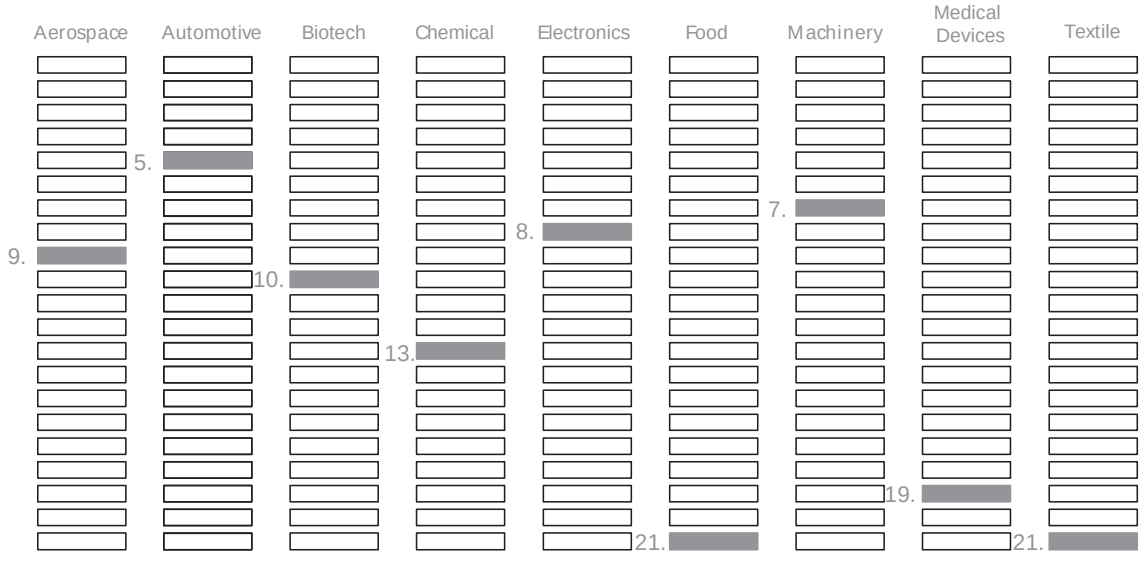


Figure 23: Importance ranking of simultaneous engineering across sectors



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).

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

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

Figure 24: Results of t-tests

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

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 companies. 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 sim-

ilar 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.

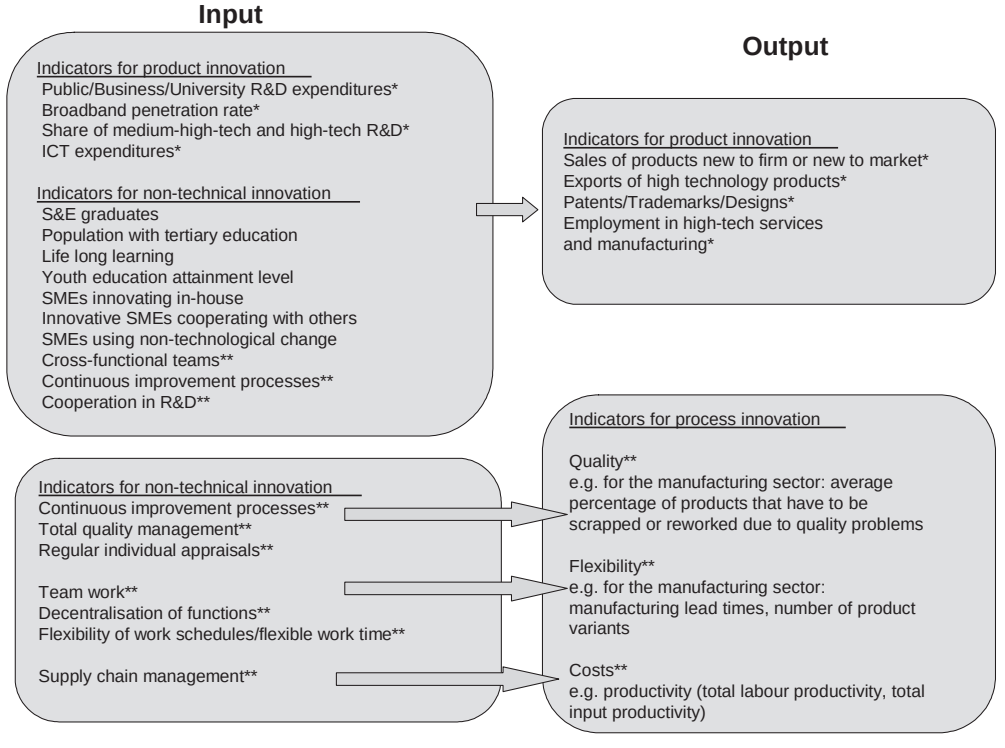
Flexibility as a performance indicator has not yet been considered in the EIS. It is therefore proposed to include flexibility as an additional output innovation indicator for process innovation. Examples for the measurement of flexibility are manufacturing lead time for flexibility in terms of velocity, 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

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



* Existing indicators in the EIS ** Recommended new indicators for the EIS

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).

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

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

	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

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.

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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9 Appendix 1: Theoretical outlines on organisational innovation

9.1 Evolutionary approaches

CONTRIBUTION OF B. CORIAT AND C. LEGUEHENNEC (CREII, FRANCE):

After a long period of theorising focused solely on "technological innovation", the revolution in organisation theory finally opened the way to a series of original development around the concept of organisational innovation. The attention thus, turned to be concentrated on the "intangible" factors that account for firms' competence and performance. Some basic works, like Chandler's regarding firms' structures[7], Penrose's (1958) 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 brought out the existence of specific organisational capabilities and, in order to do so, has developed a series of tools that are often quite refined. On this line of reasoning, the revival of the "resource-based theory" of the firm (Wenerfeld, 1984; Montgomery, 1995; Conner and Pralahad, 1996; Foss, 1997a and 1997b) evolved significantly with behavioural (Cyert and March, 1963) to the firm. At the heart of this reflection the joint notions of organisational competences and organisational learning around which such evolutionist authors as Nelson and Winter (1982), Dosi and Marengo (1994) or else Teece and Pisano (1994) focused their attention, have made possible the renewal of the classical visions of firms' behaviours and performances. On that ground the evolutionary approach to the firm has given to 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; and for a comprehensive assessment, Dosi, Coriat and Pavitt, 2000).

With regard to the notion of organisational innovation, this school of thought can be associated with a series of basic ideas and assumptions allowing apprehending and understanding the meaning and implications of the notion of organisational innovation. They can be summarised as follows.

(7) For a synthesis of its own views on firm competences see his (1992) article.

(1) Organisations as loci of specific intangible ("non-technical")[8] capabilities and competencies

The first idea proper to Evolutionary approaches to organisations (and/or organisational innovations) is that —all things being equal—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[9]. 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 to "agency" theory and transitions costs theory, see: Dosi, G. and L. Marengo, 1999). One of the basic features of these evolutionary approaches is to insist 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 (see below 5 the point on "organisational learning). As Teece, Pisano and Shuen (1992) 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 their 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 to highlight the 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 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 actions. Routines thus economise "deliberation". They accelerate the decision making process (For an assessment see Cohen et al., 1995).

(3) Routines as "problem solving devices" and repertories of coordinated actions

These competences and routines embed in the individuals and the organisations in which they operate constitute repertories of answers. In that sense they are problem solving devices. An organisation based on a given set of routines is thus able to perform efficiently the tasks required

(8) To use a recent terminology introduced in European CIS surveys.
(9) To a certain extent this recent theorizing has given new strength and relevance to the "X efficiency" hypothesis, first formulated in the seminal paper by Leibenstein, 1982.

to achieve the production program, with an in-built ability to face the majority of the many unpredictable events that may hinder the good functioning of the production flux. Note that the smooth running of an organisation implies that routines be flexible enough to absorb minor changes during their execution and smooth them out (Levinthal, 2000). Routines can thus be considered as the 'organisational memory' of the firm: they constitute the accumulated stock of organisational know-how used by economic agents (firms, organisations) in order to ensure the smooth functioning of the operations they are dedicated to (Cohen and Bacdayan, 1994).

The repertory of responses which characterise routines should be understood as consisting both of 'the way of doing things' and 'the way of determining what should be done'. To the extent that, in both cases, the responses are 'automatic', the comparison with genes is taken seriously by the evolutionary authors. Like genes, routines gather their information from the surrounding environment, process it and send back the messages necessary for the smooth running of the organisation. Ultimately, it is therefore by means of routines that organisations function. According to evolutionary authors "even the sophisticated problem-solving efforts of an organisation fall into quasi-routine patterns, whose general outlines can be anticipated on the basis of experience with previous problem-solving efforts of that organisation" (Nelson and Winter, 1982, p.136). For this reason, these theorists sustain that that 80% of the tasks performed by an organisation are achieved through "routines". Only the remaining 20% require deliberation and the exercise of "rationality" in the decision making process.

(4) Routines and the dynamics of organisational innovations: the key role of "organisation learning"

Since routines are 'replicable', once introduced successfully in one place, they are transferable to other places. In this way, the efficiency of the organisation is increased. If it cannot be transferred, an efficient routine can be 'imitated', that is, transferred from one context to another (in particular, the initial context may be a rival or a "parent" organisation, aspects of which one wishes to imitate). This circulation/imitation of efficient routines is one of the key channels through which organisational innovations occur.

But more important is the process of organisational learning that lies at the heart of the strengthening of organisational capabilities and henceforth the building of relative advantages. In this respect it has to be noticed that if organisational learning is obviously linked with the change of individual skills (sometimes indeed with the loss of some of them), it is also and primarily related with changes of collective representations, rules, and even of hierarchical set-ups (Dosi, Nelson and Winter, 2000). In that sense the organisational nature of learning is largely reflected by its being linked with changes in organisational practices which might not display any evident correlation with what individual "know". Thus organisational knowledge and organisational learning ought to be partly considered as an emergent property, shaped by the interaction amongst multiple learning/ adjustment processes occurring within the organisation itself. Nevertheless, all forms of long-lasting organisational learning imply some mechanisms of codification of knowledge and interaction procedures. Despite the "tacitness" dimension of routines and the fundamental incompleteness of codification mechanisms themselves (Dosi, Marengo and Fagiolo 1996), codification–also in the form of archives, documents, training practices, etc. – deals with the persistence organisational knowledge well beyond the mobility of organisational members (See Coriat (2000a) for the use of codification in the "continuous improvement" policy at Toyota). Relatedly, the very codification of (individual or more collective) skills is a fundamental aspect of the establishment of an organisational memory (For a discussion regarding the impacts on efficiency of two alternative types of codification (Uddevala vs/ Toyota) see Coriat, 2000a).

(5) Organisational innovation and technological innovation

There are intimate (but not strict reciprocal) links between organisational competencies/innovations and technological competencies/innovations. Changes in the collective "knowledge of

nature" (which characterises a technological competence) and the procedures to master it – being it related to the design and production of a new machine tool, a new drug, a new type of airplane, etc. – usually go together with changes in skills distributions, information flows, action patterns and sometimes even "cultures" within the organisation (Patel and Pavitt, 1998). But the converse does not necessarily hold: one may indeed observe even significant changes in the social division of labour, in action patterns, etc. without any dramatic change in the technical competences the organisation holds. In fact, this lack of one-to-one correspondence between technological and organisational innovation is also a necessary premise for the comparison of the performances of diverse organisational set-ups, when holding strictly technological knowledge roughly constant. Moreover 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).

(6) Path dependency and social embeddedness of organisational trajectories

Organisational learning just as organisational innovation is never a purely cognitive process: rather it finds a crucial ingredient in processes of social adaptation, learning and modification of organisational rules, development of shared interaction patterns, etc (Coriat and Dosi, 1998). In turn, this bears far-reaching implications in terms of comparative assessment of e.g. "the Japanese firm" vs. "the American firm", or in the trajectories followed by individual firms kept in different institutional settings (Hall and Soskice, 2001).

Organisational trajectories are ridden with path-dependencies whereby incumbent competences shape and constrain the patterns of future exploitation. One has to notice that assessment of the degrees of path-dependencies of organisation learning bears important consequences for the comparative diagnostics of the diffusion of particular organisational forms e.g. between Europe, the USA and Japan, (or Germany vs. Portugal). Without any path dependency, when observing a given diffusion pattern one may safely talk of "laps" and "leads" across regions and countries. However, the picture is much more blurred when path-dependencies matter, since some organisational innovations might yield superior performances in some context and given a particular history might not do so along other institutional and organisational paths (Coriat, 2000b and 2002 for comparative studies conducted at the EU level).

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CONTRIBUTION OF R. EVANGELISTA, M. PIANTA AND A. VAONA (LUNARIA, ITALY):

Evolutionary Approaches to 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.

After this general perspective of evolutionary studies, a second issue to be addressed concerns the various definitions of organisational innovation. On the one hand there are authors focusing on the question of *which are the features of organisations that favour their ability to innovate*–such as Slappandel (1996), Sorensen and Stuart (2000) and Damanpour (1996) – where the term "innovations" may include either product and process technologies or new organisational arrangements or new administrative systems. On the other hand, there are those, like Pettigrew and Fenton (2000) that focus on the *changes in the production process and in the interaction between agents that make this process possible*. A particularly effective definition of organisations and their change is proposed by Greenan (2003): organisational innovation is defined as a *change in "the way decision making units are structured within the firm, the way decision making power and skills are distributed within the firm and between decision-making units and the type of information and communication structures that are in place"* . The latter definition is particularly useful in order to understand the current trends in organisational innovation, classify different types of organisational innovation, and explore their economic effects.

A third problem addressed by this literature concerns the main directions that organisational change has taken in the last decades. They have generally been summarised with the following keywords: decentralisation, deregulation, informality, delayering, reduced role of hierarchy, more

collective work, task/work enlargement, "controlled autonomy", more responsibility for each worker, greater variety of tasks performed by workers, but also a stricter definition of them (Caroli, 2001; Jensen, Johnson, Lorenz and Lundvall, 2004; Leoni and Usai, 2003). In other words, we should expect to find a shift from "an organisation that is good at cumulative learning and derives its innovative capabilities from the development of organisation specific collective competences and problem solving routines", to an "organisation that rely more upon individual specialist expertise, organised in teams able of speedy responses to changes in knowledge and skills" (Lam, 2004). Teece (1998) has theorised that different kinds of organisations entail different kinds of innovation, being either "autonomous" or "systemic" ones. First the introduction to the market of "autonomous" innovations, with difference to that of "systemic" ones, do not imply a radical modification in related products or processes. Second, "autonomous" innovations are better implemented by small flexible structures, whereas the "systemic" ones by more integrated structures. Therefore, if Teece's theorising is right, one should have observed an increase in the last years in "autonomous" innovations, more than in "systemic" ones.

A fourth issue concerns the dynamics and the sources of organisational innovation. The issue here is whether organisations gradually adapt, having their own internal engine of change, or if organisational innovation is more 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: organisation 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).

A fifth issue raised by the evolutionary-type literature addresses the interaction between technological and organisational change and the effects on economic activities and employment. 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. This is generally not associated with an increase in the number of employees, with the exception of management occupations. Organisational and technological changes in services, on the other hand, have reflected the opportunities offered by ICT to overcome time and space constraints in the provision of services, leading to major flows of job creation and destruction, and to rapidly changing skill requirements. A variety of strategies of restructuring, emergence of networks, subcontracting, and outsourcing has resulted, leading to polarisation effects in skills and wages (Petit and Soete, 2001b; Frey, 1997). 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 sum. On the other hand, changes in organisations or in technologies may be pursued as alternative paths in contexts of restructuring and job losses.

The last issue concerns the effects of organisational change on the skill content of labour and the human resources managment models used in firms, as proposed by both Pianta (2004) and Greenan (2003). Organisational innovation, especially together with the introduction of ICTs, may lead to either upskilling and more involvement of workers in the production process (Adler, 1992) or to deskilling and more control on workers by the management (Shaiken, 1984; Green, 2004). Antonioli et al. (2003) stress the importance of cooperative industrial relations, with bi-directional information sharing, consultation and bargaining procedures at the local level, argu-

ing that they have a positive effect on firms' performance. On the dynamics of organisational change, they also propose a distinction between hierarchical systems and more democratic ones: in the first case most organisational changes are proposed by the management, while in the second by workers.

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9.2 Business administration approach

CONTRIBUTION OF M. SZWEJCZEWSKI (CRANFIELD SCHOOL OF MANAGEMENT, UK):

(1) Definitions of innovation

The definition of innovation is disparate, with little consensus among writers (for examples see Rickards and Moger, 1991; Nystrom, 1990; Vrakking, 1990; West and Farr, 1990). Goffin and Pfeiffer (1999) concur that there is no commonly accepted understanding of what innovation means, especially within a business context. The literal meaning of innovation – introducing something new (Oxford English Dictionary), whilst clear, unfortunately offers little guidance to those tasked with managing the process.

Historically, academics have made a distinction between invention and innovation, with innovation normally being couched in terms of commercial success (Trotterdell et al, 2002). Van de Ven (1995) furthers this distinction between invention and innovation by pointing out that new ideas that are not perceived as useful tend to be described as mistakes rather than innovations. 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 (or detriments) remain to be determined after an innovation has been implemented (Trotterdell et al., 2002). This is at odds with the definition proposed by the UK Government's Department of Trade and Industry (DTI) who state that something is only an innovation once the change has successfully exploited – 'the successful exploitation of new ideas' (DTI, 2005).

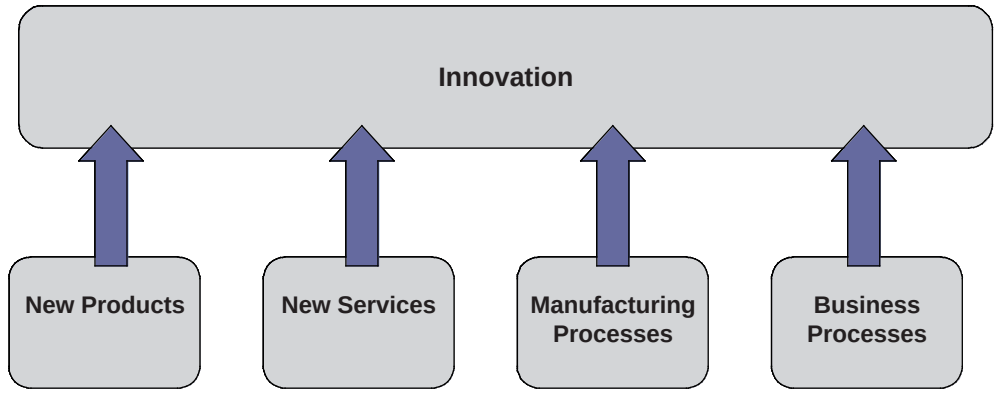
Other definitions of innovation take the approach of trying to be all encompassing, such as the definition of innovation proposed by Nohria and Gulati (1996) "any policy, structure, method, or process, product or market opportunity that the manager of the innovating unit perceived to be new". This is 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 focus of discovery and creativity has been the centre of other innovation definitions Yu (2003) stating, "innovation is a discovery". Dosi (1988) also focuses on discovery and the search processes involved – "innovation concerns the search for, and the discovery, experimentation, development, imitation, and adoption of new products, new production processes and new organisational set-ups". The view has been further elaborated by Bono (1992) who argues that if we move out of the main routine track and see things differently, we are innovating. This definition links with that proposed by Tidd et al. (2001) who state that innovation is "essentially about change".

(2) Types of Innovation

Unfortunately the concept of innovation has the potential to be treated as one dimensional, mainly because it is so strongly associated with the development of new products (Goffin and Szwejczewski, 2001). In reality innovation is an umbrella for at least four types (Goffin and Szwejczewski, 2001) highlighted in Figure 27. Companies can innovate by developing new services (which can help to differentiate products and also earn additional revenues) and/or by improving manufacturing or service delivery processes (normally referred to as process innovation). In addition, companies can innovate by optimising business processes that make it easier for customers to do business with the organisation.

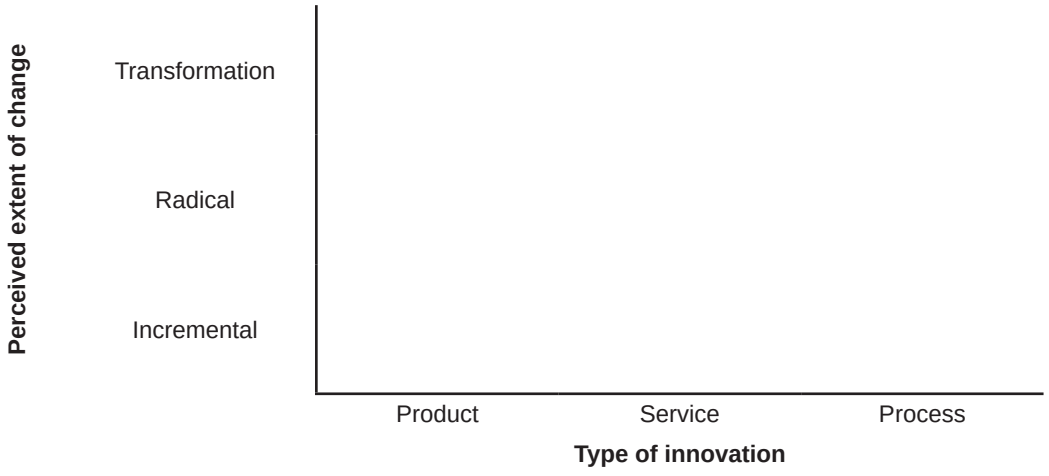
Figure 27: Four types of innovation (based on Goffin and Szwejczewski, 2001)



Tidd et al. (2001) use the concept of innovation types as described above, but consolidate manufacturing and business processes. They concentrate on two forms – changes in the things organisations offer i.e. products and services and change in the ways they are created and delivered i.e. process.

In addition to innovation types Tidd et al. (2001) present a second dimension referred to as the degree of novelty involved. Novelty refers to the continuum between minor, incremental improvements, through to radical, discontinuous changes (which transform the way industry operates to the perception of customer requirements). Arguably these differences are important to the way that we manage the innovation process. The management of incremental, stead state innovation is a relatively familiar process for firms in comparison to radical, step change innovation, which is dealt with occasionally and is often an unfamiliar process. These two dimensions (type of innovation and novelty) can be plotted on a simple matrix (Figure 2) to define the space that has to be managed.

Figure 28: Dimensions of innovation space (adapted from Tidd et al., 2001)



(3) Process and Product Innovation

In the last two decades a considerable number of empirical studies on the determinants of innovative activity have been undertaken (for example, Levin, Cohen and Mowery, 1985; Zimmerman, 1987). Within these investigations the difference between product and process-innovation has been largely neglected (Kraft, 1990). Slack et al. (2004) augment this train of thought when discussing the practitioner perspective, indicating that often the design of products and services are dealt with on one hand and the design of the processes which make them on the other, as though they are completely separate activities. Yet they are clearly related, since frequently the manufacturing of a new product can only be possible if a new process is implemented (Kraft, 1990).

CURRENT TRENDS FROM THE LITERATURE – SINCE 2000

(1) Discontinuous Innovation

The issue of discontinuous, breakthrough innovation is one that has received keen interest both on the academic and practitioner fields. Whilst this is outside the remit of this literature review, it has brought with it interesting challenges to the way that organisations structure themselves and manage their processes. This section will examine innovations in management processes that have been linked to discontinuous innovation

(2) Ambidextrous Organisation

The failure to be able to deal with the complex issue of managing both stead state innovation and breakthrough innovation has been evident in many organisations. The approaches suggested to deal with this dichotomy have often tended to be old ideas which have been revised and repre-

sented, for example cross-functional teams and corporate venturing. However, O'Reilly III and Tushman (2004) have claimed that a company may be able to shift back and forth between different organisational models – i.e. moving between those focusing on exploitation of existing capabilities for profit and those focusing on exploring new opportunities. In short the company needs to become an ambidextrous organisation. Thus enabling it to sustain a "competitive advantage by operating in multiple modes" (Tushman and O'Reilly, 1999) as illustrated in Figure 29. The multiple modes allow control of the short-term efficiency by emphasising 'stability and control' and for long term (breakthrough) innovation 'by taking risks and learning by doing'.

The premise of an ambidextrous organisation is the ability of the firm to recognise the two distinct approaches required (see Figure 29). These concepts are further supported by Rice and Colarelli (1998) who observed different organisational approaches to incremental innovation compared to discontinuous. It was evident from their studies that discontinuous innovations occurred in separate organisational units. The rationale from the separation was discontinuous projects were badly aligned with the operating businesses' reward structure, uncertainty was too high, timeframes where too long and investment was too high given the risks. Tushman and O'Reilly (1999) further confirm this as they argue, "different kinds of innovation require different kinds of organisational hardware-structures, systems and rewards and different kinds of software – human resources, networks, and cultures".

Figure 29: The Ambidextrous Organisation (based on Tushman and O'Reilly, 1999)

Alignment of:	Exploitative Business	Exploratory Business
Strategic intent	Cost, profit	Innovation, growth
Critical tasks	Operations efficiency, incremental innovation	Adaptability, new products, breakthrough innovation
Competencies	Operational	Entrepreneurial
Structure	Formal, mechanistic	Adaptive, loose
Controls, rewards	Margins, productivity	Milestones, growth
Culture	Efficiency, low risk, quality, customers	Risk taking, speed, flexibility, experimentation
Leadership role	Authoritative, top down	Visionary, involved

Ambidextrous leadership
Different alignments held together through senior-team integration, common vision and values, and common senior-team rewards

Whilst disconnect of the actual business units is required, integration of the senior team and managers is paramount. The ambidextrous organisation recognises that ambidextrous organisations require "ambidextrous senior teams and managers – executives who have the ability to understand and be sensitive to the needs of very different kinds of businesses" (O'Reilly and Tushman, 2004) requiring mangers to be "consistently inconsistent" (O'Reilly and Tushman, 2004). It is only through this alignment and integration of the senior team that common visions and values can be achieved.

(3) Next Step on from Lean

Since its introduction in the early 1990s the concept of lean production has grown in popularity (Womack et al., 1990). However, recently agility has started to attract more attention. Agility has

been hailed, by some, as the next generation manufacturing philosophy for companies (Kidd, 1997). The agile enterprise represents a new global industrial competition mode for 21st century manufacturing (Gunasekaran and Yusuf, 2002).

Agility relates to the interface between the company and the market. Essentially it is a set of abilities for meeting widely varied customer requirements in terms of price, specification, quality, quantity and delivery. Agility has been expressed as having four underlying principles. These are: Delivering value to the customer, being ready for change, valuing human knowledge and skills and; forming virtual partnerships (Katayama and Bennett, 1999)

Such industries that have implemented the concept of agile is numerous including speciality chemicals (Guisinger and Ghorashi, 2004), cables industry – manufacturing large cables for power transmission and distribution, telecommunication (Prince and Kay, 2003), automotive (Brown and Bessant, 2003) computing industry (Brown and Bessant, 2003).

(4) Agile and supply chains

Although the concept of agility has been mainly applied to manufacturing some writers have stated that it should be extended to the supply chain. As Slack et al. (2004) state all business environments contain some degree of uncertainty; therefore supply chains need to be sufficiently flexible to cope with this uncertainty and the disruption that often stems from it. The wider concept of agile recognises that "within the supply chain, companies should work together to achieve a level of agility beyond the reach of the individual company. Companies as wide as raw material suppliers, manufacturers and retailers may need to be involved in the process of achieving an agile supply chain" (van Hoek, Harrison and Christopher, 2001). Prater, Biehl and Smith (2001) propose that whilst agile has become a major topic of research the manufacturing literature has overlooked the issue of supply chain management. Their research found that in many cases, a firm's international supply chain might not be able to respond quickly and reliably as the rest of the organisation. Through their empirical work they show that internationally operating firms have made distinct tradeoffs between agility on one side and complexity and uncertainty on the other side.

(5) Joining the two concepts- lean and agile

Agility was considered to be significantly different from lean. However, current thinking seems to be moving towards integrating the two concepts of lean and agile (Prince and Kay, 2003; Katayama and Bennett, 1999; Towill and Christopher, 2002). Towill and Christopher (2002) conclude "they are not mutually exclusive alternatives. Rather they should be used separately or conjointly, according to the demands of the market-place and the characteristics of the physical product (e.g. design, supply constraints, etc.)".

(6) Sustainability

The issue of sustainability is an area that has received a lot of attention and covers many different aspects from economic, environmental and social. As part of this literature review to cover all of these different aspects in detail would be beyond the task of this review, however the field of operations management has taken a key interest in sustainability and this is what this section will concentrate on.

Sustainable development is defined by the World Commission on Environment and Development (WCED) (1987, p 8.) as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". For the concept of sustainability to be meaningful, it must refer to maintaining, renewing or restoring something specific (Sutton, 1999) but also include the ethical dimension of fairness of trade-off between current economic pressures and the future needs of the environment (Wilkinson, Hill and Gollan, 2001).

Angell (2000) argues that previously operations managers have traditionally tended to see environmental pressures as external constraints imposed by regulations. However, Angell (2000) goes on to state that in recent years these have begun to be reinforced by internal pressures from within the firm itself.

Angell and Klassen (1999) refer to plans for 'industrial ecology' building on the theme of 'industrial development' but in which industrial processes are viewed across several businesses as an ecosystem in which waste from one system could serve as the raw materials for another. Examples of this are cited in some Germany companies locating their facilities closer to recycling plants or raw materials suppliers to reduce the need for packaging and transportation, following the introduction of the Packaging Ordinace in 1991. Furthermore, Angell and Klassen (1999) also cite a recently opened BMW factory, which disassembles automobiles for the reuse and recycling of parts thereby moving from the traditional approach of simply recovering automobile scrap. These examples, however, appear to be small in number compared to the vast unsustainable industrial activity taking place, even though more companies are now including statements relating to environmental management within their mission statement.

The changes taking place in operations management as a result of environmental concerns although significant in their own right, are not as widespread as they might be and are often to be found in particular industrial sectors where environmental impacts are clear for all to see, such as the chemical industry or waste treatment (Wilkinson, Hill and Gollan, 2001).

(7) Customer Management Relationship (CRM)

CRM has been described as "an organisation wide process, which focuses its activities on treating different customers differently to increase value for both customer and organisation" (Knox, Maklan, Payne, Peppard and Ryals, 2003). Alternatively CRM can be described as "a business strategy focusing on winning, growing and keeping the right customers" (European Centre for Customer Strategies 2001).

Essentially relationship marketing is concerned with how organisations manage and improve their relationship with customers for long-term profitability. Within this area customer relations management is becoming a topic of increasing importance in marketing (Ryals and Payne, 2001). Primarily CRM is concerned with using information technology (IT) in implementing relationship-marketing strategies. It also requires changes to the way a company is organised and managed. A recent CRM report published by the Financial Times (Ryals et al., 2000) suggests that CRM consists of three main elements:

- Identifying, satisfying, retaining and maximising the value of the firm's best customers;
- Wrapping the firm around the customer to ensure that each contact with the customer is appropriate and based upon extensive knowledge both of the customer's needs and profitability;
- Creating a complete picture of the customer

However, a further study by Ryals and Payne (2001) established that there are a number of barriers that prevent CRM being successfully implemented:

- Lack of skills in building and using new system
- Inadequate investment
- Poor data quality and quantity
- Failure to understand the benefits
- Functional boundaries
- Inadequate measurement systems

Largely it would appear from interviews with 24 standouts in customer knowledge management that firms need more than transaction data to gain insight (Davenport, Harris and Kohli, 2001). The likes of Procter & Gamble and Harley-Davison insist that their companies succeed because they consider the person behind the transaction – recording what customers do during sales and service interactions – it is about making the data "meaningful". Davenport, Harris and Kohli (2001) present a series of points that enable the relative inexperienced company to implement a success CRM policy.

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9.3 Industrial sociology approach

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(1) Introduction: Different types of innovation

Generally, the term innovation is closely linked to research and development of new products. There are many studies on innovation revealing that increased research and development activities lead to innovative products enabling the company to achieve competitive advantages and to gain market shares. However, through increased global competition companies are forced to search for other innovation areas in order to maintain their competitiveness as solely the development of advanced product technologies is no longer sufficient to persist in competition.

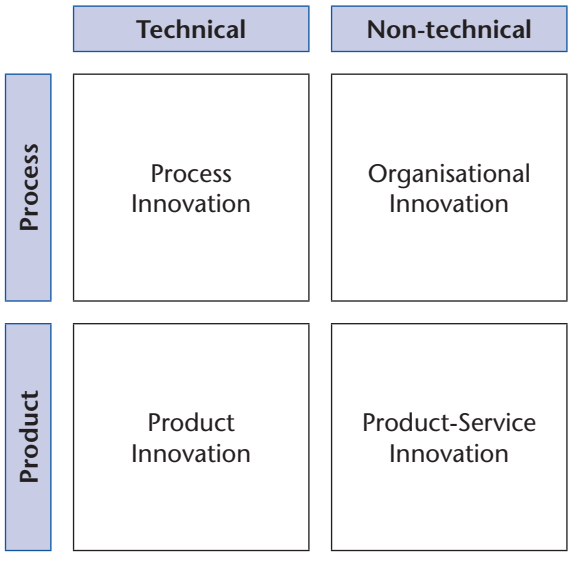
Therefore, scientists and management practitioners have started to define innovation in a broader sense. They suggest that innovation activities take place in four different areas which can be

further differentiated into technical and non-technical innovations. 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; Dumanpour and Evan, 1994; 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. Product-service innovation offers the customers several services which go along with the new 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 function units into divisions or just-in-time concepts.

We proceed as follows. In a first part (chapter 2), we will provide a chronological overview of organisation theory presenting the contemporary shift in organisational paradigm (Whittington 1999). During the last decades there has been a radical change in the understanding of organisations reaching from centralised to decentralised approaches. This shift of organisational paradigm is also reflected in currently discussed concepts of organisational innovations as most organisational innovations incorporate certain issues of decentralisation or flexibility. In a second part (chapter 3) we will provide further insights into the concepts of organisational innovations by providing a more detailed definition.

Figure 30: Different types of innovations (based on Kinkel, Lay and Wengel 2004)



(2) Centralisation and decentralisation

Organisation theory is no homogenous discipline with a single dominating paradigm. It incorporates different theories and shows a strong overlap to surrounding research disciplines such as sociology, psychology, management science or engineering. There is also a number of different perspectives to which organisation theory may address, for example, processes within internal structures, leadership, internal and external stakeholders (Schreyoegg, 1999).

Despite the heterogeneous character of organisation theory there is a general shift as regards the overall orientation. During the last decades, the concept of what is considered to be an innova-

tive organisation has evolved from the classical principles of Taylorism/Fordism[10] respectively "scientific management" (Taylor 1977) at the beginning of the 20th century to the currently favoured ideal of a decentralised, autonomous and cooperative organisation. Taylorism and Fordism–as the most prominent representatives of the classical approaches–refer to a mechanistic view both of the process of organisation and of questions of leadership. The main principles of these classical approaches are: specialisation through division of labour, clear division between planning and workmanship, clear hierarchy structures, leadership through command and control and centralised decision structures (Taylor, 1977; Kieser, 2002a; Schreyoegg, 1999).

In the middle of the 20th century the "Human Relations Movement" as well as the emerging discipline of organisational psychology marks the transition from classical to modern approaches (Staehle, 1999; Kieser, 2002b; Schreyoegg, 1999). The paradigm shift was triggered off by the realisation of the strong impact of psychological factors on the work outcome. This realisation has led to a stronger consideration of the situation of employees and their motivational background and later, after 1950, to the development of modern organisational theories. Representatives of modern organisational theories are for example the contingency theory, micro-economical approaches (principal-agent-theory, transaction cost theory, theory of property rights), evolutionary approaches, institutionalism or system theory (Kieser, 2002; Schreyoegg, 1999). Given the variety of different theoretical approaches it is difficult to find a common understanding of organisational innovation which would take all the different aspects into consideration. Nevertheless there seems to be one main difference between classical and modern organisational theories. While classical approaches emphasise centralised and hierarchical structures, modern concepts mainly focus on flexibility and adaptability of organisational structures and processes according to changes in the environment (technology, demand, competitors, suppliers etc.).

Organisational innovation can be considered at least from two different perspectives. Besides the *intra-organisational* aspects of organisational innovation there is an *inter-organisational* dimension regarding the interchange between the organisation and its environment. Cross-boundary activities and boundary-spanning processes have an impact on organisational structures and can therefore be linked to organisational innovation. Boundary spanning activities are considered to provide the adjustment and adaptability of organisations and are expected to be reflected in the units established to handle boundary-spanning-matters (Thompson, 2004, p. 70). Organisations facing for example a heterogeneous environment are expected to have a variety of functional divisions, each corresponding to a relatively homogenous segment of the environment. These functional divisions might also be further subdivided. If, in addition, the task environment is also dynamic, boundary spanning units will operate on a decentralised basis to monitor and plan responses to changes in its sector of the task environment (Thompson, 2004, pp. 72-73). Furthermore, new business models have a strong impact on organisational structures. Technological progress particularly in the area of information and communication technologies leads to new possibilities of boundary management and alliances between organisations. The concepts of the "boundaryless organisation" or "virtual enterprise" mark the extreme pole of the current discussion about the dissolution of classical organisational boundaries (Ashkenas at al., 1998; Davidow and Malone, 1992; Picot et al., 2003; Reichwald, 2000; Ortmann and Sydow, 1998 and 2003; Sydow and Windeler, 1994). The virtualisation of organisations and the dissolution of organisational boundaries have an internal aspect, reflected in modularisation as well as an external aspect, reflected in the formation of networks (Picot et al., 2003, p. 429).

(3) Operative and strategic decentralisation

The underlying general principle of modern approaches is decentralisation. Decentralised structures are supposed to be most suitable for absorbing the high level of complexity and uncertainty of the organisational environment (Picot et al. 2003; Sauer 2001). The paradigm of decen-

([10]) Together with the Theory of Bureaucracy (Max Weber) and the Administrative Approach (Henri Fayol)

tralisation can be applied both to the *strategic* and to the *operative* level in organisations (Faust et al., 1999; Latniak et al., 2002; Goshal and Bartlett, 1998).

Strategic decentralisation refers to the new formation of units, the relocation of tasks or competencies between different divisions, or the outsourcing of entire organisational divisions. Strategic decentralisation is also closely related to the reduction of administrative units and departments with centralised functions. Operative decentralisation means a shift of planning and controlling functions from the management to the working level and/or the reintegration of administrative tasks. A high degree of operative decentralisation leads to job enlargement and job enrichment for employees, thus allowing for more flexibility in a situation of growing product complexity and variety as well as decreasing batch sizes and lead times.

Business networks (Sydow, 1992; Picot et al., 2003; Zentes et al., 2003) can be considered as an advanced form of strategic decentralisation of organisations. Especially cooperation between different organisations along the value chain leads to a stronger concentration on core competencies and to the relocation and distribution of tasks within the network. This may have implications for the structures and procedures of the organisations. Modularly structured organisations, for example, may more easily cooperate with other organisations because of the existence of multiple interfaces.

The relation between strategic and operative decentralisation varies depending on specific characteristics of the organisation. There is no automatism between these two forms of decentralisation. A high degree of one type of decentralisation does not automatically mean a correspondingly high level of the other. Besides differences in the form of decentralisation a variety of intensities within both strategic and operative decentralisation can be found (Latniak et al., 2002). An accurate assessment of the appropriate level of strategic or operative decentralisation in an organisation can therefore only be made on the basis of more detailed indicators.[11] It might differ in a specific way within different sectors but particular patterns of the degree of strategic and operative decentralisation will also occur across sectors.

(4) Importance of organisational innovation

Although Schumpeter (1934) already referred to organisational innovation in 1934, it is still a new and rather unexplored field of research. This is especially true for the measurement of organisational innovation. However, the measurement and investigation of organisational innovation is of particular interest as organisational innovation is not only a source of competitive advantage in itself but also enables and facilitates product and process innovations. The success of new products or technologies also depends on the degree to which the organisational structures and processes correspond to the use of these new technologies. Thus, the implementation of organisational innovations may act both as a direct source of competitive advantage as well as a prerequisite and facilitator of an efficient use of a technical innovation (e.g. Damanpour et al., 1989). Moreover, in the service sector respectively for hybrid products new organisational models are indispensable and highly linked with new product innovations.

(5) Different forms of organisational innovation

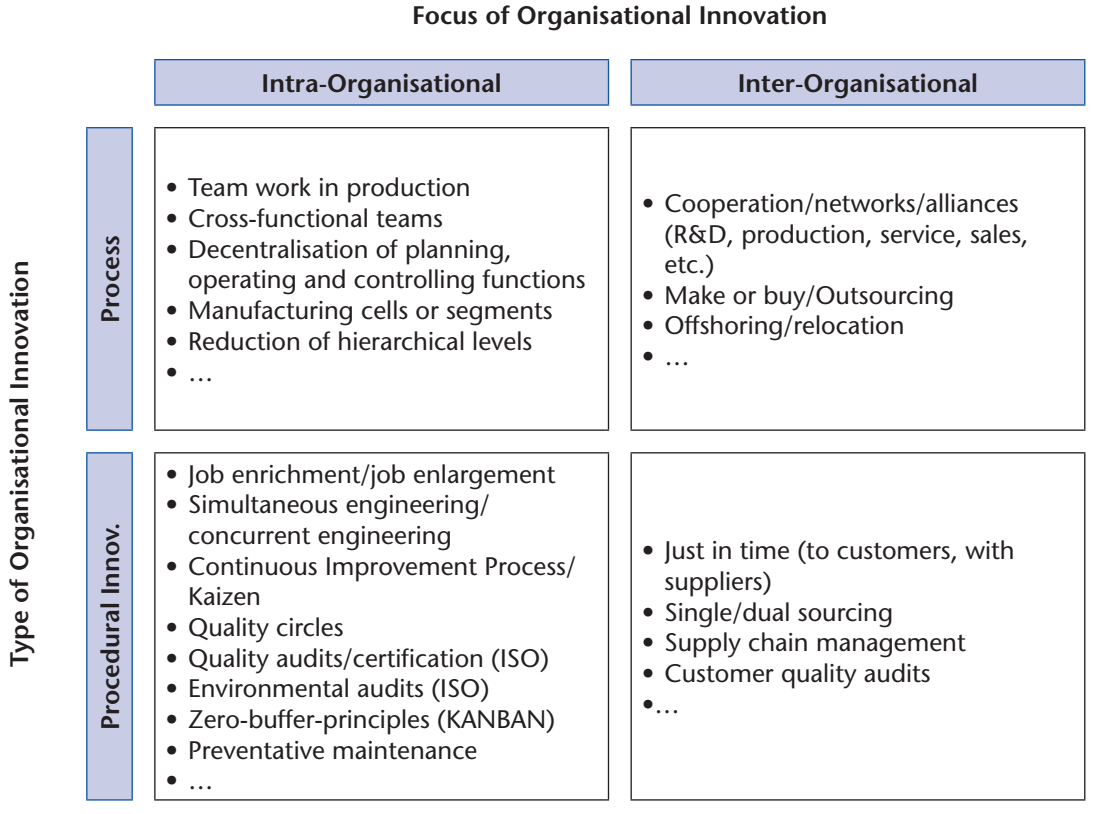
Based on the preceding chapter organisational innovation can be differentiated into an *intra-organisational* and *inter-organisational* dimension. While intra-organisational innovations occur within an organisation or company, *inter-organisational innovations* include new organisational structures or procedures with the organisation's environment, such as joint-ventures, R&D coop-

(11) See Latniak et al. (2002) for an attempt to find such indicators in the context of the manufacturing industry in Germany. While the measured level of strategic and operative decentralisation seemed to be relatively high in companies when asked about its mere existence, this rate decreased dramatically when additionally asked for more detailed characteristics.

eration or supply chain management (SCM) with other firms. *Intra-organisational innovations* occur at a unit and at an organisational level. Organisational innovations may concern particular departments respectively functions or may effect the overall structure and strategy of the company as a whole. Inter-organisational innovations are, for instance, the implementation of team work, quality circles, continuous improvement processes or the certification of a company according to ISO 9000.

Organisational innovation can be further differentiated into *structural* organisational innovations and *procedural* organisational innovations. *Structural organisational innovations* affect the organisational structure of a company. They influence and change responsibilities, accountability, command lines and information flows as well as the number of hierarchical levels, the divisional structure of functions (research and development, production, human resources, financing etc.), or the separation between line and support functions. Thus, structural organisational innovations include instruments and measures to change and improve the organisational structure of a company. Such structural organisational innovations are for instance the implementation of (cross-functional) teams or the change from an organisational structure of functions (engineering, production, human resources etc.) into one of divisions or business units (products, services).

Figure 31: Classification of organisational innovations



On the other hand, *procedural organisational innovations* affect the operations and procedures 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 the production (e.g. continuous improvement process, total quality management). As procedural organisational innovations are often concerned with new forms of management an alternative term to procedural organisational innovation is managerial organisational innovation.

There is a vast variety of different organisational innovations. Figure 31 gives some examples of organisational innovations and their position in terms of type and focus of organisational innovation. From these examples it becomes clear that the proposed categorisation is of an analytical nature. In reality, most innovative organisational concepts address different aspects of organisational change at the same time.

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10 Appendix 2: Existing surveys on organisational innovation

10.1 European Community Innovation Surveys

CONTRIBUTION OF R. EVANGELISTA, M. PIANTA AND A. VAONA (LUNARIA, ITALY):

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 (CIS1) was launched by Eurostat and the EU Commission in the early 1990s. Since then other three rounds of CIS have been carried out. The last one (the CIS4 covering the period 2002-2004) is currently under way. 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 and the first round of CIS were very much 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, CIS2 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 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 revised version of the Oslo Manual which is currently under way. 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 discussed in the ongoing process of revision of the Oslo Manual. Given the difficulties mentioned above, the strategy chosen by Eurostat has been a rather conservative one and consisted in in-

cluding in the CIS3 and CIS4 questionnaires some very basic questions on the organisational changes introduced by firms in the periods covered by the surveys.

In CIS3 firms have been asked whether, beside technological innovation, they have had introduced other types of "changes" and namely changes in the "strategy", in the "management", in the "organisation", in the "marketing", and in the "aesthetic features of the products".

With the only exception of the last category, all the other types of "changes" could be interpreted as forms of "organisational innovations" or as activities involving some kind of organisational change. The national statistical offices which have carried out the surveys have further qualified in their questionnaire the definition of non-technological innovation following specific suggestions provided by Eurostat. In the case of Italy, "changes in the strategy" included the setting up of new production or commercial agreements while "changes in the management" included the implementation of organisational models based on "just in time" and "total quality". As examples of organisational changes, the Italian CIS3 questionnaire mentioned the "set up of new operative units and departments", changes in the internal hierarchy, and processes of de-centralisation of decision processes. As examples of innovation in marketing the use of telemarketing, e-commerce, and other types of media and customer care practices were given. Similar qualifications have been included in the questionnaire used in the other CIS3 national surveys.

CIS4 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 effective and clear-cut. Firms have in fact been asked whether they had:

- "implemented new or significantly improved management systems to better use or exchange information, knowledge and skills";
- made a major change to the organisation of work within the enterprise, such as changes in the management structure or integrating different departments or activities;
- introduced new or significant changes in the relations with other firms, such as alliances, partnership, outsourcing and sub-contracting;
- made significant changes to the design or packaging of a good or service;
- introduced new or significantly changed sales methods or distributions channels, such as internet sales, franchising, direct sales, or distribution licences.

In addition, in CIS4 firms have been asked to assess the impact of such changes and namely on "the time needed to respond to customer", "the quality of the products and services", "production costs" and "employee satisfaction and turnover".

Along with the data coming from the answers of firms to these direct questions on organisational changes, CIS3 and CIS4 provide information on the ways in which the innovation process itself is organised. The information on the presence of cooperation agreements, the use of different channels of information, the importance of organisational rigidities slowing down the innovation process can in fact be used to improve our understanding of the different organisational strategies pursued by firms as well as their impact.

While the last two CIS have collected only a limited range of information on organisational innovations, data provided by these surveys show three major strengths which could be summarised as follows:

- The first advantage of CISs is that for the first time they provide data on organisational change which are fully representative of the entire universe of manufacturing and service firms across

Europe. This in turn allows to make comparisons, highlight differences and identify stylised regularities in the nature, relevance and impact of organisational change across industries, countries and firm size classes all over Europe.

- The second advantage of CISs is that they provide comparable data on both technological innovation and organisational change. This allows a thorough investigation on the extent to which these two types of innovation strategies are complementary (or substitutive) in nature. While it is commonly argued in the literature that organisational and technological change are closely linked with each other, there is less clear evidence on the strength of such a relationship and on whether this complementary relationship holds in all industries and typologies of firms. An interesting point which needs to be addressed is whether manufacturing and service industries differ in the relevance played by organisational innovation and whether service and manufacturing firms pursue different strategies of organisational change.

- Third, the availability of data on both technological and organisational innovation allows exploring the possibility of measuring the innovation performances of industries and countries going beyond indicators based on the use of the traditional technological inputs.

- Last but not least, CIS data allow to make a first empirical assessment of the impact of organisational changes (as compared to the introduction of new products and processes) on the economic performance of firms and industries using as performance indicators such as the average growth of sales, labour productivity or the shares of export on turnover as well as the rate of changes of these indicators over time.

The results of CIS3 published by Eurostat (Eurostat, 2004) have shown the potential of these data to explore the relevance of organisational innovation in manufacturing and service industries and for studying the link between organisational and technological change. More particularly, they show the widespread diffusion of organisational change across industries and the complementary relationship between organisational changes and the introduction of technological innovation. In the majority of cases firms innovate by both advancing their technological basis and by making changes in their organisational structure and routines. On the other hand, CIS3 data show that organisational rigidities do not emerge (on average) as a very important obstacle to the introduction of new technologies, or as a factor preventing the introduction of new products and processes. However, the highly aggregated form in which CIS3 data are made available by Eurostat does not allow to go deeper into the analysis of the role played by organisational change in the different National Systems of Innovation and industries, nor to explore the ways in which organisational changes are combined with product or process technological innovation, or with the use of different types of technological inputs. These types of analysis require a more in-depth exploration of CIS3 data, and namely the possibility of getting access to these data at three different levels of aggregation:

- The currently available Eurostat NEW-CRONOS database contains CIS3 data aggregated at the level of main macro-sectors and firm-size classes. These data can be used in order to highlight the main patterns of organisational innovation across country and groups of industries.

- Sectoral CIS data can be provided by National statistical offices. Compared to Eurostat, national statistical offices usually publish, or make available, CIS data at a finer level of sectoral aggregation and for a larger number of variables. These data can be used for getting a more detailed picture of the sector-specific nature of organisational change in both the manufacturing and service industries.

- Micro data could be accessed either from Eurostat (once appropriate procedures will be defined) or from national CIS databases. In some cases, and under specific conditions preserving the confidential nature of CIS data, national statistical offices make micro data accessible. The use of firm-level data allow the use of more sophisticated statistical and econometric techniques in order to study the determinants and effects of organisational change, to disentan-

gle the role played by sector and country specific factors and to explore the relationship between the different types of innovation strategies.

Given the limited availability of other large-scaled surveys on organisational innovation, these data could provide original insights on the locus, relevance and nature of organisational innovation across firm size classes, industries and countries. More in particular these data can effectively be used to:

- identify what are the most important forms of organisational changes occuring within the heterogeneous universe of manufacturing and service industries;
- develop sectoral taxonomies of organisational and technological change;
- identify major differences across European countries as regards the impact of organisational change;
- study the linkages between the use of traditional technological inputs, the use of ICTs and organisational innovation and in particular highlighting the presence of complementary or substitutive relationship between these different forms of innovation and knowledge assets;
- assess the relative importance of technological innovations, ICTs and organisational changes as determinants of the economic performance of firms, industries and national economies.
- verify the extent to which organisational change has a different nature and economic impact in the case of service and manufacturing industries.

This in-depth exploration of the CIS3 data on organisational change could also have important methodological implications. It could provide indications on alternative options for collecting systematic data on organisational innovation in both industry and services, and in particular on the extent to which the CIS framework is suitable for such a purpose. The results emerging from this project could therefore contribute to the on-going debate regarding the revision of the Oslo Manual, as far as the measurement of organisational change is concerned.

10.2 Other surveys

CONTRIBUTION OF H. ARMBRUSTER, E. KIRNER AND J. WENGEL (FRAUNHOFER ISI, GERMANY):

If and how organisational innovation is monitored on a quantitative empirical basis depends on the scientific or political interest in this kind of innovation. Many approaches settle 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 stream 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 for 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. In the following, a number of surveys are briefly described which include a very significant share of questions relating to organisational innovation in a wide scope or which (only) touch upon it but cover at least sev-

eral European countries. The list 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) taking into account further projects (like STILE) aiming at coordination and harmonisation in this area:

Overview of surveys covering organisational innovation

Survey	Institution	Countries	Sectors	Year	Sample	Content	Depth	Impact indicators
CIS	Statistical Offices, different research institutes	EU plus several OECD countries	private sector	1997 (UK) 2001 2005	> 15000	multi focus	general	objective and perseived
European Survey on Working Conditions	European Foundation	EU 15 EU 25	all	1990 1995 2000 2005		single focus on working conditions	general	none
European Restructuring Monitor	European Foundation	EU 15	private sector	continuous	ca. 2500	job reduction or creation	(newspaper, business reports)	objective
European Survey on Working Time and Work-life Balalance	European Foundation, Infratest	EU 15	all	2004	>16000	working time	general	none
Statistical Indicators Benchmarking the Information Society	EU, INRA	D, Fi, F, Gre, UK, It, Es	all (decision makers, IT responsibles)	2002	3139	IT use	general	?
Observatory of European SMEs	European Commission	EU15 plus Lie, CH, N, Ice	private sector	1992-today	7800 SMEs	multi focus	very detailed	almost none
ISI Manufacturing Survey	Fraunhofer ISI	Germany D, CH D, CH, A, UK, F, Slo, CR, Tur, It	investment goods, chem./ plastics since 2001	1995, 1997, 1999, 2001, 2003	1305 1329 1442 ca 1950 >2500	multi focus	very differentiated	perceived and objective
International Manufacturing Strategy Survey (IMSS)	IMSS consortium (mainly universities)	14 countries (>20)	mechanical engineering/assembly (ISIC 38)	92-94 96-98 2002	? ? 474 (600)	Manufacturing strategies	detailed (scales)	perceived
Employee Participation in Organisational Change	EPOC research group	Europe	all	1996	5786	single focus on participation	very differentiated	perceived
The Collaborating Firm* (DISKO module 2, OECD/ NIS project)	University of Aalborg (DRUID research group)	Denmark parallel surveys in F, A, E, It, Swe, Fi, N	manufacturing sector	1997/8	1022 (324)	single focus on collaboration in product design	very differentiated	objective
INNFORM	Oxford University et al	UK, US, NL, F, J, E, SE, CH	large, medium industry	1997	ca. 450	multi focus	very differentiated	objective (relative)
Flex-2: Change in Enterprise	Nutek	Sweden	all	1998	3360	multi focus	very differentiated	perceived and objective
Enterprises as Employers	Statistical Office	Finland	private sector	1996	2110	multi focus	very differentiated	perceived and objective

Survey	Institution	Countries	Sectors	Year	Sample	Content	Depth	Impact indicators
Flexibility in Working Life	Institute for Social Research/ Statistical Office	Norway	all	1997	2130	multi focus	very differentiated	no impact indicators
Workplaces in Sweden*	National Institute for Working Life	Sweden	all	1991/2	2135	multi focus	very differentiated	no information
IAB Establishment Panel	Institute for Employment Research ("IAB")	Germany (similar surveys in other EU countries)	all	1993 -2003	15856	multi focus	very differentiated	
The Flexible Firm* (DISKO module 1)	University of Aalborg (DRUID research group)	Denmark	private sector	1996	1900	single focus on organisational flexibility	very differentiated	objective
Workplace Employee Relation Survey	Advisory Concilation and Arbitrary Service	United Kingdom	all (except agriculture, mining)	1990-1998	2188	multi focus	partly differentiated	perceived and objective
Georgia Manufacturing Surveys	Georgia Institute of Technology	USA (Georgia)	manufacturers	1994 1996 1999 2002 2005	1700, 1002, 778, 635 >1300	multi focus	partly differentiated	objective
Organisational Changes and Computerisation	Statistical Office (SESSI), DARES	France	industry	1998 2005 (planned)	N/A	multi focus	very differentiated	almost none
Computerisation and Company Respondence to Social Change	Japan Institute of Labour	Japan	private sector	1996 ?	558	multi focus	very differentiated	no information
Survey on Personnel Policy Systems t	Japan Institute of Labour	Japan	private sector	1998 ?	N/A	Changes in corporate/ work organisation	varied	no information

Surveys in grey letters are one time activities or unlikely to be continued.

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Wengel, J. et al. 2000: Surveying Organisational Innovation on an European Level – Challenges and Options, Final report for the scientific follow-up of the Community Innovation Survey (CIS) – Project no. 8.

CONTRIBUTION OF J. BELAK (MER, SLOVENIA):

In Slovenia, one of the leading academics in the field of innovation prof. dr. M. Mulej has developed the typology of innovations twenty years ago. The author argues in his recent research (Mulej et al., 2002, p. 222) that we are still not aware of different forms (types) of innovations. Mulej defines the following types (forms) of innovations (and inventions):

A. Regarding the content of innovations (inventions) the following types of innovations can be distinguished:

Program innovations – introduction of a new product which is well accepted by the customers.

Technical and technological innovations – these innovations improve products and production processes.

Organisational innovations – introduction of new organisational forms of work and cooperation. Such innovations include: human relationships, human resources management, learning organisation, TQM etc.

Managerial innovations – introduction of improved relationships between managers and subordinates; new styles of management which encourage and activate all employees in order to make work organisation a collective resource of innovation.

Methodological innovations – introduction of new methods of management and cooperation which support managerial innovations in realization.

B. Regarding the consequences the following types of innovations can be distinguished:

Radical innovations – significant (and useful) changes in a firm.

Incremental innovations – innovation which proceed as a series of small steps. Such innovations are very important especially form psychological, sociological and psychological viewpoint since their author can be almost everyone.

C. Regarding the official duty to innovate:

Inside – among inside innovations are those which are carried out and done by people in their working place.

Outside – are innovations created by the employees in areas for which they are not directly responsible.

Each innovation (and invention) has one of the characteristics defines under A, B, and C. In practice the innovations which are characterised by the combination (1), (1), (1) are the most risky but also the most profitable.

Mulej (2003, p. 12) and Krošlin (2005, p. 95) argue that these definitions of innovations are useful when we are talking about encouraging the innovation-invention processes within the firms, but are difficult to use in empirical researches (surveys). Therefore surveys are very often concentrated on those types of innovations for which the measurements problems do not exist. This is especially true for technological product and process innovation. In different analysis are very often omitted small improvements in work procedures (which represent according to some estimates about 70% of all innovations) and other non-technological innovations (management, organisation, methods of work and coordination).

According to Mulej the organisational innovation is the introduction of new organisational forms of work and cooperation. Such innovations include: human relationships, human resources management, learning organisation, TQM etc.

According to Oslo Manual organisational innovations are defined as the introduction of significantly changed organisational structures, the implementation of advanced management techniques and the implementation of new or substantially changed corporate strategic orientations. As such this definition is broader than the one developed by Mulej.

The classification of innovation (and invention) proposed by Mulej was used in the empirical research done by Krošlin (2005). It is in detail described in the next chapter.

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CONTRIBUTION OF R. EVANGELISTA, M. PIANTA AND A. VAONA (LUNARIA, ITALY):

(1) Empirical Studies in Southern European Countries

The empirical evidence produced in the literature regarding Italy, Spain and Portugal has been relatively scattered, differing for methodologies, sectoral coverage, sample sizes and approaches. We will first overview the contributions regarding Italy, then those regarding Spain and finally those concerning Portugal. A summary of the findings is shown in the Table attached.

As far as Italy is concerned, most of the attention has focused on organisational innovation and human resources management. Guidetti and Tortia (2003) focused on Emilia Romagna directly highlighting the connections between firm size and organisational change, comparing firms with a task centred human resources management with those based on job rotation and team working. They found that in the second case new hires tend to be trained within the firm on flexible task assignments, vacant jobs tend to be covered by internal horizontal and vertical mobility, the career advancement of skilled workers is based not only on their characteristics but also on pre-constituted paths, multipurpose training is more likely than the on-the-job one and, finally, flatter hierarchical structures are more widespread.

Colombo and Delmastro (2003) estimated the effect on firm profitability of "high performance" human relations management practices–such as total quality management, formal team working, job rotation and employee involvement programs–and a leaner organisational structure, defined as a reduced number of hierarchical layers and more decentralisation in decision making. They performed both static and dynamic econometrics estimations on a longitudinal dataset of 109 single-plant manufacturing firms observed during 7 years, finding a positive impact of organisational innovation on economic performance.

Antonioli et al. (2003) performed a wide study on organisational innovation in 199 firms based in the Reggio Emilia province in the years 1998-2001 and on its connection to human resources,

focusing on both the presence of "best organisational practices" inside firms–that is total quality management, job rotation, team work, quality circles and just in time–and the introduction of other innovations implying a greater involvement of employees into decision making. Their results are that decisional decentralisation intervenes at a slow pace, though the 67.3% of the total number of firms have at least one of the five "best organisational practices" listed above. They divided the other innovations mentioned above into innovations of products, services, processes, remuneration systems and work organisations, finding that most of the firms introduced changes in the first three and in work organisations. What is more, most of the organisational innovations were proposed by the management.

A further aspect where organisational innovation can affect the relation between labour and management is the system of worker evaluations and rewards which is constituted by: (a) formal evaluation of workers; (b) individual bonuses and incentives; (c) flexible wages negotiated with worker representatives. All of them were present in most of firms, highlighting a complex process for wage determination. Their major econometric results are that innovation is hampered by complex hierarchies while it is fostered by collaborative industrial relations. Furthermore, "firms with rigid labour utilisations in work organisations tend to compensate it with a larger use of flexibility in employment contracts and a higher intensity of organisational innovations".

Differently from the previous studies, Russo and Pirani (2003) tried to understand how important are traditional indicators, such as R&D expenditure, to grasp the innovation activities of Small and Medium Enterprises grouped in districts. They analysed a panel of 331 firms of the metal-engineering sector in the Italian region of Emilia Romagna classifying them according to five dimensions: product type, technology, relationships with customers, with competitors and with suppliers. It is worth stressing that Emilia Romagna is one of the Italian regions dynamically emerging during the transition from Fordism to Post-Fordism and therefore reputedly at the forefront of organisational innovation in Italy. Their findings point to the limited role of R&D investments as compared to other forms of innovation activities especially in the case of Small and Medium Enterprises. In fact, small firms tend to have a disappointing performance according to the indicator above, even though they focus on the production process making use of sophisticated technologies and outsourcing all the accounting and administrative parts of their business to local trade associations.

Finally, Piva, Santarelli and Vivarelli (2003) analysed the skill effect of organisational change. They considered a dataset of 412 Italian firms with no fewer than 11 employees. The database comprises the replies to three questionnaire waves administered by the investment bank Mediocredito Centrale (MCC) in 1991, 1994 and 1997, with each questionnaire collecting retrospective data for three years. Controlling for sectoral and firm-size specificities together with the effect of take-overs or brake-ups during the period of observation, they obtained econometric estimates pointing to the fact that upskilling depends more closely on reorganisational strategies than on technological change. However, these two types of strategies have been found to be complementary in nature. In particular a superadditive effect was found: a stronger effect of the joint presence of organisational change and R&D with respect to organisational innovation only.

Moving from Italy to Spain, but sticking to the effect of organisational change on the occupational structure, Aguirregabiria and Alonso-Borrego (2001) analysed a panel of 1080 Spanish firms for the period 1986 – 1991. Their data include the number of permanent workers – distinguishing between managers, professionals, commercials, clerical workers and blue collars – temporary workers, physical capital, investment on R&D and purchases of new technological equipment generated outside the firm. Their findings point to a strong persistence of demand for labour inputs and to a strong effect of the adoption of new technological capital on the occupational structure, favouring for instance commercials over blue collars. This points to the fact that changes in the occupational structure go hand in hand with qualitative changes in the organisation of production.

With difference to Aguirregabiria and Alonso-Borrego (2001) that performed mainly an econometric exercise, Medina, Lavado and Cabrera (2004) adopted a case study approach selecting four innovative firms belonging to the Andalusian Innovation Network: CANLA (manufacturer of citrus derivatives and other agricultural products), MP (manufacturers of elevators), ACISA (dedicated to the manufacture, installation and conservation of urban and inter-urban, signalling and traffic control lighting, lighting systems, beacons and guidance for airports and heliports, presence and access control systems, etc.) and ISOFOTON (manufacturer of photoelectric and thermal energy panels). Three of these may be considered to be small or medium-sized companies. Their results mainly concern organisational strategies and point to the importance of customer tailored production, to the widespread use of subcontracting for specific activities, some resorting to temporary or short-term contracts. The structure of the firms was not very hierarchical, although this could be explained by their dimension. Communication processes were found to be informal in all cases thus facilitating speed in decision making.

Let us move now to consider empirical studies concerning Portugal. Winther (2003) has analysed the development of the industrial district of Marinha Grande, specialised in mould production, focusing especially on networks of firms. He found support for the view stressing the restructuring of European local production systems leading towards more hierarchisation among local firms and the emergence of formalised networks and economic concentration, that challenge the historical organisation and institutions of the industrial districts in which small was beautiful.

Godinho and Mamede (2000) targets the issue of the organisation of the innovative process and the question if innovative firms are substantially different in a catching up economy, like Portugal, with respect to a developed economy, like the UK and the US. They found that firms tend to acquire innovation from outside more than develop them indoor, they tend more to react to external developments than strategically attempting to shape their environment, there are scanty interactions with a large array of external providers of inputs to the innovation process but that of buying innovation. However, there are two major exception to this last general features, the textiles, clothing, leather and footwear industries that have experienced a remarkable export performance (as it is possible to expect for a catching up economy), and the industries of machinery and equipment and of chemicals. However, Laranja (1997) pointed also out that this lack of interaction between local firms and Science and Technology Institutions within a catching up economy may not be of an organisational nature, rather of policy one. In other terms, there has been a mismatch between the technological policies implemented and the Portuguese economic structure that was not ready for take advantage of measures mainly concerned with fostering R&D spending. More suitable interventions would have been technical information dissemination, referral information services and consultancy.

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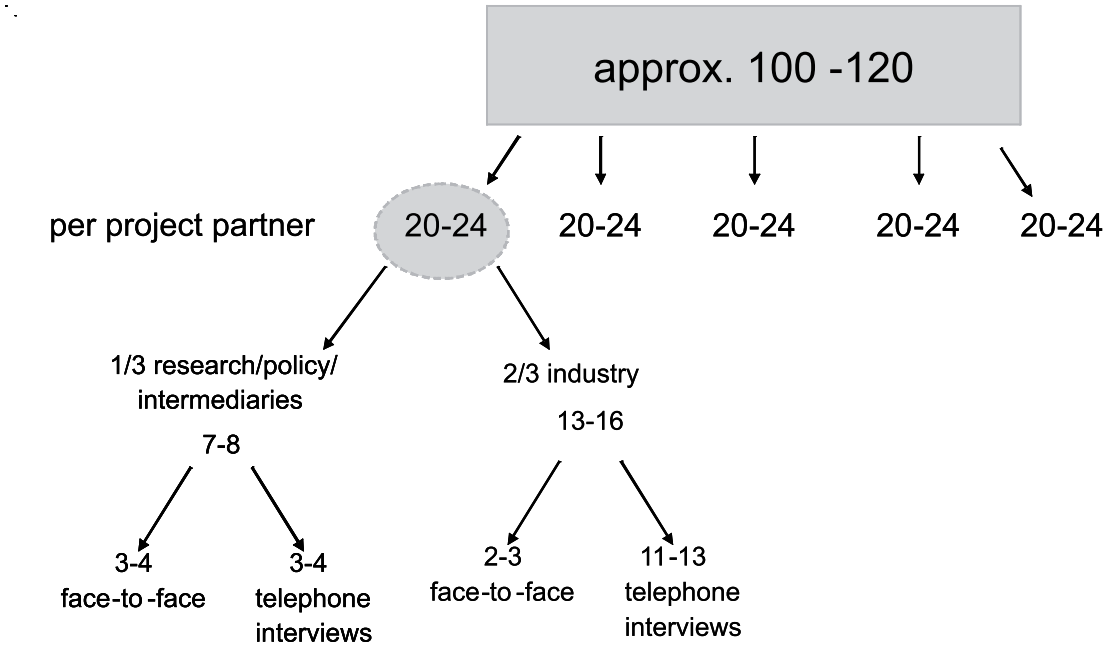
11 Appendix 3: Further details on stakeholder interviews

11.1 Distribution between face-to-face and telephone interviews



11.2 Interview partners

Number	Sector afiliation	Type of institution	Country	Type of interview	Responsible partner
1	Aerospace	Industry	UK	Telephone	Cranfield
2	Aerospace	Industry	UK	Telephone	Cranfield
3	Aerospace	Industry	UK	Telephone	Cranfield
4	Aerospace	Industry	UK	Telephone	Cranfield
5	Aerospace	Industry	UK	Telephone	Cranfield
6	Aerospace	Industry	France	Telephone	CREII
7	Aerospace	Industry	Germany	Telephone	ISI
8	Aerospace	Industry	Italy	Face-to-face	Lunaria
9	Aerospace	Research	Germany	Face-to-face	ISI
10	Aerospace	Research (Intermediate)	UK	Face-to-face	Cranfield
11	Automotive	Industry	UK	Telephone	Cranfield
12	Automotive	Industry	France	Telephone	CREII
13	Automotive	Industry	France	Telephone	CREII
14	Automotive	Industry	France	Telephone	CREII
15	Automotive	Industry	France	Telephone	CREII
16	Automotive	Industry	France	Face-to-face	CREII
17	Automotive	Industry	France	Telephone	CREII
18	Automotive	Industry	France	Telephone	CREII
19	Automotive	Industry	France	Telephone	CREII
20	Automotive	Industry	Germany	Telephone	ISI
21	Automotive	Industry	Italy	Telephone	Lunaria
22	Automotive	Industry	Slovenia	Face-to-face	MER
23	Automotive	Research (University)	Italy	Telephone	Lunaria
24	Automotive	Research (Intermediate)	Germany	Telephone	ISI
25	Automotive	Research (University)	Germany	Face-to-face	ISI
26	Automotive	Research	Germany	Telephone	ISI
27	Automotive	Research	France	Telephone	CREII
28	Automotive	Research (University)	France	Face-to-face	CREII
29	Biotechnology	Industry	UK	Telephone	Cranfield
30	Biotechnology	Industry	UK	Telephone	Cranfield
31	Biotechnology	Industry	France	Telephone	CREII
32	Biotechnology	Industry	France	Telephone	CREII
33	Biotechnology	Industry	France	Telephone	CREII
34	Biotechnology	Industry	France	Telephone	CREII
35	Biotechnology	Industry	Germany	Telephone	ISI
36	Biotechnology	Research	Spain	Telephone	Lunaria

Number	Sector afiliation	Type of institution	Country	Type of interview	Responsible partner
37	Biotechnology	Research	France	Telephone	CREII
38	Chemical	Industry	UK	Telephone	Cranfield
39	Chemical	Industry	France	Telephone	CREII
40	Chemical	Industry	Germany	Telephone	ISI
41	Chemical	Industry	Germany	Telephone	ISI
42	Chemical	Industry	Germany	Telephone	ISI
43	Chemical	Industry	Italy	Face-to-face	Lunaria
44	Chemical	Industry	Slovenia	Telephone	MER
45	Electronics	Industry	UK	Telephone	Cranfield
46	Electronics	Industry	France	Telephone	CREII
47	Electronics	Industry	Germany	Telephone	ISI
48	Electronics	Industry	Italy	Telephone	Luniaria
49	Electronics	Industry	Italy	Telephone	MER
50	Electronics	Industry	Slovenia	Face-to-face	MER
51	Electronics	Industry	Slovenia	Face-to-face	MER
52	Electronics	Research (University)	Ireland	Telephone	Cranfield
53	Electronics	Research (University)	UK	Face-to-face	Cranfield
54	Electronics	Research (University)	UK	Face-to-face	Cranfield
55	Electronics	Research	Germany	Face-to-face	ISI
56	Electronics	Research (Intermediate)	UK	Telephone	Cranfield
57	Electronics	Research	France	Telephone	CREII
58	Food	Industry	UK	Telephone	Cranfield
59	Food	Industry	France	Face-to-face	CREII
60	Food	Industry	Italy	Telephone	Lunaria
61	Food	Industry	Italy	Telephone	Lunaria
62	Food	Industry	Italy	Face-to-face	Lunaria
63	Food	Industry	Italy	Face-to-face	Lunaria
64	Food	Industry	Slovenia	Face-to-face	MER
65	Food	Research (University)	Italy	Face-to-face	Lunaria
66	Food	Research (University)	Czech Republic	Telephone	MER
67	Machinery	Industry	UK	Telephone	Cranfield
68	Machinery	Industry	France	Telephone	CREII
69	Machinery	Industry	Germany	Telephone	ISI
70	Machinery	Industry	Germany	Face-to-face	ISI
71	Machinery	Industry	Germany	Telephone	ISI
72	Machinery	Industry	Germany	Telephone	ISI
73	Machinery	Industry	Italy	Face-to-face	Lunaria
74	Machinery	Industry	Slovenia	Telephone	MER

Number	Sector afiliation	Type of institution	Country	Type of interview	Responsible partner
75	Machinery	Research	Italy	Face-to-face	Lunaria
76	Machinery	Research (University)	Italy	Face-to-face	Lunaria
77	Machinery	Research (University)	Italy	Telephone	Lunaria
78	Machinery	Research (University)	Germany	Telephone	ISI
79	Machinery	Research (University)	Bulgaria	Telephone	ISI
80	Machinery	Research (University)	Croatia	Telephone	MER
81	Machinery	Research (University)	Sweden	Telephone	Cranfield
82	Medical Devices	Industry	UK	Telephone	Cranfield
83	Medical Devices	Industry	UK	Telephone	Cranfield
84	Medical Devices	Industry	UK	Telephone	Cranfield
85	Medical Devices	Industry	UK	Telephone	Cranfield
86	Medical Devices	Industry	UK	Telephone	Cranfield
87	Medical Devices	Industry	France	Telephone	CREII
88	Medical Devices	Industry	Germany	Telephone	ISI
89	Medical Devices	Industry	Slovenia	Face-to-face	MER
90	Medical Devices	Research (University)	UK	Face-to-face	Cranfield
91	Textile	Industry	UK	Telephone	Cranfield
92	Textile	Industry	France	Telephone	CREII
93	Textile	Industry	Germany	Telephone	ISI
94	Textile	Industry	Italy	Face-to-face	Lunaria
95	Textile	Industry	Italy	Telephone	Lunaria
96	Textile	Industry	Italy	Face-to-face	Lunaria
97	Textile	Industry	Italy	Face-to-face	Lunaria
98	Textile	Industry	Italy	Face-to-face	Lunaria
99	Textile	Research (University)	Italy	Telephone	Lunaria
100	Textile	Research (University)	Poland	Face-to-face	ISI

11.3 Guidelines for industry interviews

Remarks to the interviewer for the industry interviews

Please read these remarks carefully:

(1) **Conducting sector-specific interviews:** Please remember that these interviews aim to identify the importance of organisational innovations in different industry sectors. Thus, you conduct interviews with industry representatives of a certain sector, and therefore please make sure that representatives always answer the questions for their industry sector. For instance, if you interview a manager in the automotive industry, then make sure that all answers are given for the automotive industry only.

(2) **Reporting of the interviews:** This is a guideline for the interviews. Please make sure that you take your own notepad with you in order to write down as much as possible during the interview. Please report the answers as soon as possible after the interview using the template at the end of this document.

(3) **Comments supporting the interviewer:** Please find comments in italic for the interviewer after every question.

Guidelines for industry interviews

Name of interview partner: . . . . . .

Institution of interview partner: . . . . . .

Sectoral coverage of interview partner: . . . . . .

Name of interviewer: . . . . . .

Date and place: . . . . . .

Section 1: Introduction *(This part aims to explain the scope of the interview to the interviewee. Please give definition of organisational innovations to the interviewee and stress the fact that they should give answers for their industry sector.)*

- We conduct this interview in the frame of a project for the **European Commission.** The aim is to further develop the concept of **organisational innovation and change**, particularly to assess the **importance of organisational innovations across different industry sectors.**
- In the following short interview (about 30 minutes), we would like to ask you a few questions on **organisational innovations and change**.
- We understand organisational innovation as a **separate form of innovation**, besides product, process and service innovation *(please show figure 1 whilst carrying out face-to-face interviews and explain figure 1 in telephone interviews).*
- While product innovations mean the development of new products or services, there are also new processes, which contribute to the innovativeness of a company. Such processes can be either technical or non-technical. Organisational innovations refer to **non-technical** innovations.
- Thus, we define organisational innovations as the implementation of **changes** in **business practices** that improve innovation capacity and business performance within a company.
- All questions are related to organisational innovations and their impact within companies. Please give answers always with regard to the **industry sector** you are working in.

Section 2: Questions for face-to-face and telephone interviews

1. How important is organisational innovation compared to product, technical process and service innovation in your company? Please rank these four innovation types from 1 (most important) to 4 (least important).
(This question aims at assessing how important and relevant organisational innovations are for the companies in comparison to product, technical process and service innovations.)

- Product innovation: Rank No.__
- Process innovation: Rank No.__
- Organisational innovation: Rank No.__
- Service innovation: Rank No.__

1.1 Do you consider your answer as typical for your industry sector or is it specific for your company only?
(This question aims at understanding whether the importance and relevance is only true for a single company or for its whole industry sector.)

2. In the following, we will name several organisational innovations which might be important in your industry sector. Please assess for every organisational innovation the impact on quality (product and process quality), flexibility (product, lead time and batch size flexibility), costs (personal and capital costs) and innovation ability (product and process innovation) in your industry sector.
(The interviewer has to make sure that the interviewee understands the terms quality, flexibility, costs and innovation ability. Please give examples for these terms as they are provided in brackets. The interviewer has to start with the question whether one organisational innovation is relevant in the industry sector and if, yes, the interviewer continues with the impact questions. It is absolutely important to remind the interviewee that s/he has to answer the questions for the industry sector s/he is working in.)

	Relevance		Impact on increased quality				Impact on increased flexibility				Impact on reduction of costs				Impact on increased innovation ability			
	yes	no	low	moderate	strong	don't know	low	moderate	strong	don't know	low	moderate	strong	don't know	low	moderate	strong	don't know
(1) Decentralisation on a strategic level of the company																		
Decentralisation of functions into customer or product-line oriented departments	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Decentralisation of formerly centralised functions (e.g. personnel, service, administration, etc.)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
(2) Decentralisation on an operative level of the company																		
Team work/Group work	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Cross-functional teams (teams consisting of members from different functions)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

	Relevance		Impact on increased quality				Impact on increased flexibility					Impact on reduction of costs				Impact on increased innovation ability			
	yes	no	low	moderate	strong	don't know	low		moderate	strong	don't know	low	moderate	strong	don't know	low	moderate	strong	don't know
(3) Cooperation with other Companies (e.g. alliances, networks, partnerships)																			
Cooperation in production	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Cooperation in R&D	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Cooperation in administrative activities (IT, service, personnel, marketing, procurement, purchase)	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
(4) Outsourcing/Relocation																			
Outsourcing/Relocation of production	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Outsourcing/Relocation of R&D	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Outsourcing/Relocation of administrative activities (IT, service, personnel, marketing, procurement, purchase)	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

	Relevance		Impact on increased quality				Impact on increased flexibility					Impact on reduction of costs				Impact on increased innovation ability			
	yes	no	low	moderate	strong	don't know	low	low	moderate	strong	don't know	low	moderate	strong	don't know	low	moderate	strong	don't know
(5) Quality Management																			
Continuous Improvement Processes (CIP)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Total Quality Management (TQM/ISO)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
(6) Human Resources Management																			
Flexibility of work schedules/flexible work time	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Upskilling (Job enlargement, Job enrichment, empowerment)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Regular individual appraisals	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Performance based wage systems	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

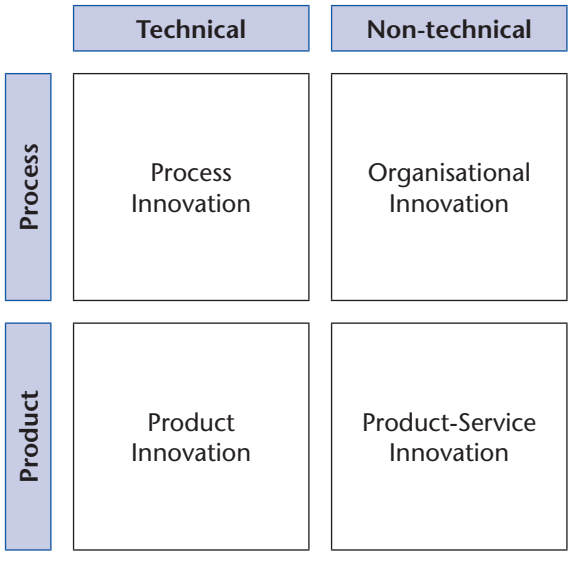
	Relevance		Impact on increased quality				Impact on increased flexibility					Impact on reduction of costs				Impact on increased innovation ability			
	yes	no	low	moderate	strong	don't know	low		moderate	strong	don't know	low	moderate	strong	don't know	low	moderate	strong	don't know
(7) Knowledge Management																			
Systematic instruments to strengthen knowledge sharing between employees (e.g. communities of practice, knowledge sharing platforms, yellow pages, etc.)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
(8) Production Management																			
Just-in-time	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Zero-Buffer	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Simultaneous Engineering	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Supply Chain Management	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
(9) …																			
	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

3. Besides the organisational innovations named above, which other organisational innovations can you think of? Have you introduced any other organisational innovation within your company over the last years?

If yes, which was the reason for the implementation and what experiences have you made (problems, impact etc.)?
(This is an open question. It seeks to identify new organisational innovations we have not thought of so far. Ask about problems experienced, success factors and what the impact has been. In order to estimate the impact of the named organisational innovations, please use the above table.)

Thank you very much for the interview!

Figure 1: Four fields of innovation



Template for the documentation of stakeholder interviews (2-3 pages)

1. Introduction: Characteristics of the interview partner: institutional/industrial background, sector(s) addressed

…..

2. Importance of organisational innovations compared to product, technical process and service innovation

…..

3. Assessment of organisational innovations (relevance and impact) (please include the table)

…..

4. Other organisational innovations, not mentioned in the questionnaire

…..

11.4 Guidelines for research interviews

Remarks to the interviewer for the research, intermediaries and policy interviews

Please read these remarks carefully:

(1) **Conducting sector-specific interviews:** Please remember that these interviews aim to identify the importance of organisational innovations in different industry sectors. Thus, you conduct interviews with industry representatives of a certain sector, and therefore please make sure that representatives always answer the questions for their industry sector. For instance, if you interview a manager in the automotive industry, then make sure that all answers are given for the automotive industry only.

(2) **Reporting of the interviews:** This is a guideline for the interviews. Please make sure that you take your own notepad with you in order to write down as much as possible during the interview. Please report the answers as soon as possible after the interview using the template at the end of this document.

(3) **Comments supporting the interviewer:** Please find comments in italic for the interviewer after every question.

Guidelines for research, intermediaries and policy interviews

Name of interview partner: . . . . . .

Institution of interview partner: . . . . . .

Sectoral coverage of interview partner: . . . . . .

Name of interviewer: . . . . . .

Date and place: . . . . . .

Section 1: Introduction *(This part aims to explain the scope of the interview to the interviewee. Please give definition of organisational innovations to the interviewee and stress the fact that they should give answers for their industry sector.)*

- We conduct this interview in the frame of a project for the **European Commission.** The aim is to further develop the concept of **organisational innovation and change**, particularly to assess the **importance of organisational innovations across different industry sectors.**
- In the following short interview (about 30 minutes), we would like to ask you a few questions on **organisational innovations and change**.
- We understand organisational innovation as a **separate form of innovation**, besides product, process and service innovation *(please show figure 1 whilst carrying out face-to-face interviews and explain figure 1 in telephone interviews).*
- While product innovations are the development of new products or services, there are also new processes, which contribute to the innovativeness of a company. Such processes can be either technical or non-technical. Organisational innovations refer to **non-technical** innovations.
- Thus, we define organisational innovations as the implementation of **changes** in **business practices** that improve innovation capacity and performance within a company.
- All questions are related to organisational innovations and their impact within companies. Please always give your answers with regard to the **industry sector** you are familiar with.

Section 2: Questions for face-to-face and telephone interviews

1. **Which industry sectors are you familiar with? For which industry sectors have you the knowledge to assess innovative organisational concepts?** *(Please note that if the interviewee is familiar with more than one sector, then you will have to ask each question separately for each industry sector in comparison to product, technical process and service innovations.)*

2. **How important is organisational innovation compared to product, technical-process and service innovation in the industry sector that you are familiar with? Please rank these four innovation types from 1 (most important) to 4 (least important).**
   (This question aims at assessing how important and relevant organisational nnovations are for certain industry sectors in comparison to product, technical process and service innovations.)

   - Product innovation: Rank No.__
   - Process innovation: Rank No.__
   - Organisational innovation: Rank No.__
   - Service innovation: Rank No.__

3. **In the following, we will name several organisational innovations which might be important in the industry sector you are familiar with. Please assess for every organisational innovation the impact on quality (product and process quality), flexibility (product, lead time and batch size flexibility), costs (personal and capital costs) and innovation ability (product and process innovation) in your industry sector.**
   (The interviewer has to make sure that the interviewee understands the terms quality, flexibility, costs and innovation ability. Please give examples for these terms as they are provided in brackets. The interviewer has to start with the question whether one organisational innovation is relevant in the industry sector and if, yes, the interviewer continues with the impact questions. ***It is very important to remind the interviewee that s/he has to answer the questions for the industry sector s/he is familiar with.)***

	Relevance		Impact on increased quality				Impact on increased flexibility				Impact on reduction of costs				Impact on increased innovation ability			
	yes	no	low	moderate	strong	don't know	low	moderate	strong	don't know	low	moderate	strong	don't know	low	moderate	strong	don't know
(1) Decentralisation on a strategic level of the company																		
Decentralisation of functions into customer or product-line oriented departments	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Decentralisation of formerly centralised functions (e.g. personnel, service, administration, etc.)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
(2) Decentralisation on an operative level of the company																		
Team work/Group work	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Cross-functional teams (teams consisting of members from different functions)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

	Relevance		Impact on increased quality				Impact on increased flexibility					Impact on reduction of costs				Impact on increased innovation ability			
	yes	no	low	moderate	strong	don't know	low		moderate	strong	don't know	low	moderate	strong	don't know	low	moderate	strong	don't know
(3) Cooperation with other Companies (e.g. alliances, networks, partnerships)																			
Cooperation in production	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Cooperation in R&D	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Cooperation in administrative activities (IT, service, personnel, marketing, procurement, purchase)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
(4) Outsourcing/Relocation																			
Outsourcing/Relocation of production	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Outsourcing/Relocation of R&D	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Outsourcing/Relocation of administrative activities (IT, service, personnel, marketing, procurement, purchase)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

	Relevance		Impact on increased quality				Impact on increased flexibility					Impact on reduction of costs				Impact on increased innovation ability			
	yes	no	low	moderate	strong	don't know	low		moderate	strong	don't know	low	moderate	strong	don't know	low	moderate	strong	don't know
(5) Quality Management																			
Continuous Improvement Processes (CIP)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Total Quality Management (TQM/ISO)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
(6) Human Resources Management																			
Flexibility of work schedules/flexible work time	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Upskilling (Job enlargement, Job enrichment, empowerment)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Regular individual appraisals	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Performance based wage systems	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

	Relevance		Impact on increased quality				Impact on increased flexibility					Impact on reduction of costs				Impact on increased innovation ability			
	yes	no	low	moderate	strong	don't know	low		moderate	strong	don't know	low	moderate	strong	don't know	low	moderate	strong	don't know
(7) Knowledge Management																			
Systematic instruments to strengthen knowledge sharing between employees (e.g. communities of practice, knowledge sharing platforms, yellow pages, etc.)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
(8) Production Management																			
Just-in-time	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Zero-Buffer	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Simultaneous Engineering	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Supply Chain Management	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
(9) …																			
	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

4. **Besides the organisational innovations named above, what other organisational innovations can you think of and what are their impacts?**
   (This is an open question. It seeks to identify new organisational innovations we have not thought of so far. In order to estimate the impact of the named organisational innovations, please use the above table.)

Section 3: Questions only for face-to-face interviews

5. **Do you have any recommendations on how to measure and survey organisational innovation?**

   For instance: Who within a company can be interviewed in order to obtain more insights into organisational innovation?

   For instance: How should organisational innovations be asked? For labels, such as "team work", "simultaneous engineering", etc.?

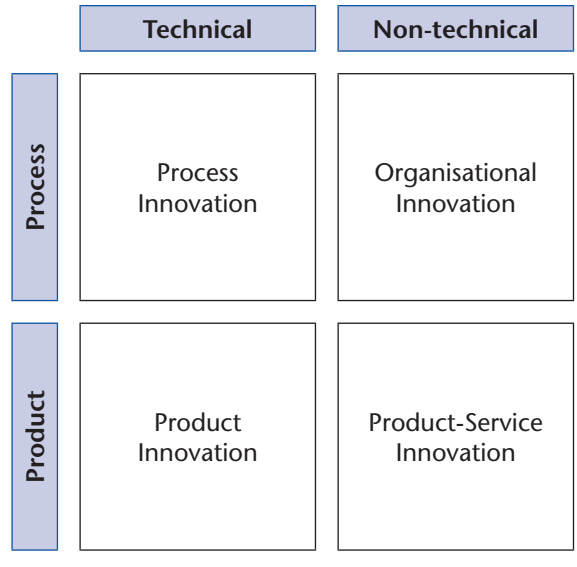
   For instance: Is it important to measure the change of organisational concepts and their novelty (whether an organisational innovation has been implemented within the last three years) or is it more important to find out if a company has implemented an organisational innovation at all (question with yes and no)?

6. **Do you have any additional ideas on further output indicators for organisational innovation besides quality, flexibility, costs and innovation ability? How could the effect of organisational change be measured better?**

   For instance: Extent of use of existing skills of work force, product diversity management, etc.

Thank you very much for the interview!

Figure 1: Four fields of innovation



Template for the documentation of stakeholder interviews (2-3 pages)

1. Introduction: Characteristics of the interview partner: institutional/industrial background, sector(s) addressed

…..

2. Importance of organisational innovations compared to product, technical process and service innovation

…..

3. Assessment of organisational innovations (relevance and impact) (please include the table)

…..

4. Other organisational innovations, not mentioned in the questionnaire

…..

5. Recommendations for measuring organisational innovation

…..

11.5 Definitions of organisational innovations

Decentralisation on a strategic level

Decentralisation is any of various means of more widely distributing decision-making to bring it closer to the point of service or action. Organisations often seek to decentralise when they feel that their systems and processes are becoming too slow because too much decision making, even on small matters, is being referred to the centre.

One might distinguish between decentralisation of functions into customer or product-line oriented departments where the organisation is no more organised along the functions (HR, finance, production, etc.) but along products or customers (e.g. chemical, pharmaceutical, plastics or private customers, business customers etc.).

A further from of decentralisation is to decentralise formerly centralised functions (HR, finance, service, etc.). This might imply that former corporate HR or service are relocated to the different divisions respectively customer or product-line oriented departments or business units.

Team work / Group work

By group work we understand an enduring cooperation of two or more employees accomplishing their regular daily work tasks. They are interdependently linked to the achievement of mutually agreed goals.

Cross-functional teams

A term used to describe the use of individuals from different parts (functions, departments) of the organisation to develop solutions to process related problems that affect the institution as a

system. For instance, product development teams are usually cross-functional teams bringing together employees from different parts of the organisation in order to achieve higher creativity and to better cope with highly complex tasks.

Cooperation of production, R&D or administrative activities

A cooperation is an association of legally independent but mostly economically dependent companies in order to achieve a common, usually economic, benefit. Cooperation between companies might take place in the field of production, research and development or for administrative tasks such as services, marketing, or procurement.

Outsourcing/ relocation of production, R&D or administrative activities

Relocation/outsourcing is the process of moving parts of the company to a different physical location of the own company (relocation, e.g. moving production plants to a country with a lower wage level to save costs) or to an external entity (outsourcing, e.g. delegation of non-core operations to external companies that have specialised in these operations). Outsourcing and relocation might take place in the field of production, research and development as well as for administrative tasks (service, IT etc.).

Continuous Improvement Processes (CIP)

Continuous improvement process (CIP) is a management concept which tries to initiate favourable changes in companies by taking incremental, but continuous steps and avoiding quantum leaps. This concept was popularised in Japan where it is known as "Kaizen" and has been translated to "continuous improvement" in Western countries. The main focus of CIP is the improvement of product and process quality in order to gain long-term competitive advantages. The involvement of employees and their encouragement to participate are key elements of CIP. Employees and particularly teams of employees are asked to actively make suggestions in order to improve business processes and product quality. Initially CIP had only been covering production processes but meanwhile may comprise all business processes of a company.

Total Quality Management (TQM/ISO)

Total quality management is a set of systematic activities carried out by the entire organisation to effectively and efficiently achieve company objectives so as to provide products and services with a level of quality that satisfies customers, at the appropriate time and price.

Flexibility of work schedules/flexible work time

Various models exist of how to let employees take part in the decision process of when to work (shifts / hours) and create a flexible and changeable schedule. These models aim to absorb times of work over- and under-load with more flexible working hours. Flexible working hours comprise a higher autonomy for accomplishing the tasks and are usually based on a trusty relationship between employer and employee.

Upskilling

Improving skills e.g. by further training, broadening of competencies, giving more responsibilities to employees (job enlargement, job enrichment, empowerment).

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 appraisal presents an opportunity to give feedback on work content and work load as well as to review on what has been achieved during the reporting period and to agree on objectives for the following one.

Performance-based wage systems

These wage systems are entirely or partly based on either the performance of the individual, the department, the business unit or the entire organisation. A higher performance is linked to higher wage.

Knowledge Management

Knowledge management is concerned with strategy, process and instruments to acquire, store, share and secure organisational and individual knowledge, common understandings, insights and core distinctions.

Just-in-time

Just-in-time is a strategy for inventory management in which raw materials and components are delivered from the vendor or supplier immediately before they are needed in the manufacturing process. Just-in-time concepts reduce in-process inventory and its associated costs and therefore increase company's return on investment.

Zero-buffer

The aim of zero-buffer is to eliminate all buffers during the production process within the company, saving space, time and money. Each step in the production process is completed by the time the subsequent process has to start in order to finish production at a certain point of time.

Simultaneous Engineering

Simultaneous Engineering is a way of simultaneously designing products, and the processes for manufacturing those products, through the use of cross-functional teams to assure manufacturability and to reduce cycle time.

Supply Chain Management

The coordinated 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.

12 Appendix 4: Results of stakeholder interviews per sector

The importance of every organisational innovation has been measured in the following way: 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, medium or high impact. In the figures in the nine different sectoral analyses below this is reflected in 1 for low, 2 for moderate and 3 for high. In the case of no relevance of the organisational innovation the value is zero, indicating that there is no impact on the four dimensions.

The sectoral figures show for each of the four output dimensions quality, flexibility, costs and innovation ability the average impact assessment of experts in terms of the 21 different organisational innovations. The fifth chart shows the overall ranking of importance of 21 organisational innovations in the respective sector. This overall importance is measured by the average impact the organisational innovation has on all the four output dimensions. The aim of this analysis structure is to distinguish between the different aims of organisational innovations. Since the various types of organisational innovations do probably not aim at the same goal, they have different effects on outputs like quality, flexibility, costs or innovation ability. These different targets of organisational innovations can be differentiated by an analysis of relevance according to the different output dimensions. To conclude, overall results of the importance of different organisational innovation on the one hand across different sectors, on the other hand across different output dimensions will be presented.

12.1 Aerospace

WRITTEN BY M. SZWEJCZEWSKI (CRANFIELD SCHOOL OF MANAGEMENT)

For the aerospace industry, 10 stakeholder interviews have been conducted, thereof 8 interviews with industry representatives and 2 interviews with research representatives. The interviews have been conducted with employees of aerospace companies in Germany, France, Italy, and in the UK.

12.1.1 Desk research

The aerospace industry serves two large markets – civil and military – each of which has been experiencing problems in recent years. Civil is the larger of the two sectors (by turnover), but it is currently experiencing its worst downturn in decades. While, defence has faced the twin pressures of reduced defence spending (following the end of the cold war) and tougher procurement regimes (Smith and Tranfield, 2005). Procurement changes have come about because of concern about cost overruns. The traditional 'cost plus' approach (i.e. cost plus a profit margin) has been replaced by a regime of competitive tendering and fixed price contracts. However, there are still some major military development projects underway, for example the F-35 Joint Striker Fighter (JSF). The industry is dependent on heavy research and development expenditure (in the UK alone it accounts for 9.5% of the UK's total research and development activity).

The last decade has also seen the aerospace industry (both defence and civil) go through a period of mergers and acquisitions. These changes have also had an impact on the supplier base, as the prime contractors (e.g. Aerospatiale, and British Aerospace) have sought to improve their competitiveness by making their supply chains more efficient (Smith and Tranfield, 2005). The trend has been for the prime contractors to reduce the size of their supply chain and to introduce long-term agreements with their suppliers. The role of suppliers has changed; there has been a significant transfer of functions from the prime contractor to suppliers. This has been most apparent at the first tier level. The companies at this level are now expected to manage the supply base for the prime contractor and to initiate improvements in their manufacturing operations. The emphasis has moved towards creating partnerships and collaborating more with suppliers and ensuring greater early involvement of suppliers in new projects.

Consolidation in the industry has also been necessary due to the huge sums now required to research and develop new products, this means that smaller companies can no longer develop major weapons systems on their own (Keynote, 2003).

In the area of satellite manufacturing, for many years European nations have been using a collaborative development approach on major projects undertaken by the European Space Agency (ESA). In a bid to improve the way new products are developed the aerospace industry has taken a leading role in the implementation of concurrent engineering (also known as simultaneous engineering). The drive to achieve increased concurrency and to allow manufacturing-related issues to be dealt with during the early design phase has led industry to apply rapid prototyping to improve the product introduction process. The ultimate development of rapid prototyping, in terms of speed, cost and flexibility, is virtual prototyping – the use of a 3D computer model of the product to explore engineering manufacturing and ergonomic performance of a product prior to actual physical construction. By implementing this system British Aerospace has been able to introduce the use of radical concurrent engineering, which has brought down the cost and lead times for product introduction and allowed 'right-first-time manufacture' (Bennett, 1997).

The aerospace sector has recognised the opportunity to eliminate waste within its value streams and so a lean manufacturing revolution has been underway in the sector for several years now. The adoption of lean manufacturing started among the aerospace, avionics and engine manufacturers and it has recently been embraced by the airframe manufacturers (Crute et al, 2003). As part of the process of adopting lean manufacturing, various companies have implemented continuous improvement processes.

There is evidence of supply chain learning (the sharing of learning between firms in the chain) taking place within the aerospace industry (Bessant et al, 2003). The benefits to the prime contractor (and the 1st tier suppliers) have been that quality and delivery time of materials have been improved leading to cost savings throughout the supply chain and the added benefits of relationships between participating companies having been enhanced.

An area that is of growing importance in the aerospace industry is aircraft maintenance, repair and overhaul (MRO). Time to delivery and higher standards of service have become business imperatives in aerospace maintenance. A lower quality of service is unacceptable as it compromises the safety of air travel. In addition to better quality and competitive maintenance costs, airline customers also desire efficient service – the repair turnaround (defined as the duration taken to repair or overhaul aircraft components and return them as useable to the customer). To this end, the application of TQM principles could prove useful (Goh and Lim, 1996).

12.1.2 Impact of organisational innovations on output dimensions

The experts (in research and industry) were asked to assess the intensity of impact (low, moderate and strong) of 21 organisational innovations on quality, flexibility, cost and innovative ability. The organisational innovations cover the following areas: decentralisation at the strategic level, decentralisation at the operative level, cooperation with other companies, outsourcing and relocation, quality management, human resource management, knowledge management, and production management. Let us now examine the impact of each innovation.

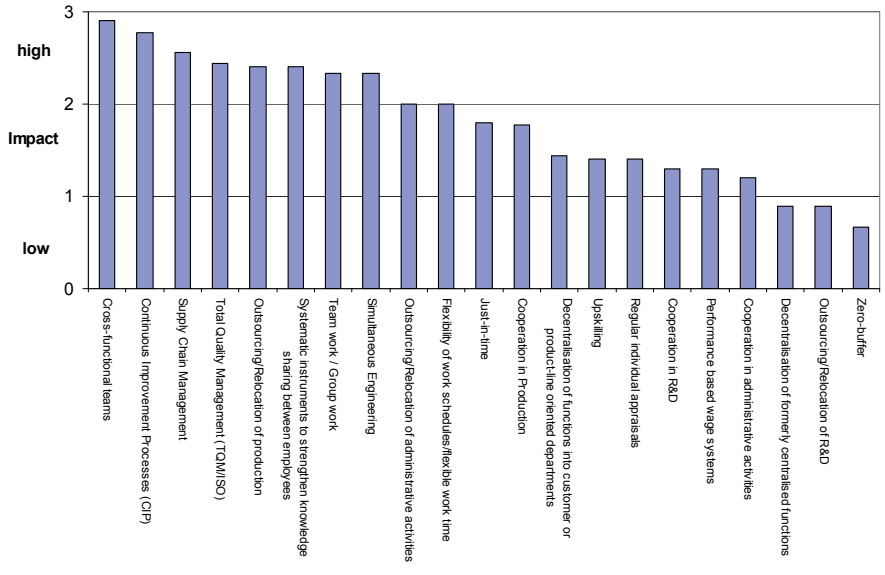
(1) Decentralisation at the strategic level

In the aerospace sector decentralisation at a strategic level was of fairly low relative importance according to the experts. They were of the opinion that decentralisation of functions into customer or product line orientated departments had a low impact on all the output dimensions. The decentralisation of formerly centralised functions had a low impact on the four dimensions.

(2) Decentralisation at an operative level

The results of the interviews point to the fact that the experts considered decentralisation at an operative level to have a greater impact than at the strategic level. The experts were of the opinion that team work/group work had a strong impact on quality, and cost (see Figure 33 and Figure 34 respectively), but only a moderate impact on innovation, while cross-functional teams are considered to have a strong impact on all four factors, flexibility, quality, innovation ability and costs. Both team work and cross-functional teams are considered by the experts to be in the top five most important organisational innovations for the aerospace sector.

Figure 32: Ranking of the impact of different organisational innovations on flexibility in the aerospace sector, n = 10



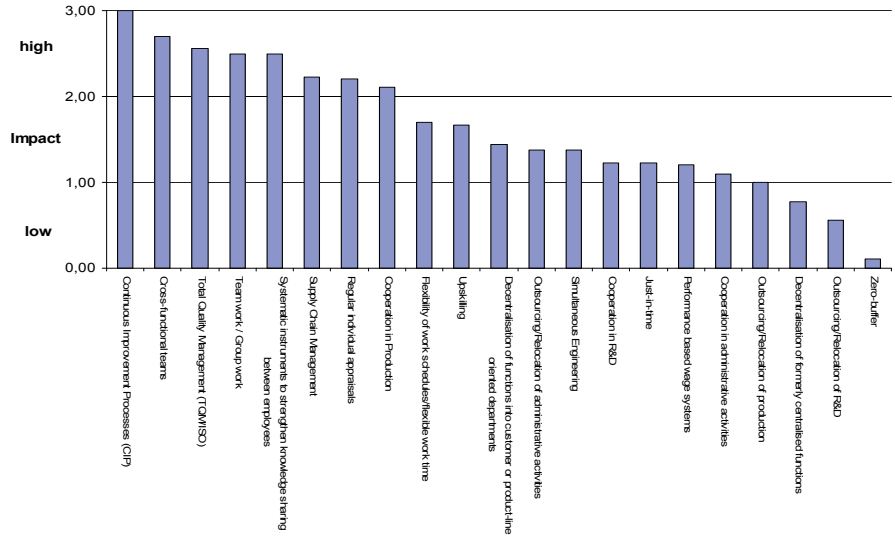
(3) Cooperation with other companies

There are some differences, according to the experts, between the various forms of cooperation. Cooperation in production is considered to have a moderate impact on flexibility, cost and innovation and a low impact on quality. Cooperation in R&D was considered to have a low impact on the four output dimensions. Cooperation in the administrative activities had a low impact on quality and costs (see Figure 33 and Figure 34 respectively), and a very low impact on flexibility and innovation.

(4) Outsourcing/relocation

The experts were of the opinion that the outsourcing/relocation of production had a strong impact on cost (see Figure 34), a moderate impact on flexibility (see Figure 32) and a low impact on quality and innovation. The outsourcing/relocation of R&D was considered to have a very low impact on the four output dimensions. The outsourcing/relocation of administrative activities is considered to have moderate impact on cost (see Figure 34), but a low impact on the quality, flexibility and innovation.

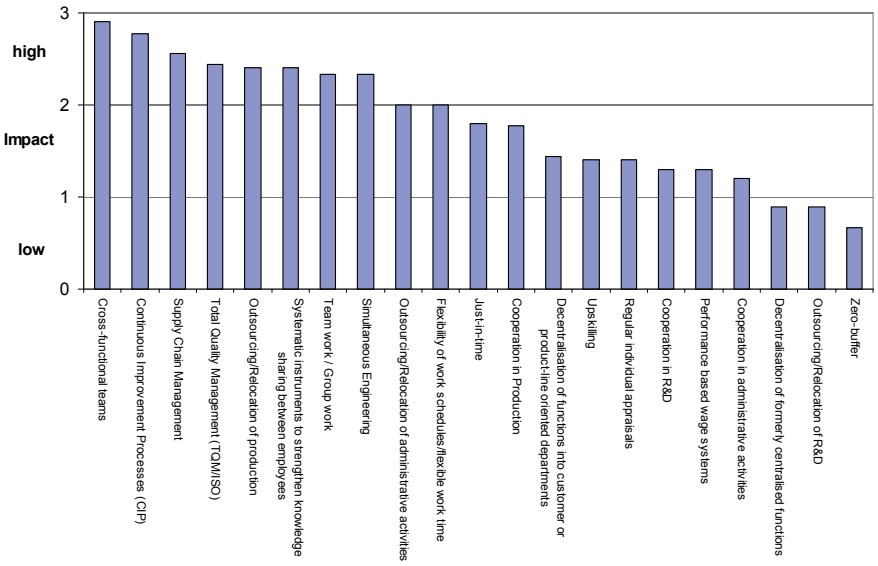
Figure 33: Ranking of the impact of different organisational innovations on quality in the aerospace sector, n = 10



(5) Quality Management

The experts were of the opinion that continuous improvement processes and total quality management had a significant impact on the four factors. Continuous improvement was considered to have a strong impact on quality (see Figure 33), flexibility, cost and innovation. It was considered to be the second most organisational important innovation in the aerospace sector (see Figure 36). Total quality management was considered to have a strong impact on quality (see Figure 33), flexibility, cost and innovation. Quality management was also considered to be important in the sector; it appears in the top 5 organisational innovations along with continuous improvement.

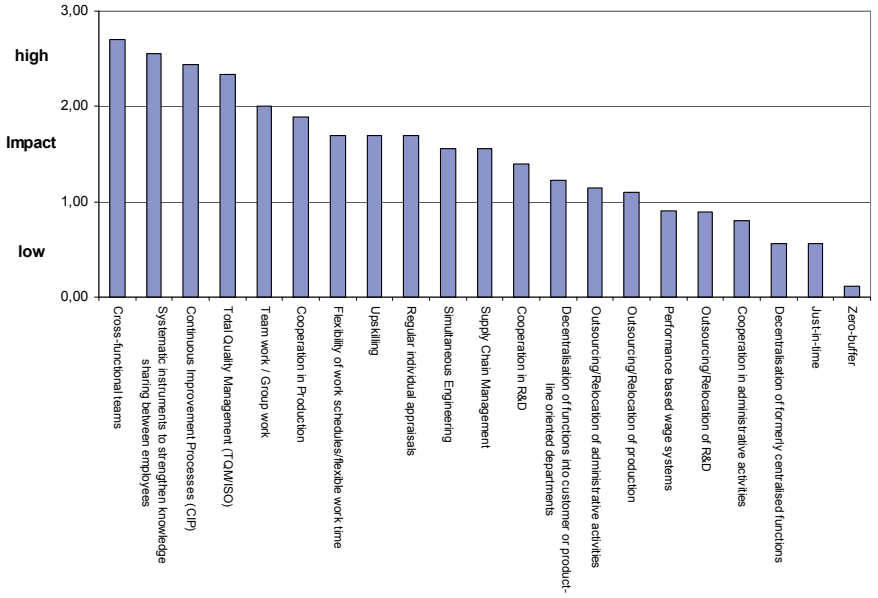
Figure 34: Ranking of the impact of different organisational innovations on cost in the aerospace sector, n = 10



(6) Human Resources

The flexibility of work schedules was considered to have a strong impact on flexibility (see Figure 32), a moderate impact on cost (see Figure 34) and a low impact on quality and innovation. Regular individual appraisals had a moderate impact on quality and innovation ability and a lower impact on cost and flexibility. Upskilling and performance based wage systems had a low impact on the four output measures.

Figure 35: Ranking of the impact of different organisational innovations on innovation ability in the aerospace sector, n = 10



(7) Knowledge management

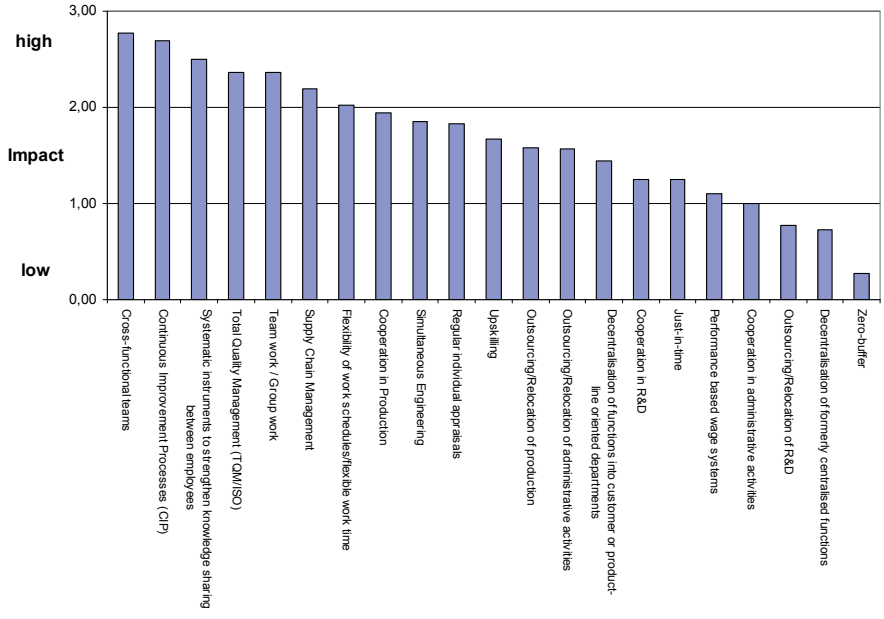
The interviews indicated that systematic instruments to strengthen knowledge sharing between employees are considered to have a strong impact on flexibility, cost and innovation, but only a moderate impact on quality.

(8) Production Management

The experts were of the opinion that supply chain management strongly increased a company's quality, flexibility and reduces cost. However, it had a lower impact on the firm's innovation ability.

Just in time was considered to have a low impact on quality, flexibility, cost and innovation. While, simultaneous engineering was considered to have a strong impact on cost, a moderate one on flexibility, but a low impact on innovation ability and quality. Zero-buffer was considered to have very low impact on the four output dimensions.

Figure 36: Ranking of the importance of different organisational innovations in the aerospace sector, n = 10



12.1.3 Conclusion

The interviews with the experts indicated that the decentralisation at a strategic level was of medium importance in the aerospace sector. In particular, the decentralisation of formerly centralised functions was considered to be the second least important organisational innovation.

However, in the case of decentralisation at an operative level (team work, cross-functional teams) the situation is different, it was considered to be of high importance. Team work was considered to have a strong impact on quality and flexibility, while cross-functional teams had a strong impact on quality and innovation. The importance of cross-functional teams (it was considered to be the most important organisational innovation) is not surprising given the tendency of employees in aerospace firms to work in teams on major new product development projects.

Cooperation with other companies is considered to be of low importance in the aerospace sector. The experts were of the opinion that cooperation in production was of medium importance,

while cooperation in R&D and cooperation in administrative duties was of low importance. This result is surprising given the view that cooperation between the firms is an important feature of this sector. The result for cooperation in R&D is surprising given the fact that the sector has such a high level of R&D expenditure.

Outsourcing/relocation was considered, in general, to be of low importance. The outsourcing/relocation of production and the outsourcing/relocation of administrative activities were considered to have a greater impact than the outsourcing/relocation of R&D. In fact, the outsourcing/relocation of R&D is the third least important organisational innovation. This may be due to the fact that aerospace companies place a high emphasis on research and development, so the strategy of outsourcing/relocation of this activity is not considered to be feasible.

Quality management appears to be of the highest importance in this sector. Continuous improvement and quality management were considered to have a strong impact on quality, flexibility, cost and innovation. Continuous improvement was considered to be the second most important organisational innovation. The aerospace sector is concerned about quality and this helps to explain the importance of continuous improvement and quality management.

The experts were of the opinion that human resource management had a medium level of impact in the sector. The flexibility of work schedules/flexible working was considered to be the most important innovation among the group of four. However, although it was the most important in the group it was only the 7th most important organisational innovation out of the 21 innovations. While, the least important human resource innovation was performance based wage systems (which ranked in the bottom 5, overall).

Knowledge management was considered to be of medium importance in the aerospace sector.

The importance of production management organisational innovations varied. The experts were of the opinion that supply chain management had a high impact on quality, flexibility and cost but a lower impact on innovation. Although, it was considered to have a high impact, it was not considered to be as important as some of the other organisational innovations, since it was only sixth in terms of overall importance. Simultaneous Engineering was also considered to have a strong impact on cost and a moderate one on flexibility. Overall it was considered to be of medium importance in the aerospace sector. It is surprising that it was not considered more important given the benefits it had delivered to some of the aerospace firms that had used it. This may be because the concept has not been adopted by all the firms and so an understanding of the benefits may not be widespread in the aerospace community. Just in time and zero buffers are considered to have a low impact on quality, flexibility, cost and innovation.

The results of the interviews indicate that in the opinion of the experts the most important organisational innovations in the aerospace sector are: cross-functional teams, continuous improvement, systematic instruments to strengthen knowledge sharing, total quality management, team work and supply chain management.

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12.2 Automotive

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12.2.1 Desk research

From the years 1970, the European car manufacturers try out many alternatives to Taylorism until in the years 1990 when the System of Toyota Production becomes "the one best way". These attempts explain only very partially the organisational innovations observed in this sector, innovations more impelled by the need than planned.

In a first part, based on a review of the literature, we very briefly recall the reorganizations which marked the European automobile sector during years 1990. In a second part, we present the results of our study. Finally, in a third part, we confront our own results with the principal organisational innovations underlined in the first part.

Despite the small number of interviews, our results agree with those of the literature. And among these innovations, the implementation of a modular production completely restructured the sector.

During years 1980, much of European car manufacturers tried out the small islands of production. Subsets of the cars (doors, cockpits…) were produced by teams organized in fixed stations. If such a practice is completely abandoned today, in particular due to the increasing complexity of the vehicles, the manufacturers delegated the production of these subsets. The result is an essential organisational innovation, qualified modular production.

Vis-a-vis an increased international competition, in particular from Japanese and Korean manufacturers, the need for carrying out economies of scale and to reduce the production costs, the modular production is adopted quickly by the whole of the European manufacturers.

The production of subsets by subcontractors required a deep reorganization of these companies. Few SME which survived this movement are today large international companies.

The modular production also resulted in a high degree of specialization along the value chain, from car makers or Original Equipment Manufacturers (OEMs) to raw material. Today OEMs are brand integrators focusing one product planning and marketing.

Under these conditions, producing a vehicle requires a perfect coordination between manufacturers and subcontractors of 1st rank and lower. The physical network organization adopted by the OEMs is the construction subcontractors' parks of subcontractors, the latter having factories concentrated around the unit of final assembly. Supply chain management, just in time system and Total Quality Management (TQM) are essential practices here.

The externalisation of the European OEMs related not only to the production of subsets. Today, first level's subcontractors are also responsible for the design and conception of new subsets. And the OEMs use more and more the services of companies to design new models of cars and test prototypes. "In general it can be said that communication and cooperation issues have become an evermore important area of learning and capability building. As in the supply chain for car production the process chains for car development has become more fragmented and actors are specialising on specific roles" (cf. Ulrich Jürgens, 2003).

Consequently, we observe the existence of complex bonds between manufacturers, manufacturers and subcontractors and subcontractors. And alliances, fusions and acquisitions or scissions continue to reinforce the specialization of firms of the automotive sector.

This inter firms organization made it possible to reduce the cycle of life of cars, the innovations of products and processes being realized faster today than in the years 1980 and 1990. The production costs also were strongly reduced with the installation of sites of production in the countries of Eastern Europe. Quality is increased and manufacturing lead times are reduced.

These performances are also the result of innovations inside the firms: team work/group work, cross-functional teams, upskilling and Continuous Improvement Processes (CIP). Despite everything, the organization of work rests still more on Taylor's principles that on the principles implemented by Toyota.

Does the investigation carried out near institutional and of professionals of the sector confirm such organisational practices?

12.2.2 Impact of organisational innovations on output dimensions

In average, the organizational innovation is classified in third position in term of global impact on performances of 14 firms concerned by our questionnaire. More precisely, the organisational innovation with a 3.02 average score is considered less important than products innovation (1.79). The organisational innovation also appears less important than the process innovation (2.96) but is better classified than the services innovation (3.90) that gets the last rank in 9 out of 14 cases.

Those first results highlight the importance dedicated to the customer, importance that summarises quiet well the following remark done in an interview:

"What is important first is the customer who knows the company by its product and this is only thanks to this "satisfying" knowledge that the customer will make live the company by buying its products again. It is imperatively necessary on this topic to succeed in innovating to remain in the race and always keep the customer interested".

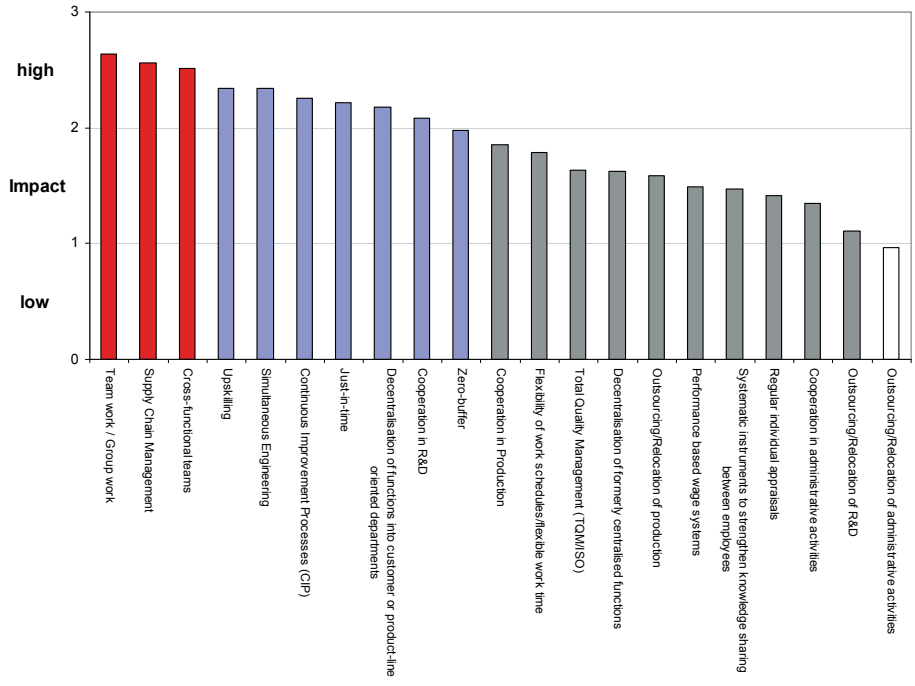
However, it seems important to highlight the difficulty of the exercise consisting in comparison between different types of innovations that come from decisions with different terms and appraisal criteria. Organisational innovation, compared to others forms of innovation…

"It is more an intervention on the structure with a return on long term investment with appraisal criteria that are different from accounting information"

As far as the interviewed companies are organised to answer the best to the customers' requirements, from the conception to the sell of cars, the application of just in time principles is considered by all of our interlocutors as a prerequisite. However, the production with tended flows presents the disadvantage of being particularly vulnerable to any problem likely to occur during manufacture. Delays of delivery or a bad synchronization between the delivery of subsets (limp of speed, seats, panes...) cause the stop of the whole of the production process. From where importance attached to supply chain management which appears as the organisational innovation whose impact on the total performances of the company is most significant (score 2.56 out of 3.00).

At the workshop, other problems can also occur and lead to a rupture of the whole of the production process (breakdown machine, defective part...). These ruptures are not rare. But, in order to prevent that they do not disturb the whole of the process, it is imperious that the causes are quickly located and find a solution. This is why it is necessary that engineers and technicians are present in the workshop, to the side of the operators. After supply chain management, the impact on the global performances of the cross functional teams is also considered to be important (score 2.51).

Figure 37: Ranking of the importance of different organisational innovations in the automotive sector, n = 18



In order to avoid having to stop the chain of production to each encountered problem, the workmen have certain technical skills which must enable them to solve a certain number of these problems in real time. In this case, to avoid with the workman concerned taking delay and to disturb all the line of production, it must be able to be given the aid of other workmen, being in the same team. In addition to technical skills, the workmen must thus be able to carry out whole or part of the tasks which are under the responsibility of its team. Consequently, the impact on the global performances of upskilling (2.34) and to a lesser extent team work/group work (2.00) are important.

The continuous improvement of the production process also makes it possible to prevent many problems. Its impact on the total performances is considered to be significant by our interlocutors (score 2.26 out of 3).

In addition to innovations relating to the organization of the production process (manufacture and assembly of the parts, components and subsets), the organization of the R&D also takes an important strategic dimension with simultaneous engineering (score 2.34). This practice makes it possible to reduce considerably the times of design of a new vehicle as well as the costs while guaranteeing quality. According to our interlocutors, such an organisation is considered as essential, to face the competition resulting in a significant reduction of life cycle of cars. With cooperation in R&D (2.08), not only the company is more reactive but the effects on quality, the reduction of the production costs and more particularly the innovation are also perceived like significant.

In addition, the total impact of the Just in time as a technique "appears" only in 6th position. That is explained by the fact this IO is initially associated with a greater flexibility and reduction of costs. Its impact on quality and the innovation is considered as relatively weak.

Finally last IO whose impact on the total performances strongly is decentralisation of functions into customer or product-line oriented departments (2.18 out of 3.00). This result is in conformity with declarations of people questioned for which, as we already noted previously *"What imports initially and by far is the customer"*.

The total impact of other organisational innovations, lower than 2 out of 3, is considered to be weak.

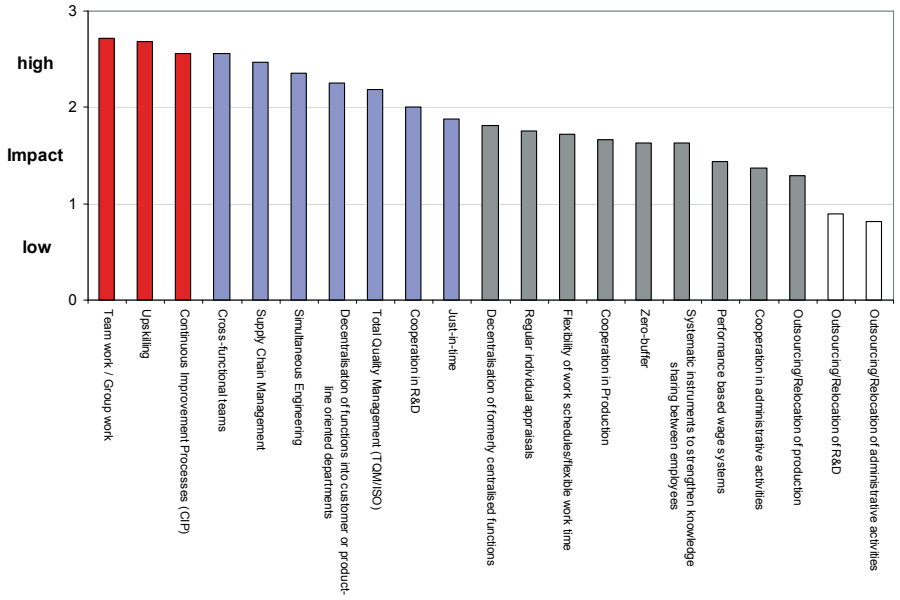
As we underlined for the Just in time, the impact on the total performances can mask sometimes significant disparities between quality, flexibility, reduction of the costs and capacity to be innovated. This is why we devote the paragraphs following to detail the answers obtained for each one of these measurements of the performance.

It is interesting to note that organisational innovations whose impact on quality is judged important (score higher than 2), are 10 like previously and that we find practically the same practices, except for just in time (1.8).

However, the classification of these practices presents some differences. In particular, organisational innovations whose impact is most significant on the quality of the production relate first to the organization of work in the workshop: Upskilling (2.69), Continuous Improvement Processes (2.56), cross-country race-functional teams (2.56) and team work/group work (2.23).

Total Quality Management and ISO standardization (2.19) are even regarded as having a strong impact on quality whereas the score obtained by these practices in term of total impact is weak (1.63). If the majority of the questioned people recognize effectiveness of those practices to improve quality, much consider their implementations complicated and expensive. Some of our interlocutors even agree on the fact that obtaining ISO standards would concern a simple effect of advertisement.

Figure 38: Ranking of the impact of different organisational innovations on quality in the automotive sector, n = 18



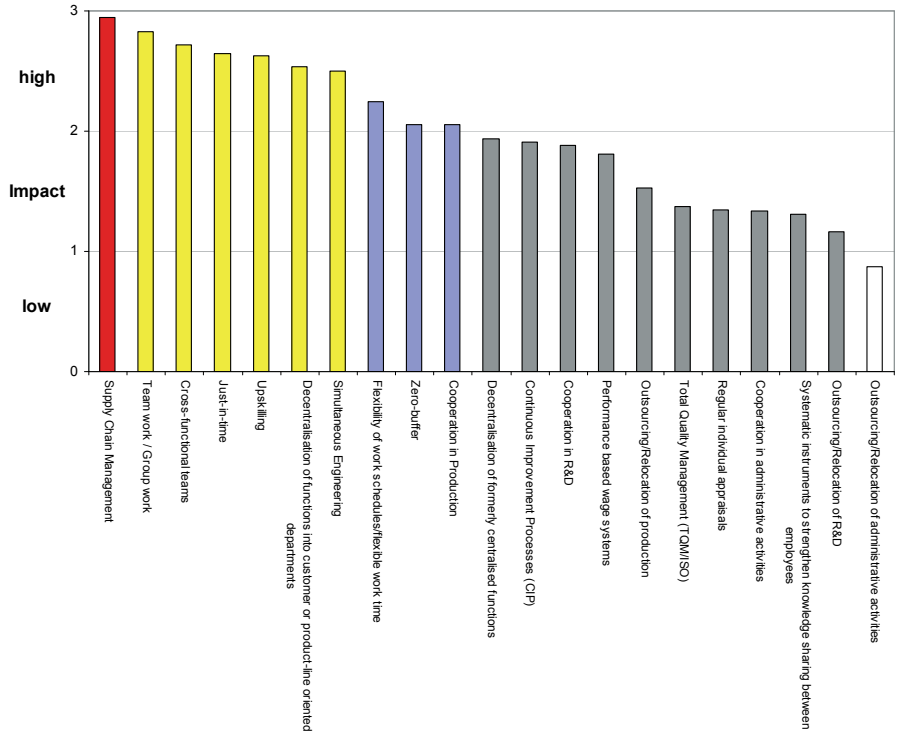
Other organisational innovations whose impact on quality relate to the organization of customers suppliers relationships (supply chain management, 2.47) and the organization of R&D with simultaneous engineering (2.36) and co-operation in R&D (2.00).

The similarities with the preceding results are again significant. However, certain differences need to be underlined.

Initially, the organization of the production process between customers and suppliers have a higher impact on flexibility than on quality or the total performances, flexibility being inter-

preted here like the capacity to answer quickly variations of the request. In addition to the weight granted to the supply chain management (2.94), the practice of just in time and the reduction of stocks are practices also more voted by plebiscite (respectively 2.65 and 2.33). Those practices make it possible to tighten the flow of production not only inside the different production units but also from subcontractors to final assembly. Then, the practices relating to the organization of the workshops are always regarded as having a significant impact. However, among these practices, Continuous Improvement Processes (1.91) and Total Quality Management (1.38) are not regarded any more as innovations having a strong impact. According to our interlocutors flexibility is more sensitive to flexibility of work schedules/flexible work time (2.25) and to a lesser extent to co-operation in production (2.06).

Figure 39: Ranking of the impact of different organisational innovations on flexibility in the automotive sector, n = 18



Lastly, concerning the organization of R&D, simultaneous engineering (2.50) has a stronger impact on flexibility than quality (2.50 against 2.36 has noted previously). On the other hand, the consequences of a co-operation in R&D are estimated as weak by the questioned people (1.88).

The supply chain management is the IO most important impact on the reduction of costs (2.88).

Just in time (2.75) and "zero stocks" (2.88) also have an impact considered to be significant on the reduction of the costs.

Lastly, the delocalisation of part of the production is also regarded as a means of reducing costs effectively while at the same time the impact of this device on other dimensions of the performance appears weak. Some industrials note on this subject that profit in term of reduction costs is, in the first times, counterbalanced by the problems of quality and reactivity which appear.

With the difference of other dimensions, the number of devices of management concerned is reduced. Only four organisational innovations, against 10 previously, have an important impact

on the innovation. And among these four organisational innovations, two relate to the organization of the R&D: simultaneous engineering (2.29), cooperation in R&D (2.17). This result seems to us significant, on the one hand, of the difficulty of apprehending the sources of the innovation in the company and on the other hand with the tendency of a majority of interlocutors to associate the innovation to radical change.

Figure 40: Ranking of the impact of different organisational innovations on cost in the automotive sector, n = 18

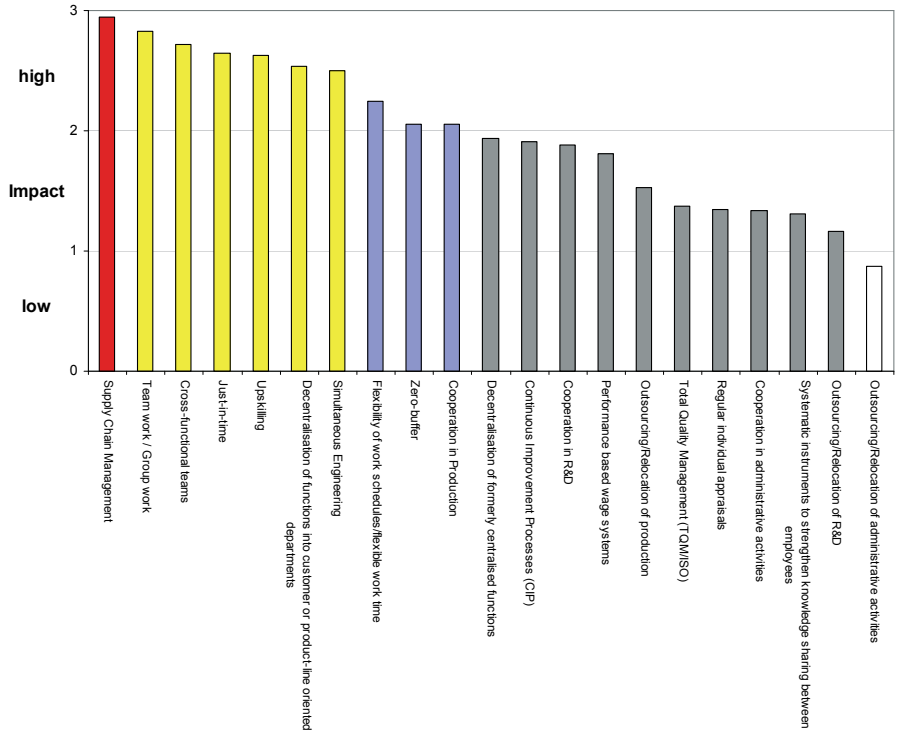
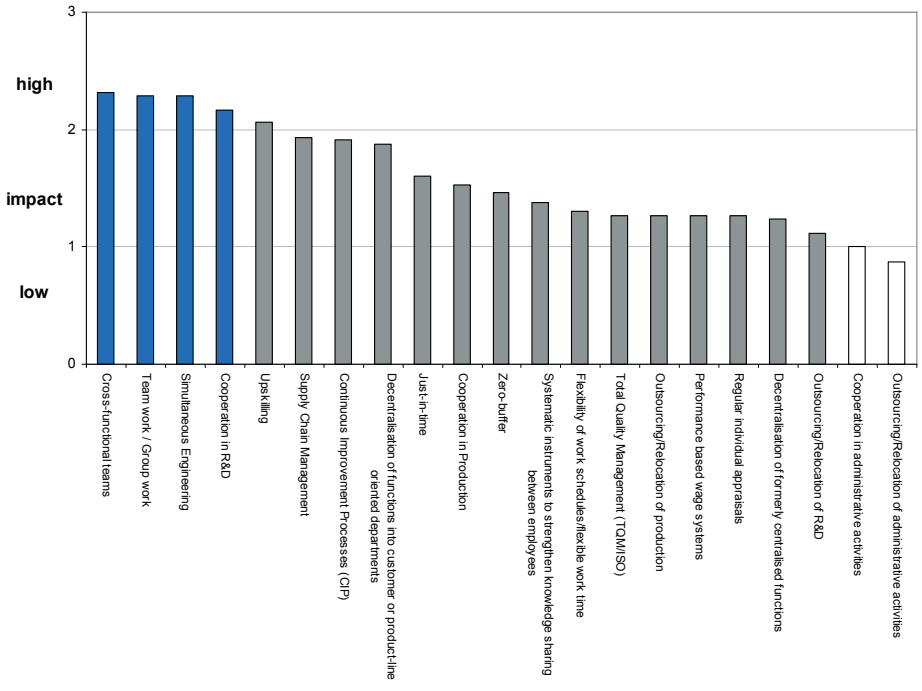


Figure 41: Ranking of the impact of different organisational innovations on innovation ability in the automotive sector, n = 18



12.2.3 Conclusions

The results of our investigation corroborate our short review of the literature. The principal conclusion which comes out from this work is the major organisational innovation for the European automotive sector is the modular production. This organisational innovation is not directly mentioned in our questionnaire. But, within the framework of the last open question, many of our interlocutors mentioned it as an essential practice. And it is the implementation of this principle of modularity which led to many organisational innovations on two narrowly complementary levels.

On the level inter firms with the constitution of networks where each actor is very specialized in his field of competences.

And on the level will intra firms with a greater responsibility entrusted to the staffs and to a lesser extent a decentralization of the functions.

12.3 Biotechnology

Written by B. Coriat and C. Leguehennec (Centre de Recherche en Economie Industrielle Internationale (CREII), France)

12.3.1 Desk research

To our knowledge no study specifically treating organisational innovations in the biotechnology and the pharmaceutical sector was still carried out. Therefore, these research interviews provide first insights into organisational innovations' extent of importance in this sector.

A majority of the questioned people made a point of underlining the difficulty in classifying the various forms of innovation of product, process, organisational and of service and that for two reasons mainly:

- There are strong complementarities between these various forms of innovation. As a new product is developed, that call necessarily the development of new services, of new manufacturing processes and of the organisational changes.

- And, even notices that for the automotive sector, it is complicated to compare forms of innovations which concern decisions at the different temporal horizons. For example, in a start-up of biotechnologies, an organisational innovation can intervene quickly while the innovation of product is much longer.

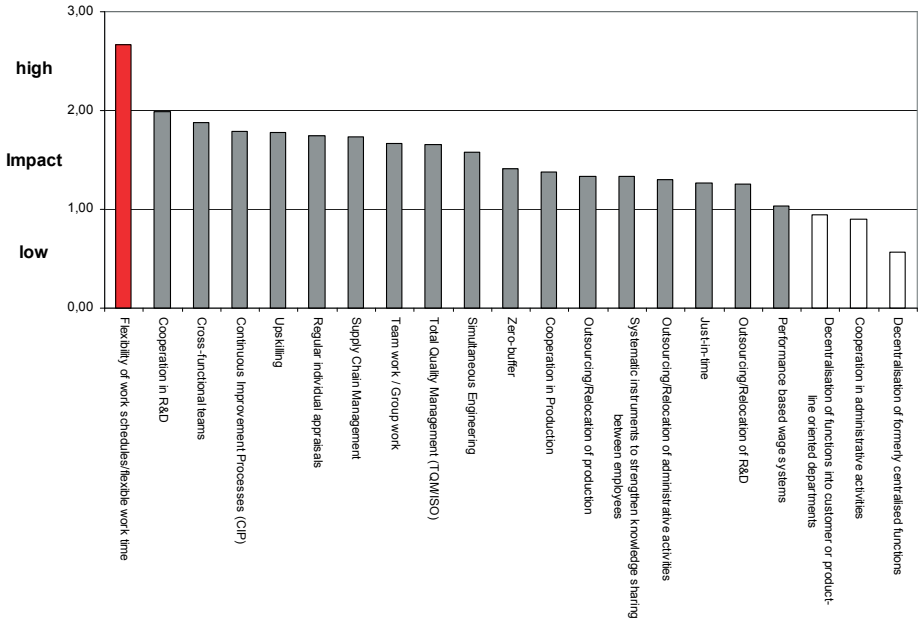
However, the questioned people agreed to classify the four forms of innovations retained in our questionnaire. The innovation of product is incontestably the form of the most significant innovation in 6 cases out of 8. For 2 of the questioned industrialists this form of innovation occupies only the second place. Then the innovations from process and the innovations of service come. And the organisational innovation appears as the form of the least significant innovation relatively in 6 cases out of 8.

In addition, the interpretation of the results is made difficult by the fact that they amalgamate the answers of people working in very different structures. The difference, foreseeable, between start-ups and undertaken pharmaceutical is particularly clear. The size of the structure of the pharmaceutical companies covers the whole of the activities of the design to the sale of drugs and returns to an organization more formal than that of the start-ups like illustrates it our following comments. We think that this difference partly explains the average impact of organisational innovations on the performances of the companies of questioned biotechnologies.

12.3.2 Impact of organisational innovations on output dimensions

At the reading of the statistics concerning the impact of the organisational innovation on the global performances, a first result appears immediately remarkable: only an organisational practice on the 21 is considered by our interlocutors like having a significant impact on the total performances of the company (score higher than 2). It is about schedules/flexible work time (2.67). If the impact of this organisational innovation is considered to be significant at the same time by the questioned start-up and pharmaceutical companies, the reasons are different. In the case of the start-up this flexibility can be very significant and return to situations where part of the personnel of research shares his professional time between its activity for the company and its activity within the framework of a university research laboratory. For the pharmaceutical companies, the degree of flexibility is quite less and relates to mainly the schedules of work with, for example, the possibility of arriving between 7 and 9 o'clock in the morning.

Figure 42: Ranking of the importance of different organisational innovations in the biotechnology sector, n = 9



With exception of flexibility of the schedules/flexible work time, all the other devices have only an impact considered as moderated in 17 cases out of 21 to see weak (3 cases out of 21). This result confirms, if need be, that the performances of the companies of biotechnologies depend mainly on the innovation of product and a secondary way of the organisational innovation. However, this last form of innovation should not be neglected. A great number of the listed organisational innovations are absolutely necessary. But necessary is not sufficient.

This difference between relevance of the organisational devices and impact on the performances again leads us to make a distinction between pharmaceutical companies and start-ups questioned. For these last, that is to say the organisational innovation is relevant or is not. And if it is relevant this is because it cannot works differently, certain of our interlocutors going even until being astonished openly by the interest to put some questions. However, the need for such or such is organisational innovation is generally associated with a moderate impact on the total performances of the company. The performances seem more related to technical and technological skills.

In all the cases questioned–start-up or big pharmacies–to oppose an organization by function to an organization by product and/or customer does not have sense in biotechnologies. All the

structures are at least organized by product: The questioned start-ups aim at the development of a new product or process. As for the big pharmacies of our sample, a matrix organization–by product and customer to see geographical–is considered to be impossible to circumvent. For as much, the impact on the total performances of this device is negligible (0.94).

Co-operation in R&D is also considered to be essential. But, if the impact on the total performances is large, it is also strongly uncertain, which would tend to explain the average score of this item. Concerning the other forms of cooperation–to produce and administrative matter – it makes sense only for the large pharmaceutical companies. Moreover, the interest to cooperate to produce returns initially to the concern of being present on large markets.

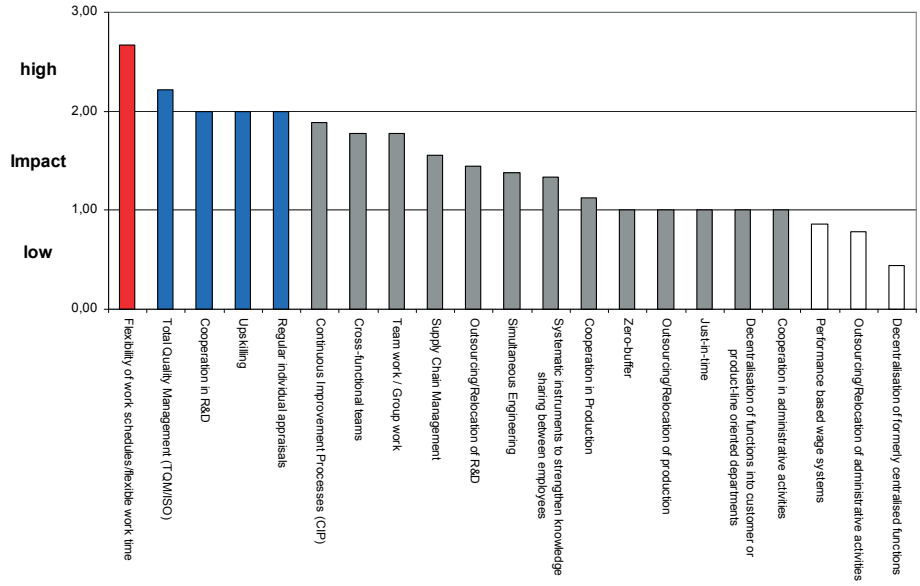
In the same way subcontracting and delocalisation are important organisational practices especially for the large pharmaceutical companies questioned and their impact on the total performances is far from being obvious. If the cost of qualified labour is an advantage, the quality of the production is problematic.

In addition to the differences already underlined, the practices as regards human resources management and the impact of these practices on the total performances constitute also an interesting example of behavioural opposition start-ups versus companies of biotechnologies concerned by our questionnaire. In both cases mutual adjustments are important means of coordination between employees. But, unlike the start-up, the pharmaceutical companies have also recourse to the standardization of processes, results and qualifications to a significant degree.

The results on the total performances hide significant disparities as for the impact of the organisational innovation on quality, flexibility, reduction of costs and innovation capacity. From where interest to differentiate these four dimensions as following.

The organisational innovation impacts quality more than other dimensions of the performance. In addition to the importance given to flexibility of work schedules/flexible work time (2.67), the four following practices have a score higher or at least just equal to 2: Total Quality Management, co-operation in R&D, upskilling and regular individual appraisals.

Figure 43: Ranking of the impact of different organisational innovations on quality in the biotechnology sector, n = 9



Concerning Total Quality Management, this practice is also concerned with International Standard Organization (ISO) in our questionnaire. Consequently and insofar as obtaining these stand-

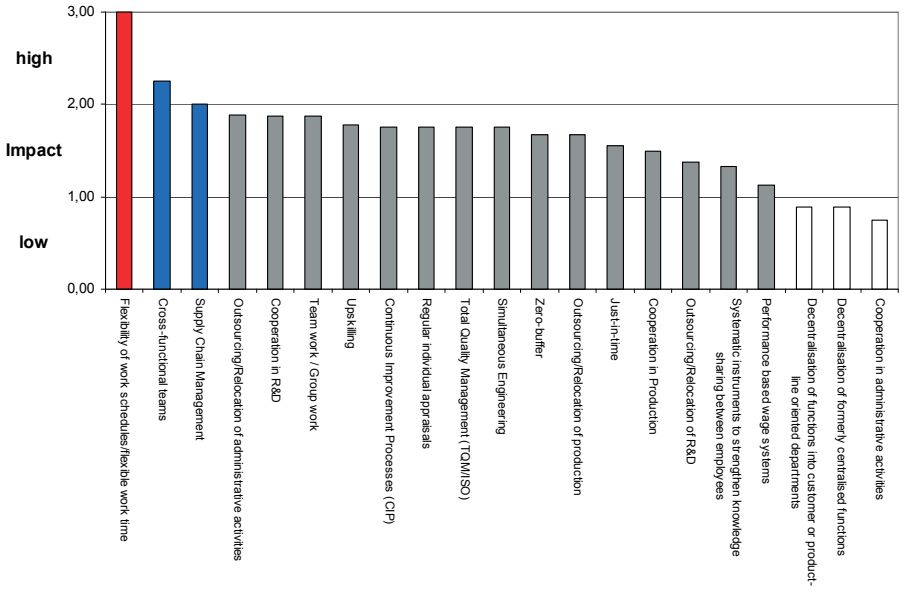
ards are obligatory to guarantee the quality of the product and/or the manufacturing process in biotechnologies, it is normal that they have a strong impact on quality.

Cooperation in R&D has also an important impact on the activity of the companies of biotechnology. The argument advanced by some of our interlocutors is that rare are the companies to control the whole of the parameters as regards design, development and/or sale of products and production processes often highly complex.

Concerning upskilling and regular individual appraisals, those organisational innovations are developed firstly by the companies other than start-ups. Once again, according to questioned people's working of the start-ups questioned, collaboration between the small number of paid which composes these structures is informal. And "if somebody does not make the deal then it is fired".

The three organisational innovations whose impact on flexibility is significant are: flexibility of work schedules/flexible work time (3.00), cross-country race-functional teams (2.25) and to a lesser extent supply Chain Management (2.00).

Figure 44: Ranking of the impact of different organisational innovations on flexibility in the biotechnology sector, n = 9



It is interesting to note that flexibility of work schedules/flexible work time, that we find everywhere else as practice whose impact is most significant, achieves here the unanimity among the whole of the questioned people. In the presence complex products and processes, flexibility is closely related to the capacity of the employees qualified to mutually coordinate in order to answer often single problems as soon as possible.

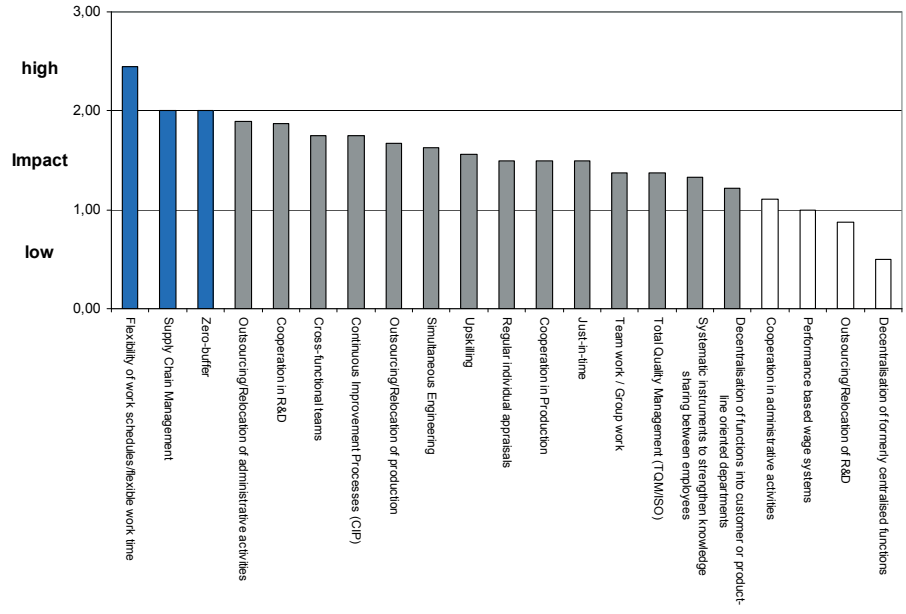
Cross functional teams for the start-up is an organization which is essential as one of our interlocutors claiming "not to know another method".

On the contrary, supply chain management has initially some importance for the pharmaceutical companies rather than for the start-up which are very small structures.

The three organisational innovations whose impact on the reduction of costs is considered to be significant are as follows:

- Schedules/flexible work time (2.44)
- Supply Chain Management (2.00)
- Zero-buffer (2.00)

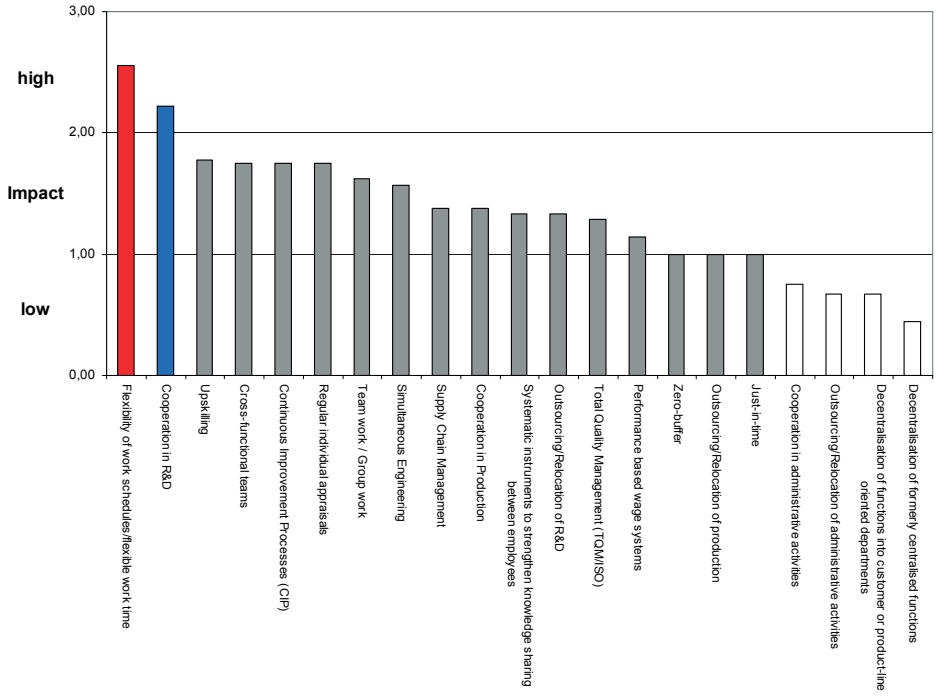
Figure 45: Ranking of the impact of different organisational innovations on costs in the biotechnology sector, n = 9



In addition to the recurring importance attached to the schedules/flexible work time device, we once again find dichotomy between pharmaceutical companies and start-up: supply chain management and zero-buffer are prerogatives of structures having significant activities of production and sale which is not the case of the start-ups interviewed.

Once again, towards particularly complex problems, the capacity of an organization to mobilize experts around these problems and the aptitude of these experts to coordinate themselves to bring a solution are very important elements in biotechnologies. This is why schedules/flexible work time (2.56) and to a lesser extent co-operation in R&D (2.22) were organisational practices considered to be important by the questioned people.

Figure 46: Ranking of the impact of different organisational innovations on innovation ability in the biotechnology sector, n = 9



12.4 Chemical industry

WRITTEN BY H. ARMBRUSTER, E. KIRNER, G. LAY (FRAUNHOFER ISI)

For the chemical industry, 7 stakeholder interviews have been conducted, thereof 7 interviews with industry representatives and no interview with research representatives. The interviews have been conducted with employees of chemical companies in Germany, France, Italy, Slovenia, and in the UK.

12.4.1 Desk research

Since the 1990s the chemical industry structure has considerably changed. Restructuring of multinational corporate companies including mergers and acquisitions as well as spectacular spinning-offs and outsourcing of business units have occurred and still occur in the chemical industry. Main raisons for the restructuring are companies' effort to concentrate on core areas of their business in order to compete successfully in the global market or to get into niche markets. As a consequence, companies mainly decentralised their organisational structures into business units such as crop science, material science, polymers, fine chemicals etc. This decentralisation also effects the organisation of firms' research and development. Many former centralised research and development departments were (re)transferred into the divisions to mainly focus on research and development of the company's core areas. At the same time, research and development of chemical companies becomes more interdisciplinary and cross-functional. Firms increasingly invest into cross-functional projects, for instance Degussa established project houses which bring together around 20-30 scientists from various business units of Degussa. But there is not only an increasing internal R&D cooperation between business units but also an intensive cooperation with external partners such as universities, research institutes and even customers, suppliers and competitors. Chemical companies clearly have more R&D cooperation as all companies in other manufacturing sectors. Thus, organisational innovations which are of particular importance in the chemical industry are decentralisation of organisational structures at a corporate level as well as at an operative level. At the corporate level, companies are forced to reduce their business activities to core areas and therefore also to outsource business functions, to acquire new business activities or to merge with competitors. At the operative level, chemical companies increasingly establish cross-functional teams and projects and R&D cooperation with external partners.

Environmental legislation and quality standards are also playing an important role in the chemical industry. This gets even more important with the EU's new chemical legislation "Registration, Evaluation and Authorisation of Chemicals (REACH)" stating that chemical manufacturers and suppliers must assess risks for humans and environment for every chemical product and to take the necessary measures to manage any risk they identify. Thus, the implementation of quality control systems such as quality audits (ISO 9000: 2000 certification), environmental audits (ISO 14001) as well as continuous improvement processes (CIP) and Kaizen are of particular importance in this sector.

Highly qualified personnel are also important for future competitiveness of the chemical industry. However, there has been a sharp decline in the number of students graduating in chemical-related disciplines in Europe and this trend might continue in the future. Therefore, chemical companies have to use measures for attracting and maintaining human resources. Organisational innovations in the field of human resources management such as regular appraisals covering also employees' personal development are becoming increasingly important in chemical industry.[12]

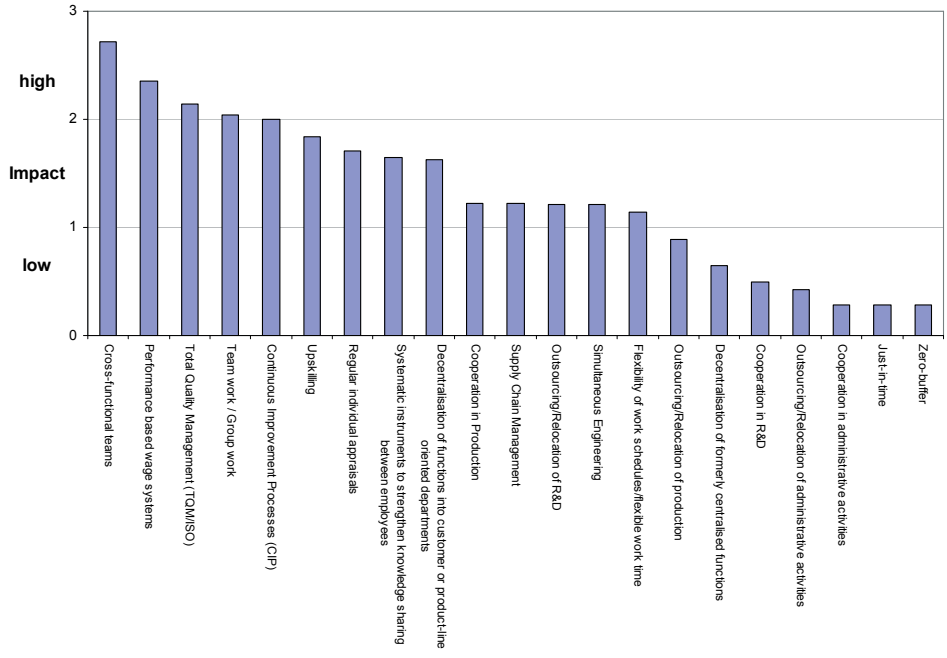
([12]) References used for chemical sector: Balzert, Kuhlmann and Sperling (2003); Cesaroni et al. (2004); European Chemical Industry Council (2004), Rehfeld et al. (2004).

12.4.2 Impact of organisational innovations on output dimensions

The results of the interviews with the experts of the chemical industry basically show a similar picture to the above theoretical considerations (see Figure 47). According to the experts in chemical industry, organisational innovations in the field of quality, decentralisation and human resources are considered to be of high importance in the chemical industry. The experts think that (cross-functional) team work, human resources management activities such as performance based wage systems, regular individual appraisals or upskilling are important organisational innovations for chemical companies. Contrary, organisational innovations such as zero-buffer, just-in-time or relocation activities are considered not important for the chemical industry. This estimation is plausible as in the process industry manufacturing processes are continuous and concepts such as just-in-time or zero-buffer are much less crucial in this industry.

An analysis of the estimated impacts of every organisational innovation on quality, flexibility, costs and innovation ability shows that for every organisational innovation their effects on these four output dimensions are rather similar (Figure 48 to Figure 51). Zero-buffer, just-in-time as well as outsourcing are considered to have almost no impact on all four output dimensions (quality, flexibility, costs, and innovation ability). Contrary, cross-functional teams, team work, human resources management activities (performance based wage systems, upskilling), and organisational innovations that are attached to quality aspects (total quality management, continuous improvement process) have a medium to strong impact on all four output dimensions.

Figure 47: Ranking of the importance of different organisational innovations in the chemical sector, n = 7



However, based on the theory, these results are less plausible. For instance, total quality management mainly influences quality (which has been indicated by the experts) and has a much lesser impact on flexibility, costs or innovation ability. Nevertheless the experts estimate that total quality management influences these three output dimensions. The same is true for decentralisation of functions into customer or product-oriented departments. The main effect of this organisational change as it is postulated by theory is an increasing flexibility. However, experts estimate the same impact of decentralisation of functions into customer or product oriented departments for all four output dimensions. As far as organisational theory is considered at least a lower impact on innovation ability might be expected.

Figure 48: Ranking of the impact of different organisational innovations on quality in the chemical sector, n= 7

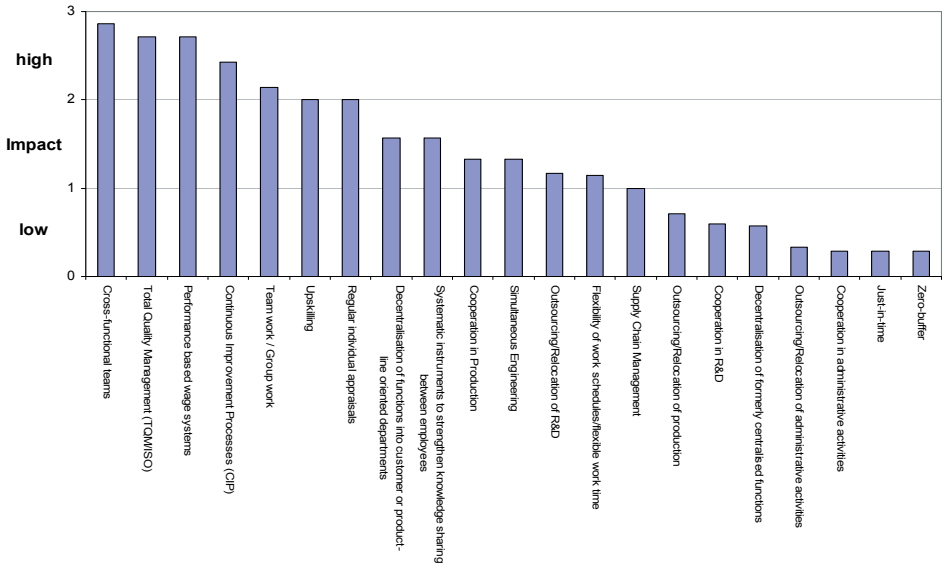


Figure 49: Ranking of the impact of different organisational innovations on flexibility in the chemical sector, n= 7

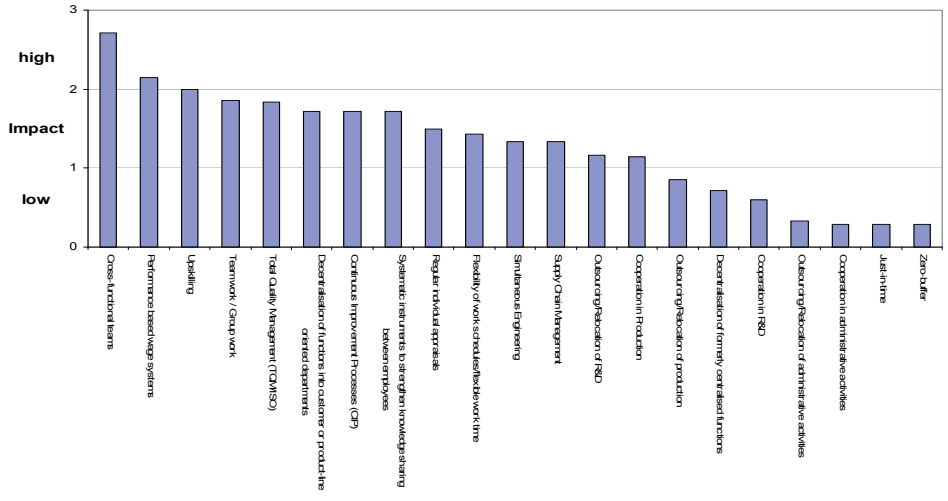


Figure 50: Ranking of the impact of different organisational innovations on costs in the chemical sector, n= 7

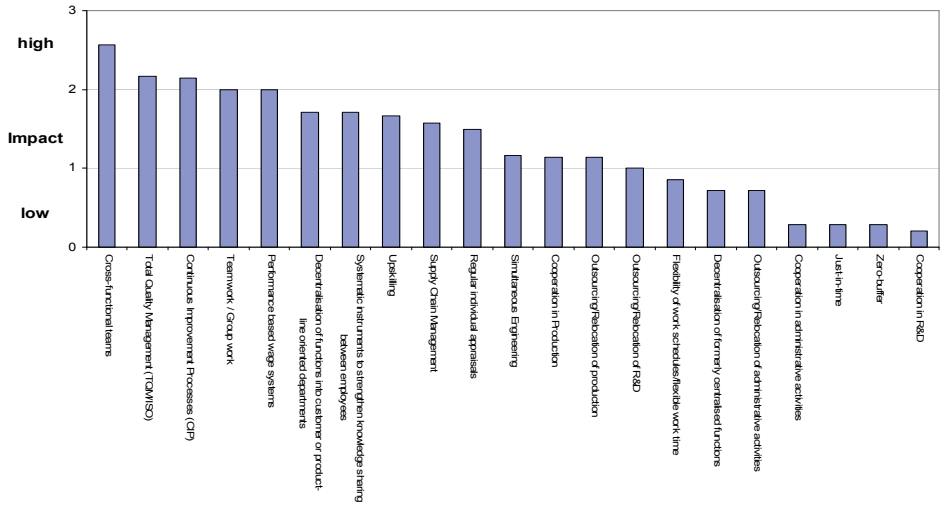
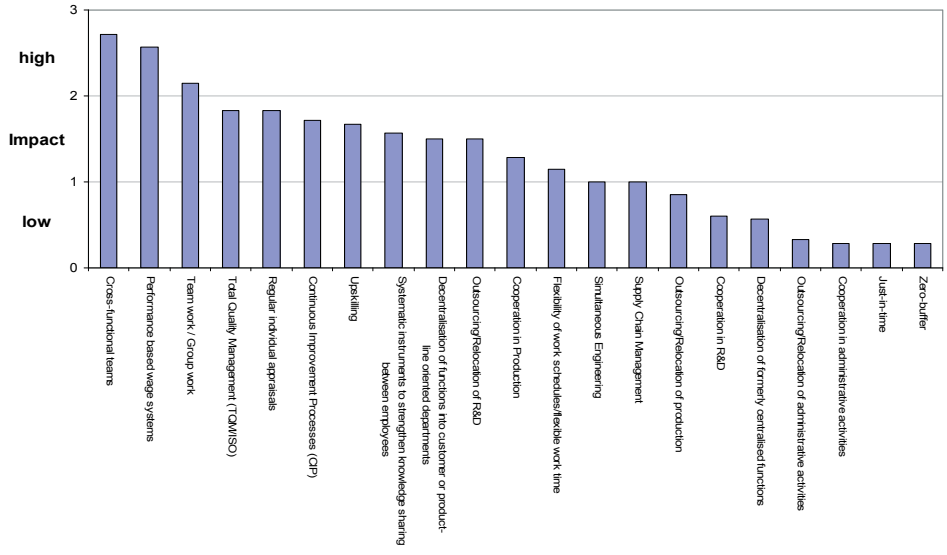


Figure 51: Ranking of the impact of different organisational innovations on innovation ability in the chemical sector, n= 7



12.4.3 Conclusions

Estimations of the experts in the chemical sector show a clear picture: organisational innovations in the field of quality (total quality management, continuous improvement process), human resources (performance based wage systems, upskilling) as well as team work and cross-functional teams are considered of high importance for the chemical industry and all moderately to strongly influence the four output dimensions (quality, flexibility, costs, and innovation ability). On the other hand, organisational innovations such as zero-buffer-principle, just-in-time concepts or relocation activities are of almost no relevance according to the experts' opinion. These results are plausible because in the process industry concepts such as zero-buffer are not relevant because production processes are continuous.

12.5 Electronics

Written by Jernej Belak, Janko Belak, M. Duh (MER Evrocentre for Management and Development, Slovenia).

12.5.1 Desk research

Products from electronics sector are to be found in all areas of modern life, arising from a continuous demand for evermore powerful, multifunctional and portable products. Electronics sector covers all aspects of electronics manufacture, from electronic component production through to the incorporation of these components into the finished goods.

According to Structural Business Statistics (SBS) nearly 3.2 million persons were employed in the manufacture of electrical or electronic equipment in 2001. This corresponds to 9.3% of the total number employed in manufacturing in the European Union. The manufacture of electrical and electronic equipment accounted for 9.5% of the EU's manufacturing value added in 2001 (Van den Eyndecoppin, 2005).

Germany is the biggest single contributor to value added in this sector (EUR 44 billion, a share of 30%), far ahead of France (EUR 21 billion, a 14% share) and the United Kingdom (EUR 18 billion, or 13%). These three Member States alone recorded a total turn over of EUR 346 billion, or 57% of the sector total in the EU in 2001 (Van den Eyndecoppin, 2005).

The above stated data give us the impression of the electronics sector's importance and the importance of its impact on employment and economic growth of these countries and EU as a whole. Generally the sector is divided in manufacture of electrical machinery and electronic devices. Within the sector the manufacture of electrical machinery and apparatus are most important, both in the EU as a whole and in most Member States. By contrast, the manufacture of domestic appliances is generally of lesser importance, except in Slovenia and Sweden.

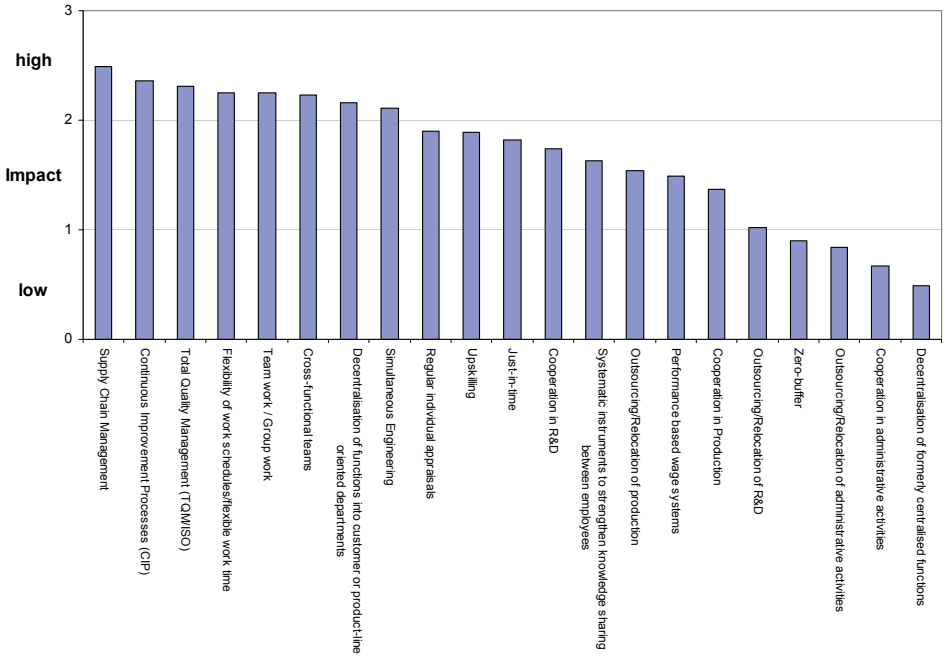
62% of 110 000 enterprises in EU (in 2001) belonged to the manufacture of electrical machinery and apparatus. The share of micro-enterprises is high throughout the various sub-sectors. Female employment appears to be relatively high (54%). Especially in the Czech Republic, Hungary, Slovenia and Slovakia, women form the major part of the workforce. Generally, a high level of education is found in this sector, especially in the manufacture of office machinery and computers.

According to the literature and researches the electronic sector is facing high level of competition therefore the products and processes of the enterprises in this sector should be of top quality. On the other hand in this sector it is very important that enterprises are highly innovative. One of the problems that literature refers to is the costs of R&D in the area of electronics, which are very high due to the fact that it requires very expensive infrastructure. Anyhow, the literature and the expert research shows that in recent years corporate research labs have been steadily moving towards the study of company specific short-term issues, rather than long term generic research that could bring benefits in years to come. According to the above mentioned facts and expert research we expected industry research to show high concern for quality management on one side and aim for the highest level of innovation ability on the other, which are elements that are considered by the literature as the key success factors in electronic sector.

12.5.2 Impact of organisational innovations on output dimensions

In the Figure 52 we can observe the importance of different organisational innovations in electronics sector. The values represent the average scores given by the companies and experts to different impact dimensions of organisational innovations, which were quality, cost reduction, flexibility and innovation ability.

Figure 52: Ranking of the importance of different organisational innovations in the electronics sector, n = 13



The mean value of the impact of different organisational innovations that can be observed in Figure 1 is 1,61 which shows only moderate importance of these innovations in electronics sector. Further we can see that there is huge discrepancy between the importance of the particular organisational innovations: on one side the impact of organisational innovations as *supply chain management, total quality management, flexibility of work time, continuous improvement process, simultaneous engineering, team work, cross functional teams* and *decentralization of functions into customer or product-line oriented departments* can be perceived as relatively important due to the score that is higher than 2. On the other side the Figure 1 shows the organisational innovations as *outsourcing/relocation of R&D, zero-buffer, outsourcing/relocation of administrative activities, co-operation in administrative activities* and *decentralization of formerly centralized functions* which have the impact value that is below 1.

Considering the above we can say that in the electronics sector the innovations in a frame of product quality are of higher importance: control over product (as Total Quality Management), improvement of the production processes (as Continuous Improvement Processes), quality of human resources (as Team Work/Group Work) and control of the external relations (as Supply Chain Management). The important cognition in a frame of electronics sector is that the innovations as *simultaneous engineering* rank pretty high (the impact value above 2). All these reflect the electronics sector specific features which are specified by the literature as the control over the final product quality and the improvement of R&D strategies.

The average value of the impact of organisational innovations on quality is 1,63. The research cognitions show that the most impact on quality in electronics sector have the organisational innovations as *total quality management* and *continuous improvement,* where on the other hand the organisational innovations as *outsourcing/relocation of R&D, outsourcing/relocation of administrative activities, zero-buffer, cooperation in administrative activities* and *decentralization of formally centralized functions* have very low impact on quality in the electronic sector.

This cognition shows that the enterprises in electronics sector aim to keep high product quality standards in the entire production process cycle. On the other hand the enterprises in this sector have to ensure new products therefore also *Simultaneous Engineering* for improving the enterprises' R&D strategies is of high importance.

Figure 53: Ranking of the impact of different organisational innovations on quality in the electronics sector, n = 13

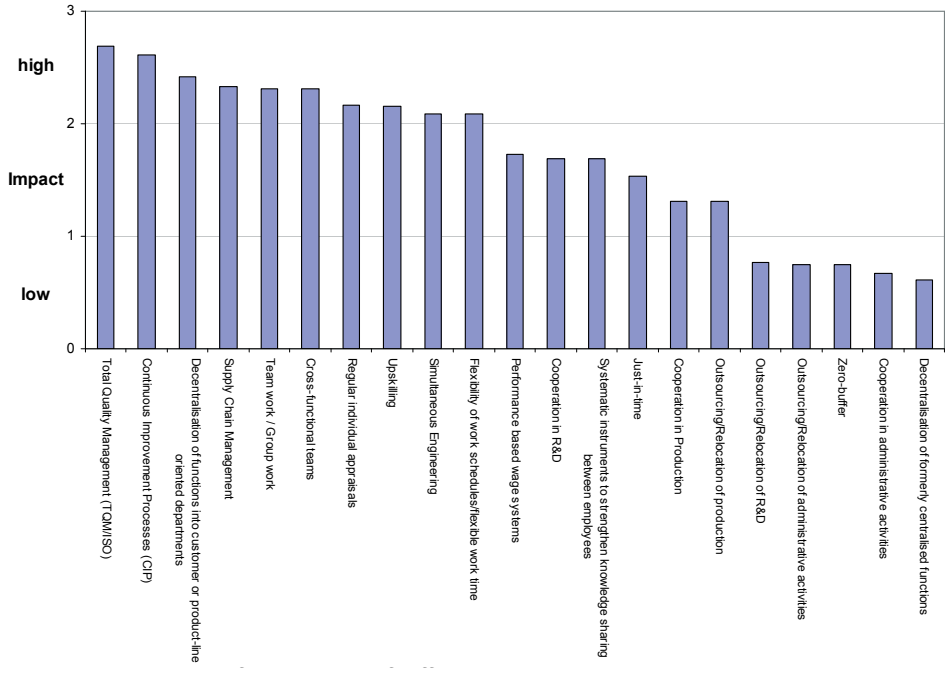
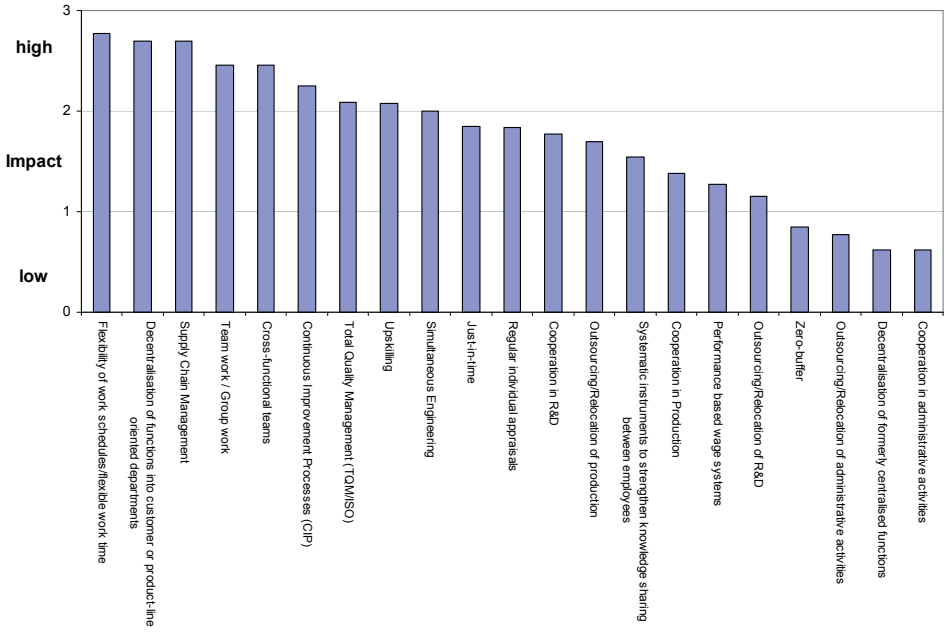
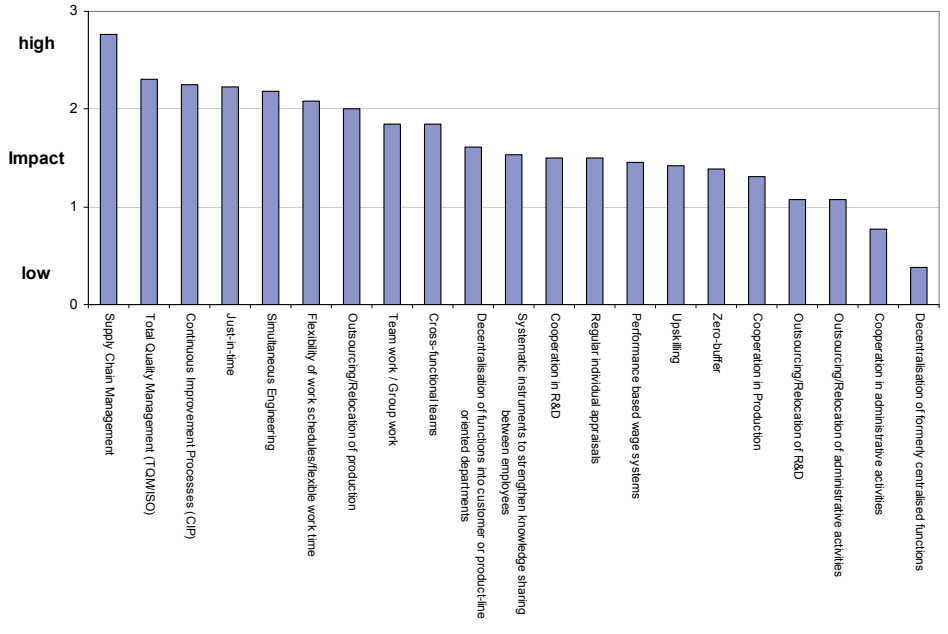


Figure 54: Ranking of the impact of different organisational innovations on flexibility in the electronics sector, n = 13



In a frame of costs reduction we face the lowest impact of organisational innovations considering the mean value of 1,56. This supports the previous indications that in the electronics sector the enterprises have to ensure the top quality and new products whereby they have to be very flexible. Anyhow, the research showed that the most impact on reduced costs in electronic sector have the organisational innovations *supply chain management* (value higher that 2,50), *total quality management, simultaneous engineering, flexibility of work schedules, continuous improvement processes* and *just-in-time management* (value 2 or higher), where on the other hand the lowest impact on costs reduction have the innovations *decentralization of formerly centralized functions, cooperation in administrative activities, outsourcing/relocation of administrative activities* and *outsourcing/relocation of R&D* (impact values less than 1) (see Figure 55).

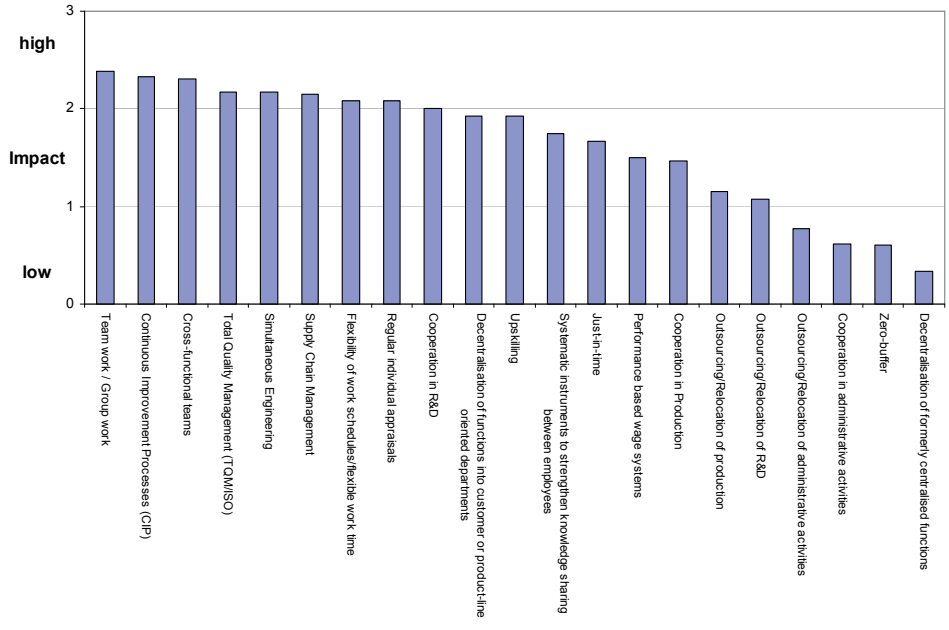
Figure 55: Ranking of the impact of different organisational innovations on costs in the electronics sector, n = 13



The mean value of the impact of the organisational innovations on increased innovation ability is 1,56. In comparison to other categories the most important organisational innovations have relatively strong impact in this category. Organisational innovations can therefore be considered as important factor for ensuring the innovation ability as the enterprises' competitive advantage. This again confirms previous indications that enterprises in electronics sector has to ensure the top quality products and to improve their R&D strategies in order to perform successfully – innovation ability is definitely one of the most important factors for achieving this.

Considering the research cognitions the most impact on increased innovation ability in electronic sector have the organisational innovations *total quality management, team work/group work, and continuous improvement process, flexibility of work schedules, regular individual appraisals, simultaneous engineering, cross-functional teams* and *supply chain management* (impact value higher than 2). On the other hand the research results show that the lowest impact on increased innovation ability have the innovations as *decentralization of formerly centralized functions, zero buffer, cooperation in administrative activities* and *outsourcing/relocation of administrative activities* (impact value lower than 1) (see Figure 56).

Figure 56: Ranking of the impact of different organisational innovations on innovation ability in the electronics sector, n = 13



12.5.3 Conclusion

Due to the importance of organisational innovations in electronic sector and their impact on flexibility, quality, costs reduction and innovation ability, the organisational innovations can be generally divided in two categories. Some of the accounted organisational innovations are of less importance for the electronic sector (e.g. *decentralization of formerly centralized functions, cooperation in administrative activities, outsourcing/ relocation of administrative activities, zero-buffer,* and *outsourcing/relocation of R&D* – all these organisational innovations with mean value less than 1). The most important organisational innovations in electronics sector are *supply chain management, total quality management, flexible work time, continuous improvement process, simultaneous engineering, team work/group work, etc.* (with impact value 2 or above) and have significant impacts on the four output dimensions (quality, flexibility, costs reduction and innovation ability).

Figure 57: Mean values for impact on quality, flexibility, costs and innovation ability

	Impact on increased quality	Impact on increased flexibility	Impact on reduced costs	Impact on increased innovation ability	Average
Decentralisation of functions into customer or product-line oriented departments	2,23	2,50	1,50	1,79	2,00
Decentralisation of formerly centralised functions	0,57	0,57	0,36	0,31	0,45
Team work / Group work	2,14	2,29	1,71	2,21	2,09
Cross-functional teams	2,14	2,29	1,71	2,14	2,07
Cooperation in Production	1,21	1,29	1,21	1,36	1,27
Cooperation in R&D	1,57	1,64	1,38	1,86	1,61
Cooperation in administrative activities	0,62	0,57	0,71	0,57	0,62
Outsourcing/Relocation of production	1,21	1,57	1,86	1,07	1,43
Outsourcing/Relocation of R&D	0,71	1,07	1,00	1,00	0,95
Outsourcing/Relocation of administrative activities	0,69	0,71	1,00	0,71	0,78
Continuous Improvement Processes (CIP)	2,43	2,08	2,08	2,15	2,18
Total Quality Management (TQM/ISO)	2,71	2,15	2,36	2,23	2,36
Flexibility of work schedules/flexible work time	2,15	2,79	2,14	2,15	2,31
Upskilling (Job enlargement, Job enrichment, empowerment)	2,00	1,93	1,31	1,79	1,76
Regular individual appraisals	2,23	1,92	1,62	2,15	1,98
Performance based wage systems	1,58	1,17	1,33	1,38	1,37
Systematic instruments to strengthen knowledge sharing between employees	1,57	1,43	1,43	1,62	1,51
Just-in-time	1,43	1,71	2,07	1,54	1,69
Zero-buffer	0,69	0,79	1,29	0,55	0,83
Simultaneous Engineering	2,17	2,00	2,17	2,15	2,12
Supply Chain Management	2,31	2,64	2,71	2,14	2,45
Mean value	1,64	1,67	1,57	1,57	1,61

Considering the mean value of the impact of organisational innovations in electronic sector (1,61) we can say that the impact is rather of moderate importance. Surprisingly the impact of organisational innovations on innovation ability and costs reduction of enterprises in electronics sector is the lowest (mean value 1,57). On the other hand the research results show that the most relevant organisational innovations in electronics sector are those that are linked to the improvement of the product and processes quality. In a frame of human resource management also organisational innovations as *team work* have an important impact in electronic sector, which results in the strongest impact of organisational innovations on increased flexibility (mean value 1,67).

12.6 Food

WRITTEN BY R. EVANGELISTA, M. PIANTA, C. COZZA (LUNARIA, ITALY)

For the food industry, 9 stakeholder interviews have been conducted, thereof 7 interviews with industry representatives and 2 interviews with research representatives. The interviews have been conducted with employees of food companies in France, Italy, Slovenia, Czech Republic, and in the UK.

12.6.1 Desk research

The food sector is generally considered a traditional and low-tech industry. In spite of that, both the economic literature and the interviews carried out for the current project show a slightly different situation. In particular, some specific issues related to organisational innovation can play an important role in this industry.

Recent contributions (Schiavone, 2001; Giulietti, Mccorriston and Osborne, 2004) show that, using the percentage of firms introducing innovation as a technological indicator, the food sector is positioned slightly below the overall manufacturing average, with less than two thirds of innovative firms in total. Furthermore, firms in the food sector spend only half of the manufacturing average. Those data seem to show that technological innovation – in a strict sense – does not represent the main competitive advantage in this sector. Other types of innovation and organisational strategies might also play an important role.

In fact, the existing literature shows that firms in the food sector pursue different types of strategies aiming at increasing the quality of their products, processes and the supply chain. In recent years, one of the major opportunities for small firms has in fact been the shift towards organic food and regional brands; in order to resist international competition, they have reduced the use of chemical inputs, increased the human capital intensity and acquired leadership in niche sectors. This way, organisational innovations can be seen as means to combine improvements in both products and processes. Large firms are likely to pursue a wider range of technological and organisational strategies aiming at exploring the potentials of bio-technologies and achieving efficiency gains through the internationalisation of production and a tight control of the supply chain. R&D in the food sector is mainly concentrated in large firms and organisational changes directed to improve these activities are likely to be of little relevance among SMEs. The food sector as a whole is "FDI intensive" and this has important implications for organisational change. However, the importance of FDI varies significantly across the industries that comprise this sector. Furthermore, FDI tend to concentrate in developed countries: it is likely that quality and safety requirements have spurred large firms to locate plants in countries with a skilled labour force, making use of expertise in order to better meet the needs of a more sophisticated demand.

Furthermore, both the regional clustering of small firms and the search of large firms for a highly skilled labour force led to a higher interaction with local infrastructure, thus producing a collaborative development of new products and labour practices. We can therefore assume that total quality management and quality circles are expected to be keywords to understanding organisational change in this industry.

Moreover, the experts interviewed think that decentralisation at a strategic level is very relevant: decentralisation of functions into customer or product-line oriented departments as well as the decentralisation of formerly centralised functions strongly influence quality and flexibility and moderately influence the innovation ability and costs. As regards other variables, such as relocation/outsourcing, experts rather disagree on whether they are relevant or not in the food sector, thus implying the need for verification through industry interviews.

The considerations above represent some stylised features of innovation in services which can be drawn from the existing literature and recent surveys; the issues can be further investigated using the results of the interviews to firms and experts. In the following we look for direct evidence on the following three questions:

Is organisational innovation as a whole important in the food sector?

Which are the most relevant organisational innovations?

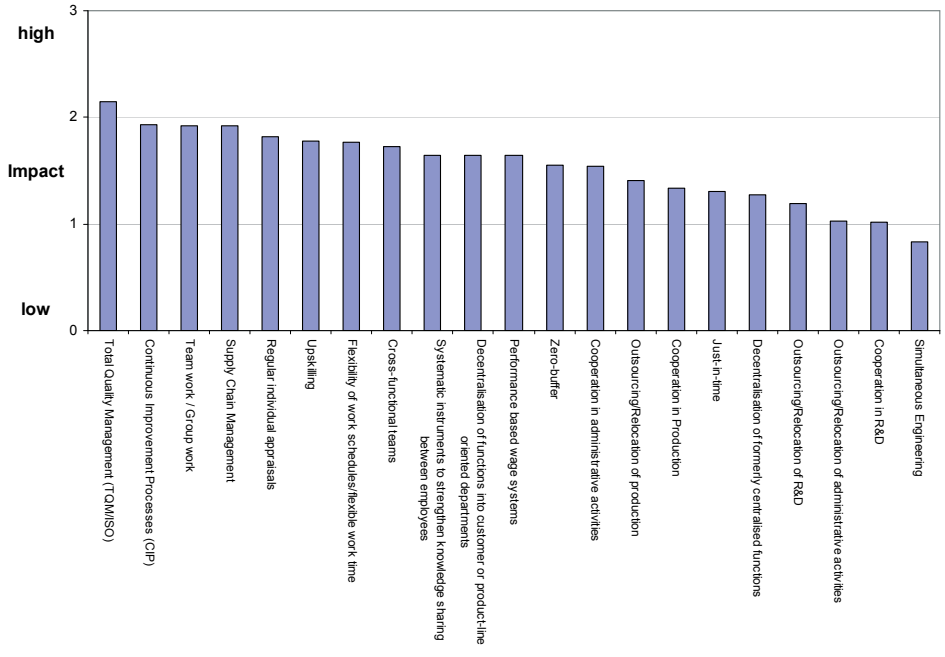
What is their impact and which domains of firms' performances are more affected by organisational innovations?

12.6.2 Impact of organisational innovations on output dimensions

The average impact of organisational innovations

The interviews carried out for the food sector allow us to estimate the overall importance (measured in terms of impact) of the various types of organisational innovation taken into account in this study. Figure 58 shows – for each organisational innovation – the average score given by firms and experts to different impact dimensions of organisational innovation (namely quality, costs, flexibility, innovation ability).

Figure 58: Ranking of the importance of different organisational innovations in the food sector, n = 9



The average value across the different organisational innovations in Figure 58 is 1.54: that means a moderate importance of organisational innovations in the food sector. That is coherent with the evidence regarding technological performances of this industry. Figure 58 also shows a rather limited variance of the indexes across the different types of organisational innovations which confirms the idea of an overall moderate impact of organisational innovations in this industry. Nonetheless some organisational innovations are perceived as relatively important obtaining an average score above 2.

We can note that innovations which are likely to have a more direct impact on product quality have a higher importance. These innovations are linked to the overall control of quality in the

firm (such as Total Quality Management), to the improvement of the production processes internal to the firm (such as Continuous Improvement Processes), to the quality of human resources (deriving from Team work and Upskilling) and to the control of external relations (for instance by Supply Chain Management).

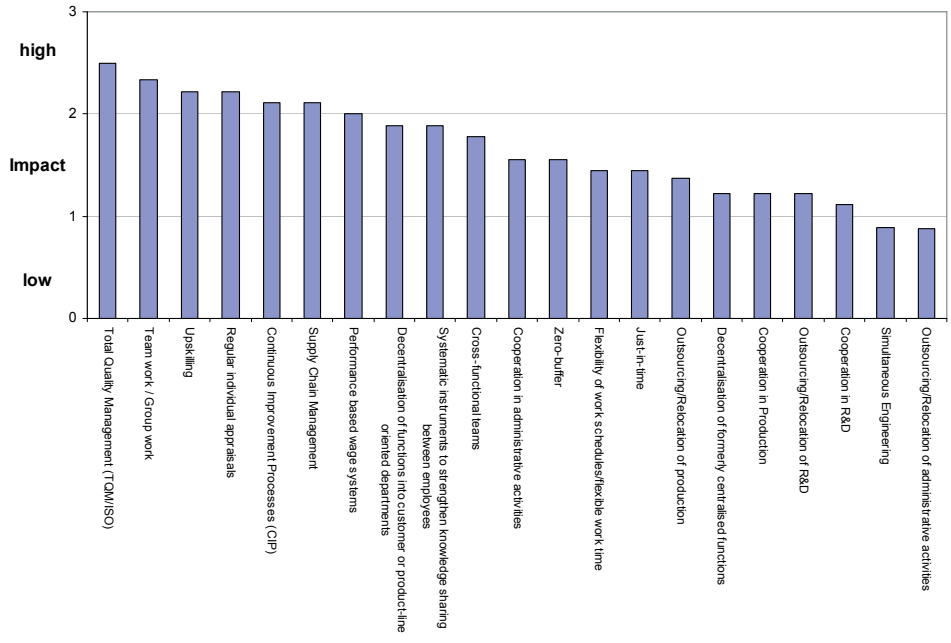
On the other side, the least important innovations are those linked to the improvement of R&D strategies and of the mere technical aspects of processes (for instance, Simultaneous Engineering is considered the organisational innovation with the lowest importance). This is likely to reflect a sector-specific feature. As suggested by the literature, the food sector is characterised by a high focus on the control of the final product quality. Quality is obtained via the implementation of a set of organisational arrangements aiming at keeping high quality standards in the entire production process cycle and filière rather than through R&D efforts. In this sense product, process and organisational innovation can be conceived as part of a unique and integrated strategy.

The impact of organisational innovations on quality

The considerations presented in the general part are confirmed by the chart on the impact of organisational innovations on quality (see Figure 59). First of all, in this case we obtain the highest mean value (1.67), meaning that organisational innovations in the food sector are more important for the achievement of increased quality than for other "impact categories". Several organisational innovations contribute to this result, given that seven of them are above a significant value (2.00). As pointed out by experts, Total Quality Management is still the most important category, as well as organisational changes in the human resources area of human resources (Team work and Upskilling) and those aiming at improving the quality and efficiency of processes and the relationship with suppliers (Continuous Improvement Processes and Supply Chain Management). All those innovations assure the control on quality standards, which are of prominent importance in the food sector.

Finally, the three least important organisational innovations are the same as on average, though with a different ranking: Cooperation in R&D, Simultaneous Engineering and Outsourcing/Relocation of administrative activities.

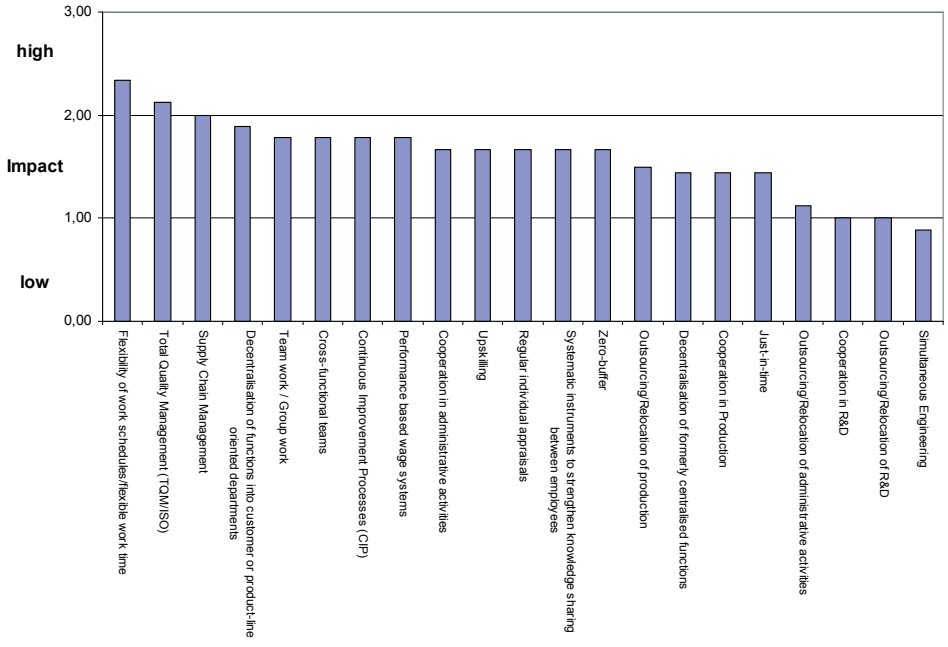
Figure 59: Ranking of the impact of different organisational innovations on quality in the food sector, n = 9



The impact of organisational innovations on flexibility

Organisational innovations seem to have a lower impact on flexibility (see Figure 60) than on quality. In fact, only three innovations show a moderate impact (values equal or above 2.00) on flexibility. As expected, the highest impact is related to organisational innovations finalised to improve the flexibility of work practices (such as Flexibility of work schedules/flexible work time: 2.33). The organisational innovations linked to quality improvements show also a moderate impact. Finally, among the three least important categories, Outsourcing/Relocation of R&D replaces Outsourcing/Relocation of administrative activities; while Simultaneous Engineering maintains the lowest position, thus confirming the previous indications.

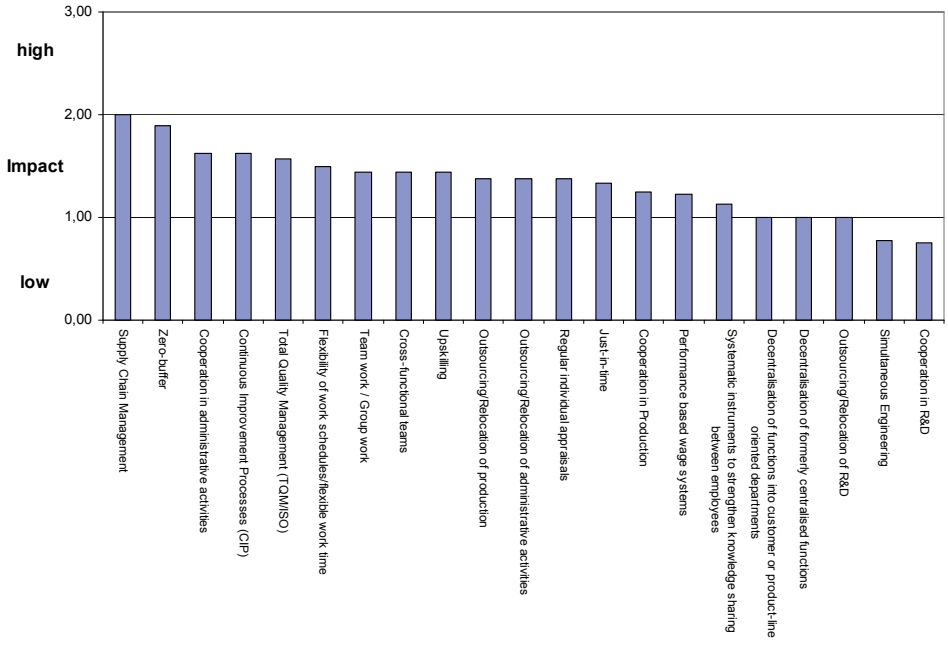
Figure 60: Ranking of the impact of different organisational innovations on flexibility in the food sector, n = 9



The impact of organisational innovations on costs reduction

A more important result seems to come from the analysis of the impact of organisational innovations on costs reduction (see Figure 61). The overall mean is only 1.34. Only Supply Chain Management (with a value of 2.00) seems to have a moderate impact on costs reduction, thus implying two considerations: if quality is the main competitive strategy in the food sector, it is coherent that firms tend to ignore the opposite strategy represented by the reduction of costs; Supply Chain Management is a double-face strategy, since it allows both the improvement of quality standards and the control of costs. This is confirmed by the opinion of experts which support the idea that organisational innovations in the food sector have a higher importance if connected with the qualitative improvement of products rather than with the reduction of costs.

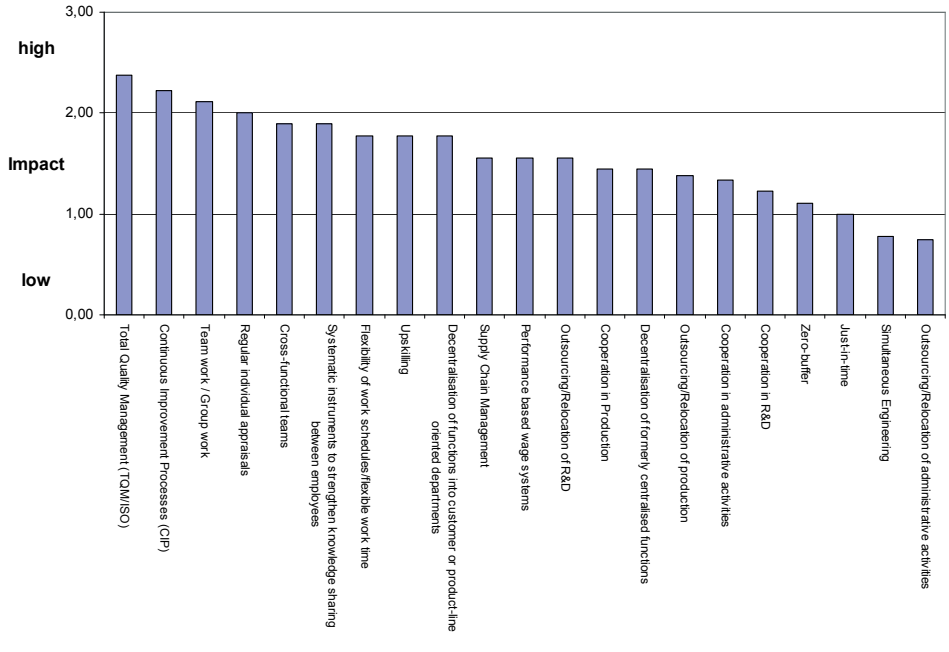
Figure 61: Ranking of the impact of different organisational innovations on costs in the food sector, n = 9



The impact of organisational innovations on innovation ability

In the case of impact on innovation ability (see Figure 62), the overall mean is in line with the average chart (1.57). The most important organisational innovations seem to have a higher impact on this category than on the previous ones, although lower than on quality. Therefore, organisational innovations can be considered useful in order to strengthen firms' ability to use them as a fruitful competitive advantage. The more they are used inside the firm, the more innovation ability rises and this leads to better performances. From this point of view, it is coherent that innovations linked to the improvement of quality standards (for instance, Total Quality Management and Continuous Improvement Processes) or human resources (e.g. Team work) show the highest impact on innovation ability.

Figure 62: Ranking of the impact of different organisational innovations on innovation ability in the food sector, n = 9



12.6.3 Conclusions

Figure 63 allows us to summarise the results of the interviews.

The first and most striking result is that organisational innovations in the food sector seem to have only a moderate importance. A first implication of this result is that the innovative profile of this industry remains rather low even when organisational changes are taken into account. Secondly, the most relevant organisational innovations are those linked to the improvement of *quality standards* referred to both products and processes. *Total Quality Management* and *Continuous Improvement Processes* – on the process control side – and *Team work* – on the human resources side – are the most important types of organisational innovations introduced in this industry. This result is consistent with the opinion of experts which have suggested that firms in the food sector, in order to be competitive, have to keep a tight control on the quality standard of human resources, of internal production processes and of the supply chain. This is confirmed by the results of the interviews which show high scores attached to *Continuous Improvement Processes (1.92)* and *Supply Chain Management* on average (1.92). Both these types of organisational changes have a relevant impact on quality.

Costs reduction strategies seem on the contrary less important as competitive factors. The same can be said regarding organisational changes in the *R&D* area (cooperation and outsourcing) as well as other typical *production management* tools: *Just-in-time* and *Simultaneous Engineering* are always among the least important organisational innovations.

Figure 63: Synthesis of most relevant organisational innovations in the food sector, n = 9

AVERAGE IMPACT	
Mean	**1.54**
Four most relevant organisational innovations	Total Quality Management (2.14)
	Continuous Improvement Processes (1.93)
	Team work / Group work (1.92)
	Supply Chain Management (1.92)
Four least important organisational innovations	Outsourcing/Relocation of R&D (1.19)
	Outsourcing/Relocation of administrative…(1.03)
	Cooperation in R&D (1.02)
	Simultaneous Engineering (0.83)

IMPACT ON INCREASED QUALITY	
Mean	**1.67**
Most relevant organisational innovations (values equal or above 2.00)	Total Quality Management (2.50)
	Team work / Group work (2.33)
	Upskilling (2.22)
	Regular individual appraisals (2.22)
	Continuous Improvement Processes (2.11)
	Supply Chain Management (2.11)
	Performance based wage systems (2.00)

IMPACT ON FLEXIBILITY	
Mean	**1.60**
Most relevant organisational innovations (values equal or above 2.00)	Flexibility of work schedules (2.33)
	Total Quality Management (2.13)
	Supply Chain Management (2.00)

IMPACT ON REDUCED COSTS	
Mean	**1.34**
Most relevant organisational innovations (values equal or above 2.00)	Supply Chain Management (2.00)

IMPACT ON INNOVATION ABILITY	
Mean	**1.57**
Most relevant organisational innovations (values equal or above 2.00)	Total Quality Management (2.38)
	Continuous Improvement Processes (2.22)
	Team work / Group work (2.11)
	Regular individual appraisals (2.00)

References:

Giulietti, M., Mccorriston, S. and Osborne, P. (2004): Foreign direct investment in the UK: evidence from a disaggregated panel of UK food sector. In: Applied Economics, 36, 653-663.

Schiavone, F. (2001): Un caso meridionale di delocalizzazione produttiva. Finalità, strategie, ipotesi. In: Economia e Società Regionale, 3, 63–83.

12.7 Machinery

WRITTEN BY H. ARMBRUSTER, E. KIRNER, G. LAY (FRAUNHOFER ISI)

For the Machinery industry, 15 stakeholder interviews have been conducted, thereof 8 interviews with industry representatives and 7 interviews with research representatives. The interviews have been conducted with employees of machinery companies in Germany, France, Italy, Croatia, Bulgaria, Slovenia, Sweden, and in the UK.

12.7.1 Desk research

The machinery sector is one of the largest manufacturing sectors in Europe, contributing about 10% of the EU production value. It includes a heterogeneous group of manufacturers: for instance, machine tools, machinery for textile, apparel and leather production, machinery for iron and steel production and agricultural machinery. All over Europe, 2.7 million people are employed in the machinery industry.[13] The sector is of significant importance for the European economy and for employment. The major producers of machinery are Germany (35% of the machines manufactured in the EU are produced there), Italy, France, and the UK. Within these countries, the performance of the machinery sector has a major relevance for employment and economic growth.

The machinery sector is dominated by small and medium sized companies. Compared to other manufacturing industries, this sector employs a higher share of highly qualified employees[14] and is characterised by a high level of innovation activity. A satisfying supply of qualified personnel is therefore needed. The production is labour-intensive and needs highly qualified staff to produce products of high performance and quality. Cyclical variations in demand require companies to be flexible and able to adjust their capacities and products in order to meet the demands of the customers. Therefore current restructuring activities often aim at flexibility. The sector has been confronted with a recession in 1992/1993, leading to a significant loss in employment and eco-

([13]) of which 900.000 employees in Germany alone.
([14]) In Germany, the share of highly qualified technicians is 16%, whereas on average for all manufacturing industries it only reaches 10%.

nomic strength. After the end of the recession period, parts of this loss have been compensated through increased price competition and the continuous introduction of innovative products. Nowadays, however, the sector is increasingly confronted with competition from the USA, Japan, and Asia. As a response to globalisation, machinery producers have increased their foreign direct investments and their international activities in terms of global sourcing and outsourcing. New information and communication technologies support these international activities.

The EU is still leading in the machinery sector providing 65% of all innovations (new products, patents etc.) within the entire manufacturing sector. The main sources of innovation are R&D (42% of all innovations emanate from this source); interaction with clients (30-50%), interaction with enterprise groups (30%) and interaction with suppliers (18-21%). Innovation activities of this sector take place in close cooperation and collaboration with clients, suppliers and research organisations. Interdisciplinary innovation teams also play an important role for innovation in the machinery sector. Rapid prototyping and simultaneous engineering are further requirements for continuous, collaborative innovation. Cross-sectoral, cross-regional and international partnerships are becoming increasingly important for product and system development, especially with regard to the rise of larger multinational companies. Facing the emergence of large competitors, small and medium sized companies are pressured to reformulate their business strategies and networking linkages within and beyond their home regions.

Due to the high complexity of their products, machinery producers are required to offer a wide range of product related services to their customers. They also often act as general contractors to their customers, integrating the contributions of different subcontractors. Here, the efficient management of cooperation networks is of significant importance.[15]

12.7.2 Impact of organisational innovations on output dimensions

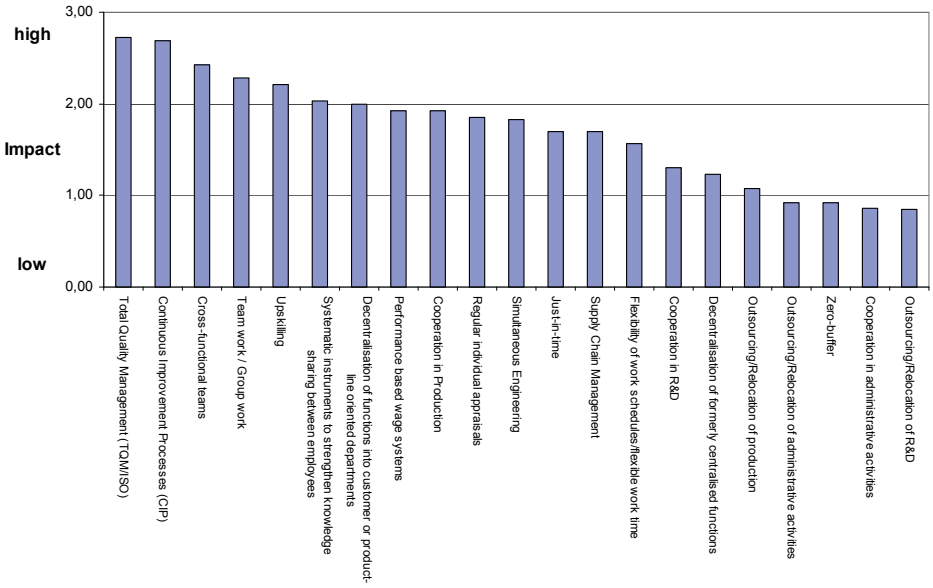
Within the context of PORCH 15 stakeholder interviews have been conducted in the machinery sector of which 8 with research and 7 with industry representatives. In this sector, organisational innovations play an important role for enterprises. Except outsourcing/relocation of R&D no organisational innovation has been assessed as having no impact. Every one of the 20 other organisational innovations are considered by the experts to be of relevance for this sector. This confirms the results of the desk research which already indicated a high degree of innovativeness of the machinery sector. Enterprises compete not mainly on the basis of costs but on the basis of innovation and quality. This implies that outsourcing of R&D is not a favoured strategy since the innovation capacity is one of the key core competences of many enterprises in this sector.

Impact of organisational innovations on increased quality

As expected the assessment of the different organisational innovations by the stakeholders considering their impact on quality revealed that the highest impact on this output dimension results of the two quality related organisational innovations total quality management (TQM) and continuous improvement processes (CIP). These two quality measures show the same degree of impact followed by cross-functional teams, team work/group work and upskilling. This is plausible ranking, since all three other organisational innovations with still high impact on quality are related to qualification and wider competences which enable higher quality. In contrast, according to the experts, organisational innovations like zero buffer, cooperation in administration or different forms of outsourcing are of almost no relevance for increased quality. These organisational innovations do not aim at the improvement of quality but have different targets like the reduction of stock keeping or costs. Therefore it is not to be expected that they display a high impact on increased quality.

(15) References used for machinery sector: Wengel and Shapira (2004); Vieweg et al. (2002); Kuhlman, Sperling and Balzert (2004); European Commission, Enterprise Directorate General (2002); European Commission, Enterprise Directorate General (2003); The European E-Business Market Watch: Electronic Businesses in the Manufacture of Machinery and Equipment (2005).

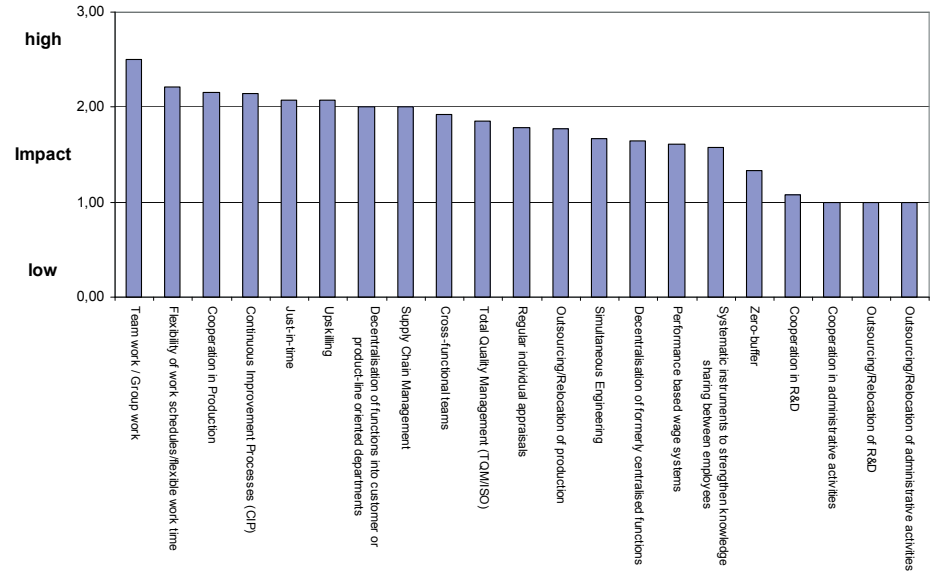
Figure 64: Ranking of the impact of different organisational innovations on quality in the machinery sector, n = 15



Impact of organisational innovations on increased flexibility

In case of the effects on increased flexibility it can be observed that all organisational innovations have at least low impact on this dimension in the machinery sector. Team work/group work has the strongest impact on flexibility, followed by flexibility of work schedules and cooperation in production. All these organisational innovations precisely aim at flexibility, team work and flexibility of work schedules through a more flexible work organisation, and cooperation in production through the possibility to allocate production orders among the cooperation partners and thus being flexibly able to adapt manufacturing capacities to the demand situation.

Figure 65: Ranking of the impact of different organisational innovations on flexibility in the machinery sector, n = 15



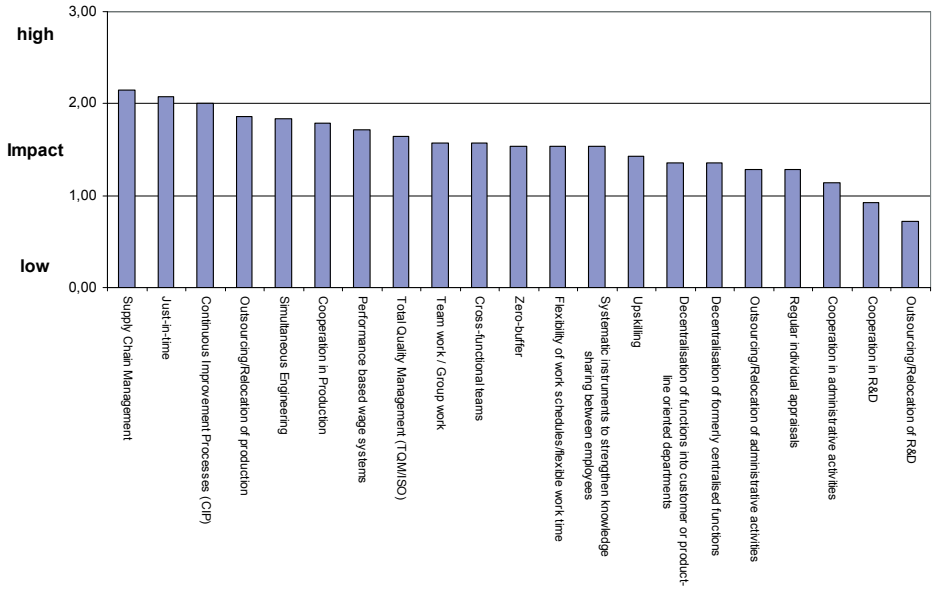
Experts ascribe the least impact on flexibility to outsourcing or administrative activities, outsourcing of R&D and cooperation in both of these areas. This might be due to the special focus

of outsourcing and cooperation in the areas of administration and R&D. Outsourcing and cooperation of administrative activities do not increase internal flexibility because the processes are externalised and therefore less accessible and controllable by the enterprise. Similarly, in case of outsourcing and cooperation in R&D, the R&D process is not entirely taking place inhouse and therefore can be much less influenced flexibly by the enterprise itself. Through the involvement of subcontractors or cooperation partners into the R&D process, the degree of freedom decreases for the single company.

Impact of organisational innovation on reduced costs

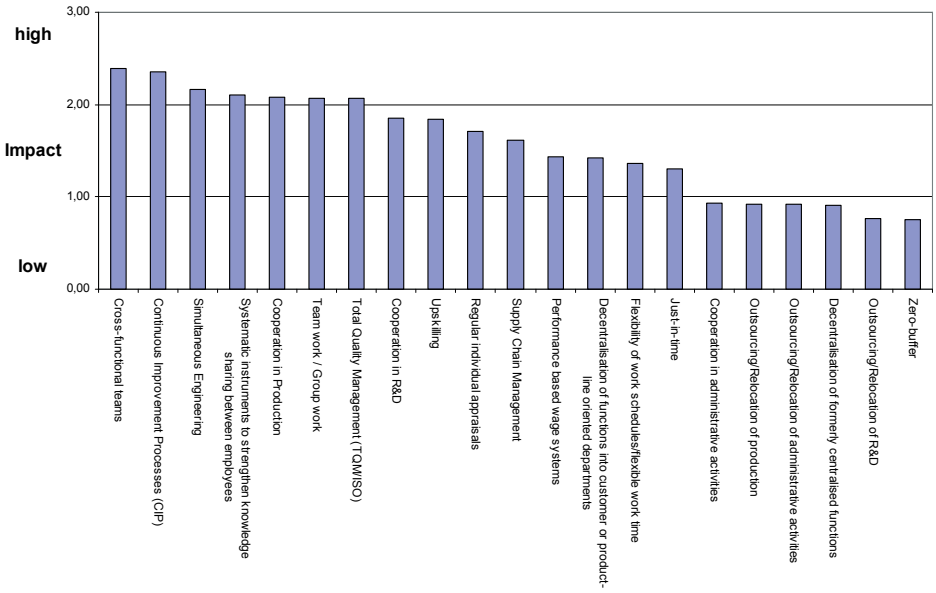
The experts have assessed the impact of organisational innovations on the reduction of costs to be only medium to low. In the machinery sector, organisational innovations do not seem to have a very strong influence on cost reduction according to the stakeholders. Most of the organisational innovations asked for have been estimated to have less than medium impact on the reduction of costs. Only supply chain management, just in time and continuous improvement processes (CIP) have been considered to be of significant relevance for the goal of cost reduction while outsourcing and cooperation in R&D seem to have the least effect on costs. This is to be expected, since the aim of cooperation in R&D and outsourcing is to acquire external know-how.

Figure 66: Ranking of the impact of different organisational innovations on costs in the machinery sector, n = 15



Considering the impacts of different organisational innovations on the innovation ability of an enterprise, the assessments of the stakeholders revealed huge differences for the machinery sector. Some organisational innovations like cross-functional teams, continuous improvement processes, simultaneous engineering or systematic knowledge management have been estimated to have strong impacts on increased innovation ability of companies in the machinery sector. Cross-functional teams and simultaneous engineering are indeed organisational innovations which precisely aim at improving the product development process. Their strong impact on the innovation ability of enterprises is therefore not surprising. Equally, although continuous improvement processes are mainly quality related, they also have effects on the overall performance of the firm, as well as effective knowledge management.

Figure 67: Ranking of the impact of different organisational innovations on innovation ability in the machinery sector, n = 15



Besides organisational innovation with a high impact on increased innovation ability, experts have also identified some organisational innovations which do not seem to influence this output dimension in the machinery sector. Zero buffer, outsourcing of R&D, decentralisation of formerly centralised functions, outsourcing both of administrative activities and of production or cooperation in administration are organisational innovations which do not play a role related to the innovation ability of an enterprise. While most of these aspects are clearly not related to the innovation ability of a company, but rather to other aims, it is surprising that outsourcing of R&D should be considered of low importance. This might be explained through differences in the understanding of the term innovation ability. If this was understood by experts as strictly in-house innovation ability, then the outsourcing of R&D clearly does not increase it.

12.7.3 Conclusions

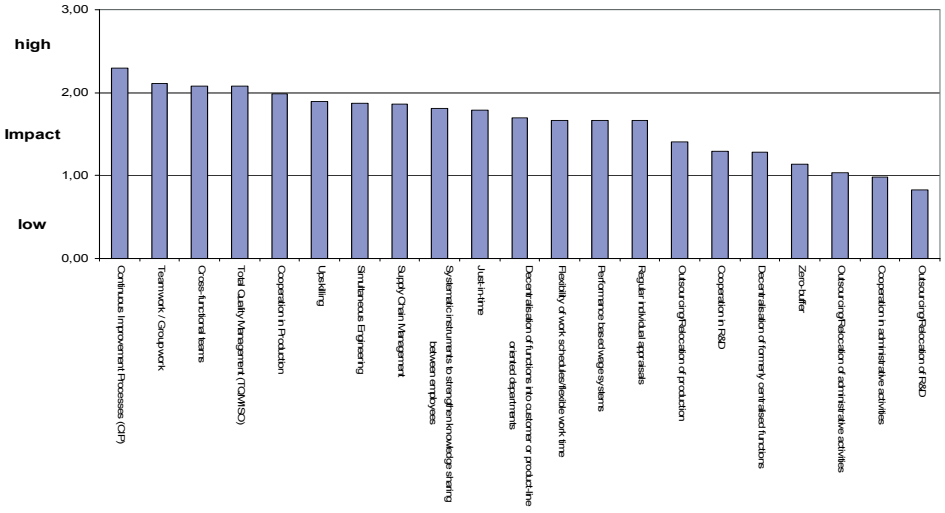
The analysis of the stakeholder interviews in the machinery sector has shown that the organisational innovations asked for generally displayed the highest impact on quality and generally less on cost reduction. The most controversial effects of organisational innovations have been estimated by the experts on the innovation ability of the enterprise. Here, organisational innovations seem to differ very strongly.

If looking at the overall relevance of organisational innovations in total, integrating all four different output dimensions in one ranking, it becomes clear that organisational innovations have only a medium relevance for the machinery sector, based on their impact on the output dimensions quality, flexibility, costs and innovation ability. The overall relatively most important organisational innovations in this sector are continuous improvement processes, team work, cross-functional teams and total quality management. This ranking shows that organisational innovations which explicitly aim at quality improvement, innovation and increase of flexibility play the most important role in the machinery sector. Of medium overall relevance for this sector are production management related organisational innovations like just in time, supply chain management or simultaneous engineering while outsourcing and cooperation in administration and R&D are of no significant relevance here.

These overall results confirm the general situation of the machinery sector drafted on the basis of desk research. The machinery sector mainly competes on the basis of quality and innovation.

Therefore, outsourcing of R&D is not a main issue, since also own innovation capacities have to be developed as a core competence besides sustaining cooperations in this area.

Figure 68: Ranking of the importance of different organisational innovations in the machinery sector, n = 15



12.8 Medical devices

WRITTEN BY M. SZWEJCZEWSKI (CRANFIELD SCHOOL OF MANAGEMENT)

For the medical industry, 9 stakeholder interviews have been conducted, thereof 8 interviews with industry representatives and 1 interview with research representatives. The interviews have been conducted with employees of medical devices companies in Germany, France, Slovenia, and in the UK.

12.8.1 Desk research

The medical devices sector has a high level of research and development (R&D) activity. Research and development expenditure as a percentage of turnover is more than twice that of many other manufacturing sectors. More than fifty percent of the turnover of medical devices companies is as a result of products that are less than 2 years old. The sector is very dynamic and is characterised by short product life cycles. This leads to the conclusion that organisational innovations that deal with simultaneous and therefore faster research and development processes may be of particular importance for firms in this sector. Examples of such organisational innovations are simultaneous engineering and cross-functional teams.

One of the main influences on medical device companies is the federal administration system, for example the European Agency for the Evaluation of Medical Products (EMEA) or the Food and Drug Administration (FDA) in the USA. Medical devices are predominantly controlled for their security and technical performance, as well as for the patients' benefits. Therefore, producers of medical devices are obliged to establish quality documentation systems. They have to prepare quality data about these products in a much more expensive way compared to other sectors. Consequently, organisational concepts dealing with the monitoring of internal quality such as total quality management or quality circles should be of particular importance to this sector.

The medical devices industry is mainly composed of small and medium sized companies, but there are also several large companies operating in this sector. Most of the small, medium and large companies are regionally clustered. One of the main characteristics of this sector is the high level of cooperation between the small, medium and large firms. The small and medium sized organisations often provide ideas for a product, whereas the large firms deal with obtaining funding and getting market access. Thus, cooperation between firms is one of the main characteristics of this industry. Therefore, organisational concepts supporting cooperation between companies might be of particular importance for this sector. Joint ventures, R&D cooperation, networks and alliances as well as corporate venturing concepts are possible organisational innovations, which are of particular importance to his sector.

Through increased competition in the medical devices market, companies are more and more forced to respond to customers' demands. It is the business strategy of many medical devices companies to increasingly focus on process chains. This leads to less centralised organisational structures and to more decentralised product and customer-oriented units. Innovative organisational concepts dealing with decentralisation and process-oriented structures such as business process reengineering might be of importance in this sector.

12.8.2 Impact of organisational innovation on output dimension

The experts (in research and industry) were asked to assess the intensity of impact (low, moderate and strong) of 21 organisational innovations on four dimensions: quality, flexibility, cost and innovative ability. The organisational innovations cover the following areas: decentralisation at the strategic level, decentralisation at the operative level, cooperation with other companies, outsourcing and relocation, quality management, human resource management, knowledge management, and production management. Let us now examine the impact of each in turn.

(1) Decentralisation at the strategic level

In the medical devices sector, decentralisation at a strategic level is of relatively low importance according to the experts. The decentralisation of functions into customer or product-line orientated departments only has a low impact on all four of the output dimensions (quality, flexibility, cost and innovation). The decentralisation of formerly centralised functions also has a low impact on all four dimensions. The results show that, in the opinion of the experts, decentralisation at a strategic level is considered to be of medium importance (see Figure 73).

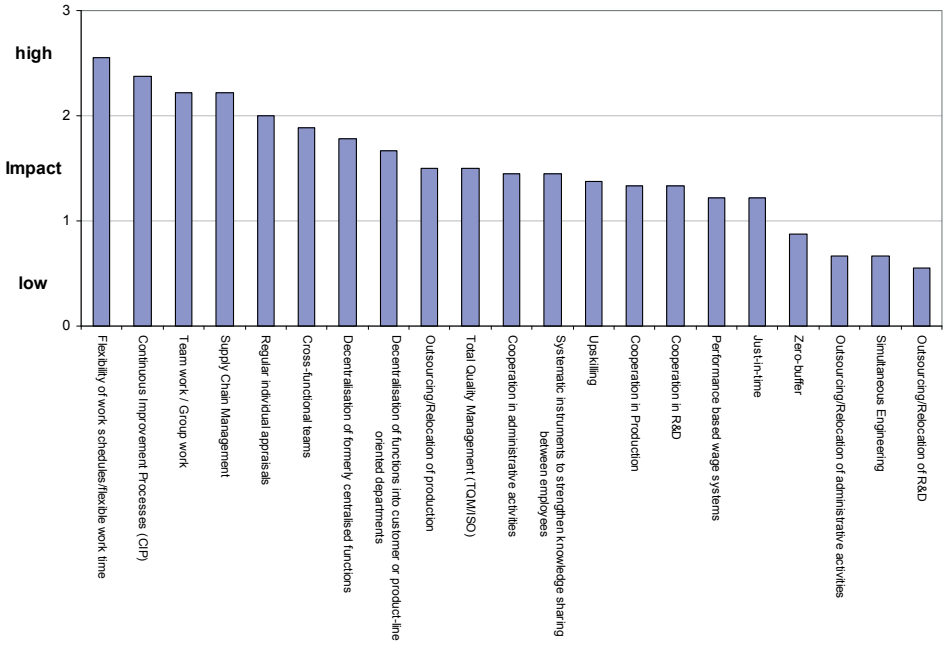
(2) Decentralisation at an operative level

The results of the interviews with regard to the decentralisation at an operative level suggest a different position compared to decentralisation at the strategic level. The experts indicate that both team work/group work and cross-functional teams have a significant impact on the output dimensions. Team work/group work has in their opinion a strong impact on quality and flexibility (see Figure 70 and Figure 69 respectively). While cross-functional teams are said to have a strong impact on quality and innovation (see Figure 70 and Figure 72 respectively). Both team work and cross-functional teams are considered by the experts to be in the top five most important organisational innovations for the medical devices sector (see Figure 73).

(3) Cooperation with other companies

Cooperation with other companies is considered to have a low impact in this sector. The experts suggest that cooperation in productions cooperation in R&D and cooperation in administrative activities have a low impact on the four output dimensions.

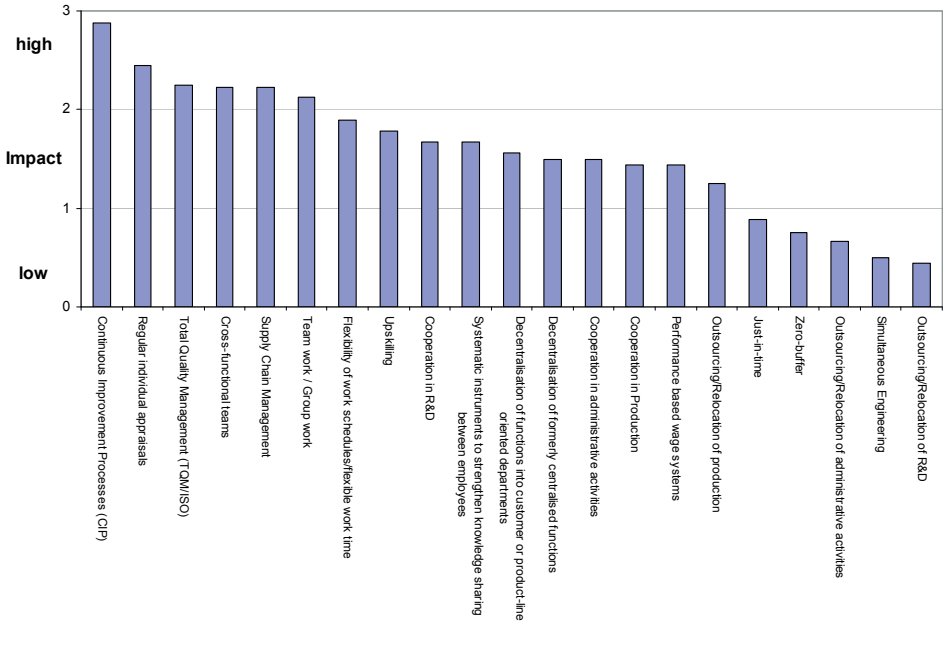
Figure 69: Ranking of the impact of different organisational innovations on flexibility in the medical devices sector, n = 9



(4) Outsourcing/relocation

The outsourcing/relocation of production is considered to be partially important in this sector. The experts are of the opinion that the outsourcing/relocation of production has a much bigger impact than the outsourcing/relocation of R&D or the outsourcing/relocation of administrative activities. The outsourcing/relocation of production is considered to have a moderate impact on cost (see Figure 71), and a much lower impact on quality, flexibility and innovation. The outsourcing/relocation of R&D is considered to have a very low impact on the four factors. The outsourcing/relocation of administrative activities is also considered to have very low impact on the four factors.

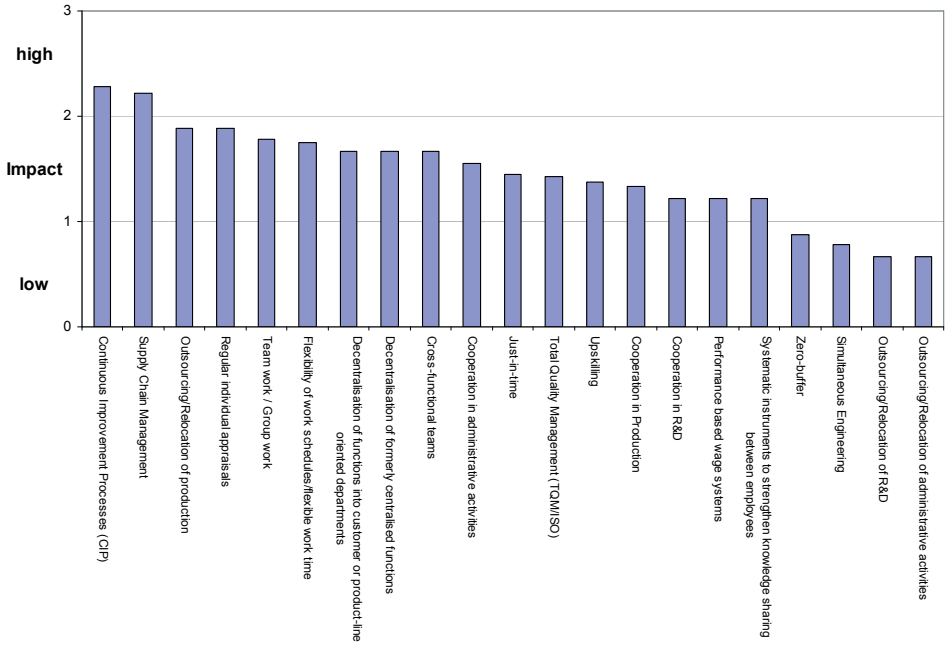
Figure 70: Ranking of the impact of different organisational innovations on quality in the medical devices sector, n = 9



(5) Quality Management

The experts are of the opinion that continuous improvement processes and total quality management has a significant impact on the four factors. Continuous improvement is considered to have a strong impact on quality (see Figure 71), flexibility, cost and innovation. Across all the organisational innovations continuous improvement is considered to be the most important innovation in the medical devices sector (see Figure 73). Total quality management is considered to have a strong impact on quality (see Figure 70), but to have less impact on flexibility, cost and innovation. Overall, quality management is considered to be important in this industrial sector.

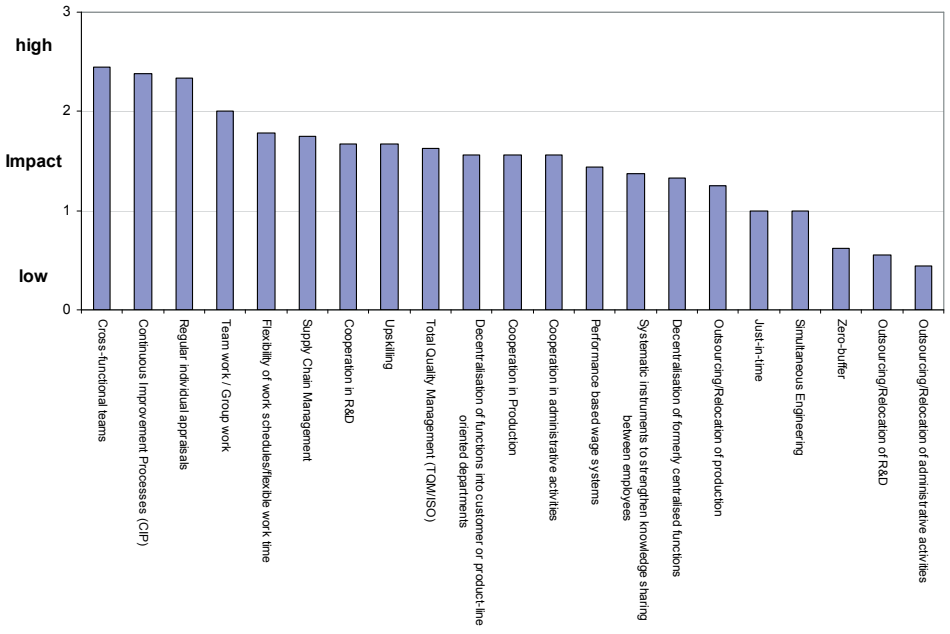
Figure 71: Ranking of the impact of different organisational innovations on cost reduction in the medical devices sector, n = 9



(6) Human Resources

The experts' opinions suggest that the organisational innovations in the area of human resources management have, in general, a moderate impact on the four factors. The flexibility of work schedules is considered to have a strong impact on flexibility (see Figure 69) and a moderate impact on quality, cost and innovation. Regular individual appraisals have a strong impact on quality and innovation ability and a moderate impact on cost and flexibility. Upskilling and performance based wage systems appear to have a low impact on the four output measures. In this group the four organisational innovations do vary in their impact, regular individual appraisals appear to be considered to be the most important – they rank second in importance out of the 21 organisational innovations. The flexibility of work schedules is also considered to be important, it appears in the top third in terms of overall impact. The other two organisational innovations are considered to be of less importance.

Figure 72: Ranking of the impact of different organisational innovations on innovation ability in the medical devices sector, n = 9



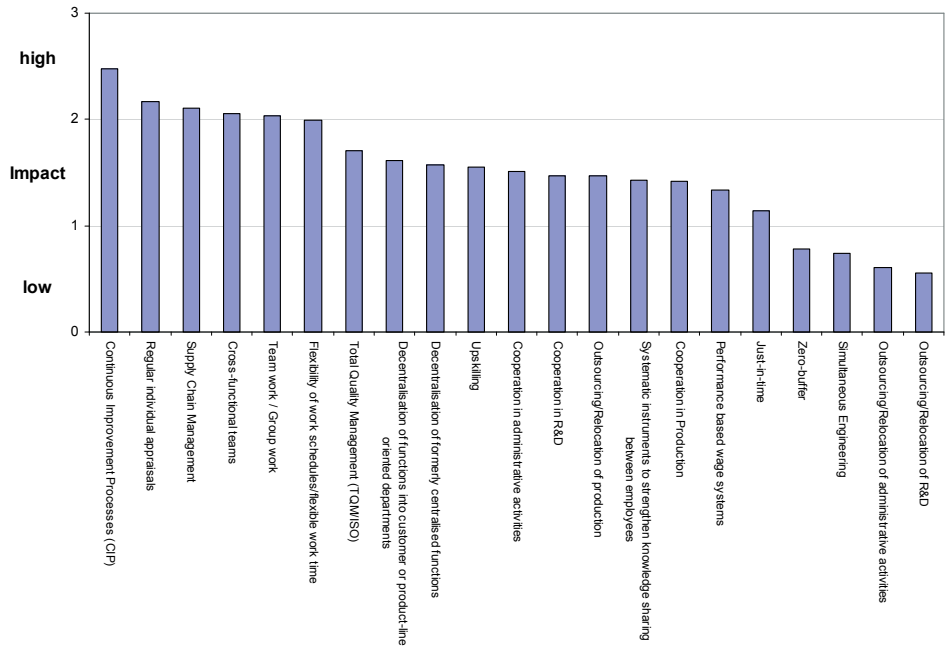
(7) Knowledge management

The interviews indicate that systematic instruments to strengthen knowledge sharing between employees are considered to have a low impact on quality, flexibility, cost and innovation. This organisational innovation is considered to be of medium importance, it appears in the middle third of all the innovations (see Figure 73).

(8) Production Management

The experts are of the opinion that supply chain management strongly increases a company's quality, flexibility and reduces cost, but it has a lower impact on the firm's innovation ability. Just in time is considered to have a low impact on quality, flexibility, cost and innovation. While zero-buffer and simultaneous engineering are considered to have an even lower impact. The experts are of the opinion that simultaneous engineering has a low impact on the innovation ability and an even lower impact on quality, flexibility and costs. Zero-buffer has a very low impact on all four output dimensions. Of the four organisational innovations in this group, supply chain management is considered to be the most important in the medical devices sector. The other three organisational innovations are all considered to be far less important, they all cluster together in the bottom third (see Figure 73).

Figure 73: Ranking of the importance of different organisational innovations in the medical devices sector, n = 9



12.8.3 Conclusion

The interviews with the experts indicate that decentralisation at a strategic level is of medium importance in the medical sector. However, in the case of decentralisation at an operative level (team work, cross-functional teams) the situation is different, it is considered to be of high importance. Team work is considered to have a strong impact on quality and flexibility, while cross-functional teams have a strong impact on quality and innovation.

Cooperation with other companies is considered to be of medium importance in the medical devices sector. The experts are of the opinion that cooperation in production is less important than cooperation in R&D and cooperation in administrative duties. This result is surprising given the view that cooperation between the firms is an important feature of this sector.

Outsourcing/relocation was considered, in general, to be of low importance. The outsourcing/relocation of production was considered to have a greater impact than the outsourcing/relocation of R&D and the outsourcing/relocation of administrative activities. This may be due to the fact that medical device companies place a high emphasis on innovation, so the strategy of outsourcing/relocation of this activity is not likely to be a major consideration.

Quality management appears to be of the highest importance in this sector. Continuous improvement and quality management are considered to have a strong impact on quality. Continuous improvement is also considered to have a strong impact on the flexibility, cost and innovation. The medical devices sector has a major focus on the quality of the products and this helps to explain the importance of continuous improvement and quality management.

The experts were of the opinion that human resource management has a significant impact in the medical devices sector. Regular individual appraisal is considered to be the overall second most important organisational innovation out of the 21 innovations. The other important organisational innovation in the human resources group was flexibility of work schedules/flexible working which was considered to be the sixth most important innovation.

Knowledge management is considered to be of medium importance.

Supply chain management is considered to be of high importance in this sector, but zero buffer and just in time are considered to be of low importance in the sector. Simultaneous Engineering is also considered to be of low importance. The medical devices sector is very R&D intensive and so it is surprising that simultaneous engineering was so unimportant. This may be due to the fact that the sector has a large number of small and medium sized firms who are not completely familiar with the concept and the benefits it can deliver.

The results of the interviews indicate that in the opinion of the experts the most important organisational innovations in the medical devices sector are continuous improvement, regular individual appraisals, supply chain management, cross-functional teams and team work.

12.9 Textile

WRITTEN BY R. EVANGELISTA, M. PIANTA, C. COZZA (LUNARIA, ITALY)

For the textile industry, 10 stakeholder interviews have been conducted, thereof 8 interviews with industry representatives and 2 interviews with research representatives. The interviews have been conducted with employees of machinery companies in Germany, France, Italy, Slovenia, Poland, and in the UK.

12.9.1 Desk research

The results of the Community Innovation Survey have shown that the textile and clothing sector is one of the industries with the lowest performance in innovation. Only 50 % of the surveyed firms, in fact, have introduced innovations, against three out of four firms in more dynamic industries. The same picture emerges when considering the total innovative expenditures per employee, with the textile sector ranking in the lower quartile of the distribution of all the manufacturing sectors. A large literature has pointed out that textile firms tend to rely on price competitiveness more than on technological one. Considering the labour intensive nature of the industry, experts have stressed the importance of strategies for the relocation of production and outsourcing, with the aim of obtaining cost reductions and increased flexibility. This assessment is confirmed by the results of case studies, stressing the importance of cost cutting measures due to increased international cost competition. Besides relocation and outsourcing, decentralisation is also of importance for textile firms, both in terms of strategy and of operations, while the existence of networks of specialised suppliers has emerged in case studies as a relevant strategy for selected, localised groups of firms. Conversely, cooperation is not considered a critical issue for this sector. Building on such evidence, we can expect that the most important organisational innovations to be found in the textile industry could be those associated to processes of relocation and outsourcing, with the general aim to reduce costs.

Looking at the textile and clothing industry with greater detail, however, a highly diversified and fragmented structure emerges, with a production cycle broken down in several phases, usually carried out by relatively small, highly specialised firms. In other words, it seems that the processes of decentralisation and outsourcing (both within EU countries, and beyond their borders) have long been relevant in this sector, and have led to the current industry structure. Moreover, each process tends to assume different forms in different phases of the production process. Labour intensity is very high in clothing but less in weaving and in knitwear, and it is even lower in spinning. In clothing, technological innovations cannot succeed in considerably reducing the incidence of labour costs on total costs. Sometimes, the production of high quality/highly priced clothing is compatible with the use of low quality raw materials. As a consequence, such plants can be relocated on the basis of the lowest production costs, without compromising quality requirements. Quality management may therefore play an important role in association to costs reduction strategies.

Finally, the use of labour and the management of the labour force is the object of controversial views in the literature. While performance based wage systems are expected to have a medium

impact on output measures, other aspects – such as flexible work schedules, upskilling and regular individual appraisals –seem to have a lower impact on quality, flexibility and costs. The same applies for systematic knowledge management instruments. Instead, in the area of production management, all organisational innovations except simultaneous engineering are expected to have a high impact on costs and flexibility.

The considerations above summarise key stylised facts from the literature and recent surveys. The issues can be further investigated using results from interviews to firms and experts. In the next sections we will consider the direct evidence on the following three questions:

- Is organisational innovation as a whole important in the textile sector?
- Which are the most relevant organisational innovations?
- What is their impact and which domain of firms' performances is more affected by organisational innovations?

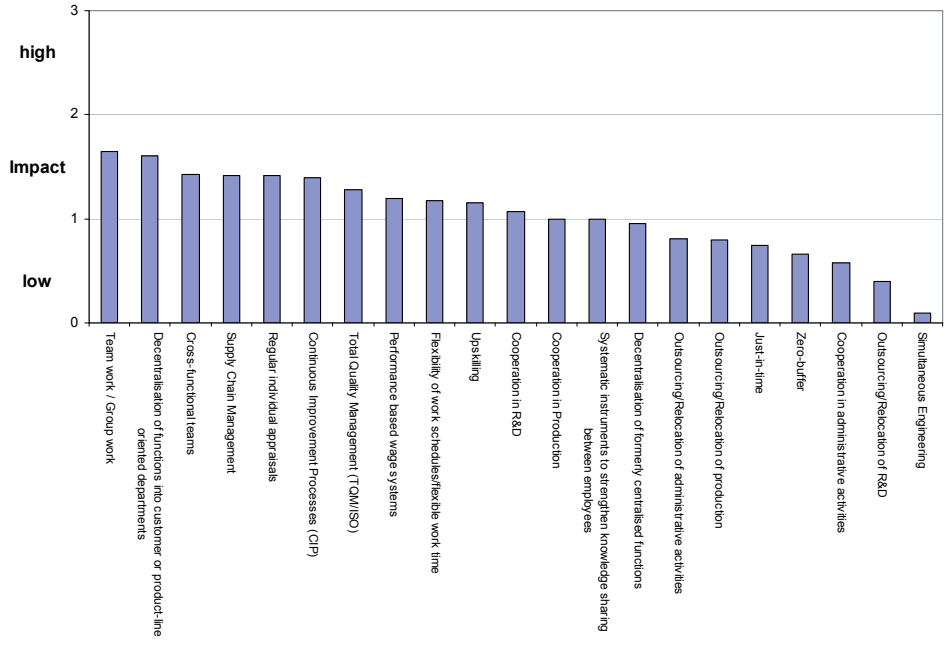
12.9.2 Impact of organisational innovations on output dimension

The average impact of organisational innovations

The interviews carried out for the textile and clothing industry allow us to assess the overall impact the variety of organisational innovations considered has on firms. Figure 74 shows, for each type of organisational innovation included in the analysis, the average score given by firms and experts to different impact dimensions–quality, costs, flexibility, innovation ability–of organisational innovation.

The average value in Figure 74 is 1.04. Organisational innovations have a low importance in the textile sector, a result that is consistent with the evidence from the studies on technological innovation. Such a low mean derives from two factors: on the one hand, no organisational innovation reaches a moderate importance (value of 2.00) and only two innovations – Team Work and Decentralisation of functions – are above 1.50; on the other hand, many organisational innovations (mainly related to production management and R&D) show very low values, further reducing the overall mean.

Figure 74: Ranking of the importance of different organisational innovations in the textile sector, n = 10



In the textile industry no type of organisational innovation appears to play a dominant role. Team Work has the highest value, but other innovations related to human resources – such as Upskilling – fail to reach a significant position. That is coherent with the experts' view of a controversial impact of human resources management on the four categories.

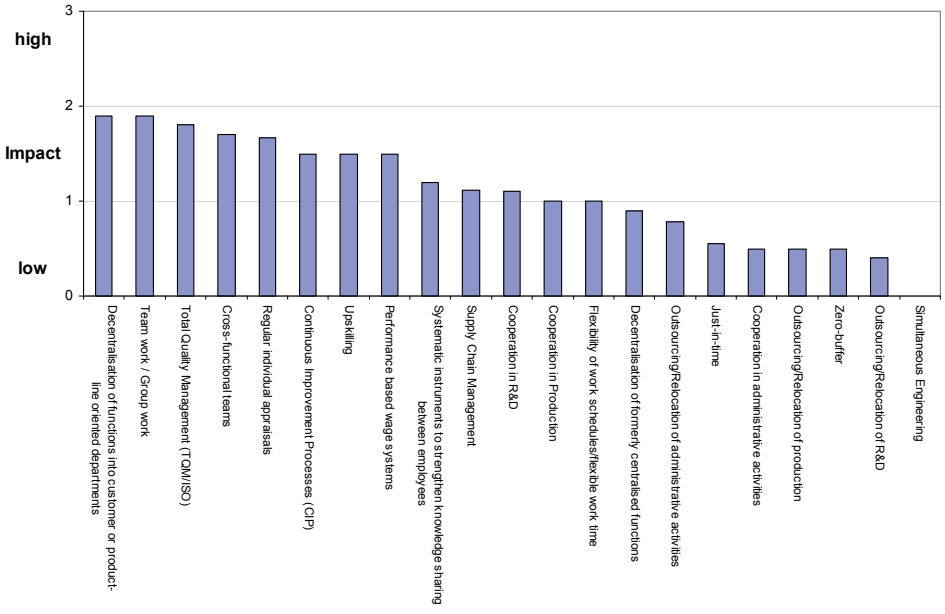
Decentralisation of functions into customer or product line oriented departments is second in rank, with a medium importance that could reflect the firms' need to adapt their products to a fast changing demand, but Decentralisation of formerly centralised functions and Outsourcing-related innovations seem to have a very small relevance.

Finally, organisational innovations related to production management and R&D have values much lower than 1.00; this suggests a weakness of corporate actions on research-based strategies and production processes, confirming the low-tech specificity of the sector.

The impact of organisational innovations on quality

Quality appears as one of the most important drivers for the modest pattern of organisational innovations in the textile industry; it shows a slightly higher mean (1.10) than the overall results, but it is still too low (in absolute terms) to suggest a significance of organisational innovations (see Figure 75). Team Work and Decentralisation of functions get the highest values (closer to 2.00); as in the food sector, quality can be considered a key issue. The pursuit of quality appears to be based on two main pillars. The first one is an overall organisational design that brings firm's activities closer to customers' tastes while assuring a comprehensive approach to quality, as shown by the presence, as the third most important organisational innovation, of Total Quality Management. The second pillar concerns an organisation of work based on team work and flanked by the relevance of cross-functional teams (ranked four here), that reflects a model of work organisation typical of small units with high flexibility (see below). Again, production-led activities (from simultaneous engineering to R&D) emerge with a minimal impact on quality, confirming the experts' views.

Figure 75: Ranking of the impact of different organisational innovations on quality in the textile sector, n = 10

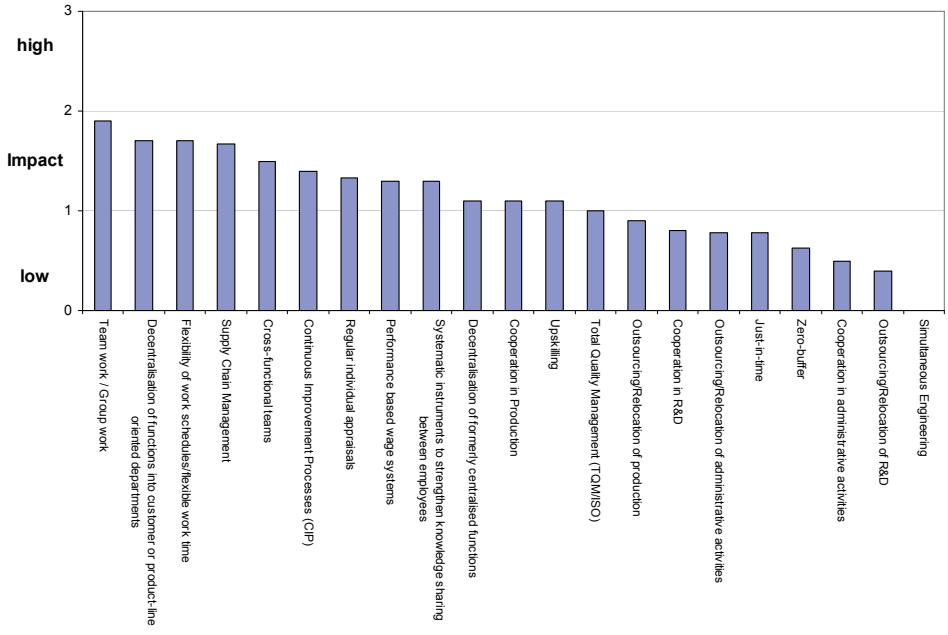


The impact of organisational innovations on flexibility

The same considerations apply to the impact of organisational innovations on flexibility (see Figure 76), where the mean shows a similar value (1.09). Only one organisational innovation –

Team Work – presents in this case a value close to moderate importance. Flexibility tools receive a higher rank than in the overall assessment, but they are still too low (Flexibility of work schedules/flexible work time has a score of 1.70) to be considered a relevant firm strategy. Supply Chain Management is fourth in rank (score of 1.67), followed by Cross-functional teams. Again, the two pillars of organisational design and work organisation emerge from these results. In the former, a stronger role of Supply Chain Management emerges, as a crucial model for organising a production process that is fragmented in several phases and is carried out by many different small firms. As to work organisation, the flexibility of labour use emerges with greater relevance alongside teamwork.

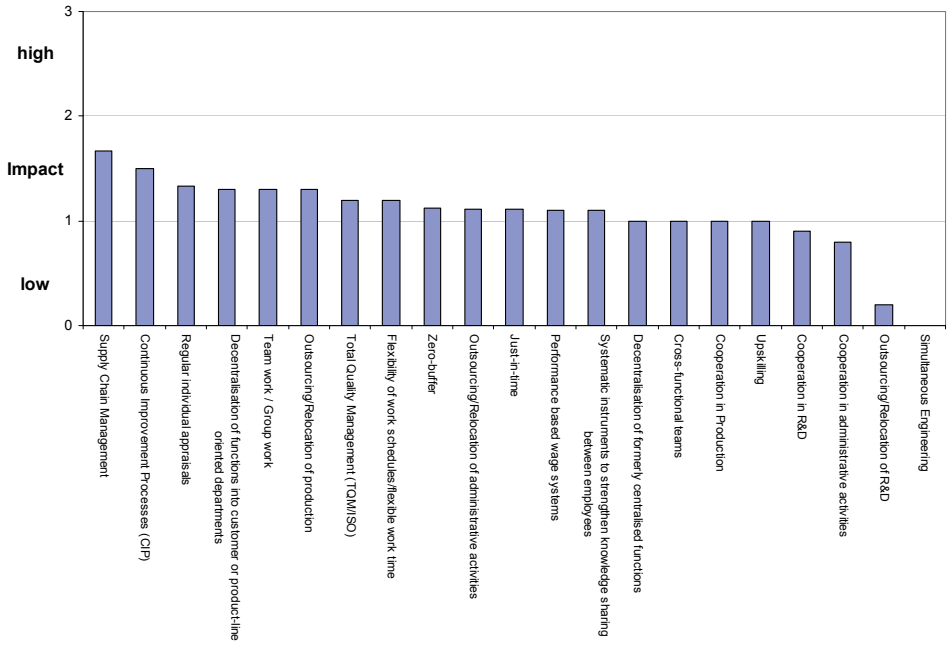
Figure 76: Ranking of the impact of different organisational innovations on flexibility in the textile sector, n = 10



The impact of organisational innovations on costs reduction

The impact of organisational innovations on costs reduction (see Figure 77) is in line with the previous two categories. The mean value is similar to the average impact one (1.06) but only one innovation–Supply Chain Management (with a value of 1.67)–is above the critical value of 1.50. We have seen in the previous section that Supply Chain Management contributes greater flexibility to a production process that involves a large number of suppliers; here we find that it makes possible, at the same time, cost reductions in the overall production process, as opposed to the cost savings that can be implemented within the firm alone. This latter direction for cost reduction is suggested by the organisational innovation that is second in rank, Continuous improvement processes, while sixth in rank is the Outsourcing/relocation of production that is here identified as a further cost-cutting strategy, well established in the industrial changes that have transformed the European textile sector in the past decades.

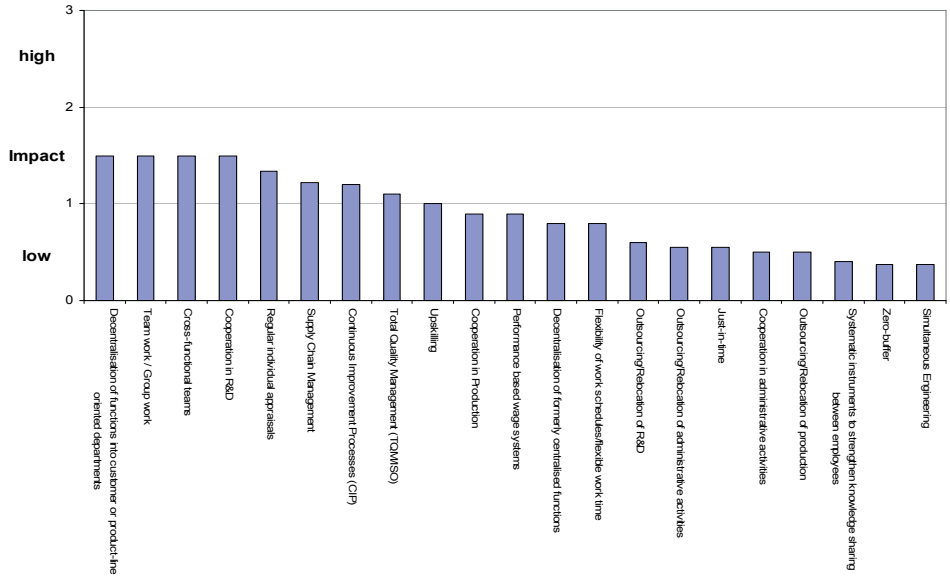
Figure 77: Ranking of the impact of different organisational innovations on costs in the textile sector, n = 10



The impact of organisational innovations on innovation ability

While quality and flexibility have emerged as important aims of organisational innovations, the improvement of innovation ability appears to be the least relevant one (see Figure 78); the overall mean (0.91) is much lower than in the average chart. The constraints typical of the textile industry–a traditional sector founding its competitiveness on cost/price factors (including quality improvements), rather than on technological advances –render a view and a practice of organisational innovations as a factor contributing to the overall innovative performances of firms difficult. Still, the most important factors that emerge here do point out the need for a close connection between organisational innovations and the development of new products (Decentralisation of functions is ranked first, Cooperation in R&D is third), and between organisational innovations and changes in firms' processes (Cross-functional teams is ranked second). The result for Cooperation in R&D, which is usually among the least important variables, may mean the recognition of a moderate importance of R&D in strengthening firms' innovation ability, in spite of a presumed low impact on quality improvement and cost reduction. Production management variables – especially Simultaneous Engineering and Zero-buffer – remain tools of little relevance in this regard.

Figure 78: Ranking of the impact of different organisational innovations on innovation ability in the textile sector, n = 10



12.9.3 Conclusions

Figure 79 summarises the results of the interviews carried out for the textile and clothing sector. First of all, organisational innovation appears to have a very limited impact in this industry, confirming and complementing the analysis of the literature on technological innovation.

Second, the most important organisational innovations in the industry appear to be related to two pillars of firms' strategies–the patterns of organisational design and of work organisation. At the core of former we find the Decentralisation of functions and the Supply Chain Management; in the latter Team work and Cross-functional teams are crucial; several other organisational innovations flank these ones in the pursuit of more specific objectives. Decentralisation and outsourcing variables, which were pointed out as important ones by experts, emerge as relevant factors only relatively to the other organisational innovations considered, and have low absolute scores.

Third, the domain of firms' performances that are more affected by organisational innovations include quality and flexibility, where the two pillars described above emerge with a moderate impact of their key organisational innovation variables. In all cases, production and research-related organisational innovations have a minimum impact on the textile and clothing industry.

These results confirm the picture of a low technology sector, where the dominance of small, specialised firms leads to an emphasis on the search for efficiency in the overall production system (as opposed to that within individual firms). Such improvements appear to be pursued either in the direction of quality improvements in high-priced market niches, or in the direction of more flexible (and therefore less costly) arrangements of the several phases of complex production processes. In any case, the impact of organisational innovations on innovation ability remains extremely low.

Figure 79: Synthesis of most relevant organisational innovations in the textile sector, n = 10

AVERAGE IMPACT	
Mean	**1.04**
Three most relevant organisational innovations	Team work / Group work (1.65)
	Decentralisation of functions into customer or product-line… (1.60)
	Cross-functional teams (1.43)
Three least important organisational innovations	Cooperation in administrative activities (0.58)
	Outsourcing/Relocation R&D (0.40)
	Simultaneous Engineering (0.09)

IMPACT ON QUALITY	
Mean	**1.10**
Most relevant organisational innovations (values above 1.50)	Decentralisation of functions into customer or product-line…(1.90)
	Team work / Group work (1.90)
	Total Quality Management (1.80)
	Cross-functional teams (1.70)
	Regular individual appraisals (1,67)

IMPACT ON FLEXIBILITY	
Mean	**1,09**
Most relevant organisational innovations (values above 1.50)	Team work / Group work (1.90)
	Decentralisation of functions into customer or product-line…(1.70)
	Flexibility of work schedules (1.70)
	Supply Chain Management (1.67)

IMPACT ON REDUCED COSTS	
Mean	**1.06**
Most relevant organisational innovations (values above 1.50)	Supply Chain Management (1.67)

IMPACT ON INNOVATION ABILITY	
Mean	**0.91**
Most relevant organisational innovations (values above 1.50)	-

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