

Organizational innovation: The challenge of measuring non-technical innovation in large-scale surveys

Heidi Armbruster^a, Andrea Bikfalvi^b, Steffen Kinkel^{a,*}, Gunter Lay^a

^a*Fraunhofer Institute Systems and Innovation Research, Breslauer Strasse 48, D-76139 Karlsruhe, Germany*

^b*Department of Business Administration and Product Design, University of Girona, Campus de Montilivi, Edifici P-I, 17071 Girona, Spain*

Abstract

Although the implementation of innovative organizational concepts is considered to be highly important for a company's competitiveness, so far there has been little research on possible approaches to measure and monitor organizational innovations in large-scale surveys. Based on an item-oriented typology of organizational innovations which serves as the precondition for a common understanding, we describe and compare how organizational innovations have been measured through existing surveys in Europe. Using a large-scale survey comprising data of 1450 German manufacturing companies, we show how these different approaches lead to significantly different results regarding the organizational innovativeness of companies within one and the same sample. We derive four implications for the future measurement and monitoring of organizational innovations. Our findings contribute to the further development of an adequate methodology for an organizational innovation monitoring system.

© 2008 Elsevier Ltd. All rights reserved.

Keywords: Organizational innovation; Non-technical innovation; Surveys; Measurement; Diffusion of innovations

1. Introduction

In the current scientific debate, the term “innovation” is predominantly linked to the research and development (R&D) associated with creating new products. There are many studies on innovation which reveal that increased R&D activities lead to innovative products which enable companies to achieve competitive advantages and to gain market shares (e.g., Freeman and Soete, 1997). As a consequence, an increasing number of economies started to invest in a R&D-based innovation policy. With regard to R&D investment, some rapidly developing countries have gained on the traditional European countries, the USA and Japan, who have lost their competitive advantages in some fields of product innovation.

Hence, during the last decades, companies, policy-makers and researchers in Europe, the USA and Japan have been searching more thoroughly for accompanying measures to flank their R&D-based strategy by pursuing innovation activities in additional fields. This search has revived the Schumpeterian definition of innovation since (Schumpeter, 1934) which goes beyond the sole focus on technical innovations. He distinguished five different types of innovation: new products, new production methods, new markets, new sources of supply and new forms of organization. Referring to Schumpeter and other innovation researchers (e.g., Anderson and King, 1993; Damanpour and Evan, 1984; Totterdell et al., 2002), innovation can be considered to be a complex phenomenon including *technical* (e.g., new products, new production methods) and *non-technical* aspects (e.g., new markets, new forms of organization) as well as *product* innovations (e.g., new products or services) and *process* innovations (e.g., new production methods or new forms of organization). Based on these considerations, we distinguish four different types of innovations: (1) technical *product innovations*,

*Corresponding author. Tel.: +49 721 6809 311; fax: +49 721 6809 131.

E-mail addresses: heidi.armbruster@isi.fraunhofer.de (H. Armbruster), andrea.bikfalvi@udg.edu (A. Bikfalvi), steffen.kinkel@isi.fraunhofer.de (S. Kinkel), gunter.lay@isi.fraunhofer.de (G. Lay).

(2) non-technical *service innovations*, (3) technical *process innovations*, and (4) non-technical process innovations, understood to be *organizational innovations*.

The measurement of technical *product innovations* is based on a commonly agreed definition described in the Oslo Manual (OECD, 2005) and which has achieved a methodological standardization and harmonization when officially surveying and comparing enterprises at European or international level (e.g., European Innovation Scoreboard; Community Innovation Survey). Meanwhile, the scientific debate has intensified in two other fields of innovation: Battisti and Stoneman (2005) as well as the OECD in the Oslo Manual (2005) have made valuable contributions to the field of measuring technical *process innovations*. There is also an ongoing discussion about the methodological approaches for monitoring non-technical service innovations (Drejer, 2004; Hipp and Grupp, 2005; Miles, 2005; OECD, 2005).

However, there have been few conceptual and methodological contributions to the monitoring of *organizational innovations* so far. Organizational innovations comprise changes in the structure and processes of an organization due to implementing new managerial and working concepts and practices, such as the implementation of teamwork in production, supply chain management or quality-management systems (OECD, 2005; Damanpour, 1987; Damanpour and Evan, 1984).

The importance of organizational innovation for competitiveness has been proven by several studies which analyzed the impact of organizational innovations on business performance (Caroli and Van Reenen, 2001; Damanpour et al., 1989; Greenan, 2003; Piva and Vivarelli, 2002). These studies point to two different results. First, organizational innovations act as the prerequisites and facilitators of an efficient use of technical product and process innovations as their success depends on the degree to which the organizational structures and processes respond to the use of these new technologies. Second, organizational innovations present an immediate source of competitive advantage since they themselves have a significant impact on business performance with regard to productivity, lead times, quality and flexibility (e.g., Womack et al., 1990; Hammer and Champy, 1993; Goldman et al., 1995).

Although these studies have shown the importance of organizational innovations for business performance, defining and measuring organizational innovation still lags behind. There are different interpretations of the term “organizational innovation” and the lack of a widely accepted definition causes difficulties in designing and implementing measures and indicators that sustain validity over a wide coverage (Lam, 2005).

This paper aims to take the first steps to bridging this gap by tackling both issues: the definition and the measurement of organizational innovation. First, we provide an overview of the field of organizational innovation from the perspective of existing literature and

conclude with a typology of organizational innovations (Section 2). Second, we outline initial approaches for measuring organizational innovation; in particular that of using large-scale surveys (Section 3). We then contrast the different approaches to measuring organizational innovation and show how different indicators result in different statements concerning companies’ organizational innovativeness (Section 4). Based on these considerations, we conclude with derived implications for measuring organizational innovation and ideas for further research activities.

2. Definition of organizational innovation

The existing literature on organizational innovation is diverse and scattered. There is no consensus on a definition of the term “organizational innovation”, which remains ambiguous (Lam, 2005). Different areas of research are developing their own approaches to try and understand the complex phenomenon of organizational innovation.

A first literature strand focuses on the identification of the structural characteristics of an innovative organization and its effects on product and technical process innovations (Burns and Stalker, 1961; Mintzberg, 1979; Teece, 1998).

A second literature strand—theories of organizational change and development—aims to analyze and understand how organizations change. This field of research includes models of how organizational change may occur (e.g., Greiner, 1967; Hannan and Freeman, 1977, 1984) as well as classifications of different types of organizational changes from evolutionary to revolutionary (e.g., Levy and Merry, 1986). It aims at understanding the resistance to organizational change and how to overcome the inertia of organizations and enable them to better adapt to changing environments and technologies (e.g., Lewin, 1958; Lawrence, 1954).

A third strand of literature focuses on how organizational innovations emerge, develop and grow at the micro-level within the organization. This strand focuses on theories of organizational cognition and learning (e.g., Argyris and Schön, 1978; Duncan and Weiss, 1979) as well as on theories of organizational creativity (e.g., Amabile, 1988).

All these research approaches understand organizational innovation either as a necessary adaptation to the introduction of new technologies, or as a precondition for successful product or technical process innovations. They try to understand how and under which circumstances organizations change. To do so, they analyze the triggers and the paths companies take to achieve a structure increasingly capable of continuous problem solving and innovation. However, these approaches do not focus on the resulting status of the converted organization or the concrete new elements of managerial and work practice, making it difficult to measure and compare the results of organizational innovations.

The independent contribution of organizational innovations to the superior performance and competitiveness of an organization has been largely neglected up to now. However, in the late 1980s, MIT's study of the automobile industries in Japan, the USA and Germany turned the attention of researchers and managers to organizational innovations as a driving factor for companies' competitiveness (Womack et al., 1990). Under the label "lean production", Womack et al. subsumed an integrated variety of new organizational concepts such as teamwork, job enrichment and enlargement, decentralization of planning, operating and controlling functions, manufacturing cells, quality circles, continuous improvement processes, zero buffer principles (kanban), simultaneous engineering and just-in-time delivery, which they discovered to be the main cause of the superiority of the Japanese car industry at this time.

Following this, a field of related managerial approaches like "business reengineering" (Hammer and Champy, 1993), "total quality management" (Ishikawa, 1985), the "fractal factory" (Warnecke, 1992), the "modular factory" (Wildemann, 1992), the "intelligent organization" (Pinchot and Pinchot, 1993), the "agile enterprise" (Goldman et al., 1995), "cellular forms" (Miles and Snow, 1997) or the "N-form corporation" (Hedlund, 1994) were introduced or became broadly known, all of which promised to guide the reorganization of companies in order to achieve significantly better performance indicators with regard to productivity, quality and flexibility.

Most of the concrete organizational concepts like manufacturing cells or teamwork can be found in almost all of these integrated managerial approaches. The labels these approaches coined were used to highlight one key factor of business success. Sometimes this led to a misinterpretation of these approaches as simple remedies for deeper and more intractable problems. Consequently, the labels used to characterize the organizational innovations became fashion fads with hardly distinguishable contents and an ever shorter shelf life (Kieser, 1996). On the other hand, labels, such as "lean production" or "agile enterprise" can be useful to infuse new energy into the collective enterprise's attempt to adopt organizational innovations, if not in a revolutionary manner then at least in an evolutionary one (Eccles and Nohria, 1992).

Regardless of whether managerial approaches' labels are interpreted as fashions or as enablers of reorganization, it is proven that the adoption of concrete organizational concepts has a paramount impact on the ability of a company to improve its performance (e.g., Caroli and Van Reenen, 2001; Damanpour et al., 1989; Greenan, 2003; Piva and Vivarelli, 2002). To measure and monitor the adoption and performance impact of organizational innovations, it is therefore necessary to understand them on a conceptual level, as the implementation of new and concrete organizational concepts. Thus, we define organizational innovation as the use of new managerial and working concepts and practices (Damanpour, 1987;

Damanpour and Evan, 1984). By applying this definition, it is possible to measure not only whether companies have changed their organization (structure and processes) within a defined time period, but also to provide an analysis of the adoption ratios of concrete organizational concepts in different companies and company types (sector, firm size, etc.) and the extent of use within one company. Organizational innovation defined as the implementation of new organizational concepts serve as an indicator for the intra-firm diffusion of different organizational practices.

Some attempts have been made to cluster and classify different types of organizational concepts under certain categories (e.g., Coriat, 2001; Wengel et al., 2000; Whittington et al., 1999). Based on these approaches, organizational innovation can be differentiated into *structural* organizational innovations and *procedural* organizational innovations.

Structural organizational 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 (research and development, production, human resources, financing, etc.), or the separation between line and support functions. Such structural organizational innovations include, for instance, the change from an organizational structure of functions (product development, production, human resources, etc.) into product- or customer-oriented lines, segments, divisions or business units.

Procedural organizational 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., teamwork, just-in-time concepts) or the quality of production (e.g., continuous improvement process, quality circles).

Organizational innovation can be further differentiated along an *intra-organizational* and *inter-organizational* dimension. While intra-organizational innovations occur within an organization or company, *inter-organizational innovations* include new organizational structures or procedures beyond a company's boundaries. These comprise new organizational structures in an organization's environment, such as R&D cooperation with customers, just-in-time processes with suppliers or customers or supply chain management practices with suppliers.

Intra-organizational innovations may concern particular departments or functions or may affect the overall structure and strategy of the company as a whole. Examples for intra-organizational innovations include the implementation of teamwork, quality circles, continuous improvement processes or the certification of a company under ISO 9000.

It is obvious that there is a vast variety of organizational innovations which differ in terms of their type and focus. Based on the examples provided in Fig. 1, it becomes clear that the proposed categorization is of an analytical nature.

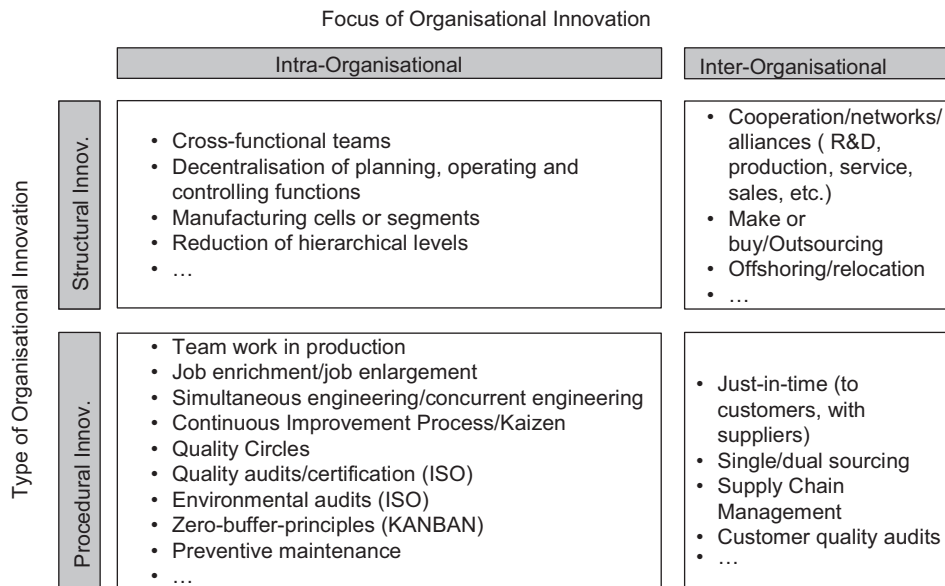


Fig. 1. An item-oriented typology of organizational innovations.

The differentiation between structural and procedural organizational innovation is rather tenuous in some cases of organizational concepts. In practice, most innovative organizational concepts address different aspects of business strategies at the same time.

3. Surveying organizational innovations

Hand in hand with the emerging awareness of the importance of organizational innovation for industrial competitiveness, several efforts have been made to include this topic in innovation surveys made over the past decade. The following chapter presents some of these attempts. This overview aims to introduce the objectives and the different methodological approaches which were chosen to cover organizational innovation in large-scale surveys. Against this background, some key questions can be derived for designing a monitoring and measurement concept for organizational innovations.

3.1. NUTEK survey “Towards Flexible Organizations”

In the framework of the OECD study “Technological and Organizational Change and Labour Demand: Flexible Enterprises—Human Resource Implications”, the Swedish National Board for Industrial and Technical Development decided to analyze the importance and distribution of flexible work organization in the Swedish economy in the mid-1990s. To provide data for this study, a survey was conducted which covered more than 700 establishments with at least 50 employees in Sweden. They included companies from the NACE sections Mining and Manufacturing, Construction, Retail, Wholesale, Hotels and Restaurants, Transport and Communication and other business activities including finance and real estate. The

written survey was conducted in 1995 by sending a questionnaire to “the executive in charge”.

One part of the questionnaire asked for a *description of the present organization* in terms of staff and qualification, work organization, technology and product/service development as well as external relations. Within the subsection concerning work organization, the relative importance of continuous improvement, total quality management, ISO 9000, just-in-time and other concepts was to be evaluated as “not”, “slightly” or “very important”. A second part had *organizational changes in the 1990s* as its topic, gathering information about important changes in the organization of the work place on a generic level (“Has there been an important change in the organization of the work place during the 1990s” with the possible responses of “yes/is being implemented/no”, for each of the 5 years 1990–1994).

3.2. DRUID project “DISCO”

Influenced by the NUTEK questionnaire, the Danish Research Unit for Industrial Dynamics (DRUID) compiled its own survey within the Project Danish Innovation System in a COmparative Perspective (DISCO), which focused mainly on flexibility. This was understood to be the ability of a firm to react to a turbulent environment by developing new products and new technological processes based on integrative organizational forms and a culture oriented towards renewal and learning (Lund, 1998). The questionnaire, sent out in 1996, addressed Danish private enterprises with 10 and more employees within manufacturing, services and construction. One thousand and nine hundred firms participated in this survey.

Regarding organizational innovations, the question was posed “Has the firm carried out important organizational changes during the period 1993–1995?” with a yes/no

response possible. A further question “Has the firm extended its use of the following organizational traits during the period 1993–1995?” aimed to gather more detailed information about the delegation of responsibility, cross-occupational working groups, quality circles, integration of functions, job rotation and systems of collecting proposals from employees (Lundvall and Skov Kristensen, 1997). This design and phrasing of the questions enabled the DISCO survey to specify the share of industry that had altered specific organizational practices.

3.3. EPOC survey

At the same time as the DISCO survey, the EPOC survey was initiated as part of a project commissioned by the European Foundation for the Improvement of Living and Working Conditions (European Foundation, 1997). This project aimed to investigate direct employee participation in organizational change (EPOC). In 1996, the EPOC questionnaire was sent to enterprises in 10 European countries (DK, DE, FR, UK, IE, IT, NL, PT, ES and SW). Five thousand and seven hundred eighty-six responding firms returned a completed questionnaire.

The EPOC survey was intended to provide empirical data on the extent of the diffusion of direct employee participation (e.g., consultative participation, delegative participation) in the European economy. Managers should declare whether or not they had implemented these forms of direct participation. If this was the case, they were also to provide information about how long they had been practising them, which specific characteristics were involved, the reasons for introducing these practices and what consequences these concepts had on the qualification and remuneration of employees.

The EPOC survey did not ask directly about the existence of different forms of work organization using “labels”, but concluded the existence of specific work organization concepts from questions about the forms of direct participation. Neither did the survey directly enquire about changes in the last years, but instead tried to obtain information about the existence of direct participation irrespective of the year of realization.

3.4. The INNFORM survey

In 1997, as part of the so-called “INNFORM project”, another international survey was conducted dealing with organizational innovation. The INNFORM project was funded by the Economic and Social Research Council in the UK and comprised research activities in Europe, Japan and the USA (Whittington et al., 1999). Its objective was to map the contours of contemporary organizational innovation, to examine the management practices and to test for the performance benefits of these changes. In order to tackle these issues, the researchers developed a survey instrument which was deployed in the UK and western

European countries. About 500 firms participated in this survey.

The survey included a large number of questions exploring organizational innovations: company structure and changes in company structure between 1992 and 1996, the extent to which decision-making is decentralized (business unit autonomy, sub-unit autonomy) explored between 1992 and 1996; linkages between headquarter and business units; use of IT; use of certain human resources practices, etc. Thus, the questionnaire addressed organizational and managerial innovations on three levels: unit, organizational and inter-organizational (Stoneman, 1999).

In terms of methodology the survey is interesting for the following reasons: (1) The questionnaire is retrospective, looking at the situation in 1992 and 1996 and is thus able to measure the existing organizational practice as well as organizational change. (2) Contrary to the EPOC survey, the INNFORM questionnaire asked about organizational innovations using particular labels and in this respect is similar to the NUTEK and DISCO surveys.

3.5. Survey “*Changements Organisationnels et l'Informatisation (COI)*”

One year after the Europe-wide INNFORM survey, a national survey was carried out in France (*Enquête sur les COI*, 1998). This survey attempted to identify the changes that had occurred between 1994 and 1997 in work organization (company functional structure, devices to manage task and work time-sharing, relations with other firms, etc.) and the use of information technologies (equipment, organization of the computer function, data transfers, etc.). The questionnaire was posted to a representative sample of industrial firms employing more than 20 people. In total, more than 400 firms were questioned.

This survey is characterized by questions about ICT innovations in combination with organizational change. Most questions allow a yes or no response by ticking the respective box. When examining the use of certain concepts, an assessment of the change (+, =, -) in the share of employees affected since 1994 is required. Some questions give ranges in percentages of employees affected.

3.6. Community Innovation Survey—CIS

The Community Innovation Survey (CIS) is the main statistical instrument of the European Union for measuring innovation activities at firm level. The methodological basis of CIS is provided by the Oslo Manual.

A specific question about organizational innovation was included for the first time in the CIS survey of 2001 (CIS III), asking about innovative management techniques and new organizational structures. This “add-on” aimed to contribute to a better understanding of the “non-technological” aspects of innovation (EUROSTAT, 2005). The question was worded 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 organizational structures?” Possible answers for both aspects were “yes” or “no” (European Communities, 2004).

The results obtained from this question varied greatly when compared across countries. The share of small and medium-sized enterprises which had at least implemented advanced management techniques or changes in the organizational structures during the period 1998–2000 ranged from 23% (France), 26% (Denmark) up to 44% (Sweden) and even 65% (Germany), 74% (Luxembourg) or 77% (Romania) (European Innovation Scoreboard, 2004).

In the CIS IV questionnaire (2004), the wording of the non-technical aspects of innovation was changed slightly. The question about innovative management concepts asked: “Did your enterprise during the 3 years 2002–2004 implement new or significantly improved management systems to better use or exchange information, knowledge and skills within your enterprise?” The organizational question was: “Did your enterprise during the 3 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 3 years 2002–2004 introduce new or significant changes in your relations with other firms, such as alliances, partnerships, outsourcing and subcontracting?” These modifications were intended to specify the questions with explanatory amendments and to give the innovations in inter-firm relations an independent role in the questionnaire. The results for these questions in the CIS IV showed less variation than in CIS III. The share of small and medium-sized enterprises introducing at least one of the above mentioned organizational changes during the period 2002–2004 was 36% in France, 44% in Sweden, 53% in Germany and 57% in Denmark (European Innovation Scoreboard, 2006).

CIS 2006 uses the same questions for measuring organizational innovation as in CIS IV. However, a pilot module on organizational innovations was attached to the survey to test new indicators of organizational innovation. Within this pilot module, the definition of organizational innovations provided in the Oslo Manual 2005 served as the basis for the question on organizational innovation. The questions are as follows: “During the years 2004 and 2006, did your enterprise introduce (a) new business practices for organizing work and procedures; (b) new knowledge management systems to better use or exchange information, knowledge and skills within your enterprise or to collect and interpret information from outside your enterprise; (c) new methods of workplace organization for distributing responsibilities and decision-making; (d) new methods of organizing external relations with other firms or public institutions?” Questions (b)–(d) are very similar

to the questions already covered in CIS IV. However, question (a) considers new business practices such as supply chain management, business re-engineering, lean production, etc., as additional innovative organizational concepts. The results from CIS 2006 and the pilot module are not yet available.

To sum up, the CIS was initially designed to cover technical aspects of product and process innovation. Recently, efforts have been made to broaden the concept of innovation to include organizational, marketing and service innovations. Organizational innovations are measured on an aggregated level by asking about the introduction of management systems or new forms of work organization but not further differentiating concrete organizational concepts such as teamwork or supply chain management. This approach provides limited response options (yes and no) and asks about change within the last 3 years, not about the share of establishments using an innovative organizational concept.

3.7. Summary

To conclude, we presented these surveys in order to demonstrate how different the attempts are to monitor organizational innovations using large-scale surveys. Four aspects can be distinguished with regard to the main differences:

- (1) *Aggregation level*: Organizational innovation is sometimes handled at a high level of aggregation (e.g., CIS), while other surveys are more detailed, gathering information about different concepts related to organizational innovation (e.g., NUTEK, DISKO, EPOC, INNFORM, COI).
- (2) *Use or change*: Methodologically, organizational innovation is sometimes treated as a change process and sometimes as the result of the adoption. This means that surveys asking about the adoption of new organizational concepts allow respondents to be classified into adopters and non-adopters of specific concepts (e.g., EPOC, INNFORM, COI). Other surveys (e.g., NUTEK, DISKO, CIS) ask about changes in a time period and can distinguish between firms with and without change processes in the field of organizational innovation within the time frame covered.
- (3) *Use or extent of use*: Surveys asking about the adoption of organizational innovations can differentiate between adopters and non-adopters (e.g., INNFORM, EPOC). In the case of adopters, sometimes the share of affected employees is also surveyed (COI), which makes it possible to monitor intra-firm diffusion as well.
- (4) *Labels vs. features*: Enquiries in the field of organizational innovation can be made by asking about their adoption using labels of new organizational concepts like teamwork or continuous improvement (e.g., NUTEK, DISKO, INNFORM, COI). In an alternative

approach, an enquiry can ask about the realization of specific features and then draw conclusions about the existence of innovative concepts (e.g., EPOC). With this latter methodology, the analysis does not rely on the judgment of the respondent or his understanding of a label.

4. Challenges to measuring organizational innovation

Based on the four different ways of measuring organizational innovation outlined in the previous chapter, we now analyze how different indicators and ways of enquiring into organizational innovation lead to different conclusions concerning a company's organizational innovativeness. We compare the different approaches of measuring organizational innovation utilized in the surveys described based on the *German Manufacturing Survey 2003*, which was conducted by the Fraunhofer Institute for Systems and Innovation Research (ISI). The objective of this questionnaire-based, mailed survey is to gather data about innovative technical production concepts, 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 organizational concepts, i.e., organizational innovations. In 2003, we wrote to 13,259 companies asking them to complete the questionnaire. 1450 companies returned a utilizable questionnaire; a response rate of 11%. These companies adequately represent the sector and company size structure of the investment goods industry, the chemical industry and the rubber and plastics industry. The survey was first launched in 1993 and is conducted every 2 years (Lay and Maloca, 2004).

4.1. Aggregation level: complexity of organizational innovations

As previously illustrated, the term 'organizational innovation' can cover many different concepts of changing traditional organizational structures. Organizational innovations can affect business processes (e.g., continuous improvement processes) as well as organizational structures (e.g., teamwork). Organizational innovations may occur within an enterprise itself (intra-organizational perspective, e.g., simultaneous engineering), but may also concern its relationships with other companies (inter-organizational perspective, e.g., R&D cooperation).

The diversity of organizational innovations implies that they may be an element of many different business strategies: (1) Replacing the traditional, centralized, tayloristic type of organizational structure by more decentralized, product- or customer-oriented organizational structures aims at improving companies' flexibility. (2) Introducing quality circles, total quality management or continuous improvement processes contributes to improved quality. (3) Establishing simultaneous engineering or cross-functional teams aims to shorten the product

development processes in the companies. (4) Implementing just-in-time and supply chain management concepts aims at increasing productivity by minimizing storage costs.

The various business strategies are fostered and triggered by different innovative organizational concepts. Therefore, an indicator that merely states whether or not a company has implemented organizational innovation in general while disregarding the type of organizational innovation involved (e.g., quality circles, continuous improvement processes, supply chain management, etc.) may only have limited explanatory power. An overall indicator of organizational innovation may merge various business activities in the field of organizational innovation which are actually targeted at different objectives like flexibility, productivity, etc., and thus might not be able to explain specific performance differences.

An analysis made using such an overall indicator of organizational innovation supports this assumption. We have exemplarily chosen a regression model to explain the influence of this indicator and other intervening variables on labour productivity. Labour productivity is defined and constructed as turnover minus inputs (for purchased parts, materials and services) divided by the number of employees. As explained above, labour productivity is just one example of a possible performance indicator in order to illustrate the effects of organizational innovations. It is assumed that the overall indicator will have no significant effect, as it is comprised different concepts of organizational innovation which might have different—and therefore sometimes also negative—effects on different performance indicators such as productivity, quality or flexibility.¹ The same assumption (no significant effect of an overall indicator of organizational innovation) would also hold true for a model explaining process quality, e.g., using the number of reworked parts as concrete performance indicator, or flexibility, e.g., regarding delivery times or manufacturing lead times.

The overall indicator of organizational innovation was composed of 13 organizational concepts: the implementation of customer- or product-line-oriented segmentation of central departments, decentralization of planning, operating and controlling functions, balanced scorecard, regular individual consultation, quality circle, continuous improvement process, quality management according to EFQM, simultaneous engineering, cross-departmental temporary development teams, segmentation of production, integration of tasks, internal zero-buffer-principle (kanban) and teamwork in production. The use of all 13 organizational concepts have been aggregated with equal weights to an indicator reaching from 0% to 100%, whereas 0% means

¹A concrete concept of organisational innovation targeted on the improvement of the flexibility towards customers' expectations regarding delivery time or the customization of products is, e.g., the creation of customer oriented production lines. It may very well have positive impacts on delivery times and product flexibility, but negative effects on productivity, as there might be a need for some redundant production capacities and thus economies of scale might be partly destroyed.

	Productivity	
	Coeff.	t
Outsourcing ratio (1 – [turnover minus inputs per turnover])	–.274	–6.19***
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 a 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 utilization	.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 innovative organizational concepts	.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.

Fig. 2. Results of a multiple regression analysis using a composite index for organizational innovation.

the use of no organizational concept and 100% the use of all 13 concepts.

Apart from the overall index on organizational innovation, a multiple regression analysis (see Fig. 2) tested various other independent variables. The R^2 value indicates that the model explains 38% of the variance of the dependent variable “productivity”. The coefficient of the variable “index of implementation of innovative organizational concepts”, however, was not statistically significant (coefficient .038). Thus, we cannot conclude that there are significant differences in productivity based on the analysis of a composite indicator on organizational innovation.

An in-depth analysis made with individual organizational innovations in the regression model instead of an overall indicator showed a different picture: some organizational concepts proved to be significantly positively correlated, showing a better performance in terms of productivity, while others had no significant influence on the dependent variable. Fig. 3 gives an overview of the results.

These first results clearly indicate the necessity to explore the impact of different innovative organizational concepts on company performance separately. In order to explain and perhaps to predict a superior performance in specific fields like flexibility, quality or productivity, it is crucial to not only enquire as to whether companies implemented organizational innovations at all, but also to ask which particular kind of organizational innovation (e.g., team-

work, supply chain management, etc.) was implemented. It is probable that the effects of an overall or composite organizational innovation indicator on performance indicators encompassing productivity, flexibility and quality overlap and may cancel each other out, resulting in no significant impact on these performance indicators.

4.2. Use or change: life-cycle of organizational innovations

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

The organizational innovations implemented in response to the changes in the organizational environment (particularly the market situation) enable companies to improve their performance as long as the market situation does not change. This implies that organizational innovations, as opposed to products, are not subject to an aging process

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

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

Fig. 3. Results of 13 multiple regression analyses each with one organizational innovation (1–13) and 11 control variables. Control variables are 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 (see Fig. 2).

per se and that the current approaches to monitoring organizational innovations applied over the last 3 years (i.e., CIS) are probably not adequate. For example, enterprises might benefit from concepts like total quality management, supply chain management or just-in-time for more than 3 years after they were first implemented as long as these organizational innovations can react appropriately to the given market situation. Indeed, the implementation of organizational concepts usually implies significant changes to organizational structures and processes which is time-consuming and cost-intensive. For instance, the implementation of teamwork in production implies restructuring manufacturing processes, integrating the tasks of employees and therefore training employees for their new tasks as well as adapting salary and working hours. Thus, the positive effects of teamwork on performance indicators might even only be measurable several years after its implementation. Product innovations, however, age because of the fast technological progress, so the return on these innovations is usually earned during the first 3 years after their introduction.

Therefore, in order to empirically measure organizational innovations, it seems necessary to apply a different approach to the one used for measuring product innovations, one which is not limited to a specific time period in which the organizational change has occurred.

Moreover, the current data on organizational innovations are often used to classify companies into innovators and non-innovators. If only those companies are taken into account which introduced a new organizational concept in the last 3 years, this means that all the other companies

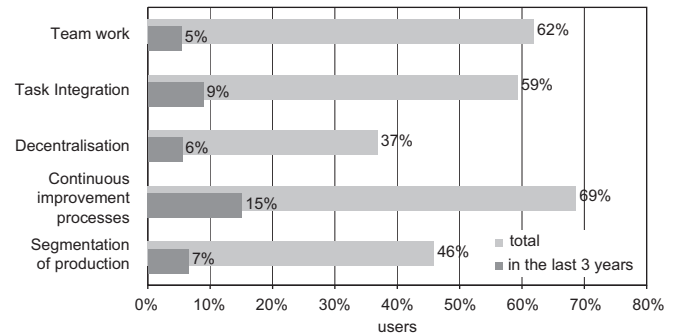


Fig. 4. Implementation of organizational concepts in total vs. within the last 3 years. Source: *German Manufacturing Survey 2003*, Fraunhofer ISI.

that might have introduced new organizational concepts 4 or 5 years ago are not considered to be innovators, even though these companies actually adopted the organizational innovation earlier. Thus, using the 3 years question to distinguish innovators and non-innovators assumes latecomers to be innovators and early adopters to be non-innovators.

The following example illustrates this argument by comparing the implementation of organizational innovations in total with the implementation of organizational innovations in the last 3 years. The data are taken from the *German Manufacturing Survey 2003* (see Fig. 4). The survey showed that 42% of all firms implemented just-in-time, 62% teamwork, 46% a product or customer-oriented organizational structure (segmentation of production) and 59% task integration.

Since the year that the particular organizational innovation was introduced was also recorded, it was possible to reconstruct the results to the question “Have you implemented teamwork, task integration, decentralization, continuous improvement process, or product- or customer-oriented structures in the last 3 years?” This led to the following results:

- (1) In the case of teamwork, 5% of all firms would have stated that they introduced this organizational innovation during the last 3 years. 57% of all firms that introduced teamwork would have been considered as not innovative even though they use teamwork, a concept still regarded as innovative. In a comparison between innovative and non-innovative enterprises, the previously named 5%, where teamwork was introduced in the last 3 years, would have been compared to 57% already using teamwork for a longer period and to a group of 38% without any implementation of teamwork so far.
- (2) Considering task integration, 9% of all companies would have been regarded as innovative, even though this innovation has actually been implemented by 59% of all companies.
- (3) Six percent of all firms would have been seen to introduce decentralization, even though 39% of all firms have already launched this process.
- (4) Instead of the 69% who have introduced continuous improvement processes in reality, only 15% would have been recognized as having done so.
- (5) As to the introduction of product and customer-oriented structures (segmentation of production), by applying the 3-year-rule, only 7% of the companies would have been registered in comparison to the 39% who have actually implemented this approach.

The percentages above clearly illustrate that the group of non-innovative firms is not described correctly when the questions concern only the innovations of the last 3 years. Comparing the performance of those firms characterized as innovative with those regarded as non-innovative (based on the 3 years question) might then be expected to result in the following: the group of non-innovative firms might actually perform better because of the large number of enterprises that have already been using the innovations over a longer period (more than 3 years).

To conclude, when measuring organizational innovations, all the firms that use organizational innovations have to be included in the set of innovative firms. Limiting firms to those that introduced innovations in the last 3 years incorrectly characterizes the latecomers (who are the least innovative of the group of the innovative firms) as innovative.

4.3. Use or extent of use: scope of organizational innovations

The extent to which innovation characterizes a company is crucial. When product innovations are offered on the

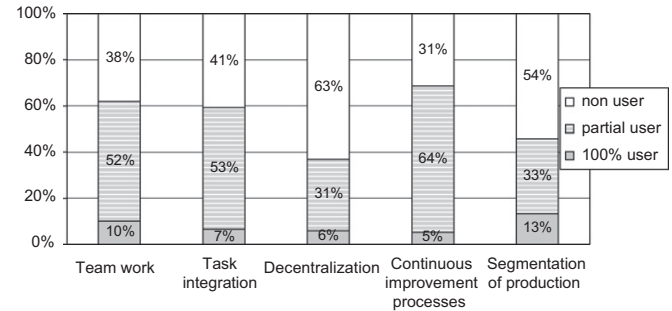


Fig. 5. Diffusion of organizational innovations between ‘use’ and ‘non-use’. Source: *German Manufacturing Survey 2003*, Fraunhofer ISI.

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 whether or not a firm has launched a product innovation on the market. Such a question will identify innovative firms and provide information for policy-makers.²

However, this is not valid in the case of organizational innovations. For example, if an organizational 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 overall performance of the business at all. Limited effects might occur if the organizational innovation is realized in highly relevant departments of the business, but without overall implementation. Ultimately, an organizational innovation can be implemented throughout the firm so that its impact on the performance of the business is maximal and no unutilized potential remains.

This shows that it is crucial to ask about the extent of use in a firm when investigating and measuring organizational innovation. Only with this knowledge is it possible to estimate the effects of organizational innovation and, furthermore, to quantify the unutilized potential for non-users and part-users of these organizational innovations.

The analysis of the *German Manufacturing Survey 2003* shows that only a small proportion of the companies that make use of a certain organizational innovation have fully implemented this organizational innovation in all business areas (see Fig. 5):

- (1) More than 60% of all firms claim to have implemented teamwork; however, only 10% say that they have fully exploited the potential of this organizational innovation.
- (2) Task integration has been realized by more than 60%, but only 7% have implemented this innovation throughout the whole corporation.

²Nevertheless, it has to be recognized that economic success is only achieved through significant sales, therefore, many surveys measure the share of turnover with new products.

- (3) Thirty-seven percent of all enterprises use decentralization, yet only 6% indicate that they have completed the process of decentralization.
- (4) Almost 70% of the companies stated that they use continuous improvement processes, but only 5% indicate that they have completely implemented this organizational concept.
- (5) A total of 46% have begun the segmentation of production; however, just 13% state that the potential of this innovation has been fully exploited.

If the extent of use of an organizational innovation is not considered in a comparison between innovative and non-innovative firms, it is difficult to estimate the impact of this organizational innovation on performance indicators. For instance, if the group of innovative firms contains a high percentage of businesses that have only partially implemented various organizational innovations without this having increased their performance so far, this group of organizationally innovative firms will not stand out by reason of a superior performance.

4.4. Labels or features: quality of organizational innovation

Most organizational innovations are not linked to clearly defined measures for changing organizational 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 organizational innovations.

Particularly when organizational innovations are very new and are not yet able to be assessed as established concepts, companies tend to label their small realization efforts as a successful implementation of the organizational innovation. This can be illustrated using the example of teamwork in the *German Manufacturing Survey 2003* (see Fig. 6).

Sixty-two percent of the firms answered “yes” when asked if they had realized teamwork (10% have fully exploited its potential and 52% are partial users). This result suggests that teamwork is used by a relevant part of the economy. However, when asking if the teamwork was

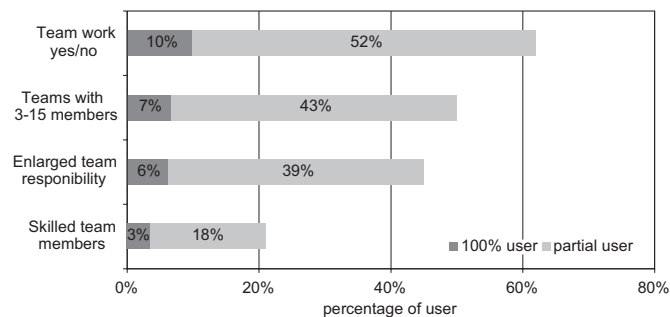


Fig. 6. Diffusion of ‘teamwork’. Source: *German Manufacturing Survey 2003*, Fraunhofer ISI.

realized with a team of 3–15 members, the share decreased to 50% (of which 43% are partial users). This indicates that 12% of the enterprises are realizing teamwork with a group of 1–2, or more than 15 which does not comply with the basic idea of teamwork and therefore will not lead to the positive effects that are intended.

When restricting teamwork to those models that have teams consisting of 3–15 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 should be 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, trying to measure organizational innovations using no more than a term like “teamwork” will yield results that are highly questionable. The above example could give rise to the assumption that two thirds of all firms are profiting from all the possible advantages of teamwork. In fact, this is only true for less than a quarter of the firms, since only this proportion has realized the concept of teamwork in its proper sense. Moreover, only 3% of all the firms utilizing teamwork are doing so according to the three mentioned elements (team size, enlarged responsibility, skilled team members) in all parts of the business.

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

5. Implications, limitations and future research

Although the use of innovative organizational concepts is evidenced to have a positive impact on a company's competitiveness, research in defining and measuring organizational innovation lags behind. This paper attempts a more detailed definition and measurement of organizational innovations by providing a typology of organizational innovations and contrasting different approaches of measuring organizational innovations.

Comparing approaches to measuring organizational innovations in existing surveys by modelling these organizational innovation indicators in the *German Manufacturing Survey 2003* leads to four main implications for measuring organizational innovation:

- (1) *Complexity of organizational innovation*: It is not sufficient to only enquire about “organizational innovation” in general. It is necessary to include specific questions about different types of organizational innovations (e.g., teamwork, supply chain management, etc.). This is important because different organizational innovations have different effects on performance indicators. An index based on the summation of various organizational innovations that neglects the different types of organizational innovation involved has been shown to have only limited explanatory power.

- (2) *Life-cycle of organizational innovation*: It is not sufficient to enquire about the introduction of organizational innovations within the last 3 years. In contrast, it is essential to determine the proportion of firms which have implemented any organizational innovation at all because organizational innovations do not age as fast as product innovations do. Thus, applying the “three years question” incorrectly classifies only latecomers as innovative and early adopters as non-innovative.
- (3) *Extent of use of organizational innovations*: It is not sufficient to only ask about the “use” or “non-use” of organizational innovations. It is necessary to identify the extent to which organizational innovations have been implemented into business processes. Only this additional information can indicate the utilized and non-utilized potentials within the company. The extent of use of organizational innovations has to be taken into consideration in order to generate viable estimations of the performance effects of organizational concepts.
- (4) *Quality of organizational innovation*: It is not appropriate to word questions using labels of organizational innovations like “teamwork” or “task integration” as these organizational concepts are defined and shaped differently in each company and the respondents’ replies vary according to their own understanding of these labels. It is crucial to know how terms like “teamwork” or “TQM” are used in the respective company. The use of general labels when enquiring about organizational innovations will bias the diffusion of organizational innovations across companies.

Our analysis provides evidence that these four points should be taken into consideration when measuring organizational innovation in order to adequately survey companies’ and countries’ innovativeness as regards the adoption of organizational concepts.

However, there are several limitations to our findings. First, it is obvious that surveying detailed definitions of organizational innovations instead of solely labels will increase the complexity of a questionnaire. To include items that monitor the different forms and definitions of organizational innovations within companies may sometimes hardly be realizable, depending on how many elements of organizational innovation are to be surveyed. Second, adding the extent of use of organizational innovations will sometimes lead to rough assessments on the part of the respondents instead of facts. But these estimations still allow a better understanding of the “internal adaptation” of an organizational innovation than a simple yes/no response. Finally, it will be more complex to interpret and present the results of a survey which has included the above considerations. It is not recommended to score companies or countries according to one composite index indicating the most or least innovative in using innovative organizational concepts. On the

contrary, with this type of analysis, the innovativeness of companies or countries is based on a number of individual organizational innovations and not on an index. We are aware that these results are more difficult to interpret, but are convinced that they are more useful than simply integrating all the organizational innovations into one index. Multi-dimensional charts such as the spider graph are one way to display multi-task-based results for organizational innovations (Grupp and Mogege, 2004).

This paper is not intended to design a universally applicable, “one size fits all” methodology, but simply aims to shed some light into the black box of measuring organizational innovation in large-scale surveys. If it is assumed that a better understanding of the compound concepts is helpful in order to develop an adequate monitoring system, then more research is needed into the theoretical conceptualization of organizational innovations. For instance, it might be interesting to investigate the importance of organizational innovations across different industry sectors since we only discuss organizational innovations relevant for the manufacturing sector in this paper. These organizational innovations might be less relevant for other sectors. Further research is needed to find out for which organizational innovations there is a common understanding across companies. An interesting task for research might also be to investigate the life-cycle of an organizational innovation. It may help to develop future indicators if more is known about when, i.e., after what period of use, an organizational innovation becomes effective in terms of positively influencing performance indicators. Research could tackle this issue by analyzing the influence of different organizational innovations on different performance indicators in longitudinal studies. Finally, this paper proposes to include questions about individual organizational concepts into large-scale surveys, however, it does not analyse *which* specific organizational concepts should be included. In order to select specific organizational concepts for large-scale surveys, their impact on performance should firstly be analysed. As different organizational concepts are targeted towards different objectives such as decreasing manufacturing lead times, increasing product and process quality or decreasing costs, it is, moreover, interesting to analyse their impact on these performance indicators specifically. For instance, total quality management is important for gaining advantages in product and process quality rather than for gaining flexibility improvements, whereas customer-oriented production lines clearly aims at increasing flexibility but does not predominantly intend to decrease costs. Likewise, supply chain management mainly focuses on cost savings whereas continuous improvement processes mainly aim to increase company’s innovation ability. Thus, analyses on how different organizational concepts effect, e.g., manufacturing lead times as an indicator for flexibility or the average percentage of products that have to be reworked as an indicator for process quality might enrich the debate about an adequate organizational innovation monitoring

system. One might then select those organizational concepts having the strongest impact on these performance indicators as they are considered most important in order to achieve higher performances in terms of quality, flexibility, productivity or innovation ability.

There is still plenty of research to do before organizational innovation surveys achieve the degree of homogeneity and standardization that advanced R&D and technical innovation surveys possess. However, the need to construct an organizational innovation monitoring system is becoming increasingly important as shown by the attempts of the European Commission to integrate indicators of organizational innovations into the European Innovation Scoreboard.

Acknowledgements

We are grateful to colleagues from the Fraunhofer Institute of Systems and Innovation Research (ISI) for their valuable comments on earlier versions of this article. We would also like to thank Spomenka Maloca for her support in the data and methodology section.

References

- Amabile, T., 1988. A model of creativity and innovation in organizations. In: Cummings, L., Staw, B. (Eds.), *Research in Organizational Behavior*. JAI Press, Greenwich, CT.
- Anderson, N., King, N., 1993. Innovation in organizations. *International Review of Industrial and Organizational Psychology* 8, 1–34.
- Argyris, C., Schön, D., 1978. *Organizational Learning: A Theory of Action Perspective*. Addison-Wesley, Reading, MA.
- Battisti, G., Stoneman, P., 2005. The intra-firm diffusion of new process technologies. *International Journal of Industrial Organization* 23, 1–22.
- Burns, T., Stalker, G., 1961. *The Management of Innovation*. Tavistock Publications, London.
- Caroli, E., Van Reenen, J., 2001. Skill biased organizational change? Evidence from a panel of British and French establishments. *The Quarterly Journal of Economics* 116 (4), 1149–1192.
- Coriat, B., 2001. Organizational innovation in European firms: a critical overview of the survey evidence. In: Archibugi, D., Lundvall, B. (Eds.), *The Globalizing Learning Economy*. Oxford University Press, Oxford, New York, pp. 195–219.
- Damanpour, F., 1987. The adoption of technological, administrative and ancillary innovations: impact of organizational factors. *Journal of Management* 13 (4), 675–688.
- Damanpour, F., Evan, W.M., 1984. Organizational innovation and performance: the problem of “Organizational Lag”. *Administrative Science Quarterly* 29, 392–409.
- Damanpour, F., Szabat, K.A., Evan, W.M., 1989. The relationship between types of innovation and organizational performance. *Journal of Management Studies* 26 (6), 587–601.
- Drejer, I., 2004. Identifying innovation in surveys of services: a Schumpeterian perspective. *Research Policy* 33, 551–562.
- Duncan, R., Weiss, A., 1979. Organizational learning: implications for organizational design. In: Staw, B. (Ed.), *Research in Organizational Behavior*. JAI Press, Greenwich, CT.
- Eccles, R., Nohria, N., 1992. *Beyond the Hype*. Harvard Business School Press, Cambridge.
- Enquêtes sur les Changements Organisationnels et l’Informatisation, 1998. *Organizational Change and Information Technology Survey*. <<http://www.enquetecoi.net/>>.
- European Communities, 2004. *Innovation in Europe—Results for the EU, Iceland and Norway, Luxembourg*. <ftp://ftp.cordis.lu/pub/innovation-smes/docs/results_from_cis3_for_eu_iceland_norway.pdf>.
- European Foundation for the Improvement of Living and Working Conditions, 1997. *New forms of work organization. Can Europe realize its potential? Results of a survey of direct employee participation in Europe, Ireland*. More about the survey: <<http://www.eurofound.eu.int/areas/participationatwork/epocsurvey.htm>>; Overview of main results: <<http://www.eurofound.eu.int/publications/files/EF9803EN.pdf>>.
- European Innovation Scoreboard, 2006. <http://www.proinno-europe.eu/doc/EIS2006_final.pdf>.
- Eurostat, 2005. *Task Force Meeting on Oslo Manual Revision—Draft of the Third Edition*, 31 January 2005, Luxembourg.
- Freeman, C., Soete, L., 1997. *The Economics of Industrial Innovation*. Pinter Publishers, London, WA.
- Goldman, S., Nagel, R., Preiss, K., 1995. *Agile Competitors and Virtual Organisations: Strategies for Enriching the Customer*. Van Nostrand Reinhold, New York, NY.
- Greenan, N., 2003. Organizational change, technology, employment and skills: an empirical study of French manufacturing. *Cambridge Journal of Economics* 27, 287–316.
- Greiner, L., 1967. Antecedents of planned organizational change. *Journal of Applied Behavioral Science* 3 (1), 51–85.
- Grupp, H., Mogege, M.E., 2004. Indicators for national science and technology policy: how robust are composite indicators? *Research Policy* 33, 1373–1384.
- Hammer, M., Champy, J., 1993. *Reengineering the Corporation*. Harper Business.
- Hannan, M., Freeman, J., 1977. The population ecology of organizations. *American Journal of Sociology* 82, 929–964.
- Hannan, M., Freeman, J., 1984. Structural inertia and organizational change. *American Sociological Review* 49, 149–164.
- Hedlund, G., 1994. A model of knowledge management and the N-form corporation. *Strategic Management Journal* 15 (5), 73–90.
- Hipp, C., Grupp, H., 2005. Innovation in the service sector: the demand for service-specific innovation measurement concepts and typologies. *Research Policy* 34 (4), 517–535.
- Ishikawa, K., 1985. *What Is Total Quality Control? The Japanese Way*. Prentice-Hall, Englewood Cliffs, NJ.
- Kieser, A., 1996. Moden & Mythen des Organisierens. In: *DBW* 56/1, pp. 21–39.
- Lam, A., 2005. Organizational innovation. In: Fagerberg, J., Mowery, D.C., Nelson, R.R. (Eds.), *The Oxford Handbook of Innovation*. Oxford University Press, Oxford, pp. 115–147.
- Lawrence, P., 1954. How to deal with resistance to change. *Harvard Business Review* 32 (3), 49–57.
- Lay, G., Maloca, S., 2004. *Dokumentation der Umfrage Innovationen in der Produktion 2003*. Fraunhofer ISI, Karlsruhe.
- Levy, A., Merry, U., 1986. *Organizational Transformation: Approaches, Strategies, Theories*. Praeger, New York.
- Lewin, K., 1958. Group decisions and social change. In: Maccoby, E., Newcomb, T., Hartley, E. (Eds.), *Readings in Social Psychology*. Rhinehart & Winston, New York.
- Lund, R., 1998. Organizational and innovative flexibility mechanisms and their impact upon organizational effectiveness. DRUID—Danish Research Unit for Industrial Dynamics, Working Paper No. 98-23.
- Lundvall, B., Skov Kristensen, F., 1997. Organizational change, innovation and human resource development as a response to increased competition. DRUID—Danish Research Unit for Industrial Dynamics, Working Paper No. 97-16.
- Miles, J., 2005. Innovation in services. In: Fagerberg, J., Mowery, D.C., Nelson, R.R. (Eds.), *The Oxford Handbook of Innovation*. Oxford University Press, Oxford, pp. 433–458.
- Miles, R., Snow, C., 1997. Organizing in the knowledge age: anticipating the cellular form. *Academy of Management Executive* 11 (4), 7–24.
- Mintzberg, H., 1979. *The Structuring of Organizations*. Prentice-Hall, Englewood Cliffs, NJ.

- OECD, 2005. Oslo Manual—Guidelines for Collecting and Interpreting Innovation Data, Paris.
- Pinchot, G., Pinchot, E., 1993. *The End of Bureaucracy and the Rise of Intelligent Organization*. Berret-Koehler Publishers, San Francisco.
- Piva, M., Vivarelli, M., 2002. The skill bias: comparative evidence and an econometric test. *International Review of Applied Economics* 16 (3), 347–358.
- Schumpeter, J., 1934. *The Theory of Economic Development*. Harvard University Press, Cambridge, MA.
- Stoneman, P., 1999. Surveying organizational innovations: the search for good practice based on the CIS (UK) and INNFORM survey. Working Paper.
- Teece, D., 1998. Capturing value from knowledge assets: the new economy, markets for know-how, and intangible assets. *California Management Review* 40 (3), 55–79.
- Totterdell, P., Leach, D., Birdi, K., Clegg, C., Wall, T., 2002. An investigation of the contents and consequences of major organizational innovations. *International Journal of Innovation Management* 6 (4), 343–368.
- Warnecke, H., 1992. *The Fractal Company*. Springer, Berlin, Germany.
- Wengel, J., Lay, G., Nylund, A., Bager-Sjögren, L., Stoneman, P., Bellini, N., Bonaccorsi, A., Shapira, P., 2000. Analysis of empirical surveys on organizational innovation and lessons for future Community Innovation Surveys—EIMS Publication No. 98/191, Karlsruhe.
- Whittington, R., Pettigrew, A., Peck, S., Fenton, E., Conyon, M., 1999. Change and complementarities in the new competitive landscape: a European Panel Study, 1992–1996. *Organization Science* 10, 583–600. For more information about the project see: <<http://www.hj.se/doc/1355&lang=ege>>.
- Wildemann, H., 1992. *Die modulare Fabrik: Kundennahe Produktion durch Fertigungssegmentierung*. 3. neubearb. Aufl., St. Gallen.
- Womack, J., Jones, D., Roos, D., 1990. *The Machine That Changed the World: The Story of Lean Production*. Harper Perennial, New York.