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Innovation, Learning Organizations and Industrial Relations

by

Peter Nielsen and Bengt-Åke Lundvall

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Peter Nielsen
Center of Labor Market Studies
Aalborg University

And

Bengt-Åke Lundvall
Department of Business Studies
Aalborg University
bal@business.auc.dk

Abstract
Innovation may be seen as a process of knowledge creation and the speed and direction of knowledge creation reflects the organizational set-up of the firm as well as its investments in R&D and training. Establishing 'a learning organization' where horizontal interaction and communication inside and across the borders of the firm is a major factor promoting knowledge creation in the context of a learning economy. An important issue is to what extent direct and indirect participation of employees in shaping the new form of organization is critical for its realization.
On the basis of a unique data set covering 2000 Danish private firms it is demonstrated that firms combining several of the organizational traits of the learning organization are much more prone to introduce new products than the others. It is also demonstrated that such firms have involved employees in different forms of direct and indirect participation much more frequently than the rest. As more sectors become exposed to the need to engage in incremental product and service innovation the economic potential of diffusing good practices in terms of organization and participation is growing and needs to be reflected in firm strategies and public policies aiming at promoting innovation and knowledge creation.

Key words: Innovation, knowledge creation, learning economy
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1. The learning economy as context

It is important to reflect on why the impact of new organization forms and innovation capacity upon economic performance has increased through the 90s. As we get a better understanding of the mechanisms at work, it becomes easier to sort out what trends will dominate the future. Here we assume that the changes in the economic environment can best be captured by the concept 'the learning economy' (Lundvall and Johnson 1994).

In various contexts we have introduced an interpretation of what actually takes place in the economy under the term 'the learning economy' (Lundvall and Johnson 1994; Lundvall and Nielsen 1999). The intention is that the term should mark a distinction from the more generally used term 'the knowledge-based economy'. The learning economy concept signals that the most important change is not the more intensive use of knowledge in the economy but rather that knowledge becomes obsolete more rapidly than before; therefore it is imperative that firms engage in organizational learning and that workers constantly attain new competencies. This can be illustrated by the reference in a recent report from the Danish Ministry for Education to a German source that claims that half of the skills a computer engineer has obtained during his training will have become obsolete one year after the exam has been passed, while the 'halving period' for all educated wage earners is estimated to be eight years (Ministry of Education 1997, p. 56).

A learning economy is thus one in which the ability to attain new competencies is crucial to the economic success of individuals and to the performance of firms, regions and countries. The background for the crucial importance of learning is that the combination of globalization, information technology and deregulation of formerly protected markets leads to more intense competition and to *more rapid transformation and change*. Both individuals and companies are increasingly confronted with problems that can be solved only through new competencies. The rapid rate of change is reinforced by the fact that the intensified competition leads to a selection of organizations and individuals that are capable of rapid learning, thus further accelerating the rate of change.

The transition to a learning economy confronts individuals and companies with new demands. We see the growing emphasis on new organization forms promoting functional flexibility and networking as responses to the challenge of the learning economy. In a rapidly changing environment it is not efficient to operate in a hierarchical organization with many vertical layers. It takes too long to respond if the information obtained at the lower levels should be transmitted to the top and back down to the bottom of the pyramid. In many instances relational contracting and networking enhance functional flexibility.

One important result from what follows is that the new organization forms which tend to support competence building through learning by doing and interacting tend to speed up product or service innovation. In the next section we will focus on how knowledge creation relates to innovation and to the establishment of learning organizations.

2. Innovation and knowledge creation

Most authors using the concept of knowledge creation and knowledge production refer to technological knowledge and to technical innovation as the output of the process (Nonaka and Takeuchi 1995). In the new growth theory, the output of the R&D sector is viewed either as a blueprint for a new production process that is more efficient than the previous one or as a

production of new semi-manufactured goods that cannot not easily be copied by competitors.

A striking characteristic of knowledge production resulting in innovation is the fact that knowledge, in terms of skills and competencies, is the most important input. In this sense, it recalls a 'corn economy', in which corn and labour produce corn. But it differs from such an economy in one important respect. While the corn used to produce corn disappears in the process, skills and competencies improve with use. Important characteristics of knowledge reflect that its elements are not scarce in the traditional sense: the more skills and competencies are used, the more they develop. This points to knowledge production as a process of joint production, in which innovation is one kind of output and the learning and skill enhancement that takes place in the process is another.

Innovation as the outcome of knowledge production

There are two reasons for focusing on innovation when it comes to understand knowledge production. One is that innovation represents – by definition – something new and therefore adds to existing knowledge. The second is that innovation is a process where the innovating unit operates under uncertainty and therefore regularly is confronted with unforeseen problems.

There are important sector differences in knowledge production. Such differences are reflected in the character, the mode and the outcome of the innovation process. The taxonomy developed by Keith Pavitt (1984) represents an important effort to capture these differences systematically, so far as the manufacturing sectors are concerned. Pavitt defined four categories of firms and sectors.

- *supply-dominated sectors* (*e.g.* clothing, furniture)
- *scale-intensive sectors* (*e.g.* food, cement)
- *specialized suppliers* (*e.g.* engineering, software, instruments)
- *science-based producers* (*e.g.* pharmaceuticals, biotechnology, electronics)

For a long time, knowledge production/innovation processes were considered largely as the province of the fourth category, and still there is a bias in this direction. Often this was combined with a linear view which assumed that new scientific results are the first step in the process, technological invention the second step, and the introduction of innovations as new processes or products the third. There is now a rich body of empirical and historical work which shows that this is the exception rather than the rule (Rothwell 1977; von Hippel 1988; Lundvall 1988). The recent models of innovation emphasize that knowledge production/innovation is an interactive process in which firms interact with customers, suppliers and knowledge institutions. Empirical analysis shows that firms seldom innovate alone (Lund Vinding 2002).

This is also the background for developing a systemic approach to knowledge production. Innovations systems are constituted by actors involved in innovation and their interrelationships. The actors are firms, technological institutes, universities, training systems and venture capital. Together they constitute the context for knowledge production and innovation. The specific constellations differ across sectors, regions and nations. They are typically specialized in terms of their knowledge base, and the specific mode of innovation will reflect institutional differences. This is the background for the growing literature on innovation systems (Freeman 1987; Lundvall 1992; Nelson 1993; Edquist 1997) and technological systems (Carlsson and Jacobsson 1997).

Innovation systems may be defined as regional or national, as well as sector- or technology-specific. The common idea is that the specificities of knowledge production reflect unique combinations of technological specialization and institutional structure.

Competence as the outcome of knowledge production

The change from a linear to an interactive view of innovation and knowledge production has also been a way to connect to each other innovation and the further development of competence. As now understood, the innovation process may be described as a process of *interactive learnin*g in which those involved increase their competence while engaging in the innovation process.

In economics, there have been various approaches to competence-building and learning. One important contribution is Arrow's analysis of 'learning by doing' (1962), in which he demonstrated that the efficiency of a production unit engaged in producing complex systems (aeroplane frames) grew with the number of units already produced and argued that this reflected experience-based learning. Later, Rosenberg (1982) introduced 'learning by using' to explain why efficiency in using complex systems increased over time (the users were airline companies introducing new models). The concept of 'learning by interacting' points to how interaction between producers and users in innovation enhances the competence of both (Lundvall 1988). A more recent analysis of learning by doing focuses on how confronting new problems in the production process triggers searching and learning, which imply interaction between several parties as they seek solutions (von Hippel and Tyre 1995).

In most of the contributions mentioned above, learning is regarded as the unintended outcome of processes with a different aim than learning and increasing competence. Learning is seen as a side-effect of processes of production, use, marketing, or innovation. An interesting new development, which tends to see learning as a more instrumental process, is the growing attention given to 'learning organizations' (Senge 1990). The basic idea is that the way an organization is structured and the routines followed will have a major effect on the rate of learning that takes place. The appropriate institutional structures may improve knowledge production in terms of competence building based on daily activities (Andreasen 1995).

The move towards learning organizations is reflected in changes both in the firm's internal organization and in inter-firm relationships. Within firms, the accelerating rate of change makes multi-level hierarchies and strict borders between functions inefficient. It makes decentralization of responsibility to lower-level employees and formation of multi-functional teams a necessity. This is reflected in the increasing demand for workers who are at the same time skilful, flexible, co-operative and willing to shoulder responsibility. It is also reflected in relationships with suppliers, customers and competitors becoming more selective and more intense. 'Know-who' becomes increasingly important in an economy that combines a complex knowledge base and a highly developed, rapidly changing specialization.

Apart from these organizational changes, there is a growing emphasis on making employees and teams of employees more aware of the fact that they are engaged in learning. It has been suggested that second-loop learning and deutero learning, *i.e.* a process in which agents reflect on what has been learnt and on how to design the learning process, is much more efficient than simply relying on the impact of experience (Argyris and Schoen 1978).

A blurring of the distinction between production of knowledge as a separate (off-line) activity and as a by-product of regular routine activities (on-line)

It is useful to separate two different perspectives on the process of knowledge production which are not mutually exclusive in real life but which can be found, in more or less pure form, in the literature on innovation and growth. On the one hand, one might look for *a separate sector* in charge of producing new knowledge or handling and distributing information. Such a sector might, for instance, involve universities, technical institutes and government S&T policies, as well as R&D functions in firms. Here, the production of knowledge is assumed to take place as a deliberate activity, outside the realm of production.

On the other hand, one might regard the creation and diffusion of knowledge as rooted in and emanating from routine activities in economic life, such as learning by doing, using and interacting. Here, the production of knowledge is assumed to take place as a by-product of in daily activities, through learning by doing or learning by using.

This distinction, between deliberate and non deliberate forms of knowledge production, can also be referred to as respectively 'off-line' and 'on-line' learning activities. Above we referred to the growing focus on establishing learning organizations. Another related new trend is the emergence of a form of learning qualified as 'experimental' using 'the factory as a laboratory'. Both these forms relate to learning, taking place 'on line' (that is to say, during the process of producing the good or providing the service) but they reflect deliberate efforts to enhance competence building.

The possibility of moving to this type of learning in more and more activities represents one important transition in the historical evolution of the learning economy. In effect, as long as an activity remains located either in a separate knowledge sector or gives rise only to non-reflective learning there remains a distinct cleavage between those who deliberately produce knowledge and those who are expected to use and exploit it. When more activities move to higher forms of learning where the individual can program experiments and reflect on results, the production of knowledge tends to become a more collectively distributed responsibility. The distance between the laboratory and the shop floor becomes shorter.

3. Research questions to be illuminated

This paper tests and finds support for the following set of hypotheses:

- the probability of successful product innovation increases when the firm has organized itself in such a way that it promotes learning.

- organizational forms promoting learning have to be seen as multi-dimensional - they typically combine several of a number of internal relationships and activities and external relationships.

- internal relationships and activities include integrative organizational forms, quality management, human development efforts and compensation systems.

- external relationships include relationships to suppliers, customers and knowledge institutions.

- firms that go far in introducing organizational practices to promote learning tend to combine indirect representation of workers with direct representation.

It also tests but finds no support for the following two hypotheses:

- there is a time lag from an organizational set up promoting learning to the outcome in terms of frequent product innovations.

- the bigger the share of the labor force within the firm that is involved in a specific learning promoting organizational form the stronger the innovative activities.

In the first part of the empirical analysis we explore factors that lie behind product innovation in 2000 Danish firms belonging to manufacturing, construction and service industries. Most of the innovations are incremental rather than radical - most of them signal something new for the firm but not something new for the national economy or the world economy. We do not see that as a weakness of the analysis, however. Especially in a small open economy of the Danish type, competitiveness and economic growth will depend on continuous incremental upgrading of products. 'Domestic' radical innovations will not be frequent and there is a high probability that they will be taken over by foreign big firms before they leave strong marks on the growth pattern of the whole economy.

We will demonstrate that there are important sector differences in the frequency of innovation and that big firms innovate more than small ones. Most importantly we will show that bundling a number of different characteristics having to do with a learning organization has a major effect on the innovation capability. The functionally flexible firms that engage in networking with customers and suppliers will ceteris paribus be more active in terms of product innovation than the firms that operate in a more traditional way.

In the second part of the empirical analysis we explore the direct and indirect participation of workers. We find that there is a connection between the strength of the influence and at what stage of decision making employees are engaged in the processes of organizational change. We also find that while the tendency is towards more direct and less indirect participation the most advanced firms in terms of establishing learning organizations are the ones that most frequently use indirect forms in the organization development process.

On the basis of our theoretical considerations and empirical results it is fair to conclude that incremental innovation and learning are two sides of the same coin. It is true that 'learning organizations' are more apt when it comes to mobilize and utilize different sources of knowledge when it comes to develop new products. But it is also true that the very presence of incremental innovation increases the need for an organizational framework that can cope with new problems as they pop up during the innovation process. In terms of innovation policy it might therefore be a good idea to combine initiatives promoting organizational change with initiatives that give better opportunities and incentives to engage in product innovation.

4. Data

The empirical analysis is based on a survey addressed to all Danish firms in the private sector – not including agriculture - with 25 or more employees, supplemented with a stratified proportional sample of firms with 20-25 employees. 6991 questionnaires were sent to the firms

selected. This survey were planned to collect information from management as well as from employee representatives by means of two separate questionnaires, implemented through two phases of collection in each of the firms selected.

The overall design is comparable to the workplace employee- or industrial relation surveys, which have been carried out in Britain, Canada, Australia and France (Tomlinson 1999; Coriat 2001). This means that one aim of the survey has been to establish a set of panel data that connects a survey from 1996 (DISKO), covering the period 1993-95, to this 2001 survey covering the period 1998-00. Information links between the two surveys are established by comprehensive register data from the Danish Integrated Database of Labor Market Research (IDA) and the register of Business Data at Denmark Statistics.

I order to construct the panel the core of this survey sample had to be 1363 firms from the 1996 DISKO survey, which had 'survived' as units in the IDA-database. From those 1363 firms, longitudinal data were already available from 1990 to 1997, covering information on firm performance and employee education, -development and -turnover. The data collection addressed to this sample resulted in 637 useable responses. The rate of response among the core group of firms is 47%, which is similar to the rate of response on the first (DISKO) survey, which was 48% (Lund 1998; Lund and Gjerding 1996).

In total, 2007 usable responses from management and 473 responses from employee representatives have been collected and integrated in a cross section data set from this last survey. This makes the overall response rate of the survey 29%, which is not very satisfying. However, a closer response analysis broken down on industries and size show acceptable variations on response rates here, and non-respondent information on some of the potential dependant variables together with comparison to other surveys, do not indicate unacceptable bias.

To this survey data is linked 1998 and 1999 statistics from the Danish Integrated Database of Labor Market Research and the register of Business Data at Denmark Statistics in such a way, that integration between the two main dataset has been possible, and the longitudinal data set from 1990 to 2001 is established. The elements of the '*Innovation, Organization and Competence Panel*' are shown in Appendix A, in order to give a general overview of the data set.

5. The frequency of product innovation in the surveyed firms

The dependent variable in most of the analysis below is constructed on the basis of management response to a question about product or service innovation in the period 1998-2000. It may be argued that product innovation is important both for the economy as a whole and for the single firm. It is a necessary precondition for economic growth in a closed economy – just sticking to the old set of products would lead to saturation of markets as productivity increases (Pasinetti 1981) and it is certainly important in relation to international competitiveness. For the single firm one way to cope with increasing competition is to introduce products with new and superior use value characteristics.

Obtaining a meaningful quantitative measure of innovation and innovative behavior on the basis of information collected in firms belonging to industries with very different conditions, is not unproblematic. The phenomenon that firms refer to may vary in relation to conditions and configurations. The fact is that we are confronted with qualitative change rather than change easily captured in quantitative terms when we ask the firms whether they, in the period of 1998 -

2000, have introduced new products or services on the market.

Table 1: Product or service innovation 1998-2000 by firm size, industry, group ownership and production (percent horizontal)

	P/S innovati	Not P/S innov	Don't know	(N)
All Firms	45,4	52,4	2,2	1974
Less than 50	36,5	60,9	2,6	1022
50 - 99 Empl	47,3	52,0	0,7	433
100 and more	62,6	34,7	2,7	487
Manufacturing	58,1	40,8	1,1	723
Construction	21,7	75,7	2,6	309
Trade	41,4	55,6	3,1	549
Other services	31,1	67,1	1,8	164
Business serv.	58,7	37,6	3,8	213
Danish group	48,6	49,6	1,7	693
Foreign group	59,7	38,4	1,8	385
Single firm	36,6	60,7	2,7	882

Table 1 shows that almost a half of the firms introduce at least one new product or new service over a two year period. It also shows that the bigger the firm the greater the probability that it introduces a new product. There are substantial sectoral differences as well: Firms belonging to manufacturing and business services are much more active in terms of product innovations than the average while construction firms are far below the average. Firms owned by foreign groups have the highest innovation score, firms owned by Danish groups medium score and single - stand alone - firms the lowest score in terms of product innovation.

As indicated in an earlier section most of the innovations are not 'new on the market'. In order to uncover the various degrees of radical innovation in relation to the market context, we have asked firms whether their innovations already existed on the national market or existed on the world market. The result appears from the table 2.

Table 2: P/S innovations and their novelty on the Danish and the world market in percent (N=814)

	Known on world market	New to world market	Don't know
Known on Danish market	74,1	0,9	1,8
New to Danish market	13,1	6,1	1,7
Don't know	0,6	0,0	1,6

Table 2 shows that three-fourth of the innovations introduced within the period 1998-2000, were already known at the national as well as well as on the international markets. Firms representing this group of innovators may be termed 'local', as the product or service innovations are only new to the firms, which produced them, not new on the market. The next step is the innovations new on the national market, although already existing in world markets. 13% of the firms have introduced at least one innovation in this category. Finally, we find the small group of firms (6%), which have introduced at least one innovation new, both on the national and the world market.

6. The frequency of organizational change in the surveyed firms

The theoretical and practical importance of introducing new forms of management and building new work organizations is not at all new. This importance is for instance at the core of the theoretical discussion of developments in techno-economic regimes as understood by Freeman and Perez (1988). In the management literature, concepts such as quality control, diversification and flexibility tend to form new global 'institutional standards', value systems confronting firms as clues to competitive advantages in the new international division of labor. They are also promoted by consultancy firms operating on a world wide basis (Røvik 1992; Røvik 1998). These are some of the reasons why the empirical research in new organization practices gathered momentum worldwide in the nineties.

Table 3 gives a picture of the frequency of organizational change in different part of the Danish economy. It is based on the assessment of representatives of management and reflect a response to a question regarding the occurrence or not of important organizational change in the period 1998-2000.

Table 3: Organizational changes 1998-2000 by firm size, industry, group ownership and production (percent horizontal)

	Org. changes	No org. chag	Don't know	(N)
All firms	52,0	46,9	1,2	1992
Less than 50 emp	40,1	59,3	0,6	1037
50 - 99 employee	56,6	40,9	2,5	435
100 and more	73,2	25,6	1,2	488
Manufacturing	58,9	39,6	1,5	722
Construction	33,4	65,6	1,0	314
Trade	51,1	48,0	0,9	558
Other services	46,7	51,7	1,7	182
Business services	62,8	36,7	0,5	215
Danish group	57,5	41,5	1,0	694
Foreign group	71,1	28,4	0,5	388
Single firm	39,7	58,8	1,6	895
Standard product	56,1	42,9	1,0	725
Customized product	50,9	47,8	1,3	1188

Table 3 shows that slightly more than half of the firms responding to the survey have introduced significant change in their organization 1998-2000. The frequency in this period is the same as it was in the period 1993 -95, where the same question was directed to 1900 firms from a similar (and partially overlapping) population.

There are differences between different categories of firms. The larger the firm the higher is its propensity to engage in organizational change. Almost three-fourth among the 100 + firms have undertaken organizational changes. But even among the small firms with less than 50 employees, two-fifth have engaged in changes.

Differences between the various industries are present without being particularly pronounced, and they are in harmony with the findings in the mid-nineties. Business service and Manufacturing score high. Trade is at the average level while Other Service and Construction lie below the average. Foreign owned companies have a high proportion of organizational change and stand-alone firms have the lowest proportion. The difference between firms engaged in standard product and those producing individualized products is small.

As the next step we shall study the various reasons why organization changes were initiated. All the firms that had reported that they had introduced a major change were asked about what was

their aim with introducing it. Table 4 summarizes the different response pattern.

Table 4: Aim of organizational changes

	High extent	Some extent	Small extent	Not at all	Don't know	(N)
Increase effectiveness of daily work	71,7	25,1	1,7	1,5	0,1	1016
Improve quality and customer service	53,6	37,0	6,2	3,0	0,3	1012
Strengthen cooperation and coordination across the organisation	51,7	37,0	7,9	3,2	0,3	1003
Adapt to turbulent environments	47,5	39,8	9,7	2,6	0,4	1002
Strengthen and renew knowledge	29,7	46,4	17,5	5,4	1,1	1003
Develop new products or services	28,4	40,3	20,7	9,5	1,1	1000

More than two out of three firms refer to the promotion of work efficiency as an important aim with changing the organization. It is hardly surprising that such a general aim as 'efficiency' scores high. To enhance quality, strengthen internal and external cooperation and increase adaptability are quoted as highly important by half the firms. Strengthening and renewing the knowledge of the firm and its know-how together with continuously product/service innovation are seen as important aims by less than a third of the firms. According to the response pattern most firms are obviously aiming at efficiency and functional flexibility when changing their organization. But it is also interesting to note that only one out of four firms says that enhancing the knowledge base of the firm is of minor or no importance.

One interesting issue in this context is whether and to what extent the empirical dimensions in the table are correlated and represent common latent factors with multiple dimensions. Dimensions which all are important for the firms as aims of their organizational changes. This question can be investigated in a factor analysis, that uncovers latent factors behind empirical dimensions. Results from the factor analysis are presented in the table 5.

Table 5: Factor analysis of the aims behind organizational change.

	Factor 1: Innovation and knowledge	Factor 2: Effectiveness
Strengthen and renew knowledge	**0,76**	-0,31
Develop new products or services	**0,73**	-0,41
Adapt to turbulent environments	**0,64**	-0,13
Improve quality and customer service	**0,63**	0,27
Strengthen cooperation and coordination across the organisation	**0,52**	0,25
Increase effectiveness of daily work	0,41	**0,78**

Table 5 shows that the factor analysis uncovers two latent factors of importance as aims of organizational changes. The first factor covers specific aims, such as "the ability continuously to strengthen and renew knowledge and know-how", "continuously to develop new products or services", "adapt to turbulent environments", "quality and customer service" and "cooperation and coordination across the organization". The second factor covers only the dimension of "effectiveness of the daily work".

This analysis of how the aims behind organizational changes are interrelated first of all gives evidence of one multiple aim, covering dimensions which represent strengthening of knowledge, communication and innovation together with quality and adaptability in relation to business environments. The other factor covers the single aim of enhancing the effectiveness of daily work.

What is of special interest here is that the firms giving strong emphasis to elements involved in creating a functionally flexible organization (adaptability to change, internal co-operation and responsiveness to customers) seem to combine such aims with a strong emphasis on innovation and knowledge creation. This might be taken as a first indication that aiming at a functionally flexible organization is also to aim at establishing a learning and an innovating organizations. This is a perspective that will by analyzed in more detail in the next section.

7. Bundling organizational characteristics and analyzing the impact on innovation

The globalization of competition and changes in consumer demand through the eighties and nineties have promoted development of universal values of organizational solutions, such as delegation of responsibility, decentralized internal and external communication, quality management and competence building. Researchers and experts have developed and/or confirmed these values to what has been called "institutional standards" (Røvik, A. 1992 1998), confronting the firms as solutions of their problems or challenges in the globalized economy.

In the survey, we have measured the incidence of an array of organizational dimensions, which all directly or indirectly refer to contemporary theories dealing with innovation and functional

flexibility in organizations: Cross occupational work groups, integration of functions, softening demarcations, delegation of responsibility and self directed teams are empirical indicators, referring to Moss Kanter's theory of integrative organization and Burn's & Stalker's organic organizations. Quality circles and proposal collection systems are indicators of Quality management (TQM) and Knowledge Management (Nonaka & Takeuchi 1995). Tailored educational system and Educational planning indicate Human Resources Development and cooperation with eksternal actors refer to Innovation systems (Lundvall 1992). In the figure below the dimensions are classified in relation to the theoretical aspects they are indicators of.

Figure 1: Theoretical perspectives and organizational characteristics and practices

Theoretical perspective	Organizational characteristics and practises
The organic and integrative organization – focus on internal functional flexibility	Cross occupational working groups Integration of functions Softened demarcations Delegation of responsibility Self directed teams
Quality management – focus on engaging employees	Quality circles/groups Systems for collection of employee proposals
Human development – focus on competence building	Education activities tailored to the firm Long term educational planning
Compensation system – focus on incentives	Wages based on qualifications and functions Wages based on results
External communication – focus on external functional flexibility	Closer cooperation with customers Closer cooperation with subcontractors Closer cooperation with universities & technological institutes

In order to examine whether the dimensions cover underlying or latent but more general variables, possibly in accordance with the above-mentioned theories, a factor analysis has been performed on the use of the organizational dimensions in the work processes of the firms, as the next analytical step. Besides the theoretical interests it is known from empirical research, that clusters of dimensions further productivity as well as innovation behaviour in firms (Dyer and Reeves 1995, Huselid 1995, Huselid et.al. 1996, Wood 1999, Osterman 2000, Lund Vinding 2001, Laursen 2001). Exploring clusters of dimensions should lead us forward in the analysis of the "anatomy" of the knowledge organizations. The results of the factor analysis are shown in the

table below.

Table 6: Factor analysis: dimensions of organization, communication, human development, cooperation and compensation

	Faktor 1: Integra-tive organization	**Faktor 2:** Human development	**Faktor 3:** Eksternal cooperation	**Faktor 4:** Com-pensation systems
Cross occupational working groups	**0,66**	0,14	0,07	0,12
Quality circles/groups	**0,62**	0,11	0,02	0,01
Self directed teams	**0,61**	0,04	-0,02	0,15
Integration of functions	**0,59**	-0,01	0,08	0,03
Delegation of responsibility	**0,55**	0,08	0,02	0,38
Systems for collection of employee proposals	**0,48**	0,11	0,18	0,12
Softened demarcations	**0,40**	0,10	0,24	-0,06
Education activities tailored to the firm	0,10	**0,87**	-0,00	0,07
Long term educational planning	0,15	**0,84**	0,11	0,10
Closer cooperation with subcontractors	0,07	0,04	**0,80**	0,08
Closer cooperation with customers	0,10	0,04	**0,80**	0,04
Closer cooperation with universities & technological institutes	0,26	0,27	0,27	-0,06
Wages based on results	0,06	0,08	0,03	**0,78**
Wages based on qualifications and functions	0,17	0,04	0,06	**0,74**
Explained variation	**2,38**	**1,60**	**1,47**	**1,37**

The 14 different empirical dimensions examined in the analysis load on four factors, after a varimax rotation. The first factor, called “Integrative and quality work organization”, includes seven dimensions: Cross occupational working groups, Quality circles/groups, Self managed groups, Integration of functions, Delegation of responsibility, System for collection of proposals from employees and Softened or disappeared demarcation between occupational groups. This factor covers all the central dimensions of integrative organization and quality management. The next factor includes the human development dimensions: Tailored educational activities and Long term educational planning. “External cooperation” is the common property of factor 3 which include the two dimensions: Closer cooperation with subcontractors, Closer cooperation with customers, but not Closer cooperation with knowledge centers . Finally factor 4 is called “Compensation systems” and includes “Wages based on qualifications or functions” and “Wages based on results”.

The factors uncovered in this analysis give the impression of a "theoretically consistent" application pattern of the organizational dimensions in the firms. It is interesting to note that the first factor that explains most of the variation brings together internal organizational characteristics but neither education efforts, systems of wage nor external collaboration. This implies that building the characteristics of a learning organization may be seen as a specific effort that may or may not be supplemented by elements going into the other three factors.

Now, it is interesting to examine to what degree the four factors as latent variables affect the appearance of product or service (P/S) innovation in the surveyed firms. This analytical step is performed in a logistic regression model with occurrence of P/S innovation as dependent variable and with organizational factors as explanatory variables. The results are shown in table 7.

Table 7: Logistic regression of factors related to organization and quality (Factor 1), human development (Factor 2), external cooperation (Factor 3) and new compensation systems (Factor 4) on P/S innovation. (odd ratio, 95% confidence interval, estimates and P-values)

Dimension	Effect	Lower	Higher	Estimate	Chi-sq	P-valu
Factor 1	1,91	1,73	2,11	0,65	163,53	<.0001
Factor 2	1,38	1,25	1,51	0,32	43,20	<.0001
Factor 3	1,45	1,31	1,60	0,37	52,06	<.0001
Factor 4	1,31	1,19	1,44	0,27	31,34	<.0001

Table 7 demonstrates that each of the four factors has a significant effect on the innovation performance of the firm. The first factor "Integrative organization" shows the largest effect, with almost double the chances of P/S innovation in the firms. The other factors increase chances of P/S innovation more moderately. This model may be seen as a verification of theoretical aspects in relation to the innovative behavior of the firm. It indicates that integrative organizations are more innovative than those that are not integrative. But it also shows that other factors having to do with respectively external co-operation, education and system of pay tend to work in the same direction.

We can go further in the analysis and ask whether the organizational characteristics and practices complement each other and thus increase the chances of P/S innovation cumulatively. Such complementarity of elements might reflect that there are 'bundles' of organizational techniques that support each other and that it is only when the firm has got all the elements working together that it will harvest the full benefits in terms of innovative behavior. Another way of understanding complementarity would be that the more aspects and dimensions the firm implemented in the organization, the more the internal consciousness in the organization about the importance of learning and knowledge development among actors in the firm. This would be in accordance with the empirical findings on "clustering" of aims where there was a strong interconnection between aiming at learning and at building an integrative organization (see the comments to table 5). Building on such arguments, an additive index has been constructed applying all the fourteen organizational characteristics. The empirical distribution of observations (firms) in the additive index of organization, quality control, human development, compensation and external

communication is shown in the table below:

Table 8: Distribution of firms in terms of the number of organizational practices in terms of integratio, quality, human development, compensation and external communication (N = 2007).

Index	Frequency	Percent	Cumulative perc.
0	32	1,59	1,59
1	64	3,19	4,78
2	105	5,23	10,01
3	135	6,73	16,74
4	210	10,46	27,20
5	202	10,06	37,27
6	224	11,16	48,43
7	250	12,46	60,89
8	213	10,61	71,50
9	210	10,46	81,96
10	165	8,22	90,18
11	90	4,48	94,67
12	63	3,14	97,81
13	30	1,49	99,30
14	14	0,70	100,00

We have classified the firms in three groups, according to how many dimensions they have adapted in their organizations - in other words - how many organization, quality, human development and external cooperation facets are built into the firm's organization. We have thus divided the firms into three groups:

- Low level learning organization – includes firms that have introduced zero to four of the dimensions
- Medium level learning organizations- includes firms that have introduced five to eight dimensions
- High level learning organizations- includes firms that have introduced nine to fourteen dimensions.

This quantitative bundling aspect may be assumed to reflect the degree of organizational

sophistication. Applying many dimensions signals consciousness knowledge development. In other words it signals a culture of change and learning in the firms. In table 9 results of this construction is shown. Table 9 shows how frequent high level learning organizations are in different categories of size, industry, ownership and production.

Table 9: Learning organization development by firm size, industry, group ownership and production (percent horizontal)

Variables:	High (9-14)	Medium (5-8)	Low (0-4)	(N)
All firms	28,5	44,3	27,2	2007
Less than 50 employees	18,1	45,9	36,0	1048
50 - 99 employees	35,0	42,3	22,7	437
100 and more employees	45,1	43,3	11,6	490
Manufacturing	36,3	42,9	20,8	725
Construction	14,5	42,8	42,8	318
Trade	24,5	48,3	27,2	563
Other services	19,6	45,1	35,3	184
Business service	41,2	40,3	18,5	213
Danish group	30,1	44,7	25,3	701
Foreign group	40,7	43,8	15,5	388
Single firm	22,3	44,5	33,2	903
Standard product	29,2	45,1	25,7	725
Customized product	29,8	44,9	25,3	1192

By grouping all the firms according to the index of learning organization development we get 27% in the low category, 44% in the medium and 28% in the high category. Table 9 shows us that this distribution is size dependent. Among firms with less than 50 employees, only one out of five firms have developed a learning organization at the high level while the same is true for every second of the bigger firms. With growing firm size, the share of highly developed firms increases.

Table 9 shows as well that the diffusion of high level learning organisations varies between industries. More than 40% of the firms in Business service are in the category of highly developed learning organizations, while the same is true for 36% of the firms in Manufacturing. The rest of the industries lie below the average. It is, however, interesting to notice, that Trade together with Other Services tend to have higher shares of their in the medium category. This might be seen as illustrating that either the incentives or the opportunities to develop complete learning organizations are much less in some industries than it is in others.

Another interesting result coming out from table 9 is that firms owned by foreign groups have such a high share in the category of most developed. Firms owned by Danish groups are closer to

the general average and single - stand alone - firms are below average in this category. We will see similar patterns in several of the following analyses. The presence of foreign owned firms seems to constitute 'a progressive element' in the Danish economy while the often cherished family owned stand alone firms seem to be lagging behind both in terms of technological and organizational sophistication.

If the production is scale intensive and standardized rather than customer designed does not affect the distribution between development categories.

What is the importance of this bundling of organizational dimensions for the knowledge production and learning in the firms, indicated by product and service (P/S) innovations? In table 10 the different categories, representing increasing levels of learning organization will be tested in a logistic model with P/S innovation as dependant variable, and with control for firm size, industry ect.

Table 10: Logistic regression of learning organization level categories, size, industry, ownership and production on P/S innovation (odd ratios, 95% confidence interval, estimates and P-values)

Variables:	Effect	Lower	Higher	Estimate	Chi-sq	P-value
High level	5,18	3,90	6,90	0,82	127,30	<.0001
Medium level	2,20	1,71	2,83	0,39	37,11	<.0001
Manufacturing	2,35	1,62	3,40	0,54	38,69	<.0001
Construction	0,69	0,45	1,08	-0,68	28,35	<.0001
Business services	2,27	1,46	3,54	0,51	15,40	<.0001
100 and more	1,61	1,26	2,07	0,30	14,23	0.0002
Danish group	0,76	0,58	1,00	-0,14	3,93	0.0475
Single firm	0,58	0,44	0,76	-0,28	15,85	<.0001

We find a five times higher chance of P/S innovation in the high level category, and even in the medium category the chance is twice as high as in the low category. Among the other factors included in the model, Manufacturing and Business services remain significant with 2.3 higher chance of P/S innovation and Construction is negatively significant with a chance of 0,7. The effects of large size (100+) is positive but moderate. Danish group ownership and single firms have a chance below the average. In sum, the model has shown important and significant effects of the development of what we call learning organization on P/S innovation. This may be taken as more evidence of validity in the theoretical considerations concerning the construct of "learning organization".

For many of the firms, adoption of the operational dimensions or "institutional standards" of the learning organization is a phenomenon of the late nineties. When we measure the implementation of the organization dimensions and the P/S innovative behaviour chronological, we confront the

problem that the effect of implemented organization dimensions on behaviour may take some time. A time lag of 2-3 years, sounds reasonable when focusing on learning practices and organizational behaviour like P/S innovation. In order to take into account this aspect of organizational behaviour, a new index and categorizing of the firms has been produced, with the restriction of three years time lag on the organizational dimensions. The table below shows how far the firms had developed their organization 1997 - 3 years back in time.

Table 11: Learning organization development implemented 1997 and before (N = 2007)

High (9-14 dimensions)	Medium (5-8 dimensions)	Low (0-4 dimensions)
9,7	41,3	49,0

When we compare the distribution in table 11 to the distribution in table 9, it is obvious that the firms surveyed on average have gone through a quite rapid organizational upgrading and that many of them have moved to a higher level over the last three years. While the category of high level learning organization was as low as 10% in 1997 it had grown to almost 30% in the year 2000. Since the medium category remained almost unchanged it implies that at least as much as 40% of all the firms moved up one category over the three year period. Perhaps some caution should be applied here since response regarding the history of the firm may be especially uncertain.

It is also of interest to examine the effect of this revised model of the learning organization on innovation. The idea is to see if we can find a time lag in the impact of the organizational set up and its impact on product/service innovation and the results of the analysis is gathered in table 12.

Table 12: Logistic regression of learning organization development categories implemented 1997 and before, size, industry, ownership and production on P/S innovation (odd ratios, 95% confidence intervals, estimates and P-values)

Variables:	Effect	Lower	Higher	Estimate	Chi-sq	P-value
High level	3,42	2,42	4,87	0,62	46,53	<.0001
Medium level	1,95	1,59	2,39	0,33	41,41	<.0001
Manufacturing	2,50	1,73	3,60	0,58	46,77	<.0001
Construction	0,65	0,42	1,00	-0.76	37,24	<.0001
Business servic	2,46	1,59	3,79	0,57	20,19	<.0001
100 and more	1,86	1,46	2,37	0,35	20,38	<.0001
Danish group	0,73	0,55	0,95	-0,16	5,40	0.0201
Single firm	0,52	0,40	0,68	-0,32	22,67	<.0001

In this lagged model almost the same factors come out as significant, as in the model without a time lag. The effects of learning organization level have shrunk here, but the differences between the two models are not statistically significant. The Industry effects have the same structure but are weaker, though not significantly weaker. The same is true for size and ownership, where no significant difference is found between effects in the two models.

All in all, the result of the lagged model did not confirm an assumption that there is a time lag from organizational development levels to innovation performance. This might be seen as indicating that the causal links do not go one way from learning organizations to innovation. Instead there may also be a tendency that firms when they get involved in product innovation realize the need for organizational development.

Another question that can be illuminated by the data we have access to is the effect of the proportion employees covered by the implemented organizational dimensions or building blocks of the learning organization inside the firms. The firms may introduce the individual dimension in the organization and implement it, only covering a minor proportion of the employees. In order to examine the importance and effects of a certain amount of employees covered by each dimension, we have constructed the index and the categories with the restriction that at least 50% of the employees should be covered by the individual organizational dimensions in the model.

Table 13: Learning organization development where each dimension is covered by 50% or more of the employees (N = 2007)

High (9-14 dimensions)	Medium (5-8 dimensions)	Low (0-4 dimensions)
9,1	38,5	52,5

Table 13 shows that this restriction almost has the same effect on the distribution of the knowledge organization, as what we observed for the time lagged distribution. Of the firms that have introduced nine or more characteristics only one out of three have done so in such a way that 50% or more employees are covered on each organizational dimension. Of all firms only one out of ten have reached this very high level of learning organization.

Next we test the effects of the learning organization development where each dimension in the bundles are covered by 50% or more employees while controling for structural factors in the model.

Table 14: Logistic regression of Learning organization development categories where each dimension is covered by 50% or more of the employees, size, industry, ownership and production on P/S innovation (odd ratios,95% confidence intervals, estimates and P-values)

Variables:	Effect	Lower	Higher	Estimate	Chi-sq	P-value
High level	3,92	2,69	5,71	0,68	50,33	<.0001
Medium level	2,02	1,65	2,47	0,35	45,81	<.0001
Manufacturing	2,39	1,66	3,45	0,54	40,36	<.0001
Construction	0,69	0,45	1,06	-0.71	31,73	<.0001
Business services	2,29	1,48	3,54	0,50	15,22	<.0001
100 or more	1,93	1,52	2,47	0,38	23,64	<.0001
Danish group	0,74	0,57	0,98	-0,71	4,58	0.0324
Single firm	0,57	0,44	0,74	-0,28	16,98	<.0001

Table 14 shows that the effects of this model fit somewhere in between the original model and the time lagged model, and the results are not significantly different to the other models. Thus again, we do get a strong effect of high level learning organizations, and a more moderate effect of the medium category, when controlling for the structural factors. And the same structural factors stay significant in the model.

Why does taking account of a more wide use by employees of the bundle of practices not give stronger effects on innovation performance. When we look in vain for increasing effects in this model, we may be confronted with the organizational flexibility-stability dilemma (Zaltman et al 1973; Gjerding 1996). The hyper-flexible firm might not be the ideal environment for innovation and different stages in the innovation process may require different organizational features. While flexibility may facilitate the initiation of innovation it might on the other hand inhibit the implementation of innovation. Implementation, on the other hand, demand stability (King and Anderson 1995). This may be the reason why the model without employee restrictions get slightly stronger effects on the categories of learning organization development. Here traditional organization practices may exist in parallel with the new dimensions.

8. Indirect and direct participation

The leading argument in this analysis has been, that the changing and turbulent business environment in the nineties has promoted development of certain types of organizational solutions as institutional standards confronting the firms in industrialized countries (Røvik 1992; Røvik 1998). As we have seen, many Danish firms have reacted and adopted several of the institutional standards in their internal organization and external relations. Focusing on the implemented standards, with their reference to theoretical considerations of innovation, learning and knowledge production in organizations, it has been shown, that firms incorporating many of these standards as dimensions in sophisticated work organization, has a much higher chance of being product or service innovative on the market. So far the relation between innovative behaviour and

developments of the learning organization is tested and confirmed. An important point, however, is that the shape of what we call learning organization do vary individually to such an extent, that it may be difficult to find two firms which have built exactly similar organizations, even though they have used the same dimensions. Learning organizations are individually shaped and suited to the firm's strategic situation on the one hand, and the competences of the employees on the other.

We have stated that innovation theoretically has to do with embedded organizational competence. Embedded competence relies on the ability of the employees continuously to learn and transform knowledge into a collective resource, as well as the capability of management to bring new knowledge and ideas into the practices of the organization. It is in this theoretical light we must understand the importance of employee involvement and participation in organizational change, and not least in building the learning organization, as a structural and cultural frame of knowledge production in the firm . Through the involvement and participation principles applied in relation to organizational change, necessary commitment among the employees is established. This commitment is indeed a necessary precondition of continuous competence building, learning and knowledge production in the firm. From this follows the importance of analyzing the applied participation instruments and principles implemented, when changing and developing the organization of the firm.

Table 15: Instruments applied in the cooperation between management and employees in firms that have been through a process of organizational change (percent)

	Yes	No	Do not know	Not relevant	(N)
Employee representatives participate in management meetings	17.6	65.9	0.9	15.6	1254
One or more project group with participants from management and employees	47.3	39.6	1.4	11.8	1251
The permanent cooperation committee	29.7	43.7	1.5	25.1	1240
Employee representative on firm's board	13.7	58.9	1.3	26.1	1232
Common meetings with the employees concerned	83.3	11.8	1.1	3.9	1248
Common meetings with all employees	65.0	28.2	1.5	5.2	1243
Direct ad.hoc. consultation with the individual employee	89.4	7.1	1.3	2.3	1262

In the literature on industrial relations cooperation dimensions have been classified in two major categories (Hyman and Mason 1995):

- Indirect participation (referring to participation through local union representatives and institutions).
- Direct participation (involvement mainly through communicative and cooperative relations between management and employees).

It has been argued that over the last decade indirect participation forms have been in decline. To marginalize trade unions have been seen as an element in 'modern management' aiming at flexibility. In this context it is interesting to examine the participation dimensions applied by firms in connection with their engagement in organizational change.

Table 15 indeed shows that the direct participation forms are the ones most often used in situations of organizational change. Almost nine-tenths of the firms use direct contact with the individual employees. More than 80% of the firms use meetings with the affected employees, and two thirds use common meetings with all employees in the firm. At the border line between direct and indirect participation we find ad hoc-project groups with management and employee representatives. 47% of the firms use this form. Among the classical indirect participation forms cooperation committees score highest (30%), followed by employee representative joining management meetings (18%) and finally employee representatives in the company board (14%).

Figure 2: Instruments applied in the cooperation between management and employees classified in relation to theoretical perspectives.

Direct involvement Management initiative From direct individual to indirect collective involvement	Direct ad.hoc. consultation with individual employee (89 %) Common meetings with the employees concerned (83 %) Common meetings with all employees (65 %) One or more project group with participants from management and employees (47 %)
Indirect participation Employee initiative From indirect collective to direct individual participation	The permanent cooperation committee (30 %) Employee representatives participate in management meetings (18 %) Employee representative participates in firm's board (14 %)

In the figure 2 the cooperation dimensions have been classified in relation to the theoretical perspectives and ordered after frequency in use.The ranking of the cooperation dimensions perspectives and according to frequency of use. The data seem to confirm, that the direct participation forms are the ones most commonly used by firms in contemporary organizational change, and on this basis it is tempting to conclude that the indirect forms are of marginal importance. It is, however, important to take into consideration, that while the direct forms may be appropriate as a sort of common foundation the need for the indirect forms may become realized when organizational changes are becoming more ambitious and complex. The argument

is that the two forms of participation are not substitutes but that they go together especially in connection with the most advanced efforts to establish learning organizations.

In order to examine this proposition we shall commence by exploring the underlying pattern of correlations between the various instruments through a factor analysis. Is it possible to uncover informative latent participation factors in the empirical material?

Table 16: Factor analysis of seven instruments of involvement and participation

	Factor 1: Indirect Participation	Factor 2: Direct Involvement
The permanent cooperation committee	**0,85**	0,01
Employee representative on firm's board	**0,82**	0,05
Employee representatives participate in management meetings	**0,73**	0,11
One or more project group with participants from management and employees	**0,58**	0,34
Common meetings with the employees concerned	0,18	**0,77**
Common meetings with all employees	0,14	**0,70**
Direct ad hoc-consultation with individual employee	-0,03	**0,66**

Table 16 shows that the analysis uncovers two latent participation variables or factors among firms having experienced with organizational change. The first factor relates to indirect participation and includes the dimension of project group with participants from management and employees. The correlated dimensions represent the indirect "corporatist" cooperation. The second factor correlates the dimensions of direct involvement by individual or collective oriented measures. The factor analysis indicates that local representatives and indirect participation still is present and active as a factor in the change processes, building the new organization forms.

We can also analyze how important the different forms of participation are in firms at different levels of learning organizations. In order to examine this question, a logistic model is applied with the highly developed category of learning organization as dependent variable, and the individual cooperation instruments as independent variables.

Table 17: Logistic regression of cooperation instruments, size, industry, ownership and production on high level learning organizations (odd ratios, 95% confidence intervals, estimates and P-values)

Variables:	Effect	Lower	Higher	Estimate	Chi-sq	P-value
Employee representatives participate in management meetings	2,29	1,50	3,50	0,41	14,74	0.0001
One or more project group with participants from management and employees	3,28	2,37	4,53	0,59	51,34	<.0001
Common meetings with all employees	1,80	1,26	2,56	0,29	10,55	0.0012
100 and more employees	2,68	1,83	3,94	0,48	17,01	<.0001

Table 17 shows that three of the seven cooperation instruments have statistically significant effects in relation to chances of high level learning organizations. Project group with joined participation of management and employee representatives have the strongest effect. Employees joining management meetings have the second strongest effects, and common meetings with all employees the third strongest effect. The model indicates that while direct participation may be the most common form the indirect forms are of crucial importance for firms establishing learning organizations at a very high level.

But one thing is individual probabilities and effects of the cooperation measures. The factor analysis showed that the use of the cooperation instruments are correlated and often used simultaneously in situations of change. How they are "bundled" depends on situational factors in the individual firms. But we may expect that both direct involvement and indirect participation instruments are used in various combinations. One simple way to solve this "bundle" problem empirically is to apply a similar methodology as performed in the analysis of development degrees in learning organizations. Thus an additive index of the participation instrument used in the change processes has been constructed. The index only counts explicit "yes" or "no" in the management responses on use of the seven cooperation dimensions. The result is shown in table below.

Table 18: Distribution of firms according to the number of participation instruments used in connection with organizational change (N = 746).

Index	Frequency	Percent	Cumulative perc.
0	1	0,13	0,13
1	45	6,03	6,17
2	93	12,47	18,63
3	218	29,22	47,86
4	205	27,48	75,34
5	117	15,68	91,02
6	58	7,77	98,79
7	9	1,21	100,00

Only few firms use no or all of the cooperation dimensions or instruments, when changing the organization. More than fifty percent of the firms use three or four instruments, which represent the midpoint of the distribution. Thus the distribution can be divided into three categories with 3-4 instruments in the "medium" category, 0-2 in the "few" instruments category, and 5-7 in the "many" instruments category. Results of this classification is shown in the table below.

Table 19: Multiple use of participation instruments in connection with organizational change (N = 746)

Many (5-7 instruments)	Medium (3-4 instruments)	Few (0-2 instruments)
24,7	56,7	18,6

The distribution results in less than one fifth of the firms using 0-2 instruments. This seems to indicate that the firms do take employee participation seriously and combines the instruments in a way that suits the situation. In this perspective it is also interesting that 25% use from 5 to seven instruments. Table 20 relates the frequency of participation instruments used to to the probability of developing a high level learning organization.

Table 20: Logistic regression of multiple participation instrument categories, size, industry, ownership and production on high level learning organizations (odd ratios, 95% confidence intervals, estimates and P-values)

Variables:	Effect	Lower	Higher	Estimate	Chi-sq	P-value
Many instruments	4,99	3,53	7,07	0,80	82,28	<.0001
Medium instruments	1,88	1,47	2,42	0,32	29,91	<.0001
Manufacturing	1,66	1,09	2,53	0,20	4,71	0.0299
Construction	0,84	0,50	1,39	-0,48	10,90	0.0010
Business services	2,51	1,55	4,06	0,62	22,04	<.0001
100 and more employees	2,53	1,96	3,27	3,39	24,44	<.0001
Foreign group	1,49	1,15	1,93	0,20	9,12	0.0025

The more participation instruments applied in the change processes of the firm, the higher the chance for the firm being characterized by a high level learning organization. This is the major result of the logistic regression analysis of bundling the participation instruments. The model is controlled for structural factors such as size, industry etc. In relation to the high level learning organization, applying 5-7 participation instruments produces chances more than twice as high as applying 3-4 participation instruments. This pattern indicates the importance of cooperation in many forms and by many channels, when work organizations are changed and constructed in high level learning organizations. In other words, there is evidence of firms that go far toward establishing learning organizations need a complex and ambitious "cooperation regime" , where instruments are direct and indirect participation are combined and integrated.

The use of specific instruments may be concentrated in a certain phase of the change process, or may be spread more evenly throughout the whole process from the idea phase to the implementation. We shall examine this important issue in table 21 in relation to the three "bundle" categories.

Table 21: Phase of employee involvement in organization development by multiple participation instrument categories (percent)

	Idea phase	Decision phase	Implementation phase	(N)
Few instruments	18,8	18,1	63,0	138
Medium instruments	21,4	28,6	50,0	420
Many instrument	33,7	26,1	40,2	184

chisq p = 0,0002 Gamma = -0,23

Table 21 shows that there is a relationship between the number of instruments used and the timing of the major involvement of the employees. In all the three categories it is a minority among the firms that involve employees mainly in the idea phase. But while the minority is less than 20% among the firms using few instruments the corresponding share is more than 30%. Firms using medium number of instruments have a higher proportion starting in the decision phase, and thus a smaller proportion starting in the implementation phase. To go a bit further into the problem of what participation instruments are used in which phase, the table below has been constructed.

Table 22: Phase of employee involvement in organization development by participation instrument (percent horizontal)

	Idea phase	Decision phase	Implementa-tion phase	(N)
1. Employee representatives participate in management meetings	38,5	29,8	31,7	218
2. One or more project group with participants from management & employees	31,2	27,6	41,2	590
3. The permanent cooperation committee	24,8	28,3	46,9	367
4. Employee representative participates in firm's board	19,5	28,4	52,1	169
5. Common meetings with the employees concerned	25,5	26,4	48,1	1034
6. Common meetings with all employees	25,8	26,0	48,2	799
7. Direct ad hoc-consultation with the individual employee	24,2	26,3	49,6	1120

Table 22 shows a mixed pattern regarding timing of the different types of instruments. Two of the indirect participation instruments: Participation in management meetings and project groups with management and employees are used frequently used in the idea phase. But this is not true for the most formal instrument for indirect participation where there is a representative on the firm's board. Actually this form is used less frequently in the idea phase than the direct forms of participation. The three direct involvement instruments have almost the same structure of utilization in the phases of the change process. One fourth of the firms start direct employee involvement in the idea phase, one fourth in the decision phase and the remaining half of the firms use this kind instruments especially in the implementation phase.

Table 23: Employer assessment of employee influence on change by phase of employee involvement in organization developments (percent)

	Great influence	Some influence	Small influence	No influence	Do not know	(N)
Idea phase	33,7	62,9	3,5	0,0	0,0	318
Decision phase	14,0	73,9	11,8	0,3	0,0	322
Implementation phase	6,5	54,5	33,3	4,3	1,4	633
All firms	15,2	61,5	20,4	2,2	0,7	1273

chisq p = <.0001 Gamma = 0,65

It should be taken into account that table 23 is based on assessments made by management of how much influence the employees have in connection with organizational change. These might deviate from what employees themselves experience. The table relates the degree of influence to the timing of involvement of employees. From the table it is evident, that there is a strong relation between employee influence and phase of involvement in the change process. The earlier the involvement the greater the influence. When combined with the earlier results it indicates that influence is strongest in firms that use many instruments and especially in firms where employees take part in management meetings and participate together with management in project groups.

9. Conclusions

In the management literature there is a presumption that certain organizational characteristics promote learning and competence building. Here we have shown that when the organizational characteristics having to do with respectively integrative organization, quality management, human resource development, compensation systems and external network positioning bundles it has a strong impact on knowledge creation in terms of product innovation. The advanced learning organizations that combine several of these characteristics tend to introduce product innovations more frequently than the rest. And the effect is strong also when we take into account differences among firms in terms of size, sector and ownership.

It cannot be shown that there is a simple causality from the advanced learning organization to innovation, however. Rather the relationship goes both ways. Firms operating in market segments where continuous incremental product innovation is a prerequisite for survival and firms pursuing strategies of continuous product innovation will realize that they need an advanced learning organization. They will need it in order to organize the different sources of knowledge required for the innovation and they will need it in order to cope with the unforeseen problems they encounter as part of the innovation process.

Anyhow the results show that innovation policy needs to combine instruments that promote product innovation through enhancing technical opportunities and incentives, including advanced demand, with instruments stimulating the further development and diffusion of the elements constituting the advanced learning organization.

In the literature on industrial relations there have been different types of arguments favoring the participation of employees in decision making either directly or indirectly through workers' representatives and trade unions. One type of arguments refer to economic democracy and empowerment of employees as positive values that should be promoted. The other type of argument refers to the presumed efficiency effects from participation. We have found it of interest to illuminate these arguments in the context of the formation of advanced learning organizations.

The analysis shows that while direct participation is more frequent than indirect participation in connection with organizational change in the firms the more cooperation instruments applied in the firm, the higher the chance of highly developed learning organization. Especially the firms that have moved far toward the model of a learning organization do involve trade unions and shop stewards in organizational change. Use of the instruments are spread throughout the change process from the idea phase to the implementation phase and again the active participation of trade unions and shop stewards at the local level seems to be correlated with involvement at the early stages of organizational change.

Not all organizational theorists are happy with the uncritical enthusiasm among management consultants who promote the idea of so-called learning organizations. Our data seem to give strong support to the hypothesis that establishing several of the characteristics that in the literature is assumed to constitute such organizations are strongly correlated with product innovation also when size, sector and ownership forms are taken into account. Promoting the diffusion of good practices in this respect may therefore be seen as a major task for innovation policy and for management in sectors where product innovation is important for the competitiveness of the firm.

In the Anglo-Saxon literature there has been a tendency to establish a contradiction by the management driven efforts to establish new 'human resource development strategies' and an active role for trade unions and shop stewards. The analysis pursued here gives a more optimistic picture in this respect. In the firms that move very far toward becoming full-blown learning organizations it seems as if management has found it useful/necessary to engage local trade union representatives in the process of change.

One elementary caveat is that the data set covers firms operating in Denmark and that the patterns observed might be (and probably would be) quite different were we to bring in data on firms from other countries. The Danish innovation system has several peculiar characteristics that might explain why workers and trade unions are more motivated to support change and managers more willing to let them do so (Lundvall 2002). We are actually working on such an endeavor where we together with colleagues from the UK and France will use labor market surveys comparatively in order to check how far some of the patterns analyzed here differ in these two countries.

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Appendix A

Danish Work Organization, Innovation and Competence Development Panel

DISKO - Survey: 1993-95

1900 firms (3993)
* Organizational changes
* Job designs
* Qualification demands
* Education and training
* Product and ICT inovation

DISKO - Survey + Register data: 1990-97

1544 firms/workplaces (134.000 - 145.000 emp.)
* Value added - productivity
* Assets
* Turnover
* Job flows
* Worker flows
* Wages

DISKO2/IOC - Survey: 1998-00

637 of 1363 surviving DISKO firms (Panel)
2007 firms (Cross Section)
Questionaries to management & employee representative
* DISKO - measures
* Personnel planning
* Processes of change
* Workplace IR - Participation
* Consequences of change

DISKO2/IOC + Register data: 1990-00

Panel design: 637 firms
Time series design: 1900 + 2007 firms
* ICT variables (e-trade ect.)
* Value added - productivity
* Assets
* Turnover
* Job flows
* Worker flows
* Wages