

The Human Side of Innovation Systems

– *Innovation, Organizations and Competence Building in a Learning Perspective*

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Preface

Knowledge production and innovation are often seen as linear processes, assuming that scientific results are followed by technological invention, production and market introduction. This book, however, chooses an interactive and learning approach to innovation. Thus, product innovations are considered expressions of learning processes taking place inside firms and involving different functional groups and various decision levels, as well as relations with the firm's customers and subcontractors. A theoretical framework is constructed which combines the system of innovation approach and the system of employment approach. This framework is applied in a dynamic empirical study of enterprises in the private urban sector in Denmark. The empirical study utilizes a unique longitudinal data set. The data set combines two large surveys and detailed register data on 524 Danish firms, and it includes information on the behaviour of the firms and all employees employed in each of the 524 firms for shorter or longer tenures in the period 1990 to 2000. The ambition of this book is to open some of the black boxes in the empirical relationship between innovation, employment and competence development within the context of new learning organization forms.

The book is primarily addressed to researchers, policy makers and students of innovation, organization and employment, but I sincerely hope that it will also find its way to real life actors: business leaders, employee representatives etc. As for theoretical inspiration and analytical encouragement, I am greatly in debt to professor Bengt-Åke Lundvall, and especially professor emeritus Reinhard Lund, who read the manuscript and commented on it in detail. Without the cooperation with these two scholars, this book would not have been possible. Lis Sand did a splendid job on language revision, and Connie Krogager as well as Sisse Harrington on layout. I would like to express my warmest gratitude to the above-mentioned, and I hope that I can pay back their inspiration by publishing this book. The book is dedicated to my mother, who died shortly before I finished the manuscript.

Peter Nielsen

Introduction

1.1 A SYSTEM OF INNOVATION AND EMPLOYMENT IN ENTERPRISES

When attempting to understand the conditions of economic growth and employment development in the new millennium, the importance of innovation, learning and knowledge development is widely recognized. Innovation, learning and knowledge are considered of almost universal importance. It is considered important in individual human development, in the way firms organize modern production relations, and in our understanding of the dynamics of the economy and society at the regional, national and global level. We are inclined to consider this importance almost self-evident. Often we do not even bother to question terms like knowledge economy or learning organization and individual competence development. We do not endeavor to go beyond the terms, to try to understand why they have become so relevant and important in modern working life. The terms have become part of the everyday mindset and self-evident facts which are accepted without reflection.

Why is it that innovation, learning and knowledge have become such pervasive and all-important concepts in modern working life? In order to answer this question, it seems suitable to focus on the decade leading up to the new millennium. It was in the nineties that learning became widely accepted as a key concept at all levels of society, and the knowledge economy or “new economy” became part of politicians’ standard vocabulary anywhere in the world (OECD 1996). The reason for this development was the emergence of two important trends, which reinforced each other and penetrated the context of economic and social life worldwide.

Globalization, understood in economic as well as social terms as high mobility of goods, capital, labor, information and social values across countries and continents, was one important trend. Globalization had important im-

pacts, not only as growing competition on markets in the highly industrialized part of the world. It also gave rise to large fluctuations on the markets. As a result of globalization, growing competition and fluctuating markets, enterprises came under increasing transformation pressure in the nineties (Lundvall and Nielsen 1999). A new context of mobility, instability and transformation pressure demanded reaction at the enterprise and employment level. The ability of enterprises and the labor force to adapt quickly and offensively came to be seen as the immediate answer to these challenges (NUTEK 1996). The age of flexibility for firms as well as the labor force had emerged.

The growing importance of new information and communication technology (ICT) was another important trend, which supported and intensified the globalization trend. The innovative and rapid development of ICT in the nineties played a decisive role for the emergence of new markets as well as new goods and services. In addition, the technology became an important tool for handling the transformation pressures inside firms. It created the technical prerequisites for a firm's ability to react and adapt instantly and dynamically in turbulent market environments. Judged by its impact and pervasiveness, ICT turned out to be the leading technology of the global knowledge economy (Freeman 2001).

Globalization and the technological developments placed innovation high on the agenda in the industrial countries. Innovation became the dominant, strategic way to handle the market threats and opportunities of enterprises offensively. Developing new and improved products or services became the important response to competitive pressures and volatile markets. Product and service innovation created new markets, often lowering prices, and giving innovating firms primary gains of profits. It thus presumably supported labor demand and employment growth. However, innovation as enterprises' strategic answer also meant new ways of organizing the production processes, and it meant increasing demands on the flexibility, learning and competence development of employees within the individual firm and on the labor market in general. Furthermore, as the ICT technology became part of the innovation process and strategy, employment and employees also came under pressure. Besides its information and communication function, ICT also has

a rationalization and labor saving function. As part of technical and 'process' innovation, it puts employment under pressure.

The relationship between innovation, organization and employment is indeed quite complicated. Often it has counteracting primary and secondary effects. The aim of this book is to analyze the relationship between innovation, employment and competence development within the framework of new learning organization forms. In order to focus on the most important elements and relations, a theoretical framework will be applied which combines two system approaches at enterprise level: a system of innovation approach and a system of employment approach. The two system approaches will be combined in a learning perspective. The system approaches are both theoretically well developed (see Lundvall 1992 and Hendry 1995), but the two approaches are seldom combined analytically. A system of innovation is constituted by elements and relationships which interact in the production, diffusion and use of new and economically useful knowledge (Lundvall *op.cit.* 1992). Enterprises play the most important role in innovation systems (Lundvall 2006). Focusing on the firm as the center of the system of innovation, the external context of the firm is defined by institutional and organizational elements such as other private enterprises, government agencies, science & technology institutions and education & training organizations etc. The internal context is defined as those of the firm's institutional and organizational elements that are important for learning and promoting product and process innovation. By institutional elements we here refer to norms, values and habits that shape modes of interaction, preferences and innovation outcomes (Lundvall *ibid.*). The perspective and analysis in this book will concentrate on the internal context of learning; however, it will also relate to the external frames of the firm as they are crucial in the interactive approach to learning and innovation.

The system of employment provides a framework for understanding the nature of employment relations in the firm (Marsden 1999). The system comprises elements such as recruitment, integration, competence development, training and mobility, and the relations between these elements. Again, it is institutional and organizational elements that constitute the system. Em-

ployment systems provide a framework for analyzing the application and allocation of employees, quantitatively and qualitatively, minimizing transaction costs in relation to the firm's business strategy. (Hendry 1995). The key concepts common to the system of innovation and the system of employment will be organizational and institutional elements related to learning and the innovative behavior of enterprises. Analytically, the two systems are approached as complementary. In this way, the system of employment constitutes a loosely coupled subsystem of the system of innovation, where the core elements in the latter are the organization of product and process innovation. The employment system constitutes the human side of the innovation system, and here the concept of learning and competence building is important.¹ The combined or coupled systems establish the theoretical framework for a dynamic empirical analysis of the relations between elements and their developments over a decade.

1.2 DATA AND LONGITUDINAL DESIGN

The dynamic analysis is possible because of a unique longitudinal data set. This data set combines two large surveys and detailed register data on 524 Danish firms, and it includes all employees employed in each of the 524 firms for shorter or longer tenures in the period 1990 to 2000. The panel connects a survey from 1996 (DISKO²), covering the period 1993-95, to a survey from 2001, covering the period 1998-2000.³ Information links between the two surveys are established by comprehensive register data from the Danish Inte-

¹ Bengt-Åke Lundvall stresses the importance of human resources in a recent publication: "While globalization means that codified knowledge moves quickly, the most localized resource remains people – i.e. their tacit knowledge, their network relationships and their accumulated organizational experiences. Therefore all parts of the innovation system that contribute to competence building are becoming increasingly important" (Lundvall 2006).

² DISKO is a comprehensive research project carried out by a research group at Aalborg University. The purpose of the DISKO project is to analyze the strengths and weaknesses of the Danish Innovation System from an international Comparative perspective, hence the name.

³ Both questionnaires including marginal distributions are available on <http://www.socsci.aau.dk/car-ma/index.htm>. Methodological and other questions are welcome on peter@socsci.aau.dk.

grated Database of Labor Market Research (IDA) and the register of Business Data at Statistics Denmark.

The 1996 DISKO survey was sent to 3,993 firms in the private urban sector, and 1,900 firms responded. The questionnaire focused on the period 1993-1995 and measured product and service innovation, organizational changes, qualifications demands, competence development, education and training. The idea behind establishing a panel connecting the DISKO data to the data collected in the 2001 survey meant that the two samples should have identical population and empirical designs. The core of the sample for the 2001 survey was to be 1,363 firms from the 1996 DISKO survey which had “survived” as units in the Danish Integrated Database of Labor Market Research covering all firms with longitudinal information. From those 1,363 firms, longitudinal register data were already available back from 1990 and up to 1997, covering information on enterprise performance, employee education, job dynamics and employment turnover. The 2001 survey was sent to 6,991 firms and collected information from management as well as from employee representatives by means of two separate but matching questionnaires, implemented through two phases of data collection in each of the firms selected. Beside the exact DISKO questions on product and service innovation, organizational changes, qualifications demands, competence development, education and training, this last survey also measured issues such as participation and involvement, personnel policy and planning, and the social responsibility of the firms. In total, 2,007 usable responses from management and 473 responses from employee representatives were collected in this survey and integrated in a cross-section data set.

The main focus in the 2001 survey’s data collection was on the 1,363 surviving firms from the 1996 DISKO survey. The result was 637 useable responses from firms in manufacturing, construction, trade and service industries. The rate of response among this core group of firms was 47%, which is comparable with the 48% response rate in the first (DISKO) survey. After a data validation process, the result was usable longitudinal data on 524 firms. This reduces the response rate to 38%, which is not very satisfying. However, a response analysis broken down on industry and firm size indicates no unac-

ceptable bias. In order to give a general overview of the form and substance of the data sets, the panel “*Innovation, Organization and Competence*” is shown in Appendix A.

The possibility of combining analysis of micro and meso level information on product and process innovation with job dynamics and personnel turnover establishes the foundation for analyzing the relationship between innovation and employment in a learning perspective. Fundamentally, innovation leads to both destruction of jobs and creation of jobs in a so-called process of creative destruction emerging at the macro level (Schumpeter 1911), but it also leads to the emergence of new forms of organizations at the meso level, and learning, competence building and knowledge development among the employees at the micro level. Thus the relationship between innovation and employment involves complicated contradictions, founded at different levels. These contradictions have not yet been analyzed systematically and empirically in a dynamic perspective.⁴ It is therefore the ambition of this book to open some of the black boxes at the micro and meso level of analysis and present new knowledge on this important and interesting subject.

1.3 INNOVATION IN ENTERPRISES

As a strategic response to the transformation pressures of globalization, increasing competition and fluctuating markets, innovation in enterprises has gained growing importance up through the nineties. Having achieved this central role, an appropriate nominal definition of innovation is called for as a corner stone in building the theoretical framework of this book. In her definition of innovation, Rosabeth Moss Kanter focuses on the enterprise as the central context of the innovation process. She defines innovation as “...the process of bringing any new, problem-solving idea into use... Innovation is the generation, acceptance and implementation of new ideas, processes, products and services. It can occur in any part of a corporation and it can involve

⁴ Edquist C. Hommen, L. and McKelvey (2001) have made an excellent hypothesis generating study in their book: “*Innovation and Employment*”. Much inspiration and overview of the innovation system is owed to their book.

creative use as well as original invention. Application and implementation is central to (the) definition”, (Kanter 1983). This definition is appropriate in our theoretical framework, because it emphasizes innovation as a learning process. Implicitly it highlights competence, learning and knowledge as the necessary preconditions, fundamental principles and intangible results of the innovation process. The definition includes both external market-related products and services and internal, work-related processes in enterprises. This is perfectly in line with Charles Edquist et. al. (2001), who builds a taxonomy distinguishing between product innovation and process innovation. Product innovation includes both new goods and new services, while process innovation includes new technology and new organization forms. Their taxonomy is appropriate and will be used as building blocks in our theoretical framework, because it establishes a bridge between the external market relations and the internal work relations of the firm. This is one of the important prerequisites for bringing together the system of innovation and the system of employment.

An important proposition in the empirical analysis is that product innovations and process innovations are systematically related inside the firm. In this light, process innovation and the human side of innovation system may be viewed as necessary preconditions for product innovation. New organization forms promoting learning and knowledge production among employees in enterprises are expected to be systematically related to the probability of product innovation such as new goods or services on the market. The same relationship is expected for new technology, making it possible to develop new production or communication processes. Finally, product innovation may also change work processes and in this way promote organizational innovation.

However, in a system perspective, it is crucial to distinguish between product and process innovation. It may be difficult though, because the same new technology in one setting may be a process innovation, but in another setting it may be a product innovation (Edquist et. al. 2001). We define product innovation as new goods or new services launched on the market. The goods or services are the results of a production process and sold on a market.

They may be new to the world market or new to the national market. In other words, using Shumpeter's definition: "Goods with which the consumers are not familiar". But this definition is too narrow in our context. Product innovation must include goods and services which are new to the firm, but not necessarily new to the market. In this way we deliberately emphasize the internal learning processes of the firm in our understanding of innovation. From a theory point of view, this is important because it establishes a relation to the firm's organization and technology configurations as frames of the learning process. This relationship is fundamental in our theoretical understanding of the innovation system of enterprises. Fundamentally, we expect innovation to be an organizational competence. By organizational competence we mean competence which is embedded in the organizational structure, culture and processes within the firm, promoting, but at the same time depending on, the employees' ability for continuous learning and knowledge production.

Another important aspect of product innovation is that the innovations may be more or less radical. Product innovation may be small but important changes in existing goods or services; i.e. innovations are not necessarily radical, but still significant results of learning and organizational competence. We are, however, in line with the European Community Innovation Survey and "leave out changes which are purely aesthetic, or which simply involve product differentiation while leaving it technically unchanged" (European Commission 1993). To sum up, our definition of product innovation will be as follows: "Goods or services introduced on the market and new to the firm, excluding minor improvements of existing products".

In regarding process innovations as systemically related to product innovation, often as a precondition, we follow Edquist et al. (op. cit. 2001) in defining process innovation as new ways of producing goods and services. The new ways of producing goods and services may involve new technology or new organization forms, or both. As already mentioned, among the new technologies, information and communication technology (ICT) has been gaining increasing importance in the nineties. Chris Freeman considers information and communication technology a leading technology in the knowledge or learning economy (Freeman 2001, see also Freeman and Perez

1988). In his view, the knowledge economy can be characterized as a techno-economic paradigm. His approach to techno-economic paradigms analyzes leading technologies in a process of structural development, interacting with new production processes, industries, communication infrastructures and managerial as well as organizational changes. According to this view, a match between the leading technology of the paradigm and the so-called socio-institutional factors, i.e. production processes, industries, organization forms etc., will trigger a “Kondratieff wave” or a long wave of economic development. If, however, the development of the leading technology and the socio-institutional factors do not match, the result will be structural problems in the economy (Lundvall 2003).

Since the eighties, the productive use of ICT has developed through at least two important phases. In Danish firms, the first intensive “take-off” in the use of ICT took place in the mid-eighties (Velfærdskommissionen 1995). Before that time, the main use of ICT was for rationalization of work processes; a process of substituting capital (ICT) for labor. However, the expected results in the form of increasing productivity often failed to materialize for the firms investing in ICT. Quite the contrary, aggregate productivity showed negative growth in Denmark in the mid-eighties (Kallehauge and Madsen 1990). First of all, this development can be taken as an evidence of what has been named Solow’s productivity paradox. In Solow’s words: “Computers can be seen everywhere except in the productivity statistics” (Spiezia and Vivarelli 2000).

During its “take-off” in the mid-eighties, the use of ICT in various functions such as design, production, logistics and communication in enterprises increased. The more narrow rationalization phase dominated up to the end of the eighties; then in the early nineties a more organic, pervasive and information-oriented approach to the use of ICT started to emerge. The importance of thinking new ICT into, as an integrative part of, new managerial and organization forms became more widely recognized. Even though rationalization was still an important function, information and communication came to be seen as more and more important functions. This development of ICT from pure rationalization towards information and communication functions is in line with Zuboff (Zuboff 1985); the phases, however, are not