

19th EGOS Colloquium
July 3-5, 2003
CBS Copenhagen, Denmark

Working group 3: Organisational change in the Transforming countries

Paper Title:

The social shaping of innovation in Polish companies

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Abstract

The paper deals with strategies of innovation in Polish manufacturing companies. The point of departure is a theoretical framework of enterprise level innovation, and of the factors forming strategies of innovation on enterprise level. The paper analyses evidence from 23 Polish companies and presents two cases more in detail. The analysis shows that the Polish companies have all been quite innovative, mostly in relation to product innovation. They choose innovation strategies, which are incremental more than radical, and they tend to differentiate their product range rather than to specialise. They consider quality development a must in the fight for market shares and they adapt equipment and organisation to this goal. The factors forming and determining the strategies of the companies count the technological knowledge and expertise of the owner/founder, the structural changes of the market and the global competition and the role of foreign partners/owners.

Introduction

The general institutions of the market economy have become a fact of life for companies in large part of Central and Eastern Europe. The private sector has grown rapidly since 1990, and the liberalisation and removal of tariff barriers means that companies in these countries are under competitive pressure. To cope with competition the companies have to innovate different aspects of their production flexibly and continuously to make them able to match the challenges arising from the market.

The point of departure for the research reported in this paper is the conviction that social agents at enterprise level through their choice of innovation strategy form the destiny of the enterprises on the market. As people and their resources are different, so are their choices. However common conditions of operation, internal as well as external, may lead to patterns in these basically individual choices. It is these patterns and their determinants, which are in focus in this paper.

This paper presents results from an enterprise study of 23 Polish companies. I visited these companies in 2001 and 2002. The company study is part of an ongoing research project on 'regional innovation systems in Poland', which also includes a study of organisations and institutions of importance for innovation and business development. The approach adopted in the paper is explorative and inductive, even though a simple analytical framework structures the analysis. It aims at detecting patterns and identifying determinants of the innovation strategies of the companies of the sample. This paper focuses on product and process innovation.

First part of the paper presents the basic concepts applied. Second part of the paper presents the analysis and discussion of patterns of product and process innovation of the 23 companies and of the determinants of these strategies. Third part of the paper presents two company cases in more detail. The final part of the paper concludes and raises questions for further research.

Theoretical framework

The first notion to look at is the notion of *innovation*. The problem with this notion is that different authors define this concept differently (Edquist, 1997 Lorentzen, 2002,p10). Basically innovation means *renewal*. A definition, which is very useful in relation to enterprise studies is the definition found in Nelson and Rosenberg (Nelson & Rosenberg, 1993,p 4-5). Nelson and Rosenberg's

concept of innovation encompasses the process by which firms master and get into practice product designs and manufacturing processes that are new to them. This is regardless of whether or not they are new to the universe or even the nation. From a societal point of view this notion of the innovation process concerns the diffusion or application of new technological knowledge in the firm. In this way innovation is seen as a process in which *the firm* is the key institution.

With an expression of Freeman (Freeman, 1982 p.167), in a market economy, for the company 'not to innovate is to die'. The same idea is presented by Michael E. Porter (1990,1998). Innovation is what creates the competitive advantage of nations, industries and firms. Michael Porter develops the idea of the value chain of the firm. Every activity, not only production, is of importance to the competitiveness of a firm. The firm creates value by changes in inbound and out-bound logistics, in production operations, in marketing and sales, and in after sales services (Porter:1998:40 ff). Also changes in the support activities, like human resource management and technology development may increase the value which the firm can get from its activities. Together with other companies, suppliers, buyers and distributors, the firm is part of a value system. The firm can increase its value by managing its links in the value system. The system as such can develop into a cluster, competing with other clusters.

Porter's notion of innovation is simply a new way of doing things that is *commercialised* (Porter 1998:780). It is thus different from invention, which is the development of ideas or prototypes. Innovations can be manifested in product changes, process changes, new approaches to marketing, new forms of distribution, and new conceptions of scope. Innovations are more often *incremental* than *radical*. Incremental innovation are minor changes which result from a cumulation of experiences, insights and advances done in the company. Radical innovations result from changes in the foundations of production technology, a change towards different products or a substitution of materials. Innovation results from organisational learning as well as from breakthrough in R&D (Porter:1998:45).

While the companies can develop their competitiveness through organisational learning or research, new possibilities to compete emerge in the *environment* of the companies. Porter suggests five such changes in the environment that may cause firms to respond by innovation: These are: the emergence of new technological knowledge, new or shifting buyer needs, the emergence of a new industrial segment, shifting input costs or availability and changes in government regulation (Porter,1998:45-47). To benefit from changes in the environment a firm must notice the change and be able to respond to it.

Specialisation is a competitive strategy which has been discussed for the last two decades (Piore and Sabel,1984). Specialisation implies that a firm concentrates on certain process or products on which to compete. It is seen as opposed to *integration* of many different processes and products in the activity of the firm. Specialisation is seen as a particularly relevant strategy of competition on a globalised market, because in a global market only highly profiled products or services can compete. Specialisation presupposes an industrial environment in which a sufficient number and quality of suppliers operate and in which a sufficient number of buyers are interested in buying the specialised product or service. Small and specialised firms may operate flexibly together and supply each other with inputs, services and knowledge.

When discussing competitive strategies Porter,1998:39, talk about *focus*. To be successful companies should define a market focus, in relation to quality and cost or price, and in relation to the number of different products or production phases they want to master. Usually firms have to

choose whether they will focus on price or quality, or whether they will offer wide array of product variations or whether they will specialise on few product of superior quality.

The result of this brief clarifications of concepts is a simple analytical framework by which it should be possible to establish a first overview of the innovation taking place in Polish companies. The paper will describe the extend of innovation among the companies, whether the innovation is related to products or processes, whether the innovations are incremental or radical and whether they lead to specialisation, quality development, diversification or lower costs. Further the paper will detect the background for the innovation, that is whether it results from technological knowledge, from new possibilities on the market, from government regulation or other determinants.

Innovation during socialism

Before we start the empirical analysis, it is useful to consider briefly innovation during socialism. Innovation was not absent in the planned economy. Innovation was on the agenda of the *political* level in relation to certain branches and in the competition between the two systems, capitalism and socialism. Innovation was also part of the industrial and of the agricultural policy, which rested on ideas of modernisation and mechanisation. Industrial branch institutes, of which some still exist, took care of product and process development in industry and agriculture. At *plant level*, innovation was part of the struggle to overcome shortages of supply. Plant managers and workers were able to develop solutions to many different problems, which they had to solve in order to fulfil production targets. It would therefore be erroneous to say that the institutions of the planned economy were unable to generate innovations. Compared to the market economy the basic difference was that the core institution of innovation of the market economy, the private company, did hardly exist. Further, the market incentive to innovation was mostly absent, except of course if the products were exported to the West. While customers' needs can be said to represent the key to innovation in the western market system, the suppliers' ideas and capabilities were key to innovation in the planned economy.

After 1989 when western goods flooded the markets of CEE, industrial and private customers often preferred the imported goods. Local companies had to cope with demanding customers and tough competition. The newly established private sector, as well as the state owned companies had to learn how to innovate and compete. The following analysis conveys a first overview of how Polish companies managed to cope with this challenge.

Methodology

To study innovation in Polish companies I chose to work on a sample of manufacturing companies. Because of the regional focus of the research programme the companies should be located in or around Krakow and Wroclaw, which are towns with interesting regional development institutions and a diverse manufacturing sector. It was quite a challenge to construct a sample of companies, as I did not have access to any registers. I asked for the help of local business development organisations who dispose of member lists or lists of project participants. The staff of such organisations discussed the selection of companies with me and helped me to establish the contact.

During four visits in Poland in 1999, 2000, 2001 and 2002 the contacts developed, and I visited a total of 30 companies of which 23 have been selected for analysis in this paper.

In my research on CEE I have come to realise the value of qualitative information and the advantage of not having structured the expectations and the questions too strictly on beforehand. I found this fruitful because of the process of transformation in which rules, practices and structures are in a flux. A second reason to choose this empirical methodology is the actor focus of the research. Since the perceptions of the actors underlie their decisions on innovation, it is important to grasp these perceptions in the research. I therefore approached the companies with a semi-structured interview guide in which most of the questions were open ended and space was left for unforeseen topics.

The analysis of the many interviews is made both quantitatively and qualitatively. With the intention of detecting patterns I categorise the data for simple quantitative analysis. The categories emerge inductively although with a view to the analytical frameworks, which guide the work. With the intention of finding comprehensive patterns of company behaviour, of identifying new issues and causal relationships I analyse the qualitative information in its own right. In this paper I give examples of both.

Description of the sample

The selection of companies belongs to the broad category of manufacturing. The sample consists of 23 companies. Thirteen of the companies are located in or around Wroclaw and ten of them are located in or around Krakow. Half of the companies were founded as the turn from the planned economy towards the market economy started (table 1). A few dates from the first industrial wave in Poland around 1990, a few were founded during the last decade of communism, and another six companies of the sample were founded after 1992.

Table 1. Year of foundation	1900-1949	1980-1988	1989-1992	1993-95	1996-	Total
No of companies	3	3	11	4	2	23

Together the companies of the sample employ 3749 people. Most of the companies have between 21-100 employees. 5 of them are quite small, and a few quite big with over 300 employees (table 2).

Table 2. No of employees	1-20	21-100	101-300	301-1000	Total
No of companies	5	11	3	4	23

The companies belong to a wide variety of manufacturing branches (Table 3). The majority of the companies belong to the broad category of metal mechanical production, namely 15 companies.

Table 3. Type of production	No of companies
Food	2
Pharmaceuticals	2
Rubber and plastic products	2
Glass	1
Wood	1
Metal products	4
Machining	2
Electronics	4
Instruments	1
Machinery and equipment	4
TOTAL	23

Most of the companies are privately owned companies and have been privately Polish owned since their foundation (table 4). Four of the companies are former state owned enterprises (SOEs). Three of the former SOEs have been bought by Polish investors and one of them have been purchased by a foreign investor. There are two foreign owned companies in the sample, one of them is founded by a Polish entrepreneur from the US, the other by a West European company. There is one joint venture, and one state owned company in the sample

Table 4. Type of ownership	Number of companies
Private Polish	15
Private Polish (SOE)	3
Joint ventures	1
Foreign owned	2
Foreign owned (SOE)	1
SOE	1
Total	23

Product innovations

Product innovations are defined as changes in products, which are *new to the companies*, while there is no considerations of whether these innovations are new to the market. The period covered varies, because the companies have not lived equally long. In the interviews the interviewees mentioned the innovations made during the last few years, which have had importance for the company in their own judgement.

Theoretically speaking product innovations may be incremental or radical. They may aim at specialisation, differentiation, higher quality or lower costs. These considerations also underlie the categorisation applied below. The categories below have been made inductively, however, and reflect the way the interviewees described the changes.

The explanation of the categories is the following: An existing product type can be innovated through an increased quality, for example by better testing or quality control or by a change of material. Innovation can take place as an increase of complexity, if more functions are added to it, or if machines are integrated into a system. Finally more variations can be added within the same basic type of product, for example by adding the number of sizes and styles to glass vases. Another type of innovation is to add a product to the product range, which is different from the existing products in function. For example a producer of plastic shoe parts add plastic sheets, to their product range, while a producer of steel constructions add a production of plastic products and parts. The companies combine the different strategies in their effort to stay on the market and to expand. Table 5 summarises the result of the general analysis of the sample.

Much increased complexity in products and the introduction of other products are radical innovation for the company, which challenges the existing knowledge and organisation.

Table 5. Product innovations	Quality	Complexity	Variations	Other products
Number of companies	8	5	14	10
Total 23 comp.	34%	22%	60%	43%

The analysis of the interviews shows that all companies of the sample have innovated their products in one way or the other. The most frequent way to innovate products is to add variations. The second most frequent strategy is to add other products to the product range. A third of the companies focus specifically on quality development, and five of them add complexity.

A preliminary interpretation to this result is that the companies tend to choose the most inexpensive product innovation strategy as no one. Usually no new investment or qualifications are needed to add variations to the core products of the company. The two most important assets for a successful strategy of product variation are knowledge of the customers' needs and tastes, and creativity in the organisation.

The second most frequent strategy, to introduce a product, which is different, is not always inexpensive. It may well require new machinery, different raw materials and different qualifications. This is the case with the producer of steel and aluminium constructions who embarked a production of plastic parts and finished products of plastic. On the other hand it may require only a slight change, as when the producer of plastic shoe parts started to produce plastic sheets, based on the same knowledge and raw material.

Both strategies lead to a differentiation of the production, which allows the company to meet the demand of a larger group of customers. Differentiation is needed when the company does not trust the future market for the existing products, or if the customers prefer to buy 'the whole package' with one producer. Together 21 of 23 companies apply such a differentiation strategy in their product development.

Quality is an issue in eight companies, or a third of the companies. These companies use quality as a parameter of competition and they spend different kinds of resources on this work. While the three above mentioned strategies can be found in all the different branches of the sample, increasing complexity is a development which takes place in some of the metal-mechanical companies. Producers in instruments, electronics, metal products and mechanical equipment add complexity to their products by making them more powerful, by integrating different equipment into whole systems, or by adding machines to the production of metal parts and products. They go from simple to more complex products. This is a more expensive strategy, which requires a focus on qualifications and learning, and co-operation with customers and suppliers.

Summing up, the companies of the sample have all implemented product innovations, but mostly of the inexpensive kind. The dominating strategy of differentiation may have short-term advantages of expanding the total market of the companies, but their long-term position on the global market may suffer, because they lack focus.

Process innovations

Process innovation in this analysis is defined as changes, which have been implemented to the production process in the form of new equipment or different methods. This means that the process innovations considered are *new to the companies*. There is no consideration of whether they are new to the branch. The period covered varies also here because the companies have different years of foundation. The interviewees mentioned the innovations made during the last few years, which had been of some importance to the company in their own judgement.

Theoretically process innovation can be understood as incremental, radical, and even stationary, if the capacity is expanded at the same level of technology. It may lead to specialisation of diversification of the process, it may lead to cost reduction and to higher quality, for example in terms of higher precision.

The information obtained in the interviews has been categorised inductively in the following way: Expansion of the capacity at the same level of technology; upgrading or modernisation of equipment without radical changes of technology; automation, meaning the introduction of computer controlled equipment, or unmanned production processes, which represent a radical innovation requiring change of knowledge and of organisation; the addition of new lines or new types of machinery is a radical innovation in that it requires a change of knowledge and organisation and implies new products. It leads to a differentiation of the production process. Finally the introduction of new testing methods may or may not represent a radical change but has implications for the quality of the products.

The companies combine the different process innovation strategies, and table 6 summarises the results of the general analysis of the sample.

Table 6. Process innovations	No of companies	percentage
None	3	13 %
Expansion of capacity	5	21 %
Upgrading/modernisation	9	39%
Automation	9	39%
New lines, new machinery added	5	21%
New testing method	6	26%

The analysis of the interview shows that three companies have not introduced any innovations in the production process. Five have expanded their production at the same level of technology. Nine companies have modernised their production processes and nine have automated parts of their production processes. Five companies have added new machinery or production lines and six have added new testing methods.

The three companies which have not innovated their production process have some characteristics in common. They are small companies, and they are privately owned by a Polish entrepreneur, who is at the same time leader of the company. The companies produce complex equipment on the basis of knowledge development, while the production process is characterised by manual or semiautomatic processes and skilled labour. The existence of these companies does not depend on equipment or productivity, but on the production of scientific or technical knowledge (R&D) in the company.

The expansion and upgrading of the production process without a change of technology is done in four companies. Three of these companies produce metal products and one is a producer of wooden products for the construction sector. Two of these companies are in serious financial trouble, and cannot renew their production equipment very much, while the other two work on the basis of conventional production methods and skilled labour, and have no intention to change this.

Upgrading and modernisation is made in nine companies, of which six combine this with other strategies, namely automation (3 companies), the addition of new production lines (3 companies) or new testing methods (1 company).

Automation is introduced or expanded in many different companies. The four companies with foreign capital participation have all introduced or invested in more automation. Most of the companies introducing automation are mass producers with a focus on productivity, like frozen food, pharmaceutical products and plastic parts. One company is different, as it is a producer of customised parts in small batches. The need for precision, flexibility and productivity are the backgrounds for this company's automation.

The introduction of new production lines or additional types of machinery is made in five companies. This strategy is found with the glass producer, the food producer, two producers of equipment and a producer of steel constructions and plastic parts and products. In every case the background for adding new lines or types of machinery is to differentiate production to grasp a larger part of the market.

New testing methods are introduced in five companies who work with quality development, in electronics, in mechanical equipment, but also in rubber, and in foods. The test is required by the industrial customer or used as an argument in advertising.

The most massive investment in new process technology is made by the largest of the companies in the sample, a producer of frozen food.

Summing up, process innovations have different status among the companies in the sample. There are big differences in the financial ability to invest, and some companies prefer to continue to work with conventional methods with a focus on skilled labour. The renewals aim at increasing quality and productivity, while a few companies diversify their equipment to diversify their product range. Most renewal is seen in the companies with foreign investment, where access to capital seems to be no major limitation. Process innovation in the companies thus varies from none, over stationary, to incremental and even radical. How many companies experience their process innovation as radical is difficult to say, but six to seven companies have introduced automation or production lines, which require thorough changes in the company.

Determinants of innovation

What is the background for choosing the different innovation strategies, and what are the influencing or determining factors of their choice? In the interviews the companies were asked to mention the most important factors that formed their innovation positively or negatively. What changes in the environment caused the companies to embark on innovation? Did any of the changes suggested in the analytical framework seem to have an influence on the Polish companies (the emergence of new technological knowledge, new or shifting buyer needs, the emergence of a new industrial segment, shifting input costs or availability and changes in government regulation). The question was an open one. The answers were categorised inductively afterwards. In the analysis the following pattern emerged (table 7).

Table 7: Determinants Of innovation	No. of companies	Percentage
Type of determinant		
Owners expertise/R&D	10	43%
Change of market structure	10	43%
Competition	7	30%
Dominant foreign company	6	26%
Internet	6	26%
Knowledge networks	5	22%
Public regulation	4	17%
Specific demand	4	17%
Customer's payments	3	13%
Lack of capital	3	13%

When analysing the interviews it is noteworthy that none of the determinants are common to all companies of the sample.

Ten companies mention the R&D results and the expertise of the owner as very important for them both when they founded the company and in the development of it. The companies have been founded to realise ideas of a university researcher, or of the technical expert of a SOE. The role of the owner continues to be strong in generating ideas for further innovation, mainly in products. Sometimes the owner is the only expert, which means that the extension of his knowledge limits the possibility of the companies to develop alternative productions in difficult situations. All the companies who mention the role of the founder and owner in innovation are Private Polish companies. These companies are mainly small. Those, which have grown have established R&D departments and involved more staff in the development of new ideas. The ten companies belong to the engineering branch (seven), to pharmaceuticals (two), and to glass production (one).

Change of market structure is equally important for the innovation strategy of the companies. The role of changes in market structure is that it has had positive as well as negative influence on the possibilities of the companies to market their products. Six of the companies perceive changes of the market structure as something positive for their development, while four of them feel it as a threat to them. Positive changes in the market structure are for example the growth of the more luxurious consumer demand in relation to house and garden in Poland. Not only the total demand has grown but it has become more individualistic, creating a demand for diversified, high quality and special winter-gardens, radiators or steel pavilions for the garden. The flood in 1997 boosted the demand for certain equipment needed for the drying of walls. Negative impact, or at least a big challenge, arises from the concentration of the retail sector in Poland. While some producers of equipment for the retail sector used to trade with small shops, they now see their small customers disappear, as they are being wiped out by the hyper-market chains. These chains usually have their own suppliers of for instance cash registers or hand transport wagons. The export market suffered from the aftermath of September 11th, and those companies, which depended heavily on American customers, had to look elsewhere for customers.

Competition is mentioned by seven companies as a factor which influences their innovation very much. Several companies feel caught between high quality competition from the West and low price competition from Asia. This forces the companies to work simultaneously with productivity increases and with product quality development. As one interviewee said: In the old times our products sold themselves. The Russians came with trucks to fetch our products, and often we had to say, sorry, we have no more to give you. Today we have to work hard to sell our products.

A quarter of the companies work under the dominance of one foreign company, either the owner, the co-owner or the major customer. Three of the companies were founded by or because of foreign partners, while the foreign partners or owners of the other three came later. Some companies have done a big effort to find such a partner. The foreign investor came to exploit the low costs skilled labour in Poland, and to gain access to the CEE market. The companies with dominant foreign customers see their destiny very closely linked to this partner, so that a recession there is transferred to the Polish company. The foreign partner is very important to innovation in all six companies. The foreign partner brings product designs, machinery and market access. Dominant foreign partners or owners can be found in small and big companies, and in different branches.

A quarter of the companies (six) mention the development and the introduction of the internet as important for their innovation, their knowledge sourcing and their marketing. Through the internet they can benchmark the production, copy other products, and learn about new methods, materials

and equipment. As one company says, 'the internet opens the world'. The companies mentioning the role of the internet are of different sizes, ownership and branch of industry.

The access to new knowledge is also obtained through the participation in knowledge networks. Five companies participate in such networks. These networks consist in contacts with important customers, mother-companies abroad or with university research. Knowledge on different levels is transferred in these networks. The companies participating in such networks are of different sizes and branches of industry, and they get knowledge input, which they use in their innovation strategy.

Public regulation and specific demand are mentioned by four companies each as an input to and a reason for innovating production in certain directions. Environmental regulation expands the market for certain equipment, while quality standards put focus on quality development. Some of the customers represent specific wishes to the product development of industrial as well as finished products.

Considering the ups and downs of Polish economy astonishingly few companies have mentioned lack of money as a hindrance to innovation., namely five companies. One aspect of the problem is the missing payments from customers, another aspect is problems to get loans. As serious as it may seem to the individual companies it is not justified to say that the companies in the sample share this problem. The problem is concentrated among Polish owned engineering companies.

Compared to the changes mentioned above some of them seem to have had an impact (both negatively and positively) on the innovation of the companies: New technological knowledge, new or shifting buyer needs, and changes in government regulation. Other factors not mentioned by Porter are better accessibility of knowledge (internet and networks) and the role of international co-operation (i.e. foreign investors and customers).

Case one: The glass producer

Company one is founded in the beginning of the 1980s as a private company. It is a producer of glassware. The company has expanded from 10 employees in the start to 110 employees in 2001. The scope of production has expanded from ten different products to hundreds of different products, including tableware, art and stained glass for old buildings. Most products are finished products while a small part is industrial products. The company wants to further differentiate production and to focus particularly on hand made and hand decorated products. This strategy of differentiation is followed because the company feels a need to find market segments between the Asian low cost and the Western European high quality competition.

The technology of the company, glass making, has not changed radically since the start in the beginning of the eighties. However both the scale and the scope of production have expanded considerably during the last five to eight years. Incremental changes in products take place as new designs are continuously developed for the final products, and a new niche, industrial products, is under development. For every market there is a different offer because taste is so nationally different. There is an increasing focus on hand decorated products, and this focus will continue in the future. Further incremental change will be introduced as the product strategy is about to be diversified. For the Polish market products will be packed differently, for the foreign market new and surprising product shapes will be developed. The production process is incrementally as well as

stationary innovated. The production equipment is regularly renewed, usually it is bought in Poland, and technology has developed by the introduction of more productive and precise computer-controlled equipment for the melting and cooling of glass. The shaping of glass is still done manually (blown or in forms). It is envisaged to introduce automatic production of tableware. This is going to be a radical change of technology of the company. In sum, product innovation in this company can be characterised as incremental and stationary, aiming at diversification. The process innovation is stationary and incremental, with and expansion of the capacity, while radical change is envisaged for the future.

The major incentive to innovate is competition. The competition is complex. It arises from Polish glass factories, from low cost competition from China, and from highly automated factories in the West. Competition regards thus both costs and quality. The choice of company two has been to develop a niche, which unites quality and costs as its competitive advantage: low cost hand made products. The incentive to expand the company was a consequence of the strategy. It is necessary to achieve a certain minimum size to produce the necessary number of product variations

Innovation is based on technical *internal expertise*, basically the knowledge of one very experienced engineer employed in the company who also follows the development of the field on conferences and the internet. Apart from glass melting, the art of designing and forming the glass rests with the skilled glass workers. The core competence of the company is the technical mastery of all phases of glass manufacturing. The qualifications of the company are mainly technical. The managers are engineers. One of the engineers has great importance in the company with his 30 years of branch experience. 80 per cent of the workers are skilled, with four of five years of glass school.

The *internet* has become a very important source of information and communication in company one. For the company the internet, and the web camera, has revolutionised the search of information and communication, which has been speeded up and widened. The use of the internet has also minimized the disadvantage of localisation in a comparatively peripheral town. But traditional sources of information, newspapers and magazines are also used.

Company one participates in different knowledge networks. The knowledge network consists of organisations like the local glass school, the local chamber of commerce and different technology centres in Poland. It also consists of different companies. There is a co-operation going on with designer companies in big towns. The import-export companies which present the products of the company at fairs is also a source of information, so are direct customers who suggest product designs. Both receive samples of the production and give response to it. Some foreign companies with which the company has a contact also make suggestions on product development. Joint learning processes are made together with related companies in Poland about the development of joint products. Knowledge networks is thus a source of new knowledge which stimulates innovation of this compkany.

Case two: The machine builder

Company two is founded in 1993 as a private Polish company. The owner is at the same time the director of the company. It has developed from a few employees in the start to 180 employees in 2002. The company has developed from a small workshop to a large, modern building with new machinery. The major product group is machinery for galvanisation for industrial customers. That is

the equipment is suited for aggressive substances. The Polish producer does not deliver the software for the automatic equipment. The one important customer is a German company. The products have changed from single parts, to complete machines to whole production lines or systems. 90% of the production today consists of such systems. The products have thus become more complex, but also more specialised in terms of market segment. 98% of the production is exported. There is no competition in Poland for such products, but there not any demand either. Therefore the company would like to find alternative products for the Polish market.

The production process has also been innovated. Basically the production consists in assembly of parts and cabinets into machines and systems, as well as machining of steel and plastic parts. The strategy has been to diversify and modernise the production capacities so that whole systems could be manufactured with the newest technology. The production capacity has been expanded, and new lines have been added. For example new methods of welding in plastic have been introduced, which are quite new in Poland. The company envisage the introduction of more automated equipment, if everything goes as planned. Both in products and processes quality is of great importance, and the company will introduce ISO certification in the near future. Thus considerable innovation has taken place both in products and processes. This innovation in products is stationary, incremental as well as radical, and the same is true for the process innovations. Quality has been in focus, and the company has pursued a strategy of product specialisation and process differentiation.

The major determinant of this development was an inquiry from a German company, which soon became the major customer. The German customer wanted the Polish company as subcontractor, and suggested changes in the products and in the processes. The Polish firm consequently has invested a lot in renewal of buildings and machinery due to expectations thus raised. The German contractor delivers all materials and receives products for further sale. A recession hit the German economy, including the German customer, the orders of who dropped severely. The Polish company has begun to export to other countries as well, but not enough to make up for the crisis of the German customer. The Polish market is as yet of minor importance. The competition felt by the company is not from similar products, but from producers who master the same processes. The company has got a large construction department consisting of seven people, the size and role of this department has developed since 1997, when there were only three people there. Particularly one of the engineers in this department is very creative and has a feeling for what to consider in the development of new products, usually based on the somewhat incomplete specifications of the German customer. The company does not participate in knowledge networks other than the co-operation with the German customer. The skilled workers get training from the German partner in the production processes needed to manufacture the specific systems, and basically the point of departure for any change in products and processes is suggestions and needs of the big German customer. The problem with this knowledge strategy is that it is too dependent and specialised for a turbulent environment.

The company has therefore begun to consider a different line of development in which they seek their own customers independently, and in which they differentiate their products to meet alternative demands. But to do this the organisation must be changed. Until now it has been geared to serve the German customer. In this strategy the internet will be of great importance, so much is clear. It is already considered a very important tool in the company for any search of information. Unless the strategy bears fruit quite quickly this company will be hit by the financial squeeze known from other engineering companies in the sample.

Conclusion

Polish manufacturing companies innovate in different ways in their struggle to stay on the market and survive the difficulties arising from a combination of global competition and local conditions of transformation. The research reported in this paper shows how this innovation takes place and how it is formed socially.

The empirical analysis is based on qualitative interviews in 23 manufacturing companies in the southern parts of Poland. The companies of the sample differ in relation to branch of industry, size, age, ownership and location.

The analysis shows that all companies are actively innovating their products. Close to all companies apply a strategy of differentiation in order to satisfy still more individual consumer tastes and to spread risk. More than half of the companies develop their products qualitatively by increasing the complexity and by developing the quality. Most of the product innovations are of the inexpensive kind, not requiring new investment. Some of the product innovations can be considered radical in that they require new knowledge, investment and organisation in the company. The companies are often caught in the squeeze between high quality and low cost competition, and they try to find a way in between by uniting moderate prices and good quality.

The companies also innovate their production process, but not all companies feel a need to do so, as they unite complex products and high level of knowledge with conventional process technologies. Generally the companies have invested in the development of their production process. The mass producing companies go for automation while the others expand and upgrade their conventional equipment. A fifth of them have diversified their equipment. Investment seems to flow most freely among the companies with foreign owners or big foreign big customers. Most process innovation is stationary or incremental, but around a third of the companies engage in more radical renewals of their production process.

In product innovation there seems to be more common features than in process innovation. It thus seems that product innovation can be achieved through different routes of process innovation.

The social shaping of the innovation is evident in the interviews. The contextual determinants count access to R&D, from own research, networks or internet, change of market structure in terms of emerging or disappearing market segment and specific demands, the pressure from competition from Western Europe and Asia, and the role of foreign co-operation. These factors do not pull in the same direction, and the companies do not feel these factors equally strong. While market changes stimulate diversification strategies, foreign co-operation seems to boost innovation more than other factors do because of easy access to resources.

The paper only gives a first superficial look into the social shaping of innovation in the Polish companies. There are many other questions to consider as for example:

What can be said about the relationship between innovation strategy and competitiveness or success on the market of the companies?

What is the role of qualifications and organisation style for the product and process innovation of the companies? Does the socialist heritage make itself felt?

How can the strategies of knowledge sourcing of the companies be characterised, and is there a relationship between the choice of knowledge sourcing strategy and the innovation strategy of the companies?

How can the supplier and buyer networks of the companies be characterised and to what extent do these networks form the innovation strategy of the companies?

How globally are the companies in their orientation and is there a relationship between the global orientation and the innovation of the companies?

References

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Appendix 1

Type of production	Location	Ownership	No. of empl.	Year of foundatio
Optic instruments	W	Private Polish	15	1989
Plastic parts	K	Private Polish (SOE)	330	1911
Glass producer	K	Private Polish	110	1981
Machining/subcontracting	K	Private Polish	10	1992
Circuit boards/subcontracting	W	Private Polish (SOE)	124	1991
Windows, doord wintergardens	W	Private Polish	60	1990
Radiators	W	Dutch	80	1994
Cash registers	W	Private Polish	5	1989
Precision machining	W	American (Polish)	35	1998
Microwave technique	W	Private Polish	30	1988
Aircondition, recuperation of heat	W	Private Polish	30	1997
Machinery for galvanisation	W	Private Polish	180	1993
Aluminium and steel construction	W	Private Polish	15	1994
Plastic parts				
Antennas, amplifiers, transformers	W	Private Polish	60	1990
Steel constructions for construction	W	Private Polish	200	1994
Pharmaceuticals, natural and private	W	Private Polish	80	1989
Hand transport wagons	K	Private Polish	20	1989
Equipment for burning of waste	K	Private Polish	12	1990
Rubber products	K	German (SOE)	220	1990
Frozen food	K	Private Polish	1000	1991
Confectionary	K	Private Polish-Swiss	800	1910
Pharmaceuticals	K	Private Polish	260	1984
Small metal parts	K	SOE	73	1949

K: Krakow

W: Wroclaw

SOE: State owned enterprise

(SOE): Privatised state owned enterprise

Appendix 2

Product innovations	Quality	Comple- xity	Vari- tions	Other products
New products, knowledge development, patents		X	X	
New materials, new products	X			X
Differentiation from 10 to 500, productivity, packaging			X	
Intr. of bending and welding				X
Quality increase, minimisation, productivity, environm	X	X		
Increase of production, many variations	X		X	
From one to four product types	X		X	
From manufacturing to software modifications		X		
New prototypes together with customer			X	X
Drying of building, microwave reactors (new product)			X	X
From dryers to ventilators and aircondition				X
From parts to machines to systems		X		
Plastic parts supplementary product (to steel constr.)			X	X
From antennas to transformers, subcontracting				X
Cutting machine, tanks for chemicals		X		X
From pills to parapharmaceuticals, cosmetics			X	X
From few to many transport equipment variations			X	
Improvements, cheaper, smaller	X		X	
Quality improvements, variations, certifications.	X		X	
Fast food since 1994. Spices new	X			X
Sugar free sweets, change of packaging, productivity			X	
From cosmetics to pharmaceuticals, new products every year			X	X
New designs, together with customers	X		X	
Total	8	5	14	10

Table 5. Product innovations	Quality	Complexity	Variations	Other products
Number of companies	8	5	14	10
Total 23 comp.	34%	22%	60%	43%

Appendix 3: Process innovations

Process innovations	Expansion of capacity	Upgrading Modernisation	Automation	New lines, machines added	New testing method
None	-	-	-	-	-
Labour saving machines			x		
Up-grading, new chemicals, cooling system transportation system		x		x	
Second CNC laser cutting machine 1997			x		
Testing equipment, modernisation, increase of capacity	x	x			x
New machines, bigger hall		x			
New computer controlled equipment,automated welding			x		
none	-	-	-	-	-
New computer controlled equipment expansion	x		x		
Make measurement equipment themselves, new computer programme					x
1 year old machines, new teststation new production line (of heat exchangers)				x	x
From machining to special welding, in plastic, new machines every year		x		x	
Injector for plastic, new forms for plastic parts (made by themselves)				x	
New test method					x
Buy used machines		x			
Automation in packaging, expand production, renew machinery.		x	x		
Expansion of machine park, new store house	x				
none	-	-	-	-	-
New testing, aircondition, automation			x		x
New production lines, new plants, all machinery changed in 2002. Automation		x	x	x	
Automation, expansion of capacity, quality test of inputs	x		x		x
Continuous change, expansion of capacity, computerised production	x	x	x		
Two new machines, they make new tools for every product		x			
Total	5	9	9	5	6

Process innovations	No of companies	percentage
None	3	13 %
Expansion of capacity	5	21 %
Upgrading/modernisation	9	39%
Automation	9	39%
New lines, new machinery added	5	21%
New testing method	6	26%
Total		