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KNOWLEDGE AND KNOWLEDGE BASES IN THE LEARNING PROCESS OF POLISH COMPANIES

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The paper deals with the learning and innovation strategies of manufacturing companies in the economies of transformation. The point of departure is the development of a theoretical framework dealing innovation, knowledge and learning. The case is two manufacturing companies in Poland, the learning strategies of which are analysed and compared. These strategies have much in common and can be seen as quite successful. Some common problems also exist in relation to mismatches within and between the different knowledge bases. The differences are none the less interesting to consider. They are due to the different histories of the firms, differences in size, differences in relation to branch characteristics and differences in the insertion of the companies in the international division of labour.

A few keywords: Innovation and technical change; internal and external knowledge bases; tacit and explicit knowledge; learning and innovation; Polish manufacturing companies.

Introduction

In a globalised world, where the competitiveness of companies is continuously challenged by competitors from around the world, the survival of companies depends on the continuous development of individual as well as of collective capabilities. Central and Eastern European companies have faced the trend of globalisation since 1990, when their governments initiated processes of privatisation of state enterprises, price liberalisation, liberalisation of international trade and allowed the expansion of the private sector.

The change of macroinstitutions initiated in 1990 has stimulated the growth of the private sector, which in Hungary, The Czech and the Slovak Republic represents 80% of GDP. In Poland it covers 75% of GDP (like in Albania and Estonia). The smaller share of the private sector in GDP in Poland is mainly due to the continued state ownership of mines and steel works. The private sector of the former Soviet republics is generally smaller. The trade and foreign exchange systems of Poland, Hungary and ten other countries are comparable with the advanced industrial economies. Tariff barriers have been removed and these countries have become members of the World Trade organisation. (European Bank for Reconstruction and Development, 2001p.12-13.) According to these indicators Poland and Hungary are the countries which have achieved the highest level of market economic institutional development since 1990.

If the general institutions of the market economy have thus become a fact of life for companies in large parts of Central and Eastern Europe it means that today the companies of these countries are under competitive pressure, just as companies in the west. To cope with competition they have to innovate their production continuously. To do so, they need capabilities.

How do companies in Poland face this challenge? This is the question to be discussed in this article. The focus is on knowledge, knowledge sourcing and learning. The first part of the article develops the theoretical framework, which ends up with the list of more specified questions for empirical discussion. The second part of the article contains an analysis and discussion of two Polish companies with a particular focus on their learning strategy and their use of local, national and international knowledge sources as part of their strategy.

I Theoretical framework

Innovation, knowledge and learning

Innovation during socialism

In a market economy competition forces firms to innovate. With an expression of Freeman (Freeman, 1982 p.167), in a market economy, for the company 'not to innovate is to die'. However, innovation was not absent in the planned economy either. 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 absent. While customers' needs were the key to innovation in the West, 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.

Innovation, learning and capability building

But what is this innovation that the companies in the CEE had to learn? 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 technology in the firm. In this way innovation is seen as a process in which *the firm* is the key institution.

The introduction of both product designs and manufacturing processes in a firm presupposes access to knowledge and the ability to organise. This is what Polanyi, (1966) calls *learning*. Learning is the introduction of novel practices. Learning is thus not only a mental process but also a matter of organisation. The ability of the firm to organise the application of new knowledge and integrate it into the practice of the firm is what *innovative capability* is basically about ¹. This notion of learning overlaps considerably with the concept of innovation as defined above. This confusion is approached by Bell and Pavitt.

Bell and Pavitt (Bell & Pavitt, 1993p163) supply the debate with a useful distinction between technical *change* and technical *learning* (or technological accumulation). The former encompasses any way in which new technology is incorporated into the production capacity of firms and economies. Technological learning refers to any process by which the *resources*

¹ Lundvall (Lundvall, 219981998) sums up Polayi's points by saying that knowledge is the most important resource in innovation and learning is the most important process.

for generating and managing technical change are created or strengthened. The learning process enhance the *technological capabilities*.²

These two processes, the process of technical change and the process of technological learning expand two types of resources, which a firm possesses. The technical change expands the production capacity, while the technological learning enhances the technological capabilities (Bell & Pavitt, 1993p163).

The production capacity includes all resources used to produce industrial goods at given levels of efficiency and given input combinations, such as equipment, product and input specifications, and the organisational methods and systems used.

The technological capabilities of a firm consist of the resources needed to generate and manage technical change, including skills, knowledge and experience, and institutional structures and linkages. It is this latter type of resources, which are of importance to change, growth and the development of competitiveness.

The work of Smith (Smith, 1995) adds details to the concept of technological capability.

All firms operate with some kind of technological knowledge base. There is not just one knowledge base which firms draw on. Smith (Smith, 1995p 78-81) suggests three areas of production relevant knowledge, with different levels of specificity.

First there is the *general scientific knowledge base*. This is itself highly differentiated internally and of widely varying relevance for industrial production. It is shaped by policy or funding decisions, which usually have economic, industrial or military objectives

Secondly there are knowledge bases at the *level of the industry or product field*. Industries often share particular scientific and technological parameters. It tends to be codified in applied scientific fields like the electrical engineering. This part of the industrial knowledge base is public, in the sense that it is available to all firms. Tassely has defined this combination of knowledge and institutional base as the 'technology infrastructure' (Tassely, 1991). Such knowledge can be embodied in human, institutional or facility forms.

Thirdly the knowledge base of *particular firms* are highly localised. Firms usually dispose of one or few technologies which they understand well. These technologies represent the core of their competitive position. The technical knowledge is thus highly specific to the firm, and so is the related social knowledge. This means that the knowledge about the way in which technical processes can be integrated with skills, production routines, use of equipment and management systems is specific to the firm.

At the level of the firm, the relevant technological knowledge base may be quite informal and uncodified. The knowledge of the firm is thus localised to individuals and groups in the firm, and *often tacit*. The competence of the firm has limits when it comes to changes, particularly such innovations, which lie outside their area of competence. Even their ability to search for knowledge outside the firm may be limited. Access to knowledge *outside the firm* is thus of great importance when technical change is needed.

The three knowledge bases of importance for the capability of the firm to innovate are integrated in each other, and they develop over time. New technological knowledge tends to build on past achievements. The capability of any knowledge producing institution (firm,

² In comparison the Bell and Pavitt concept of technical change is parallel to the definition of innovation by Nelson and Rosenberg above while the concept of technological learning adds precision to the concept of learning of Polanyi

research organisation etc) is therefore the result of its past history. The whole system, its institutions and its processes are characterised by path dependence.

Tacit and explicit knowledge

To qualify the notion of capability and knowledge bases, it is useful briefly to consider the notion of *knowledge*.

Nonaka and Takeuchi (Nonaka & Takeuchi, 1995: 58) distinguish between knowledge and information. Both knowledge and information is relational and context specific (p. 59). Information is a flow of messages while knowledge is created by that very flow of information, anchored in the beliefs and commitment of its holder. Knowledge is subjective and active, and deeply rooted in the subjects value system. Knowledge is created by individuals.

In relation to the learning process of a company it is important to distinguish between different kinds of knowledge, of which some are easily transmitted and shared in the organisation, and others not. Polanyi, 1966 pointed out, that we can know more than we can tell. The individual possess *tacit* knowledge which he/she cannot communicate, as well as explicit knowledge which is transferable. The tacit knowledge may be a tacit foreknowledge of yet undiscovered things and their implications, as for example in science (p.23). This implies that tacit knowledge is not only to be considered a passive, individual knowledge, but may represent *a motive force in search processes*.

Nonaka & Takeuchi, (1995) develop the distinction between tacit and explicit knowledge suggested in Polanyi, (1966). While they add, that tacit knowledge entails technical as well as cognitive elements their main contribution is the idea that tacit and explicit knowledge are not totally separate but mutually complementary entities. These entities interchange into each other in the creative activities of human beings. Knowledge is created and expanded through social interaction between tacit and explicit knowledge in a *social conversion process* (Nonaka & Takeuchi, 1995p 61).

The authors see the process as consisting of four modes of so-called 'knowledge conversion', which follow each other in a spiral of organisational knowledge creation.

The four modes are (Nonaka & Takeuchi, 1995,p. 62 ff):

- a. From tacit knowledge to tacit knowledge, socialisation of knowledge. This process takes place as experience, observation, imitation and practice.
- b. From tacit knowledge to explicit knowledge, externalisation of knowledge. Concept creation in dialogue is the key to knowledge creation This is facilitated through the use of metaphors, analogies and models (Nonaka & Takeuchi, 1995,p.66).
- c. From explicit knowledge to explicit knowledge, or combination of knowledge. Individuals exchange and combine knowledge through media as documents, meetings, telephones or computer-networks.
- d. From explicit knowledge to tacit knowledge, or internalisation of knowledge. Learning by doing and storytelling is the process by which explicit knowledge is internalised in individuals and groups.

These four modes follow each other in a spiral of learning. Through this process innovations are created and competitiveness achieved.

The model of Nonaka & Takeuchi (1995) concerns learning within the organisation. However it might as well apply to inter-organisational learning. While Smith, (1995) claim the importance for innovation of knowledge from outside, it can be argued, that the knowledge from outside must be socialised, combined and internalised. This means that the search for external knowledge must be supplemented by a process in the company, which allows this knowledge to be learned.

The social process of learning requires a social environment which encourages knowledge sharing among individuals and groups. Redundancy or overlap facilitates dialogue among members of the organisation. So does rotation of personal between different departments. Further, group work among individuals from different departments about product development is a key to creativity (Nonaka, 1991). Specific incentives may be required to minimize individualism and reluctance toward learning (Cabrera & Cabrera, 2002).

In sum innovation in a market economy is centered in the firm. To compete firms innovate products, processes and organisation. Innovation presupposes learning, or the enhancement of technological capabilities. To develop technological capabilities firms need to access different external knowledge bases like research and development organisations or other firms. This is important because the capabilities of firms are always specific, and they are path dependent and therefore not suited for major changes. New tacit as well as new explicit knowledge may serve as point of departure for learning processes and innovation, if the new knowledge is socialised in a conversion process in the organisation. The problem with tacit knowledge is how to share it with others, while the problem with explicit knowledge is how to internalise it in individuals and groups. Not all organisation forms are equally suited to host the social process of knowledge conversion.

On this background the following problems can be expected in relation to innovation in CEE: The firm is a very new institution, which has not necessarily got accustomed to the role of being 'key to innovation'. The inherited external knowledge base developed in CEE may not suit the needs of private firms. Finally the social environment in CEE companies may not be favourable to processes of knowledge conversion. The traditional organisation form in CEE companies and organisations is highly specialised and hierarchic, not allowing for the suggested redundancy and dialogue across the organisation.

The role of the environment and of proximity

What is the trigger of the learning and innovation process described above? It has often been pointed out, that competition is the strongest incentive to innovation (Porter, 1990; North, 1990). Other environmental factors mentioned in the literature are culture and the technological infrastructure.

The role of culture for innovation and learning is mentioned in (Nonaka & Takeuchi, 1995) . They talk about the role of attitudes or perceptions prevalent in the company. (Susanj, 2000,p 350-351) points more specifically at the following culture and climate factors as being facilitative of innovation: Support for ideas; willingness to tolerate failure; challenge; risk encouragement, playfulness and debates, trust, freedom; harmony; a certain level of conflict; participative decision making and pragmatism.

The technological infrastructure or the external knowledge base may stimulate innovation. From the external knowledge base firms may find different knowledge and information inputs which may function as incentives to innovation. These inputs are for example: customer's needs and ideas; suppliers' offer and ideas; competitor's ideas and strategies; different semi-public organisations' offer of ideas and financing; financial organisations' offer of knowledge and credit-schemes; the labour market or the labour supply with its offer of different qualifications; the supply of R&D by universities or branch research organisations, technology centres and so on. The technological infrastructure creates explicit knowledge, and *shared tacit technical knowledge*, like professional intuition and basic perceptions.

The three aspects, competition, culture and technological infrastructure, are localised geographically. Recent debates on innovation have therefore 'reinvented' the role of proximity to innovation and learning.

The following overview of the viewpoints to innovation and proximity is based on Oerlemans et al, (Oerlemans et al, 2000). The authors organise the contributions in four groups: The 1) industrial districts approach, 2) the approach of 'new industrial spaces, 3) the innovative milieu approach and finally 4) the regional innovation system approach.

Early industrial districts' theory point at the external economies which small firms can achieve by locating close to each other. Already Alfred Marshall (Marshall, 1922) pointed at the importance of personal contacts and the flow of information between firms. Recent industrial districts theory focus on the qualitative elements, which make inter-organisational relations possible: Co-operation, mutual dependence and trust. The trustful relations between enterprises stimulate innovation and facilitate the diffusion of information (Oerlemans et al, 2000,p 26-27).

The approach of 'new industrial spaces' (Scott & Storper, 1992) focus on groups of small firms which specialise and draw on common external resources, among which the local labour market is the most important. Together the firms may achieve economies of scale as well as economies of scope (e.g. of variation). New production technology has enabled small firms to be extremely flexible. Flexibility also characterises the way the firms relate to each other. The district as a total is innovative and highly responsive to market changes.

An important aspect of the new industrial district is a common pool of specialised skills, conventions, norms, values and common institutions (i.e. public or semi-public organisations). The region may possess a *specific and shared tacit knowledge*, which facilitates learning and innovation. This regionally specific knowledge may explain patterns of geographic specialisation. (Oerlemans et al, 2000,p 27-28).

The French innovative milieu approach argue that the environment is *sometimes* extremely decisive to innovation, and sometimes not (Oerlemans et al, 2000,p 31-32). The importance of the environment depends on the type of innovation. As long as the firm develops along its 'path' by incremental innovation, resources can be found within the firm itself. In comparison *radical innovators* are more likely to develop relations with the local production environment. In that case the role of the environmental factors is of very big importance in fostering innovation.

Regional innovation system (RIS) approaches integrate many of the insights from the three other groups of theories. The innovation system approach focuses on knowledge (Oerlemans et al, 2000 p. 33-35). The core of the theories is the idea that the performance of an economy depends on the way companies, research institutions and the public sector interacts as regards production and distribution of knowledge. Together these organisations constitute an infrastructure, a system of innovation.

Like in the French theory on innovative milieu there is a distinction between incremental and radical innovations in relation to the role of the environment. A third type, stationary technology, is added in the innovation systems approach. The stationary technology is codified and in principle independent on specific types of environment. Incremental innovation requires flexible codes and communication with the users, so that proximity between producers and users is advantageous to innovation. Radical innovations break with the known codes and require communication of non-codified or tacit knowledge. This means that spatial proximity of user and producer becomes very important. Thus a positive *relationship* is assumed between the *degree of tacitness* of knowledge, *level of innovation* and the importance of *spatial proximity*.

It is a basic point in RIS that the region³ is an efficient level for communication and knowledge sharing (interactive learning). The trust and networks arising from participation in different local networks and associations facilitates the communication of *tacit knowledge for innovation* (Cooke & Morgan, 1998; See also Braczyk et al, 1998). The existence of localised learning networks in regions is a topic, which has been studied based on the hypothesis that the existence of such networks may explain the emergence of new and competitive regions. The social capital of such networks is what makes firms, associations and public agencies engage in processes of self-organised, interactive learning (Simmie, 1997; Cooke & Morgan, 1998; Storper, 1997; Braczyk et al, 1998).

While the notion of *social capital* is mostly used without further definition in the RIS texts, its precise definition is useful in this context: The social capital includes the resources, tangible or not, that are available through a set of social relationships, and it facilitates the attainment of goals (Bourdieu and Wacquant, 1992:119, quoted in McNaughton, 2000p 70). Social capital is not only a network of social relationships, but moreover the resources and obligations embedded in the network and available through participation in it. Social capital contributes to the formation of obligations, trust and sanctions. The economic importance of social capital is that it mitigates contracting costs among the members of the network (Routledge and von Amsberg, 1996:1 quoted in in McNaughton, 2000p 71). Its importance to innovation is that it *facilitates the sharing of tacit knowledge* among the members of the network. Morgan and Nauwelaers suggest the creation of social capital a means in regional development (Morgan et al, 1999). It should not be forgotten, however, that social capital may have negative impact on

³ The notion of the 'Region' is mostly not defined. It is not clear what the criteria are for defining the borderline of a region. This borderline may be administrative (a county, a group of counties), economic (a coal mining region) or cultural (an entrepreneurial region). The extension of a region is not defined either. Administratively defined regions vary so much in size and legislative competence, that the distinction between nation and region in relation to innovation system may not be relevant. While the definition of borderlines is a weakness, the strong point is the rediscovery of the localised dynamics of learning

growth and innovation if it excludes newcomers, if it is anti-competitive or if it discourages pioneering by demanding conformity (McNaughton, 2000p 75).

In sum the environment contribute to innovation in different ways. Culture factors in general may favour or harm innovativeness. Flexible co-operation based on trust and dependence, access to a local labour market, and shared specific tacit knowledge is what may make regions develop innovative and specialised clusters of firms. Regional learning takes place as an interaction between research institutions, companies and the public sector in the geographic area. The existence of social capital in a region facilitates the sharing of tacit knowledge. There is a positive relation between the degree of tacitness of knowledge, the level of innovation and the importance of spatial proximity. The more radical the innovation, the more tacit the knowledge and the more important is geographic and cultural proximity to other firms or organisations in the innovation process.

In relation to CEE culture factors seem discourage innovation. In his investigation of differences in culture and climate factors in East and West, Susanj (Susanj, 2000) concludes that in comparison Central and Eastern European companies are less focussed on the development of new and better products and new ways of solving problems. They are also less pioneering, wanting less to be in forefront of new technology, or search for new markets, or challenge old ideas. This *shared tacit knowledge* of the social agents in CEE is thus not favourable of innovation.

Proximity is a well-known principle in pre -1989 industrial policy and planning in CEE. Proximity was carefully planned in relation to supply chains. Examples are the big agro-industrial clusters and the steel clusters in Hungary and Poland. Concerning knowledge creation this was completely different. Technological knowledge was developed in centralised branch-related research and development institutes of the governments. Innovation was planned as a linear process starting with the political decision, the R&D process and ending up with an instruction or a new device for the production plants. Universities were not in charge of applied research. In principle there was no reason to establish contacts among production plants or between production plants and universities in the local area or in other words to establish a regional innovation system.

Today more many more producers and providers of applied research in Poland, both at the central level and at the local and regional level. (Lorentzen, 2001) Possibilities exist to source knowledge as for example the still existing branch institutes, university staff members, small contact points for technology transfer projects, and of course other companies on the market, in Poland or abroad.

The research questions

Based on the theoretical framework above the two cases will be analysed with respect to the following questions:

What kind of technical change (or innovation) has taken place in the companies?

What are incentives and motivations to innovate?

What is the role of tacit and explicit knowledge in the learning and innovation process of the companies?

What internal knowledge resources do the companies rely on in the learning process?

What external knowledge resources do they rely on in the learning process?

What is the role of proximity in relation to the external knowledge base, and on what points, if any?

What qualities, like e.g. trust and permanence, characterise the interaction of the company with its external partners?

What are the strengths and weakness of the knowledge bases of the companies?

Below follows an analysis and discussion of two selected cases from the sample of 27 enterprises. The date of interview is September 2001⁴

II Casestudies

Analysis of case one

Company one is an old company founded already in 1911 as a producer of shoes. As other Polish companies it was turned into a state-owned company in the fifties. The company was privatised in 1993 in connection with the privatisation of state-owned enterprises in Poland. Today it is a share-holding company. The collapse of former markets in the East and crisis in the Polish economy were the conditions under which this company had to adapt to the new market economy. By rationalisation and innovation of products and processes the company managed to stay on the market and to keep two thirds of its workforce. In 2001 company one employed 330 persons.

⁴ The data for this ongoing study is primary data collected through visits in enterprises. The enterprises were located in and nearby the two provincial capitals Krakow and Wroclaw,⁴ and a few of them in Warsaw. The Warsaw companies served as pilot studies. The visits were made in 1999, 2000 and 2001, and 2002 and included interviews in 27 enterprises. The selection of enterprises is made in relation to branch of industry (manufacturing) and size (between 10 to 500 employees). The enterprises were contacted through chambers of commerce, regional development agencies and technology agencies in Poland. There is no intended representativity in the data. The intention is not to describe typical characteristics but to identify 'critical' issues⁴ in the development and innovation of the companies.

The interview persons were managers on a high level in the companies. The interviews were conducted in English or German. On few occasions an interpreter was necessary.

An interview guide served to structure the conversation. The interviews were structured around the following topics. The first part of the interview guide dealt with intra-firm issues. It included history of the company; present production, historical changes and planned changes in production; production methods, historic changes and planned changes; production methods, historic and planned changes in production methods; qualification structure at present, historic changes and planned changes; organisation of the company, historic and planned changes. The interview person was in each case asked to explain why a historic change had taken place or the background for the future plans. A particular focus was on innovative activities in the company, their type, outcome and organisation.

The second part of the interview guide focused on the relations between the company and the outside world.

Issues in this section were: markets and customers, historic changes and plans

for the future, as well as co-operation with customers; supplies and suppliers, historic changes and plans for the future, as well as co-operation with suppliers. Following this came questions about sources of information about new products and production methods, markets and financing. Finally questions about co-operation in general with organisations or with other companies, and about the attitude of the company towards such co-operation. The last brief section was an overall SWOT analysis of the company. The dynamic and historic perspective is build in through the questions regarding historic development and future plans.

Since 1990 the production of company one has changed considerably. Innovation in the company can be characterised as radical, incremental as well as stationary. The radical innovations include the introduction of new materials and automation, and lately of a completely new product. While the company before 1990 produced finished shoes in wood and leather, today it produces shoe-parts in plastic for the shoe industry. As a new product, plastic film wrapping is produced. The fabrication of shoe-parts has become fully automatic, while polishing and painting is mostly done by hand. Also incremental changes are continuously being made in products (new designs) and processes (new machines are continuously being bought).

Production no longer consists of stable goods in large quantities. The product series have become shorter, and the variety of products much larger. Machinery is renewed year by year. The core competence of the company, the preparation of designs and forms for the moulding process, is gradually developed. The planned introduction of computer aided design is going to represent another radical innovation for the company and an important enhancement of the core competence of the company. Incremental product innovation is planned, as the company is searching for related products, based on moulding of plastic. Finally stationary innovation is planned, when production will be expanded at the same level of technology.

The incentive to innovate products and processes is mainly competition. The competition is double edged: Price competition from the newly industrialising countries, and from 'pirate' companies within Poland and competition on sophistication from Italy. Further the company feels a moral pressure to keep up employment, and staying on the market means to innovate. Finally the board and the shareholders exert a pressure on management to develop the company and to innovate.

The organisation of the company was radically changed in 1993, when the formerly state-owned company turned into a share-holding company, and new decision making structures were made, with the general assembly and the board as the highest authority. The internal management represents characteristics, which are inherited from the communist period. It is hierarchical and functionally divided in a multitude of departments, and with a heavy management and administrative layer. The on-going innovation of the organisation is gradual: it includes a reduction in the production staff and an increase in the staff dedicated for management and sales. In production a systematic substitution of unskilled workers by skilled workers takes place. The organisational changes are caused by the productivity changes, by the introduction of more advanced machinery which needs different qualifications in production, and by the need for market related knowledge and action.

What *types of knowledge* is the point of departure for innovation in company one? This knowledge is complex as well as solid. It consists of knowledge about the branch and about the market, of customers' needs and ideas, and of technical and organisational knowledge. Benchmarking (comparison with the performance of other companies) and market analysis represent the knowledge which is the basis for decision on the direction of innovation. The result of benchmarking and market analysis can be characterised as explicit and encoded knowledge. The designs, wishes and ideas of industrial customers for new shoe models are other sources of knowledge. This knowledge can be labelled explicit, but not always or not yet codified. Knowledge about the equipment and its use represent the key competence of the company and is the technical base for innovation. This knowledge is both explicit and

codified, as well as tacit and experience based. The explicit and codified aspects of knowledge seem to dominate the innovation and the production of the company.

The *internal knowledge* base consists of the experiences and history of the company. It is as mentioned a company with a long history, and a pre-communist as well as a communist heritage. Through its history it has accumulated knowledge on shoe production. The workers are to a large extent the same who worked in the company before 1990, when changes did rarely happen and everyone had to meet targets within his or her area according to the plan. This past is still present in the tacit knowledge of the personnel. An indication of this is the opinion of the management, that many workers are reluctant to change and to new forms of co-operation. The strategy of the management to cope with this is to gradually substitute unskilled workers by skilled workers. Further, training is continuously organised for the workers, with the assistance of a local high school of shoe making. Training is considered necessary because skills are needed to operate the new and advance equipment. A particular focus is on qualifications relevant for the introduction of ISO certification, which is a very explicit, documented and thus 'encoded' type of knowledge. While the management thus trains the staff to work on new technology, it seems that no effort is made to mobilise ideas for innovation from the staff. Innovation seems to be a 'top down' exercise.

The board of the company represents another part of the internal knowledge base. The board consists of people with ideas on how to develop the company, and they are motivated to apply these ideas in the company.

Summing up, the internal knowledge base is complex. It is on a high technical level, it is expanding and it is enabling the company to innovate continuously. But it is also characterised by contradictions and conflicts. It consists of inherited, tacit knowledge, and of new knowledge which is widely and increasingly codified. The conflict between the two types of knowledge (new and old, explicit and tacit) represents a barrier to learning and innovation which the company has to cope with. The 'top-down' approach of the management to innovation does lead to results, but it may leave hidden or tacit knowledge potentials among the general staff unused. It is further a question, whether the new knowledge related to new processes and products is sufficiently internalised among the staff.

The *external knowledge* base of the company has been widened considerably after 1990. The company has since privatisation focused on the gathering of information on products, processes, markets and management practices, and the management intends to continue this strategy. The company management understands itself as highly motivated to learn. Knowledge about the performance of other companies in the branch is regularly collected through benchmarking (systematic comparison of performance). The company watches particularly the development in Italy, which is considered to be ahead of competitors. Also Polish companies are in focus. Before 1990 there were no other companies in the branch as company one had a monopoly in Poland, so the development of the branch represents an expansion of the Polish knowledge base. The branch chamber of commerce in Warsaw (founded during the nineties) provides knowledge about the *market*. Knowledge about new trends in *products* and about *new equipment* is obtained by visiting international fairs. Contact to the western market is indirect, through indirect exports. Newly established direct contact to the West goes through the purchase of inputs from Italy and Germany. Company one exports 41 per cent of its production. There is no direct contact with customers in the West. The direct foreign customers continue to be located in Central and Eastern Europe. Knowledge about

organisation practices is provided by the branch chamber, but company one also get knowledge from other organisations and companies. When developing shoe designs there is a close co-operation with the shoe producers in Poland. A local organisation, a central laboratory of shoe making offers training and information in relation to design. The workers receive education and training on a local high school of shoe making. A licensed company is helping with the ISO certificate.

The extension of the external knowledge of company one is thus global and its composition is quite complex. It consists of foreign, national as well as local organisations and companies. Locally the technical school is important, nationally other companies and branch chambers represent knowledge sources, and internationally other companies as well as fairs play an important role. The external knowledge base of the company has undergone considerable development after 1990. The expansion of the external knowledge base is due to the institutional development in Poland as well as to the active strategy of the management of company one.

The knowledge thus transferred to the company is likely to be explicit and codified. Through the introduction of ISO this explicit, codified knowledge will become the established norm throughout the company. However, the personal interaction with customers, participants on fairs, consultants and teachers may lead to the sharing of new tacit knowledge, too. A weakness in the external knowledge base of the company is the lack of direct contact to customers in the West.

Innovation in company one results from an interplay between the internal and the external knowledge bases. The board suggests changes in products and processes based on input from the external knowledge base, particularly from customers. The management prepares the innovation projects, and the board takes the decision. The strong focus on the external knowledge base contrasts with the little interest in mobilising the staff as a knowledge base in the generation of ideas for innovation. The (tacit) knowledge of the staff is basically understood as a barrier, not as a potential. A further development of the internal knowledge base would require a less 'top-down' approach and more focus on motivation and involvement of lower levels of the organisation.

Analysis of case two

Company two 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.

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 company two. In sum, innovation in company two can be characterised as incremental and stationary, while radical change is envisaged for the future.

The 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.

No radical changes have taken place in the organisation of the company. The company was founded as a private company and basic management principles have not changed. Company two is still owned by one person, who is also the top manager of the company. The staff has expanded from 10 to 110, and a delegation of responsibilities has been introduced, and today five managers share the decision-making competence. Knowledge is mainly exchanged among the white-collar staff, which meets twice a day, with informal co-operation in between. Monthly meetings between workers and management supplement the daily co-operation between production management and workers. Future plans for organisational change include the expansion of the sales organisation, including the employment of a person dedicated for the seeking of information from outside the company. The organisation of the company has changed in a stationary way and also by incremental innovation. The general exchange of knowledge takes place through personal contacts, which enable both tacit and explicit knowledge to be exchanged.

What *type of knowledge* does the company base its innovation on? Innovation is based on technical internal knowledge, basically the knowledge of one very experienced engineer employed in the company. Apart from glass melting, the art of designing and forming the glass rests with the skilled glass workers. The melting, forming and designing of glass require both codified and tacit knowledge. Knowledge about the market is an important input to innovation, and this knowledge is both codified (figures) and tacit (impression of tastes, feeling of future trends), transferred through the inter-net or through other written sources, and by personal contacts to customers and specialists.

The *internal knowledge* base has developed in the company since the beginning of the eighties, when the company was founded. 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 qualifications of the staff have been increased, as

the engineers have attended courses in languages, technology, modern sales methods and the use of the inter-net. In the future the management would like to learn more about co-operation with the US and with Western Europe.

The strategy of the management can be interpreted as an effort to develop the internal knowledge base to better cope with operation in a globalised market economy. This is achieved by enhancing the formal qualifications of the staff through training, and to strengthen the functions of the company dealing with sales and information gathering.

The strength of the internal knowledge base is its level of technical expertise and its culture: The level of technical knowledge is high. Its comparatively flat structure and informal culture allows information and ideas to diffuse quickly in the company. The motivation of the staff to innovate is an important asset. The weakness of the knowledge base is the rather one-sided weight on technical qualifications, which is in contrast to the ambitions of the management to expand on the western markets. Further the concentration of engineering knowledge on glass making on one person makes the company vulnerable.

The development of the *external knowledge* base is in focus of the company, which give priority to the search of information of relevance for the development of the company. The knowledge base 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. A huge offer of courses by local and national organisation, some of them financed by the EU and drawing on international expertise, belongs to the picture of the external knowledge base. The inter-net has become a very important source of information and communication. For the company the inter-net, 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.

The *external knowledge* base of the company consists of local, national and foreign companies and organisations. Communication with the external knowledge base is both personal and formalised, based on written information. The extended use of inter-net should imply that the knowledge exchange is increasingly explicit, but not necessarily codified. The electronic transmission of photos and drawings convey ideas, but not precise descriptions on how to develop and produce them. The weakness of the external knowledge base is its complexity and the overwhelming mass of information that it generates. It is much more than the company can sort out and absorb in a learning process.

The ideas for new products and processes are generated in the interplay between the external knowledge base and the internal knowledge base. The sales manager, the director, the production manager and the technical manager are the core people in the internal knowledge base to find out and to decide on what innovations to implement. The sales manager conveys

the market knowledge about the development of tastes, the glass engineer the technical knowledge from outside and from the company, and the director the financial knowledge. The bottleneck is the capacity of the internal knowledge base to process all the information from the external knowledge base. A solution to this problem is envisaged by an expansion of the staff with a person dedicated to the processing of knowledge. It is questionable whether this is enough.

A modification of the external knowledge base would be a useful supplement to the enhancement of the internal knowledge base: A more strategic and goal directed development of the external knowledge base would be favourable to strategic learning in company two. Also a supplement to the single glassmaking engineer would make the company more robust.

Comparison of the two cases

The two companies share some common characteristics, while they differ on a come points.

Both companies are innovative, and incentives to innovate come from competition and from the managerial levels of the companies. The companies have introduced technical change in products and processes as have also changed their organisation. The companies have enhanced their technological capabilities through extensive processes of learning. Both companies rely mainly on technical knowledge, while knowledge about the market is a problem for both companies. In both companies explicit encoded knowledge seem to gain importance, due to among other things the introduction of certification.

Through training and the substitution of unskilled by skilled workers the companies have considerably developed their internal knowledge base. Also the external knowledge base has been developed a lot after 1989. This knowledge base they find both at the local level, at the national level, and not least, at the international level, where they regularly search for new market possibilities, new designs and new methods. The internet has enabled the companies to search widely, and to communicate rapidly. This has revolutionized their sourcing of knowledge. Neither of the two companies are particularly integrated in local or regional innovation systems. They regard local or Polish competitors with distrust, but they benefit from the services of the local chambers of commerce.. The role of the local level is to supply labour and to provide technical education and retraining of staff.

How can the considerable innovation and learning efforts of the two companies be explained? Based on the conceptual framework it is suggested that the tough global competition in combination with a highly developed internal knowledge base, or in other words a generally high level of technical skills, have enabled the companies to accumulate technological capabilities and to change many aspects of their production. The mismatch between the external and the internal knowledge bases is likely to limit the dynamic of learning and innovation in both companies, however.

The companies also differ on various points.

Company one has realized both radical, incremental and stationary innovation, while company two has made incremental and stationary innovation.

Company one relies mainly on explicit, codified knowledge, while company two, to a considerable degree relies on tacit knowledge for innovation. Company one relies mainly on external knowledge sources. Designs for example most often originate from customers.

Company two, in comparison, rely much on internal knowledge sources, when they develop their designs, however often based on ideas from outside.

Company one has got an organisation, which does not stimulate the complete process of knowledge conversion. Company two has got an organisation, which better seem to enable a full process of knowledge conversion from tacit to explicit knowledge and from explicit to tacit.

In company one the inherited tacit knowledge of the workers is discouraging innovation, while the opposite is the case in company two, where the staff joins the innovation efforts of the management.

The differences between the two companies are thus less considerable. It is suggested that explanations may be found in the different histories, in specific characteristics related to the branch of industry and its insertion in the international division of labour, as well as to a simple thing as size, or number of employees.

Company one has practically changed branch after 1989. From being a manufacturer of finished shoes, it has turned into a sub-supplier of plastic parts for shoes. Plastic manufacturing is basically an industrial process, based on encoded knowledge about plastic mixtures, temperatures and design of forms. As a sub-supplier the company is part of an industrial and global division of labour which leaves little room for independent technical change. Designs and knowledge of methods mainly come from external partners.

Company one can be described as a hierarchical and specialised organisation. Hierarchy and specialisation was the dominant organisation form during the planned economy, as it was considered to be the most efficient. Company one was in fact a state owned company until 1993, and its present organisation form can be seen as inherited from this recent past. The historical size of the company (large middle-size) may also explain the hierarchic tradition. This organisation form has difficulties to handle tacit knowledge and can hardly enable the full process of knowledge conversion. It may be a minor problem as long as the external knowledge base provides most of the knowledge for technical change. However, the tacit knowledge that does exist in the organisation is rather reluctant to change, and this is likely to raise costs and to reduce quality.

Company two is both artisan and industrial in its technology. Craftmanship is a large part of the internal knowledge base. It is therefore natural that tacit knowledge plays a larger part in the learning and innovation of this company. As a producer of final goods, and as a highly integrated producer, which controls every phase of the production process, company two makes frequent incremental innovations based on internal knowledge sources.

The organisation of company two is beneficial to the complete process of knowledge conversion, because it is flat and informal, and because of the general high level of skills. These organisational characteristics are typical of small, private manufacturing companies.

Conclusion

Based on the two cases it is possible to suggest that:

- Polish manufacturing companies are quite innovative, and they develop their technological capabilities in a dynamic process of learning. They have substantially developed their internal as well as their external knowledge bases since 1989.

- Explicit, encoded knowledge seems to dominate the learning process due to processes of standardisation and certification or due to external dependency links.
- The internal knowledge bases of the companies are not sufficiently developed to fully benefit from the possibilities of the external knowledge bases.
- The regional innovation system idea does not find support in the cases, which are characterised by global knowledge sourcing and distant partners. Only recruitment and training is provided by the local environment⁵.
- The companies were not and did not want to be member of any business network with companies in similar activities⁶. Competitors, regardless of origin, were regarded with distrust.

⁵ Boschma & Lambday, 2002 argue that clustering and regional and local learning is less relevant in branches characterised by globalisation, advanced technological development and market concentration.

⁶ Romijn & Albu, 2002 has got similar impressions in a study of electronic firms and software developers in Sout East England.

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