Innovations by Technology Transfer to Central and East Europe

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ABSTRACT

Technology transfer is not just a modern-day phenomenon. Previous epochs have also been characterised by technological gradient and subsequent technology transfer. Technology transfer necessitates the presence of invention, innovation and exnovation. In the real world technology transfer occurs in numerous forms. Lessons learned of Eastern Germany can be transferred. Examples of technology transfer to Central and Eastern Europe and Asia are given. Empirical data of an investigation into German Investors in Central and Eastern Europe are presented.

1 TECHNOLOGY TRANSFER IN HISTORY

Ever since man has used technical systems to improve his livelihood, innovations have exerted a strong influence on technical progress. There has always been a requirement for technological transfer when one particular society is in possession of, and applies, more advanced technologies than another society.

In antiquity, the Greeks were more interested in theoretical concepts than in pure mechanical application. Nevertheless, Greek technology attained a surprising level as can be seen from examples of inventions of that time - for instance, automatic machines, such as "deus ex machina" facilities in theatres. The more pragmatic Romans accepted these concepts and inventions, then improved and applied them. This historical process shows quite clearly the cultural differences which go hand in hand with innovation and is, at the same time, an early example of technology transfer.

At about 1750, the United Kingdom achieved a technological lead in the phase of the first Industrial Revolution. In the 19th century Germany was able to catch up with the UK's lead and also that of France by means of technology transfer and own innovation. After the Second World War, Japan successfully caught up with the USA by means of technology transfer, imitation and creative improvement of innovations. In the Sixties the "small tigers" of South-East Asia: Hong-Kong, Korea, Singapore and Taiwan started their remarkably successful industrialisation. Other major developing countries like Brazil, Egypt, India and Mexico imitated similar national programmes.

For years technology transfer was understood to be the relatively one-sided co-operation between western industrialised nations and Third World countries. The basic idea was to transfer technical systems and knowledge about operation of machines and facilities. However, for some years this has been complemented by a new constellation of co-operation: innovation and technology transfer in co-operation with countries in Central

and Eastern Europe which have introduced fundamental changes in their economic systems.

2 INVENTION, INNOVATION AND EXNOVATION

Some weeks ago, the famous scientist Manfred von Ardenne died. He held more than 600 patents in different disciplines. His two maxims of innovation were: „I am interested in everything. Everything can be optimised."
Innovation means the process of attaining an invention and exploiting it for the purpose of a new product or service offer; this process should be done under control of risks. Technical innovations usually focused on improving materials, providing additional functions or creating modernised design of products. But additionally they may be concerned with the production process, like new equipment and machinery, improved logistic concepts or lean organisation.
Human innovation puts the stress on personnel development programmes to enhance qualifications, or acquire, new staff. Innovative marketing strategies and media and new forms of advertising and sales promotion are more customer oriented. Using these forms of innovation management has to reflect the degree of change and novelty: basic innovation, improvements to prolong life cycle of products or periodical changes. "From 1960 onwards there was a changeover from the so-called invention or breakthrough type to the system, improvement and application type. In present-day systems, however, old and new technologies are combined in all possible variations. Improvement technologies include electronics, optics, ceramics, chemistry". (Makino/Hoshino)
To the individual employee, department, organisation or country/culture, a certain technology may be construed subjectively as an innovation, even if this invention and technology has been well known to other user groups for years (objective innovation). Consultants specialised in implementation and project managers should be aware of these environmental circumstances and risks.
Risk analysis and control is one of the most important task of management in innovation and technology transfer projects. Risk management comprises the following three phases: risk identification, analysis and assessment, risk handling. To deal with the risks in innovation and technology transfer projects, venture capital should be sought and acquired. By venture capital we mean equity capital from professional financial institutions which are not afraid of the high risks involved in research and development and in the supporting new, very often small, and unproved technological enterprises.
Third World Countries and in recent years Central and East European countries have been analysing and imitating the economic structures of West European countries and the USA. In Central and East European countries companies have to do exnovation of obsolete technologies or organisational structures and conversion of military to civil products - a necessary start-up phase of important innovation processes in industry and trade. In East Germany exnovation and innovation is organised since 1990 by „Treuhandanstalt". This public body has been entrusted with the task of privatising former state-owned enterprises. For this purpose, it has to close unprofitable enterprises and to sell off those that can be made viable.

3 TYPES OF TECHNOLOGY TRANSFER

Several different interpretations of technology transfer can be found in the journals etc. The term transfer is generally understood as a transmission process. On the other hand, the term technology has different broad definitions. The transfer of technical knowledge is also described as knowledge transfer, know-how transfer or information transfer. This implies knowledge about the method of functioning of technical systems, about their development, design and production. Sometimes the physically transport of mechanical systems and equipment are also included. The term technology transfer also usually includes knowledge about the operating and maintaining of the systems. Technology transfer means to pass on inventions and innovations, experience and expertise know-how and technology to other persons, organisations or countries.

Technology transfer takes place mainly by humanware, e.g. by qualified staff and personnel development (education, training). It is influenced and supported by corporate and cultural amplifications. But, of course, technology transfer is also realised directly by transport of hardware, like machinery, devices, facilities and computers. Know-how, though, is mainly transferred by the software (programs, procedures, rules) and by the paperware (licences, handbooks, documents, drawings). In industry, the public sector and higher education systems we find a spectrum of organisational forms and institutional relationships to realise technology transfer. These forms are listed in Table 1.

One of the most effective ways of technology transfer is to learn by *imitating colleagues* at the same, or similar workplaces, for example operating of computers. *Internal transfer* can be organised by an information exchange between departments of an organisation (new procedures learned by logistic and transferred to production department). *Rotational transfer* means to rotate personnel from line departments to project teams and back within a personnel development programme. Project leadership is a time-limited job, thus it is suitable for testing and assessing junior managers.

Client companies purchase *expertise* from specialised consulting firms. Customer and owner companies are collecting specialised knowledge by inviting well-known *tendering* companies to send bids for their project. This gratis knowledge acquisition is becoming inflationary, so that some big engineering companies are more and more hesitant to hand in detailed bids as a tender for international projects. *Contractual transfer* results in high effects of technology transfer: Clients and owners charge main contractors with the planning, co-ordinating and controlling of their project subcontractors. Additionally, these prime contractors transfer technical and procedural know-how to subcontractors as well as to the customer.

Vertical transfer is performed by big companies, when they force and instruct their suppliers, mainly small and medium-sized firms, to implement and use high-tech machinery (Numeric Control, Robotics, CAD etc.) and high quality control and testing procedures (Total Quality Control Concept etc.). A *complementary* knowledge level is expected in companies in order to co-operate successfully in projects like joint ventures, licensing or mergers. *Analogue transfer* can transport experience (e.g. in computer implementation) from one branch, like trading companies, to an other branch, like credit institutes.

The most frequently used interpretation of technology transfer is in the sense of know-*how Transfer* from higher educational and research institutions to industry and public

Table 1: Forms of co-operation and Technology Transfer

Innovation by Technology Transfer:

1. **Imitating Transfer**:
Workplace 1 / Colleague 1 ==> Workplace 2 / Colleague 2

2. **Internal Transfer**:
Division 1 / Department 1 ==> Division 2 / Department 2

3. **Rotational Transfer**:
Project Team 1 ==> Line Department ==> Project Team 2

4. **Expertise Transfer**:
Consulting Firm / Company ==> Client / Customer Company

5. **Tendering Transfer:**
Tendering Companies ==> Bid inviting Client / Owner

6. **Contractual Transfer**:
Client/Customer/Owner<==>Main/Prime Contractor==>Subcontractors/Suppliers

7. Vertical Transfer:
Big Company (= client) ==> Small/Medium-sized Enterprise SME (= suppliers)

8. **Complementary Transfer**:
Company 1 ==> joint venture Partner / fusioned Company

9. **Analogue Transfer**:
Sector / Branch 1 ==> Sector / Branch 2

10.**Know How Transfer:**
Universities/Higher Educational Institute / Research System
==>Industry, Service Sectors or Public Administration Sector

11.**Disciplinary Transfer**:
Scientific Discipline 1 ==> Scientific Discipline 2

12.**Terminological Transfer**:
Technical Language 1 ==> Technical Language 2

13.**Cross Cultural Transfer**:
Cultural / National Environment 1 ==> Cultural / National Environment 2

14.**Advanced Transfer**:
Industrialised Country 1 ==> Industrialised Country 2

15.**Developing Transfer**:
Industrialised Country ==> Developing country / emergent nation

16.**Systems Transfer**:
Market Economic System ==>Centralised State Economic System

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administration sectors. Inter-*disciplinary transfer* is well known at universities, when approaches and methods invented in one scientific discipline (e.g. mathematics) can be applied to problems of other scientific disciplines, like engineering, computer science, or economics. In this case a *terminological transfer* is necessary to connect technical languages with different interpretations of technical terms. An English-Russian-French-German-Spanish dictionary is being produced (by the IPMA International Project Management Association) on project management terms to support understanding in international projects. Within the context of international projects, *cross cultural* sensitivity and transfer is becoming more and more important. Transfer of know-how on the cultural, political, technical and social environments of multinational projects is getting more important. This is just as true for the tendering, contracting and start-up phase as for crisis and claim situations of international projects. *Advanced transfer* relates to more advanced and sophisticated technologies, like chip production facilities, which are exchanged between (highly) industrialised countries. Different restrictions and conditions are applicable to forms of *developing transfer* actions. These frequently occurring forms of technology transfer are typical for the relationships between industrialised countries and developing countries.
An acute problem of current-affairs is that of *systems transfer*. This involves all aspects and measures of transforming the centralised economic systems, especially in Central and Eastern Europe, to a market oriented economic systems.

4 TECHNOLOGY TRANSFER TO EASTERN GERMANY

The reunification of West and East Germany revealed the true extent of the technological divide between the two Germanys. For many years now the transfer of technology and thus a considerable transfer of capital has been necessary. The other Central and Eastern European states could not fall back on any such financial support from a 'wealthy brother'. This has led observers to consider eastern Germany as a unique case. Nevertheless, some of the lessons learned from the changes that have taken place there can indeed be applied to the process of transformation in other countries.
A research team from eastern Germany carried out a survey on the change there:

- Only about one quarter of the enterprises actually belong to eastern Germans.
- Almost two thirds of the present management is west German.
- 92% of middle management originates from former state-owned enterprises.
- Management: 68% university graduates, of which 80% are from technical fields.
- Only limited vocational training activities; training on the job dominates.
- Engineering cultures play a major role in shaping the process of econ. transformation.
- A technology bias (its base in products or production) results in underestimating the requirement for investment in marketing and in some cases insufficient finance.
- New enterprises have often emerged from large state-owned conglomerates. There is still no new organisation culture and a lack of internal company service functions.
- New production technologies must be supplemented by a complementary and more flexible organisation of work.

A large business directory expects a record number of 10,000 bankruptcies in eastern Germany for 1997. The whole eastern German engineering sector has to cope with a difficult period of innovation through technology transfer. The workforce has fallen to one tenth of its previous level (currently 85,000); it contributes only six percent to the

overall turnover of the German branch amounting to DM 235 bn. The export quota of eastern German enterprises is only 25%, compared to 60% for western German engineering companies. One tenth of eastern German enterprises are insolvent. Productivity lags behind by one third. The equity base of 10% is only half of that for companies in western Germany. The prefinancing of innovation and projects by banks proves to be extremely difficult.
Currently a critical debate is taking place among politicians, industrialists and scientists concerning German competitiveness, or *'Standort Deutschland'*. There is said to be a lack of innovation and the time that elapses between inventions and their manifestation as competitive products takes far too long. Work procedures in industry are inflexible. Enterprises as well as the administrative bureaucracy have to adopt leaner hierarchies and team work. On the other hand, Germany boasts a record trade surplus, the D-Mark is one of the world's strongest currencies and the level of vocational training and education is very high. For the past seven years Germany has transferred annually billions of Marks from West to East. Consequently, Germany remains attractive for West/East cooperation and technology transfer to the East. For instance, Germany's transfer of billions of Marks to Russia has been used for the construction of thousands of flats for officers of the Russian army who were stationed in East Germany. (Aleshin/Dworatschek)
In spring of this year the EU Commissioner for the Single Market criticised the obstacles created by EU member states which are still restricting the free movement of goods within the European Union. In a total of 181 cases, either products from other EU member states were prevented from entering domestic markets; or rules for the EU single market were not integrated into national legislation on time. In 1996 the EU Commission started a total of 218 proceedings against member states, drastic fines of up to one million D-Marks are to be expected. Trade and technology transfer between EU and Central and Eastern Europe may also be facing similar obstacles.

5 EXAMPLES OF TECHNOLOGY TRANSFER TO CENTRAL AND EASTERN EUROPE

Innovation by means of technology transfer necessitates the import not simply of ideas, but also foreign capital. Some countries are particularly attractive for foreign investors. Their economies have been largely transformed and they have a well-trained workforce.

Table 2: Per inhabitant capital investment in Dollars, accumulated up to mid 1996

Hungary	1186	Slovakia	139	Romania	47
Czech. Rep.	619	Poland	102	Bulgaria	46
Estonia	460	Croatia	81	Russia	42
Slovenia	323	Albania	66	Moldavia	24
Latvia	280	Lithuania	52	Ukraine	20

Source: UN/ECE, Globus; Die Presse-Economist, Wien, 25.03.97, page 18.

Two Czech semi-conductor companies were privatised under the Czech 'Coupon Programme'. A western chip manufacturer first acquired a shareholding in 1992 and now owns the majority of the shares. Following investments, the transfer of know-how and restructuring of the production (including Quality Certification ISO 9002), the chips produced were up to international standard by 1994. The CEO had special praise for the

highly-qualified eastern European engineers: 'their learning curve is impressive'. He was interested in the potential of a capable workforce (i.a. qualified engineers from the former armaments industry and local university graduates), despite the still relatively small eastern European market. In the case of highly-automated chip production, low labour costs play a less significant role than a low rejection rate, achievable only via skilled personnel. The new majority shareholder has transformed the management, introduced its own quality assurance procedures and long-term target and financial planning with budgeting, cash-flow management and loan repayment. The western investor has had similar success in Latvia and is planning technology transfer to Hungary, Poland and Russia.

Comprehending the balance sheets and ratios of Russian companies during the transition period was and remains, even for experienced consultants, an extremely difficult undertaking. Consequently, a German software company has developed a procedure for facilitating the interpretation of companies' annual reports for potential western investors. The risks involved in a potential joint-venture co-operation can thus be better assessed. Based on standard calculation software, a bi-lingual translation programme for balance sheets was developed. Western accounting know-how is being transferred. Privatisation agencies are now able to examine the suitability of a restructuring project.

Innovations in Central and Eastern European enterprises necessitate technology transfer. How can such concepts be successfully applied to the vast regions of Russia? The answer is to combine measures of vocational training with consultant activities. In 1994 the German-Russian project within the framework of the German Government's 'Transform' development programme was begun. Future trainers and consultants were first trained in Russia and Germany using interactive teaching methods. For a period of one year they analysed the weaknesses of two enterprises in the Moscow region and subsequently developed marketing programmes, cost accounting and business plans. This was followed by a practical phase working in German companies. The 17 trainers/consultants now offer Russian and foreign companies their services.

A multiplier concept was designed for the rapid, efficient and widespread transfer of management know-how into Central and Eastern Europe by means of a television series (Dworatschek/Gutsch). The TV broadcasts were to be supplemented by working groups throughout the country, which in turn would be supported by local universities. As in the nineteen-seventies in Germany, several hundred thousand viewer participants would have been able to obtain insights into free market economics and techniques in a fast way.

In mid 1996 the World Bank categorised 38% of its projects in Central Asia and Azerbaijan as 'unsatisfactory' - significantly higher than the average for all of their projects. The most important reasons given were: problems with local project management, local co-financing, provision of required goods and unfavourable legislation and political environment. The efficiency of the projects increased significantly following an improvement in the willingness of the governments concerned to co-operate and initiate reform. Up to 1997 the proportion of 'unsatisfactory' projects declined to 12% of the 43 projects undertaken by the World Bank. The technology-transfer projects involved concentrate on technical assistance, transition support, provision of the population with water, gas, electricity and telecommunications, transportation, and land reform.

6 LEARNING FROM INNOVATIVE MARKET PENETRATION IN ASIA

Small and medium-sized enterprises in the reform economies of Central and Eastern Europe can also implement innovations which German enterprises have successfully applied in the Asian market. For instance, four small to medium-sized machine-tool manufacturers set up a joint marketing office in Malaysia for the acquisition of new customers in the Indonesian, Malaysian, Singapore, South Korean and Thai markets. As result of this co-operation the marketing costs in Asia were shared among the four participating enterprises. The four companies hope to increase their turnover by as much as 5 - 10%. A local expert will be employed as sales representative.

A large German bank has established a representation in Singapore called '*Deutsches Haus'* and further branches are planned for China and India. One hundred and twenty medium-sized companies are already benefiting from this infrastructure by occupying offices there. Up to now, medium-sized enterprises have treated the Asian market with extreme caution and activities have been sporadic and unsystematic. There have been numerous reasons for this: the concentration on buoyant European markets, lack of knowledge regarding customs, traditions, language, local management and financing problems. These German representations help overcome these obstacles.

Area managers working for the Internationales Transferzentrum für Umwelttechnik - ITUT (International Transfer Centre for Environmental Technology) based in Leipzig, eastern Germany, offer assistance to medium-sized enterprises wishing to gain a foothold in Asian and South American markets. There is a particularly high demand for system solutions for environmental protection which take into account the specific requirements of poorer countries, providing not simply individual components, but also planning, financing, construction and operation of plants and the training of local operating personnel. The ITUT has already installed area managers in nine regions, including Malaysia, Indonesia, Brazil, China and India. They identify potential projects in their regions at an early stage and transfer customer queries to the medium-sized enterprises in Germany. Up to now 100 out of approximately 5,000 German enterprises involved in environmental technology have sought contacts via ITUT. The area managers, engineers trained in environmental technology, have knowledge of the local language and markets. Since eastern German engineers have similar comparable knowledge regarding the countries in Central and Eastern Europe, it would be possible to deploy them in a similar way as area managers in these regions.

7 INVESTIGATION INTO GERMAN INVESTORS IN CENTRAL AND EASTERN EUROPE

In 1996 the Institute for Project Management and Business Informatics IPMI carried out an investigation into the experiences made by German enterprises when co-operating with partners in Central and Eastern Europe. Fifteen enterprises of various sizes and from different branches, such as plant construction, machinery construction, filter technology, car component suppliers, the construction industry, the textile and foodstuffs industries were surveyed. Poland headed the list of partners with 10 projects, followed by Russia (6 projects), the Czech Republic (5), Slovakia (4), Hungary, Latvia, Ukraine, White Russia (each 2). The technology transfer takes place by means of different types of direct investment. Joint ventures (19 projects) usually involve (15) a company participation of 50% or more. Thirteen enterprises have established 100% subsidiaries. Six

companies are involved in participation with existing enterprises. In addition to the direct investment project, six enterprises have trade links with other countries.
In 16 out of 38 nominations, those surveyed mentioned quite clearly that the sales motive - to penetrate new markets and to consolidate existing ones - was uppermost in their decision for a long-term engagement in Central and Eastern Europe. The next mentioned motive was expansion. Also mentioned was the tapping of human resources and new sources of raw materials as well as diversification. Why does this engagement take place in Central and Eastern Europe rather than in other countries. Six out of twenty-one nominations showed that long-term existing trade links with the future partner plays a relatively important role. Four cases of cost advantage were mentioned (wages, production and transport costs). Two companies mentioned the easy geographical access. Only three companies successfully applied for subsidies (i.a. EU, IFC, World Bank).
Six of the surveyed enterprises handled their direct investment using project management tools (project manager, interdisciplinary teamwork, phase model). The definition and planning phase involved up to twelve months for most of the projects. Initial links to the potential partners took place via personal contacts with business partners (4) and from well-established business connections (6), search and brokering agencies played a minor role (2). Different criteria were applied to the preliminary selection of up to five potential partners: qualification and skills of the workforce (8 out of 31), the product range (7), technical facilities (6), geographical location and infrastructure (6), (assessed) integrity of management (2).
The companies surveyed perceived the following general risks involved in their engagement in Central and Eastern Europe: political instability and uncertainty (12 out of 42 nominations), lack of infrastructure (11), crime (7), and corruption (6). The following specific problems occurred during business activities: insufficient legal predictability (9 out of 15), insufficient business acumen of eastern European managers, communication problems (6), contacts with government or authorities in the host countries (5), poor product quality (5) or lack of marketing know-how.
In order to overcome the problems encountered, various forms of technology transfer were chosen: training measures (7 of the surveyed 16 companies), temporary deployment of German staff in the Central and Eastern European partner enterprises (manager, financial manager, foreman), reinforcement of financial controlling in the partner companies (2). The enterprises surveyed defined the co-operation climate as: excellent to good (6), or adequate (6). They defined the overall success of their project as: good (6), adequate (4), poor (4). The potential for expansion was assessed as: excellent (5), good (3), adequate (4), poor (3).
In all, the German investors gave a critical and realistic, but also optimistic, assessment of the business co-operation with enterprises in Central and Eastern Europe.

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