Knowledge and Technology Transfer in the Area of Berlin

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I Historical Background

Introduction

Berlin as a big city is a child of the industrialization. Even today many former factory buildings are a lasting proof of the rich industrial past inside the biggest and greatest commercial city of continental Europe Berlin was until World War II.

Here in Berlin and in entire Germany the industrialization – the change from a mainly agricultural towards an industrialized society – started later than in Great Britain because of the lack of a central German state then.

In the early years of the 19th century the hollow shell of the first German Empire – more or less a weak confederation of kingdoms, duchies, counties and some free cities – ceased to be.
Dozens of independent German states made Germany look like a coloured carpet: A network of boundaries and customs posts were a solid obstacle for the progress of trade, science and technology transfer, so were wars and revolutions.

At that time Berlin was just the capital and residence city of Prussia with a typical military bureaucracy that prevented Berlin and the surrounding areas from an early and fast industrialization. Berlin was known though as a centre of small factories but was handicapped mainly by the missing free spirit of entrepreneurs and modern tax and customs regulations. Nevertheless, Berlin had a good potential to become a centre of education, science and technology because of the central location in Prussia with an excellent infrastructure, a reformed modern educational system and the function as a hub of international trade.

In 1815 the Prussian government gave order to import steam engines from England as models for to start the local production of own steam engines and machinery.

England was the paragon country in terms of technical and economic progress at this time. Therefore goods imported from Germany had to be labelled as "Made in Germany" as a warning against a supposed minor quality – later in history this particular label became a symbol of advanced German technology...

In Berlin the "Bauakademie" (Academy of the Building Trade) and the "Gewerbeakademie" (Business Academy) were just educational institutions, but no research was yet done there. In was in 1879 that the "Königliche Technische Hochschule" (Royal Technical College) was founded in Charlottenburg, a prospering suburb of Berlin then (in 1920 incorporated as a Berlin borough).

After the war of 1870/71 against France the majority of German states became a part of the new "German Empire" under the leading federal state – Prussia. The new technical colleges all over Germany delivered the technical experts which were urgently needed to run the emerging industrial sites.

In 1899 the German Emperor (Wilhelm II.) allowed all Prussian colleges to confer the Doctor's degree like universities – since then in engineers may become doctors, too.

Whilst the importance of industry, trade and services increased tremendously a two class society developed, consisting of workers and entrepreneurs.

Three famous examples of enterprises related to Berlin will give a brief overall view of booth breakdown and success:

- Borsig
- Siemens
- Zuse

…are only examples among the many important names which helped to form this city. Many innovative developments of German industrial history took place in Berlin.

Borsig

The famous August Borsig went through all stages of the Prussian educational system, starting as a carpenter in Breslau (the Capital of Silesia, a Prussian province then) followed by studies of mechanical engineering in Berlin. Leading employers noticed his talent especially in the field of mechanical engineering. Besides his studies he worked as an engineer in a large number of companies, which were symbols of the "new economy" at that time.

In 1836 he decided to found his own company with help of a good friend. As a manufacturer of screws and rails at the beginning he was well-known for his reliability and quality. The 1840s were the beginning of a big success of August Borsig and his company. First doing research on steam engines bought in England and America he later could patent his own improvements. In 1841 his first own made locomotive won in a race against a model imported from England, so he got the appreciation of the Prussian government. Six years later he had made already 100 and in 1854 the total number of steam locomotives exceeded 500. When Borsig died in 1854 his son Albert lead the company to become the world's largest locomotive factory in the early 20th century.

Both the textile industry and mechanical engineering were booming! When in 1834 the German Tariff Union was established, it boosted trade inside Germany. Due to Prussian patriotism, the industrialization especially in Berlin lead to a fundamental change: Berlin become one of Europe's big cities. The amount of people moving from the Brandenburg countryside inward the city hoping to improve the standard of living increased in high numbers: In 1849 already a workforce of 200,000 people lived in Berlin. The fast development had a dark side, too: "Working Class Ghettos" came into existence because of accommodation problems.

During the so called "Era of the Founding Fathers" (lasting from 1871 to the early years of the 20th century) another boom hit the big cities of unified Germany - in the early 1870s 250 leading industrial companies were established in Berlin. This economic explosion lead to a crisis already in 1873, when many newly founded enterprises went bankrupt. After 1880 the situation stabilized. Until 1900 a lot of new technical inventions like telephones, a city railway system and electricity supply were realized in Berlin.

Borsig became a symbol – an economic beacon in Germany's industrial history. 14,000 locomotives were made in the "Borsighallen" (Borsig's Halls) and the "Borsigwerke" (Borsig's Works – a large factory plant in Northern Berlin built in 1896) and shipped to destinations all over the world. Just before World War I it took roughly half a year to make a new locomotive. During World War I no machinery was exported any longer, but 1,000 locomotives were delivered mainly to the German Army.

In 1918 – after the war – competition was back and stronger than ever. So, Borsig designed a new standard model that was easier and cheaper to make in high numbers. But in 1930 due to economic reasons the production came to an end. Some of Borsig's steam engines are still in use today somewhere in the world.

In 1936 Borsig became a part of the "Reichswerke" (the German Empire's Industrial Works): Afterwards only weapons and military vehicles were made. As a result of Allied air-raids 80 percent of the "Borsigwerke" plant were destroyed. Shortly after World War II the Allied Government in Germany didn't allow any industrial production there.

In 1950 Borsig then called Rheinmetall-Borsig became a holding with two joint-stock companies as subsidiaries: The Borsig AG in Berlin and und the Rheinmetall AG in Duesseldorf. In 1956 as a result of difficult economic conditions the Borsig AG was sold to the Thyssen Group.

In the 1950s boilers and refrigerators were made in Berlin and Thyssen later moved many parts of its steel production to the "Borsigwerke" plant.

Finally the Deutsche Babcock AG took over the Borsig AG in 1970.

Siemens

The Siemens company was founded in Berlin in 1847 by a young engineer and inventor Werner Siemens, a mechanic Johann Georg Halske and their companion Johann Georg Siemens (Werner's cousin).

Within a few decades the company transformed from a small workshop operating in precise electro-mechanics into one of the largest global electro-technical companies. The moving force of this growth was the combination of the innovative potential, international scale of the company's activities and the successful entrepreneurial policy. This development made Siemens the first global player with half of the 5,500 employees outside Germany in 1890 and today with about 380,000 employees worldwide and an annual turnover of more than 50 billion €.

The rise of Werner von Siemens (he was ennobled in 1888 by the German Emperor) begab even before he founded his company. With a couple of simple items like cigar boxes, tin plate, pieces of iron from different sizes and insulated copper wire he made the first full usable needle telegraph machine in 1846. In 1848 he set up the first electrical long-distance telegraph line in Europe from Berlin to Frankfurt/Main and in 1853 the Russian state telegraph network, that was completed in 1855.

The discovery of the dynamo-electric principle and the invention of the dynamo machine by Werner von Siemens in 1866 marked the beginning of an era in which electrical energy could be generated economically in large amounts.

The year 1870 was the beginning of information technology with the inauguration of an Indo-European telegraph line from London to Calcutta followed by the transatlantic telegraph cable from Ireland to the U.S.A. (1874).

The Siemens cable ship "Faraday" was built in 1873/1874 in accordance to the design of the Siemens brothers. By 1884 this ship had laid six transatlantic telegraph cables. This was the beginning of international communication networks.

The first electric railway was demonstrated at the Berlin Trade Fair in 1879 and the world's first electric tramway at Lichterfelde (then a village near Berlin, now a borough inside Berlin) was built by Siemens in 1881. The first European underground railway was opened in Budapest (1896) followed by Berlin in 1902.

The most remarkable fact is that Siemens invested in the emerging markets of this time. In 1850 he founded his first subsidiary in England followed by Russia (1855) and Austria (1858). The beginning of the business with Japan goes back in the sixties of the 19th century. Imagine how long a journey lasted to reach Tokyo at this time. In 1879 the first dynamo machine was set in function in Shanghai/China.

Already in 1914 Siemens had own companies in ten countries and 168 subsidiaries in 49 countries.

So, today one can find Siemens also in Korea: Siemens Building Technologies Ltd. which provides a wide range of products and technical services related to Building Automation and Intelligent Building Systems in Korea with over 200 employees (three local branches in Busan, Kwangjoo and Daekoo and one factory since 1990). In the beginning, the company name was Landis & Gyr Korea Co. Ltd., a group company (over 100 years old) of Landis & Gyr AG placed in Switzerland, one of the largest building automation products maker. Siemens in Korea focuses on customer groups such as Healthcare, Pharmaceuticals, Educational Institutions, Airports, Hotels, Retail Centres, Sporting Facilities, Office Buildings and Residential Homes. For them, leadership primarily means being of benefit to the customer who is the measure of all things, rather than the technological expertise that can be supplied.

Zuse

Konrad Zuse was a computer pioneer in Berlin – he created the famous machines "Z1" (1938), "Z3" (1941) and "Z4" (1945). These devices were completely different from mechanisms in contemporary cash registers or desk-top calculators.

He was born in Berlin in 1910. As a child at elementary school he wasn't a good pupil. But at the age of 16 he discovered his talent to deal with technique and drawing. So, he graduated at highschool in 1927 and started to study mechanical engineering at the "Technische Hochschule" (Technical College) in Berlin-Charlottenburg. But he changed the main subject first to architecture because he considered himself to be an artist. Architecture then was lacking technique, so again he changed to civil engineering.

In a room at his parents' house he established his innovation laboratory, convinced to create computers. He asked friends and relatives for money and bought material and tools.

Konrad Zuse had a vision: He wanted to build computers in order to release engineers from their hard work of calculating thousands of numbers. In 1943 he formulated this vision. The Computer "Z4" was planned as the prototype of a serial machine for engineers.

The Zuse Apparatebau in Berlin was founded in Berlin in 1941. In 1945 when the company was destroyed by Allied air-raids, the company had approx. 20 employees. Konrad Zuse left Berlin in March 1945 and went to Bavaria. The French and American troops were searching for the "Z4", but they did not find it because it was hidden in a barn. Then the "Z4" was the only real computer in entire Europe.

From 1945 till 1947 it was almost impossible to restore the not finished and slightly damaged "Z4". Zuse used tins from the allies to repair parts of the mechanical memory of the Z4. The first problem was to survive the years after the war. In order to get some food, Konrad Zuse made woodcuts and sold them to the farmers and the American troops.

In 1945/46 he formulated the "Plankalkuel", that was as the first complete high-level computer language of the world. He considered many problems of engineers and scientists, analyzed and described them, made dozens of examples, and then he formulated the "Plankalkuel". On the one side he used the the Boolean algebra as language constructs, on the other side he developed a mechanism to define powerful data structure beginning with the simple bit up to complicated hierarchical structures. In order to show, that the his computer language could solve scientific and engineering problems, Konrad Zuse wrote dozens of example programs. As late as in 1972 the "Plankalkuel" was published by the GMD (Gesellschaft für Mathematik und Datenverarbeitung).

In 1948 the "Z4" was build up in a former horse stable. Some calculations could be done, but it was very difficult to keep the machine working. Electrical power was only available for some hours a day.

Prof. Stiefel from the ETH (the famous Zurich Technical College, Switzerland) visited Konrad Zuse in 1948 and wanted to see the "Z4". Prof. Stiefel gave Konrad Zuse a differential equation as a problem to solve. Konrad Zuse formulated the program for the Z4. The result was correct.

Later a contract was made between the ETH and the new company Zuse KG, although Prof. Stiefel visited the machines ENIAC, MARK I and MARK II in the USA, too. The "Z4" was a great success for the ETH and the Zuse KG. Its speed was about 1,000 instructions per hour.

Until 1950 he lived in complete isolation from the world outside Germany. Today, there is no doubt that he developed many of the major concepts of the digital computer years before others did.

Then the "Z5" as an extended version of the "Z4" was made, using modern relays instead of tubes which weren't reliable enough. It was the first commercial computer in Europe. Although it was a business success after World War II. the situation in Germany and Europe was very difficult: The companies had no money to buy computers.

Germany was destroyed up to 60%. The capacity of the German economy was less than 20% compared to 1939. For this reason, Konrad Zuse tried to make some business with US companies. In 1955 the DFG ("Deutsche Forschungsgemeinschaft" / German Research Association) gave money to buy computers for universities.

The "Z11", a relay computer, was sold to German companies, mostly to the optical industry, and to universities. In 1957 the universities started to order "Z22" computers which were very flexible and cheap.

Early in 1955 Konrad Zuse began with the development of the "Graphomat Z64". It was a drawing machine with an accuracy of 0.05 mm. This machine was controlled by a program created by the Computers "Z22", "Z23", "Z25", or "Z31".

In the 1950s Zuse's main competitor was just IBM. From 1949 to 1969, the Zuse KG produced more than 250 computers. Although in 1964 the Zuse KG had lots of orders, it was impossible to to keep the Zuse KG as Konrad Zuse's own company due to financial problems:
- There was no financial support of the computing industry by the government.
- There were an increasing competition by IBM and other computer manufactures.
- The patent situation of Konrad Zuses computers were not solved at this time.
- Mismanagement.
- The company grew too fast.
- The development of software was too expansive (customers didn't want to pay for).

In 1964 the Zuse KG was bought by Rheinstahl, then by BBC und finally in 1967 completely by the Siemens company. In 1969 the logo of the Zuse KG was deleted. Konrad Zuse left the Zuse KG in 1969.

Did Konrad Zuse fail as an entrepreneur?
Konrad Zuse was years ahead with his company, computers and ideas related to computers. He died in 1995.

II Current Situation

Economy

The new Berlin is supposed to become a business location that is prepared for the challenges of the future. But since reunification, the economy of both West and East Berlin had to go through a necessary and painful process of transition in order to meet the changed conditions. Many industrial companies left Berlin after 1990 leading to big losses of jobs, but also to new opportunities for Berlin as a centre of new economic and scientific progress in the years to come.

Modern transportation systems, bio and medical technology, media, information and communications technology and – last not least – environmental technology are new industrial branches with the potential of a bright future. Modern communications networks, outstanding education and science facilities and the rich supply of qualified personnel enforce the modernization of Berlin.

A wide range of initiatives, programmes and institutions is devoted to promote business. They focus on the improvement of the economic structure as a whole, the individual promotion of SME companies and assistance in setting up new industrial companies. The Berlin government ("Senate") supports technology and new business centres with a focus on specialized branches. Special emphasis is laid on the support for branches with great potential for the future. The innovation fund of the federal state of Berlin mainly provides venture capital to encourage the foundation of new technological companies and to support existing SME companies in their innovative services. The primary goal is to link the innovative branches of trade and industry with the research and development centres in Greater Berlin.

Because of its broad scientific infrastructure, Berlin has a supply of highly qualified personnel. More than 350,000 people in the city have university or college qualifications. Well over half of the employed persons in the city are younger than 40. About 133,500 students at the three universities and 14 colleges ensure that there is a future supply of qualified personnel for all important areas of work in the branches of trade and industry of the future, thus creating favourable conditions for companies oriented towards research and technology.

SME companies predominate the economy. The Senate's economic policies endeavour to stabilize the SME ability to succeed in competition by promoting innovation and making investment capital available. Technology policies cluster various activities promoting innovation, the formation of networks and the introduction of new technologies.

The service sector is the driving force of Berlin's economic development. The service sector in Berlin has grown 40 percent with a total of 130,000 new jobs in the past ten years. This trend is directly related to the relocation decisions of major companies including debis, KPMG, Dussmann, Lufthansa and Sony. Today, more new businesses are being established in Berlin than in any other European city. Many of these newcomers are active in Berlin's research and development community. In the media and IT market Berlin is now home to 4,400 companies, a majority of them founded in the 1990s.

The majority of households and offices is connected via 100,000 miles of fibre optic cable. These are good conditions for media business and multimedia commerce.
In 2000 there were 591,000 people working in service enterprises. The growth potential has not yet been exhausted. Berlin's role as the capital city and the seat of the German government and parliament creates additional spheres of employment in areas such as news and media, the hotel and restaurant business, security and surveillance, as well as consulting and supervision. In particular, the increased presence in Berlin of organisations and associations with close ties to business, such as the Association of German Chambers of Industry and Commerce (DIHK) and the Federation of German Industries (BDI) has raised demand. International law firms and notary's offices, among others, have above average opportunities to expand, due to the new branches of foreign industrial companies and international business organisations and associations here. New fields of activity are opening up for management services and service enterprises specializing in vocational training and continuing education. The founding of new companies in the innovative technology sector is particularly important to economic development. Berlin occupies a leading position in Germany with 89 new enterprises per 10,000 inhabitants. 2000 was the most successful year so far: 64 companies, planning more than 5,500 jobs, moved to Berlin. In addition more than 1,900 software companies. The number of potential customers has expanded in the city in which Konrad Zuse built the world's first computer more than 60 years ago.

Around 73,000 people are employed in the information, communication and multimedia sectors in almost 4,000 primarily SME companies. Berlin is considered a "capital of talents" in these areas. A favourable infrastructure that includes more than 170,000 km of fibre optic cables, a digitized telephone network and important research facilities for communications and information technology supports Berlin's lead in this area. The initiative "Berlin in the information society" is helping to keep development moving forward. A total of about € 75 million is to go into "Project Future" by 2002, 60% of which will come from business.

The city's manufacturing industries are undergoing a fundamental structural change. After the significant cutbacks in industrial employment of the last decade, in February 2001 there were, for the first time, more people working in industry than there had been before the end of the year. The future of manufacturing lies in the modernization of traditional industries, such as electrical engineering, in vehicle construction, in chemistry and pharmaceuticals, in mechanical engineering and, hand in hand with this, in the establishment and expansion of new growth sectors in the field of intelligent technologies. Retail trade can also anticipate higher turnover.

The trades sector is proving to be an important stabilizing force in the economic structure of the city. There are more than 28,000 tradesmen's businesses, with 225,000 employees (2000), in Berlin. There are, in addition, approx. 9,000 companies occupied in trade-like areas, which employ around 24,000 people. In proportion to the number of people employed, the trades provide an above average number of apprenticeships.

There are also good prospects for financial service firms, banks and insurance companies. Berlin is a major regional banking centre and is now the fourth most important financial centre in Germany. There are 140 German banks active in Berlin (2000). The Berlin stock exchange has become the leading specialized market for Eastern European securities.

Science and Research

Berlin's raw material is knowledge – the city has a science and research environment that is unique in Germany. At three universities, ten specialized colleges, four art colleges and over 80 state-subsidized research establishments there are about 50,000 people working on products, solutions and innovations for the world of tomorrow. With its two university clinics, the "Charité" and the "Benjamin Franklin Clinic", Berlin is continuing a successful tradition that is closely associated with the famous names of Rudolf Virchow, Robert Koch and Ferdinand Sauerbruch.

About 133,500 young people are studying at the universities and colleges. In relation to the Federal Republic as a whole, Berlin is thus making an above average contribution to the training of the young generation.

The city sees itself as a laboratory in which ideas, products and social solutions are created. For example, new paths are being trodden in the reform of the education system. The influence of the state will be reduced and the universities and colleges will be given more independence and responsibility, especially in their financial planning. The exemplary Berlin university and college contracts guarantee the amount of the state grants for four years and forces the universities and colleges to carry out structural measures and reforms. At the same time, a pilot project clause suspends 60 paragraphs of the Berlin Universities and Colleges act and enables reforms in financing, organization and management to be tested. Outside funds need to be increasingly attracted and advertising methods used.

Research concentrates on establishing areas of emphasis in key technology fields such as biological sciences, materials sciences, information, communications and transport technology. In this connection, the universities and colleges and the non-university research institutions work closely together.

Berlin is investing over € 1.8 billion in science and research; there are more than 50,000 people working in these areas. The Adlershof science and business complex (WISTA) in the south-east of Berlin is a dynamic development area in the city which aims to become the leading technology park in Europe. A total of 5,200 highly qualified personnel are involved in research, teaching and employment in 358 innovative companies and 13 non-university research institutions. An important crystallization point for high technology research is the large-scale research installation BESSY II (electron storage ring), a high brilliance synchrotron radiation source which generates high-intensity, brilliant X-ray light which is used for such purposes as materials research. Berlin has a total of nearly 250 non-university research institutions.

With the relocation of the scientific faculties of the Humboldt University to the Adlershof campus and the concentration of research and science on the site it will be possible to achieve synergy, reduce costs and facilitate the transfer of the results of research to industrial applications. In the north of the city, the Berlin-Buch campus is developing into a research centre in biological medicine and medical science. Buch has the highest concentration of clinics, biomedical institutions and new and innovative biotechnology companies in the Federal Republic of Germany.

There are diverse challenges for the next decades, an international airport is planned to be opened in 2007, the university system has to be reorganized and a progressive marketing for Berlin and the state of Brandenburg as an ideal location for business, research and development is very much needed.

Figures

IT branch in Berlin (2002, Tsp.):

- 9,000 companies
- 100,000 employees
- € 100 billion annual turnover

German patents and trademarks (2001, VDIN and Tsp.):
125,000 new registered patents in Germany,
whereas roughly one half is done by Germans – decreasing,

but still better than the US (per person);
about 210 German registered patents per day.
Japan, the US and Germany hold 70 percent of all registered patens worldwide.

Examples for German companies:

- Siemens: 3,252
- Robert Bosch: 3,156
- Volkswagen: 1,543

In the Freestate of Bavaria the majority is registered: 14,500 patents (72.6%),
followed by the states of Baden-Wuerttemberg (22.6 percent)
and Northrhine-Westfalia (18.8%).
67,000 new trademarks – mainly IT – were registered (20,000 less than in 2000).
The "DPMA" (German Board of Patents and Trademarks) had an income of
€ 206.9 million and spent € 206.7 million.

Investment Promotion (2001, Tsp.):
The "Wirtschaftsfoerderung Berlin GmbH" / WFB (Business Promotion Berlin Ltd.)
invested € 417 million to bring
62 new companies (15 services, 15 bio/medical technology, 12 IT)
with 4,300 new jobs to Berlin.

Bankruptcy in Germany (2001, Tsp.):
32,278 companies went bankrupt – an increase of 14 percent to the year 2000,
where 200,000 employees were affected (esp. in the civil engineering branch)
and €31 billion debts were left behind;
13,277 persons ditto – an increase of 27 percent to the year 2000.

University Budgets (B. Ztg.):
e.g. the "TU Berlin" (Technical University Berlin) has a budget of € 280 million p.a.,
but in 2006 it will be cut by € 56 million (20%).

Economic Advantage:
(First Ventury) The US economy won USD 40 billion in 1999 because of the use of academic patents;
there are 200,000 jobs dependant on R&D laboratories.
(BMBF) The value of R&D on demand at universities and colleges in Germany is roughly € 400 million p.a.

III Knowledge and Technology Transfer – a never ending task

The German Challenge

“Brain Gain” instead of “Brain Drain” (BMBF):
The German federal government now invests € 30 million p.a. to make Germany more attractive to German and foreign scientists.

Germany has got only a few natural resources, therefore there is a need to translate scientific and technological innovations very quickly into products and services which are brought successfully to the markets.

Nowadays, an academic workforce of 250,000 people is unemployed in Germany whereas about 170,000 new graduated persons are leaving universities and colleges every year.

Today, competitors in America and Asia are more used to take advantage of new scientific and technological developments than Germans do, although still a lot of successful research is done in Germany. This fact is a misery for Germany as a location of high wages.

Germany suffers from the fact of the so called „Technology Cycle“:

- 1st Step: “HighTech“ Period (from 1870 to 1970)
- 2nd Step: “Standard Technology” Period (products are easy to made everywhere)
- 3rd Step: Standard technology products are made in countries with low-wages
- 4th Step: Old standard technology will be substituted by new “HighTech”

That is the reason why the state gives financial aid to the coal mining or the steel production in Germany – other countries are able to make it cheaper and today sometimes even better. And: New materials are developed as a substitute (e.g. special plastics or ceramics).

As a result of the historical development fundamental research in Germany is based upon

- 1st theoretical fundamental research at universities and at certain institutes
- 2nd practical fundamental research (e.g. “Max Planck Institutes”) and
- 3rd practical industrial research (e.g. “Fraunhofer Institutes”).

The first two pillars of science and research are independent from the question of a businesslike exploitation: The money comes from the federal government and the governments of the German states. The Fraunhofer Institutes get only a 30 percent public support.

This system couldn't cope with the needs of the 21st century.
For that reason the German federal government started a strategy dialogue between the business and the science community and the administration to enforce the successful development of exploitable technical innovations.

In addition small and medium sized companies (SME), which are in facts still the most important pillar of German prosperity, and technical colleges shall join the system. Public venture capital is given in order to attract the foundation of HighTech companies.

But there is no easy going path through the entire development period of HighTech products.

In 2001 the federal government changed an important law. Before college and university professors were the only one who could protect their own inventions. But due to a complicated patenting procedure with high costs and losses of times many of them refused. Now the universities and colleges as a corporation may patent their employees research results and make use of it.

Critics are not amused that nowadays orgware and software is patented very often – the programmers and inventors creations are taken them away…

Knowledge and Technology Transfer as Joint-venture R&D

The German Commission of Economical and Social Change formulated in 1977 the typical know-how and technology transfer procedure:

- 1st step – evaluation of scientific research data,
- 2nd step – documentation and publishing of results,
- 3rd step – realization of the particular needs,
- 4th step – economic, legal and technical information and consulting,
- 5th step – special consulting given by the know-how donor to user.

Step 2 to 4 are to be done by know-how and technology transfer agencies.

In the midst of the 1990s more than 1,000 of those transfer offices were established in Germany (as a subsidiary of colleges, universities, chambers of commerce).

As a matter of fact the transfer of know-how and technology isn't a linear process – nowadays it's realized that the transfer from science to industry is a feed-back cycle:

Vortragsreihe

Besides common technical data that is documented as a technical design drawing (e.g. a CAD file), a table filled with statistic numbers, charts with figures or even a comprehensive manual there is a certain form of knowledge based upon years of experience which can't be printed on paper and be given away easily… Some kind of knowledge has to be transferred from person to person.

The German federal government asked the Fraunhofer Institute of System Technology and Innovation Research, the "ifo" Institute of Economic Research and the European Economic Research Centre to give advices how to run the know-how and technology transfer in the future. Results were published in 2000:
Successful transfer needs direct communication between scientists both as donors and recipients.
Transfer agencies should be run like business companies (decentralized responsibilities focused on the real customers needs, use of business management methods, success orientated reward systems, permanent evaluation of results – that is controlling).
The recipient companies need an experience with innovation and project management, they should have a "culture" or "philosophy" of innovation.

The 428 "Steinbeis" transfer centres in Germany are said to be very effective and efficient.

The economic rise of Japan and Korea was possible because they had capable license using companies and a strategic policy.

Social Market Economy

The "Social Market Economy" brought (West) Germany prosperity and social equality for several decades after World War II. Today, people ask the question if and how it can meet the current problems as a result of globalisation.

The "Social Market Economy" as established by Ludwig Erhard in 1948 fundamentally changed the West German economy, and with it the whole of the post-war society. It unleashed the enormous mercantile and competitive energies that brought western Germany the so called "Economic Miracle" of the 1950s, followed by dynamic social developments. Today everybody feels the importance of the current and future task to reform social security systems and to safeguard their efficiency and funding.

Dictionaries define the "Social Market Economy" as an economic system based on the free market economy principle, aimed at guaranteeing economic efficiency and power and social justice with a high degree of individual freedom. It combines market freedom with social equilibrium, with the government playing a regulating role and creating the framework for market processes. This goes beyond merely securing competition and includes the task of ensuring social equity.

Believing in the social component, Ludwig Erhard himself never spoke of “Free Market Economy”. He was born in Bavaria in 1897 as the youngest of five siblings, attended school only up to junior secondary level and entered a commercial apprenticeship in 1913. He was given the opportunity to study at the commercial college in Nuremberg and earned his diploma in 1923. Erhard graduated in Frankfurt / Main and soon earned a reputation as an economic specialist. In an internal memorandum written in 1944, he forecast Germanys defeat and began to sketch how Germany should be rebuilt when the war was over. The document fell into American hands in 1945 and he was appointed economic adviser in Nuremberg to U.S. occupation authorities. After taking an official job in the state of Bavaria, Erhard was assigned to the Special Money and Credit Department set up in Frankfurt / Main to prepare the currency reform. In this way, he became one of the co-creators of the German Mark (DM) in 1948. He met Konrad Adenauer in 1949, and later became his Minister of Economic Affairs.

Introduction of the new policy was a matter of some controversy in war-ravaged Germany, but Erhard prevailed. Soon, the successful cabinet minister became Adenauer’s Vice-Chancellor, but tensions developed between them in the late 1950s. Though he tried, Adenauer was unable to prevent Ludwig being made his succesor as head of government in 1963. The “Man with the Cigar” was acknowledged around the world at the zenith of his prestige. Still highly esteemed as an economics expert, he died in Bonn in 1977.

History has recorded him less as Chancellor than as Father of the “Economic Miracle” and the policy he created. As documented by the Federal Republic of Germanys impressive rise from the ashes of war, this stood for a combination of prosperity and liberty. It was not his aim to create better people. But had a gift to inspire people to strive for higher achievements.

IV Sites of Interest

German Museum of Technology Berlin
Trebbiner Str. 9, 10963 Berlin
Phone: 90 254 – 0

Here the objectives are to realize a large, multi-disciplinary technology museum. It was established in 1982 and opened in 1983 representing the tradition of the more than 100 technical collections which existed in Berlin during the past centuries.
The historical buildings of the former Anhalter Freight Station and the Anhalter Rail Depot are the perfect location for this museum. This area once played a central role for traffic and supply in the city.
The idea is to built a comprehensive museum of technology, "that answers questions of our time" and which will rank equal to the world's largest technology museums. It shall "make networks and rules of our high-tech world visible, open to experience, understandable and accountable".
The "general issue" there is "movement of people, goods, power, information". The concept develops different scenarios, orientated towards the historical ensemble of the location and individual departments.
Around 30% of the development project has already been completed.
Almost every department offers demonstrations and activities. The workings of a vast number of historic machines and models are shown and explained. Visitors can actively print, weave, make paper, shred grain, work on computers or even play newscaster in a television studio.
Manufacturing techniques and household appliances: The exhibition "standardization of man and machine" focuses on the change in work and work organization. Its aim is maximum efficiency of man and machine. Economic efficiency was the top priority in manufacturing processes, so the introduction of inter-changeable, identical, standardized parts was a fundamental step.
The transition from manual work to pure precision machining and to a "scientific approach to management" (Taylorism) is demonstrated. Standardization of machine output and particularly of human work culminates in psycho-technology which was developed during World War I.
Computing and automation: Bank statements, bus tickets, telephone bills – all these come from the computer. There is wide-spread concern regarding the high scale of stored personal data. The rapid development of computer technology has led to great enthusiasm, but also to uncertainty.
Storing, processing and disclosing information are almost as old as mankind itself. The story of man's dream of developing automatic machines – i.e. machines which control themselves – is more than 2,000 years old. The exhibition casts light on the fundamentals and historical developments of computing and automation technology. The world's first computer built by Konrad Zuse in 1936 in Berlin forms the core of this exhibition.

Spectrum – the Berlin Science Center: How does a battery work? Why is the sky blue? These and hundreds of other questions are answered at “Spectrum”, the Berlin Science Center in the restored portal sector of the former freight station building.
250 experiments motivate visitors to grasp technical principles in a playful environment. Technical equipment, whether historical or modern, is usually designed and built for practical application. The individual, modern form often hides the functional mechanisms, so that people often have difficulties to understand this equipment. The museum does not merely want to exhibit objects, it also wants to clearly demonstrate how these objects work. Mankind’s environment is characterized by natural phenomena, such as sunlight and air, but is also threatened by noise and pollution caused by modern technology. These can be watched, measured and assessed at Spectrum. The Foucault's pendulum in the atrium of the Spectrum building ultimately leads the visitor to Galilei's discovery of the earth's rotation which has fundamentally influenced the physical view of the world since the 17th century, "... even so the earth does move".

Schering-Museum (“Scheringianum“)
Fennstraße 10, 13342 Berlin
Phone: 468 – 124 04

In 1986 the Schering AG opened the “Scheringianum” in its oldest preserved building in the Wedding works. In these historical rooms they offer an insight into the company's history by presenting original documents, preparations and photos.
The historical archives, the library and a special exhibition room complete the Schering Museum that is accommodated in the former central laboratory.
The “Scheringianum” is open on appointment to anyone interested in the company's history. Just arrange a date with Mr. Wlasich.

Berlin Adlershof
Internet: www.adlershof.de and www.wista.de

Berlin Adlershof is a scientific and business location with a long tradition. At the beginning of the 20th century this is where German powered aircraft first took to the skies. The German Aeronautical Research Institute (DLV) was located here as were the Academy of Sciences of the GDR and the East German Broadcasting Corporation. Reputed industrial and technical plants were also based in Adlershof.
The unification of Germany led to fundamental changes for Berlin Adlershof. The Academy and Broadcasting Corporation terminated their activities at the end of 1991.

In 1991 the Berlin State government took a far-sighted decision. Work began on creating a science and technology location in Berlin Adlershof. The Academy institutes were assessed and integrated into the research landscape of the Federal Republic of Germany. The targeted establishment of companies in selected technology areas began. An independent company, the development corporation Adlershof, was entrusted with these tasks. “WISTA-MANAGEMENT GMBH” emerged from this corporation and has been responsible since 1994 for the marketing and promotion of the science and technology park.
In order to develop a sustainable forward-looking urban structure beyond the boundaries of the science and technology park for the entire location, an area of 420 ha was formally designated an urban development zone.
The coordinated master plan, some elements of which have already been implemented, guarantees a mixed use to create a lively city district with an urban quality of life.
The concept encompasses a science and technology park, a site for the Humboldt University Berlin, the Media City, a technology park and a residential park with the related services and social infra-structure. These uses are arranged around a central urban park which will be home to Berlin's first thermal spa boasting saltwater with healing properties.
The concept’s base is academic teaching of the natural sciences, research and development linked to industrial, media and service companies as well as recreation and housing. This shall give Berlin Adlershof a unique position compared with other technological locations.
One part of the new district consists of the Science and Technology Park Adlershof, which already today ranks amongst the 15 largest in the world. It has acquired a reputation for its research results, products and services which extends far beyond the borders of Germany.
Adlershof is a traditional location for extra-university research in Berlin. Back in the 1930s the facilities of the German Aeronautical Research Institute were established here. Today, the twelve extra-university institutes in Adlershof concentrate on the research areas:

- new materials and processes,
- optical technologies,
- information and communication technology and
- environmental and energy research.

DIN

Head Office
Mailing address: 10772 Berlin
Street address: Burggrafenstrasse 6, 10787 Berlin
Phone: 26 01 – 0

DIN, the German Institute for Standardization, is a registered association, founded in 1917. Its head office is in Berlin. Since 1975 it has been recognized by the German government as the national standards body and represents German interests at international and European level.

DIN offers a forum in which representatives from the manufacturing industries, consumer organizations, commerce, the trades, service industries, science, technical inspectorates, government, in short anyone with an interest in standardization, may meet in order to discuss and define their specific standardization requirements and to record the results as German Standards.

Milestones:

- 1917 DIN is established on 22 December as the the Standards Association of German Industry (name changed in 1926 and, most recently, in 1975).
- 1918 The first German Standard is published (DIN 1).
- 1922 DIN 476 Paper formats (DIN A 4 etc.) is published.
- 1924 Beuth Verlag is founded as a publishing company, its primary objective being the sale and distribution of DIN Standards.
- 1943 The DIN offices in the centre of Berlin are destroyed in an air-raid.
- 1946 The Allied Control Council permits DIN to resume its work.
- 1951 DIN becomes a member of the International Organization for Standardization (ISO) as the "only competent German organization for standardization".
- 1961 DIN is a founding member of the European Committee for Standardization (CEN). The East German government closes the DIN offices in East Berlin, Jena and Ilmenau.
- 1975 DIN and the German Federal Government sign an agreement by which DIN is recognized as the national standards body for Germany. For its part, DIN undertakes to give priority to standardization projects initiated by the government as being in the public interest.
- 1985 Introduction of the "New approach" in European standardization (legislation refers to standards for technical specifications) with a view to speeding up the process of European unification.
- 1990 The East German "Office for Standardization, Metrology and Commodity Testing" is closed. The use of DIN Standards is recommended.
- 1996 DIN and Beuth Verlag establish their first web sites.
- 2000 A research project initiated by DIN together with the German Federal Ministry of the Economy on the "Economic Benefits of Standardization" is completed. The results of the study confirm that the overall benefit to the German economy of the work of DIN is approximately $15 billion per year.
- Standardization as undertaken by DIN is a service that aims to benefit the entire community. The results of its work have a significant influence on economic performance at both company and national level. A research project completed in 2000 confirmed the annual benefit to the German economy as being 1% of GNP, or approx. US$15 billion.

DIN Standards promote rationalization, quality assurance, safety, and environmental protection as well as improving communication between industry, technology, science, government and the public domain.

In DIN, standards work is carried out by some 26,000 external experts serving as voluntary delegates in more than 4,000 committees. Draft standards are published for public comment, and all comments are reviewed before final publication of the standard. Published standards are reviewed for continuing relevance every five years, at least.

DIN is guided in its work by the following fundamental principles:

- Voluntary basis – No one is obliged to participate in the work of DIN or to implement its standards. The results of its work are recommendations that have no authority except their inherent technical competence.
- Open book – All standards projects and draft standards are made public, and any critics are invited to present their case at the negotiating table. DIN supplies information on all technical rules in Germany (including public laws and regulations of technical relevance) and in other countries.
- Open door – Participation is open to all interested parties: manufacturing industries, consumer organizations, commerce, the trades, service industries, science, technical inspectorates and government.
- Uniformity and consistency – The range of DIN Standards covers all technical disciplines. The rules laid down for their preparation ensure their uniformity and freedom from contradictory specifications.
- Consensus – Standardization is effective because it is based on consensus. The process by which differing interests come to reach mutual agreement on the content of a standard ensures that the standard concerned will gain wide acceptance.
- General benefit – DIN Standards proceed from scientific findings and take account of the goals of society as a whole.
- Global approach – DIN acts as a strategic partner of the German and European economy in the development of global technical standards.

Economic benefits of standardization – Summary of results

Final report and practical examples (April 2000)

Among the core findings of the joint research project on the "Economic benefits of standardization" undertaken by the Technical University Dresden (TUD) and the Fraunhofer Institute for Systems and Innovations (ISI) are:

- The benefit to the national economy amounts to more than US$ 15 bn per year.
- Standards contribute more to economic growth than patents and licences.

- Companies that participate actively in standards work have a head start on their competitors in adapting to market demands and new technologies.
- Transaction costs are lower when European and International Standards are used.
- Research risks and development costs are reduced for companies contributing to the standardization process.

V Attachment: Summary "InnoRegio Programme"

Since November 2nd, 1999 in several regions of the new states in Eastern Germany partners (as members of innovation networks) are developing und realizing advanced projects and products. It proved to be successful. For particular projects new ways of a powerful co-operation based upon a clear target were found and lead to a new level of quality. Visions helped to attract even more new partners and investors to join the networks.

In order to reach the main project's goals the "InnoRegios" develop individual solutions:

a. The partners create an innovation profile of their own region.
b. Then a reliable network is established.
c. The innovation network develops innovative products.
d. These goods or services shall meet the market's demands.

"InnoRegio" is a competition programme initiative of the German Federal Ministry of Economy to begin a new policy of support and modernization of the Eastern states in Germany. It shall drive business people, scientists, politicians, administrative personnel and educational experts to co-operate in order to let visions become reality beyond bureaucracy and a department mentality:
Regions with a rich potential of science, education and business that can be used to succeed in the markets competition.

This programme is appreciated by entrepreneurs, politicians and even Germany's experts on national economics.

The most important resource in the regions are the people. They have to be convinced that together with the coaches, the members of the project managing team and those scientists who are consultants to the project, new individual ways of regional development have to be found. Other regions that join the project later shall learn from the experience of the pioneers.

Evaluation and controlling is done to get information for a new data base. Anonymous data is stored to be used for scientific research and general knowledge transfer. Both, the conditions leading to success as well as the risks are subjects of analysis. The goal is to develop model methods and procedures that lead to innovative capable regions.
Evaluation and research is done with the focus on:

- the communication and co-operation in the participating regions
- the use of the support and consultancy services
- the economic development.

Vortragsreihe

Therefore conferences, interviews and questionnaires are used to collect information. The results of this analysis are given back to the regions through certain workshops and publishing. The ministry intents to get an advice how to design future projects.

<u>For more information contact</u>:

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VI Attachment: Summary "Protection of the Environment"

Dr. Bernd Andreas: **"An Introduction to the Protection of the Environment"**
An Address held on April 9th, 2002, summarized by Dirk Pinnow

Ecosphere

Human beings use nature as an reservoir of resources (e.g. soil, water, air, plants, animals, minerals, landscape) to be processed during industrial production into goods. During manufacturing waste and pollution influence the ecosphere. When these products are used, again natural resources are needed and more waste and pollution affects the ecosphere.

Protection of the Natural Environment

Protection of the natural environment means to avoid or at least to lower the amount of waste and pollution. For any person there are different reasons why the ecosphere should be protected:

- general (e.g. enjoyable nature for all),
- personal (e.g. belief),
- professional (e.g. job preservation),
- legal (e.g. recycling law)

aspects…

Challenge to Industrial Companies

Due to new laws, investigative reports in the media, public action and projects done by citizens movements, the demand of employees, neighbouring settlements and customers the pressure on companies is getting higher.

Hierarchy of Protection

Environmental policy focuses on the protection of

- 1st human beings,
- 2nd ecosphere and

- ✗ 3rd economy.

Therefore there exists an order of three principles:

- ✗ 1st Precaution (avoidance of waste, pollution, damage or injuries)
- ✗ 2nd Liability of Institution or Person which/who caused Accident
- ✗ 3rd Co-operation (institutions of the state and society to develop new standards)

Protection Laws in Germany

For any object several laws are made for protection (people, animals, plants, air, water, soil, climate, landscape, goods, humans and ecosphere).

Handling and Disposal of Waste

In the past factories had open systems (during the manufacturing procedure lots of waste left the process). Nowadays, a "cascade of use" shall lower the final amount of waste (e.g. polluted water is purified and put back in the system or waste is processed to became a resource again – e.g. plaster). The ideal target is a closed system with a feed-back loop, where all the waste is recycled (yet that is realized only for gold processing).

Waste (always identified by a particular waste code number) is supposed either to be disposed (put on a rubbish dump, burned, destroyed biological/chemical/physical, stored in former mines) or recycled (again used as a resource).

Cyanides, nitrites and chromates are de-poisoned through oxidation or reduction. Acids and bases are neutralized. Through separation heavy metals are filtered out of polluted liquids.

Procedure of waste delivery to a processing plant (e.g.)

- ✗ 1st a sample of the waste is sent to the plant's laboratory for chemical analysis
- ✗ 2nd the content of the sample is identified and a test process is run
- ✗ 3rd based upon the analysis results a bid is made to the customer (price)
- ✗ 4th an appointment is made for delivery (date, type, amount)
- ✗ 5th the waste is delivered to the reception area
- ✗ 6th paper (application and official approval), quality and quantity check (type and amount)
- ✗ 7th another sample is taken to compare it with the old sample in the laboratory

- 8th waste is stored in containers at the reception area
- 9th waste is taken to processing area (e.g. chemical processing)
- 10th waste is processed (e.g. neutralized, de-poisoned, separated)
- 11th the clear purified water is pumped into the normal sewage system
- 12th the sludge is dehydrated to get dry powder
- 13th the powder is either sold to be used as resource (e. g. if it contains only one type of heavy metal) or disposed on a rubbish dump if it contains a mixture of metals).

Problem: This powder still contains organic material. In a few years the dumping will not be allowed any longer!
For that reason a prototype system is built now that shall remove any organic substances as early as possible. In two years this new carbon filter system shall be used as a part of the normal processing. Later when it works properly it could be sold and used all over Germany.

Technology Transfer (e.g.)

A young scientist, who is doing research at his plant and who is developing the prototype system together with Dr. Andreas started to write a dissertation. She studies at a Technical College and came to the plant for a two semester term of practical experience (to be finished in fall 2002). She has got two coaches: A professor at the college and Dr. Andreas at the plant – so, a direct transfer of know-how and technology between a student scientist, a college professor and an expert of a business company is done during the entire project. Results are also to be published and discussed at conferences.