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ARTUR GRADZIUK

Transfer technologii w stosunkach gospodarczych Chińskiej Republiki Ludowej z Unią Europejską

Technology Transfer in the Economic Relations Between the People's Republic of China and the European Union

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Technology Transfer in the Economic Relations Between the People's Republic of China and the European Union

ARTUR GRADZIUK

No. 10, JANUARY 2009

Introduction

Economic relations between the European Union and the People's Republic of China, manifesting themselves, *inter alia*, in the transfer of technologies, are beneficial for both parties. From the point of view of China, import of technologically advanced goods from Europe and a subsequent opening to investment by European enterprises, involving technology transfers, have been one of the major factors in the development and modernisation of the economy. For the European Union access to the huge Chinese market has offered new, attractive opportunities in terms of business interests and exploitation of its competitive advantages in the high technologies sector.

China has both the ambition to improve its capabilities of developing technologically advances industries, and financial resources to achieve this goal. Yet, at present there are few areas that it would be able to compete with the world's innovation leaders: the United States, the European Union or Japan. The government's policy with regard to the transfer of technologies from abroad is one of the key factors that enhance China's potential in this respect, although a number of its elements may give rise to objections. From the point of view of the EU, development of the Chinese economy creates increasing room for a development of bilateral economic relations, though there is a risk for the EU of losing its competitiveness in some market segments as a result of a quick adaptation and imitation of transferred technologies and due to insufficient protection of industrial property in China. Given the growing trade deficit, the economic relations with the People's Republic of China and, in particular, adequate protection of intellectual property, are among the most important challenges for the European Union's policy towards China as well as for the European enterprises.

This paper addresses the following issues: China's policy intended to foster the transfer of technologies that is in line with the country's development priorities, attitude of the European Union towards the technology transfer to China, which is a chance and a challenge both for its policy and for the activities of European enterprises on the Chinese market, and also the analysis of bilateral relations in the area of the technology transfer from the EU to China and of its consequences for the four selected areas:

– information and communication technology (ICT); China is currently a serious competitor with regards to the production of ICT equipment and strives to improve its innovativeness;

– nuclear energy; in order to meet a growing demand for energy, China implements a programme for a development of new nuclear power plants, mostly based on foreign technologies;

– civil aviation; growing needs have to be met through a co-operation with foreign countries, therefore the Chinese government intends to enhance development of the country's aviation industry;

– satellite navigation system; China shows an ambition to become one of the world's leaders and it is the area of strategic importance for this country.

The above areas involve the most advanced technologies. China needs a broad co-operation with the European Union in order to modernise its industry through the transfer of technologies and to pursue the strategic goals of the government's policy.

China's policy towards technology transfer

Transfer of foreign technologies for the purposes of the country's modernisation was one of the reasons why China implemented the so-called "open-door policy" at the beginning of the 1980s. At the first stage of reforms such a transfer consisted of the import of high technologies and the know-how. The main channel for the transfer of technologies was, however, foreign direct investment (FDI). The Chinese government's policy towards FDI was based on the granting preferential treatment to investment projects in selected branches of industry. Special investment incentives consisted, among others, of tax rebates or application of reduced custom duty rates on the imports of raw materials and semi-products, etc. Yet, while offering access to the huge Chinese market and cheap production resources, China required foreign enterprises to meet certain conditions which contributed to the creation of a system of "enforced technology transfer".[1]

The preferred method of admission of a foreign enterprise to conduct its activities in China is a joint venture with a Chinese partner. Establishment of a joint venture has to be approved by the Ministry of

[1] M. Dinter, *Technology Transfer to China—opportunities, risks and measures*, Institute for International Business and Law, Braunschweig, 21 November 2006, www.law-and-business.com.

Commerce and by the National Development and Reform Commission (NDRC). NDRC chooses a Chinese partner taking into account, in the first place, the country's strategic interests, while the foreign investor usually cannot influence such a choice or the choice of the location for the investment project. During the administrative accreditation process an investor has to submit to the Chinese national design center a detailed technical documentation of the planned investment project in order to allow carrying out of a feasibility study, and thanks to the joint activities detailed technical know-how is also acquired by the Chinese partner. Moreover, what is frequently required is participation of local subcontractors in the planned production process. As a rule, in order to ensure that the products satisfy the required specification and quality standards, a foreign investor has to train and properly equip the Chinese subcontractor so that the latter would be able to meet the challenge. Another form of the enforced technology transfer is the Chinese system of public procurement. Foreign enterprises, while participating in the tender procedure announced by Chinese institutions, often have to submit extensive documentation in support of their tender as disclosure of a number of technical details is required. Also in this way China acquires knowledge of high technologies.

Despite the fact that transnational corporations may have numerous objections as to China's policy towards foreign investment, the country has been extremely successful in attracting FDI and technology transfer. Such a success has translated into its performance in the exports of high-tech goods, modernisation of the economy and improvement of the structure of industrial production. In addition, transfer of technologies through joint venture companies contributed to a dissemination of knowledge on modern methods of production and to an improvement of the competition potential of Chinese enterprises on the high-tech commodity markets.

The government's priority for the years to come is to develop independent innovation capabilities and become increasingly less dependent on foreign patents. In the Medium- and Long-Term National Science and Technology Programme for the years 2006–2020, issued at the beginning of 2006, China has set itself ambitious goals:

– mastering a number of core technologies in the modern equipment manufacturing and in the ICT sector that have a bearing on China's competitiveness in order to join the world's advanced ranks in terms of technological standards;

– defence-related science and technology should lead to a development of modern weaponry;

– efficient energy use;

– emergence of a number of scientists and research teams of international standards with a major influence on mainstream science development;

– attainment of international standards in high technologies related to space research, material engineering and information technologies.[2]

The areas considered as priorities in the said plan included: energy sector, nanotechnology, advanced manufacturing technologies, information and communication technologies, and material engineering. What has been also announced is support for large enterprises in their investment in research and development (R&D) activities and in the establishment of their own research and development institutes.[3]

The main objective of the government's policy in the area of science and technology is the enhancement of the innovation capabilities of Chinese R&D centres and enterprises. Ambitious quantitative targets were also set: increase in R&D expenditure up to 2.5% of GDP by 2020 so that the share of science and technology in the economic growth would be no less than 60% and the dependence on foreign technologies would be reduced to 30%.[4] Over past years there has been a marked increase in R&D expenditure: since 2001 it has gone up from RMB 104 billion (0.95% of GDP) to more than RMB 300 billion (1.42% of GDP) in 2006.[5]

Despite the increasing scale of their activities, Chinese enterprises lack sufficient capacities to introduce innovation independently. This is the result, in the first place, of still low expenditure on research

2 "Guidelines issued to boost innovation capability," http://news.xinhuanet.com/english/2006-02/09/content_ 4156085.htm.

3 "China issues guidelines on sci-tech development program," www.gov.cn/english/2006-02/09/content_184426.htm.

4 "Excerpts from China's Medium and Long Term National Science and Technology Program," www.levin.suny.edu/ChinaInnovationConf.cfm?filename=appendix1.

5 *China Science & Technology Statistics Data Book 2007,* Ministry of Science and Technology of the People's Republic of China, p. 2.

and development, accounting for less than 1% of their investment expenditure, whereas in industrialized countries it stands at 2.5%. Furthermore, they spend more funds on the purchase of technologies from abroad than on their own R&D,[6] and only every fourth medium and large enterprise had its own R&D unit, while in industrialized countries 80% of R&D is carried out by large enterprises. The Chinese government realised that too heavy dependence on the import of technologies from abroad, accompanied with insufficient innovation capacity of Chinese enterprises, is to be the disadvantage of the future economic development of China. That is why it decided to introduce preferential policy towards those enterprises which have innovation potential and to support R&D activity to a larger extent that it had done before.[7]

Technology transfer to China from the European Union's perspective

From the European Union's point of view transfer of high technologies to China both offers some opportunities and poses certain threats. Sustainable development of the Chinese economy, which is increasingly closely interrelated with the EU economy, is in the EU's interest. The size and potential of the Chinese market create enormous opportunities for the EU industry and enterprises, a majority of whom have already incorporated China into their worldwide production and sales network. Starting business activity on the Chinese market often requires transfer of technology. Taking into account of the EU's interest, transfer of the technologies which are most relevant to the sustainable development of the Chinese economy is beneficial. Modernisation of the Chinese economy has resulted in a growing demand not only for technologies necessary for the production process, but also for high-tech consumer goods. For the EU it is important to exploit its competitive advantage in the area of high technologies also through the sale of its own products on such a promising market as the Chinese market.

However, these attempts may prove risky. Given the progress China has made in the adaptation of foreign technologies to its own needs and its tendency to copy technologically advanced products, as well as the insufficient protection of industrial property, it will be difficult for the EU to maintain its competitive advantage over China. The existing experience of European enterprises shows numerous instances of abuse on the part of the Chinese partners in their co-operation involving transfers of high technologies. Approval to build a factory or to introduce a product on the market is conditioned upon a transfer of information to local authorities. Such information is then passed on to local enterprises which use it to conduct and develop a similar type of business activity. When it comes to public procurement, selection of a particular tender means that technical details of the project to be implemented must be disclosed to an imposed partner and that the tenderer must co-operate with such a partner. This, in turn, leads to a situation where in a subsequent tender procedure the EU enterprise loses the chance to win it since usually what is chosen is the tender placed by the Chinese ex-partner who, thanks to the previous co-operation, got acquainted with all the technical details of the implementation process of the particular projects and, without any consent from the European enterprise, uses them to pursue its own interests. Other problems include, though are not limited to, copying of products of European enterprises by the Chinese co-operating partner or abuse of licences and non-payment of royalties for the use of patents.[8]

For all the foregoing reasons, the European Union is now facing a difficult challenge of seeking a balance between the transfer of technologies necessary for the further development of the Chinese economy and the need to maintain its own competitive advantages in the high-tech sector. What is also difficult is the reconciliation of various interests: of the European industry which aims at enhancement of its presence and increase of benefits derived from its activity on the Chinese market, maintaining of competitiveness of the EU economy, limiting of delocalisation of production and ensuring employment on the internal market or pursuing its own development goals with regards to China. Moreover, while seeking the balance in its policy towards China, the EU has to take into account the policy of technology transfer pursued by other countries, for example by the United States which is the most important economic and political partner of the European Union.

6 X. Liu, *China's Development Model: An Alternative Strategy for Technological Catch-Up*, Working Paper 2005, no. 05–10, Institute of Innovative Research, Hitotsubashi University, p. 16.

7 Y. Zheng, M. Chen, "China Plans to Build an Innovative State," *Briefing Series* 2006, no. 9, China Policy Institute, University of Nottingham, Nottingham, pp. 9–10.

8 P. Ranjard, B. Missone, "Study 12: Exploring China's IP Environment—Strategies and Policies," [in:] *Study on the Future Opportunities and Challenges of EU–China Trade and Investment Relations,* Emerging Markets Group, 2007, pp. 16–17.

Fast-changing China presents the most significant challenge for the economic relations between the EU and any other countries. Growing trade deficit with China, which in 2007 approximated EUR 160 billion,[9] encourages searching for ways of boosting the EU's exports to China. However, in the case of a majority of commodity groups the European products are not able to compete on the Chinese market with their local substitutes. The best prospects can be seen for luxury goods the demand for which in China has been growing, as well as for high-tech goods which, however, have to compete with their increasingly good Chinese substitutes or imitations.

In the Communication entitled "Closer Partners, Growing Responsibilities. A Policy Paper on EU–China Trade and Investment: Competition and Partnership," issued in 2006, the European Commission defined current challenges and priorities in the trade and economic relations with the People's Republic of China. One of the major challenges is the insufficient protection of intellectual property rights: patents, copyrights and trademarks, which is a serious obstacle to derive real benefits from the European competitive advantages in innovation, design and production of top-quality goods. Although there has been some progress in China in the protection of intellectual property, numerous legal loopholes still remain, thus precluding effective combating of piracy.[10]

European enterprises raise numerous concerns with regards to the conditions of business activity in China. Classified information, provided when applying for the approval to introduce a product on the market, is, in fact, unprotected; it is often published on the Internet even before the relevant approval is granted. Chinese authorities are aware of the fact that patented technologies are applied without the relevant licence, yet they do nothing to prevent such practices. What further rise concerns on the part of the EU is the insufficiently transparent and quite burdensome for entrepreneurs legal and judicial system which fails to provide adequate protection to them and thus encourages technology transfer which does not result from the entrepreneurs' voluntary decision.[11] The preferred method of response to the above-described challenges is co-operation with China through the implementation of various projects intended to, among others, improve the legal system and enhance the citizens' awareness of the law or improve enforcement of the existing regulations. EU also closely monitors implementation by China of its obligations stemming from its membership in WTO, yet the above actions do not translate into the expected progress in the area of industrial property protection.

From the point of view of private enterprises, ensuring of legal protection to their technologies and competitive advantages is among the key issues considered while making decisions on whether to invest in China or not. Transfer of a technology to a Chinese branch or joint venture often means that, after some time, it will become disseminated and new competitors will enter the market, capable of manufacturing the goods at a lower cost and posing a serious threat to the original producer. In spite of all this, the attractiveness of the Chinese market leads to a situation where numerous largest corporations whose activities are based on the worldwide production network, perceive China as an excellent manufacturing base. Positive experience with business activities on that market as well as modernisation of the country encourage a growing number of foreign enterprises to increase their capital engagement. Having regard to the increase in the population's income levels, growing consumption as well as the improving educational attainment (including one acquired at foreign schools) of the young generation, a considerable number of the largest corporations decide to establish their research and development units in China. The predominant factor that decides on the establishment of such units is the necessity to develop products to meet the needs of the large Chinese market. Hence, R&D centres working on new innovative products have also been set up recently.[12]

European private enterprises have to find the appropriate form of their presence on the Chinese market in order, on one hand, to avoid losing potential benefits by being too cautious and, on the other hand, to avoid losing their competitive advantage while actively expanding their business and meeting all administrative requirements, in consequence of a transfer of insufficiently protected technologies as well as

9 "Extra EU-27 trade, by main partners, total products," Eurostat, http://epp.eurostat.ec.europa.eu/portal/page?_pageid=1996,39140985&_dad=portal&_schema=PORTAL&screen=detailref&language=en&product=REF_TB_external_trade&root=REF_TB_external_trade/t_externaltr/tet00040.

10 Closer Partners, Growing Responsibilities. A policy paper on EU–China trade and investment: Competition and Partnership (COM(2006) 632), Brussels, 24 October 2006.

11 *European Business in China Position Paper 2007*, The European Union Chamber of Commerce in China, Beijing, 2007, pp. 60–63.

12 N. Lundin, S. Schwaag Serger, "Globalization of R&D and China—Empirical observations and policy implications," *IFN Working Paper* 2007*,* no. 710, Research Institute of Industrial Economics, Stockholm, p. 15.

imitation activities on the part of their competitors. Declining value of the EU's foreign direct investment in China (excluding Hong Kong) in recent years from EUR 6.2 billion in 2005 to EUR 1.8 billion in 2007[13] can be evidence of the difficult conditions for business activity and the risk associated with the insufficient protection of industrial property. These are the factors that more and more often have a bearing on the decisions made by European enterprises on whether to enter the Chinese market or increase their engagement therein.

Information and communication technologies (ICT)

Policy towards the ICT industry

As the ICT[14] market's production capacity and potential increase, also China's ambitions to boost the added value of production and extend the scale of activities of domestic enterprises in high-end market segments enhance. Hence growing attention is paid to the ICT industry in governmental plans and programmes. The key objectives of the government's policy are as follows:

– increased application of information and communication technologies in order to enhance the effectiveness of economy and to reduce waste;

– enhanced competitiveness of Chinese manufacturers, mostly on the domestic market, so that none of the sectors, notably those considered as strategic, would be dominated by foreign enterprises;

– promotion of domestic innovation through a support for the creation of technologies, products and standards China will have patents for and intellectual property rights to, as well as control over;

– change in the structure of foreign investment: decreasing investment in low-tech market segments and support for investment in the activities related to high-tech products and services;

– promotion of foreign trade and investment expansion of Chinese enterprises, in particular those involved in the most technologically advanced market segments;

– gradual delegation of competencies by the government in the area of ICT implementation in the economy and of responsibility for such activities to individual enterprises;

– creation of leading Chinese international enterprises(the models to be followed among the European enterprises include, for example, Nokia, Siemens and Ericsson).[15]

China uses various tools to pursue the goals listed above. The size and attractiveness of the internal market allow implementation of a selective policy towards foreign direct investment to ensure an inflow of capital, technologies and expert knowledge that meets the needs of the economy and helps pursue its development goals. Among the major incentives for investment in high-tech sectors is the preferential tax rate of 15%, while the generally applicable rate since 1 January 2008 has been 25%.[16] In return for the access to the Chinese market, China's government expects technology transfers. Taking into account the size and attractiveness of that market, many foreign companies decide to do so, even on terms that would be unacceptable in any other country.[17]

Furthermore, in order to achieve the above mentioned objectives, the largest Chinese enterprises operating in the particular ICT sub-sectors are provided with support to enable them to: dominate the domestic market, accumulate sufficient capital for the investment in research and development, and create innovative solutions and products allowing them to expand their business onto foreign markets.

13 "EU direct investment outward flows by extra EU country of destination," Eurostat, http://epp.eurostat.ec.europa.eu/portal/page?_pageid=1996,39140985&_dad=portal&_schema=PORTAL&product=REF_TB_balance_of_payments&root=theme0/t_bop/t_bop_fdi/tec00050&zone=detail.

14 Information and communication technologies comprise five broadly understood categories of goods: telecommunications equipment, computers and computer-related equipment, electronic components, audio and video equipment, and other ICT goods. ICT services include telecommunications services as well as computer and information services. See: *OECD Information Technology Outlook 2006, Information and Communication Technologies,* OECD Publishing, 2006, pp. 309–310.

15 "Excerpts from China's...," *op. cit.*

16 Enterprise Income Tax Law of the People's Republic of China*,* adopted on the 5th session of the 10th National People's Congress of the People's Republic of China on 16 March 2007.

17 C. Z-W. Qiang, *China's Information Revolution: Managing the Economic and Social Transformation,* The World Bank, Washington D.C., 2007, p. 55.

Prospective enterprises have access, on favourable terms, to various funds for a number of projects implemented abroad with financial resources available from China Development Bank and China Exim Bank which are intended to support, inter alia, projects of this particular type.

Market barriers

China is a party to the Information Technology Agreement (ITA) hence tariffs are no obstacle to the access to the Chinese market. Pursuant to ITA, imports of information technologies is subjected to a zero tariff and the average applied tariff rate for electrical machinery, appliances and supplies was reduced from 15.5% in 2001 to 9% in 2005.[18] On the other hand, there are numerous structural barriers in access to the Chinese market (e.g. a relatively low level of application of ICT products and solutions in the activities of Chinese entities), as well as non-tariff barriers to the export of European ICT goods to China.

One of the major non-tariff barriers is product standardisation and certification. In a number of cases (e.g. mobile phones, wireless Internet) the standards set by Chinese authorities are different than those applicable on the European or international market. This forces foreign enterprises to enter into an agreement with a Chinese manufacturer which holds a certificate for the production of the particular type of equipment. Co-operation with a Chinese partner also allows fulfilment of the local content requirement in the goods sold on the domestic market. Regulations laid down in this way are intended to improve the technological advancement of domestic manufacturers and increase their share in the creation of advanced products. At the same time, it is important for China that in the future its national standards could become competitive to those originating in other countries and that they would, to an increasing extent, serve as international standards.[19] From the point of view of foreign enterprises such a situation forces them to fragment their global production network to the detriment of the economies of scale. Lack of transparency in the process of establishment of standards also deprives them of any influence on its result. Standards differing from the international ones have a bearing on those Chinese manufacturers who plan their expansion on foreign markets, as they cannot base their strategy on their strong position on the Chinese market.

Other important obstacles European entrepreneurs are faced with include restricted access to the market induced by protective government regulations and insufficient protection of intellectual property rights, which discourages the former from transferring the most advanced technologies.[20]

ICT market in China

The ICT sector in China has experienced rapid development thanks to foreign direct investment and subcontracting agreements with foreign partners. Such a development was based mostly on the assembly of final products in China, using imported components. In 2004, China became the world's largest exporter of ICT equipment, thus overtaking the United States.

Table 1. Imports and exports of ITC goods, 1996–2004
(in USD billion)

IMPORTS									
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
United States	150	163	169	193	238	194	194	200	235
EU-15	106	112	127	137	167	148	140	164	226
China	17	20	26	35	51	57	76	111	149
Japan	48	46	41	49	67	58	55	61	73

18 *Trade Policy Review: Report by the Secretariat—People's Republic of China*, WTO, Geneva, 2006, p. 206.

19 C. Zhao, J. M. Graham, "The PRC's Evolving Standards System: Institutions and Strategy," *Asia Policy* 2006, no. 2, The National Bureau of Asian Research, Seattle, p. 78.

20 J. Ure, "Study 5: ICT Equipment," [in:] *Study on the Future Opportunities...*, *op.cit.*, pp. 26, 28.

EXPORTS									
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
United States	124	141	135	148	182	152	133	137	149
China	19	23	27	33	47	55	79	123	180
EU-15	73	81	87	92	111	105	100	114	139
Japan	103	104	94	101	124	95	95	107	124

The figures for the EU-15 exclude trade within the European Union.
Source: *OECD ICT Indicators*, OECD ITS database.

In 2006, the value of exports of high-tech equipment[21] totalled almost USD 300 billion, which accounted for more than 30% of the total Chinese exports. In the exports of ICT goods categories the most prominent items are computers and computer-related equipment manufactured using components imported from the other East Asian countries.[22]

Table 2. Chinese exports of ICT goods, 1997–2004 (in USD million)

	1997	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Telecommunications equipment	2,685	3,004	3,738	6,675	8,759	10,801	14,558	25,579
Computers and computer-related equipment	7,513	10,168	11,697	16,577	21,076	33,253	59,245	83,790
Electronic components	4,922	5,781	7,766	11,263	11,371	15,520	22,879	34,884
Audio and video equipment	7,168	7,501	8,453	11,165	12,616	17,855	24,289	33,309
Other ICT goods	906	965	1,009	1,316	1,483	1,948	2,332	2,859

Source: *OECD ICT Indicators*, OECD ITS database.

Foreign direct investment in more technologically advanced activities, such as designing, testing or R&D has also been growing. China is now the world's largest market of mobile phones and the second largest market in terms of demand for personal computers. On the mobile phones market the leading position is held by models of European producers: Nokia—30% market share, Siemens—11%, Ericsson—5%, and Alcatel—3%. With regards to the equipment used for the operation of mobile phone networks, the major players are also European providers: Ericsson—37% market share, Nokia—28%, Siemens—5%, and Alcatel—5%.[23]

The scope of activities of foreign branches of corporations operating in the ICT sector in China has been steadily broadening. At present, it involves not only assembly of final products, but an increasing number of companies establish their research and development centres in China. Such a trend arises from the need to adjust product specifications to the requirements of the local market. One of the factors that has had a growing impact on investment in R&D is the knowledge potential and skills of well-educated Chinese scientists and engineers, especially in the regions where there is a considerable number of universities and research institutes (Beijing, Shanghai, Shenzhen). Amongst the European enterprises, research and development centres have already been set up in China by Alcatel-Lucent, Ericsson, SAP and Nokia-Siemens.[24]

Chinese enterprises relatively quickly expand their production and export potential despite a limited, when compared with the leading transnational corporations in the ICT sector, scale of activity and know-how. One of the forms of their expansion is foreign direct investment which enable acquisition of technologies and distribution channels, as well as promotion of their brands. The key challenge faced by Chinese enterprises remains enhancement of the added value of their products and services so as to avoid being seen as manufacturers of low-end cheap products. This will require development of their own innovation capacities to decrease dependence on foreign technologies and patents.

21 According to Chinese statistics, the category "high technologies" comprises the following: aircraft, drugs, office equipment, radio and TV and communication equipment, precision, medical and optical instruments, and computers. Such a definition differs from the one adopted, *inter alia*, by OECD.

22 *OECD Information Technology Outlook 2006, Information and Communication Technologies*, OECD Publishing, 2006, pp. 140–144.

23 *Review of the Development and Communications Sector in China*, Committee for Information, Computer and Communications Policy, OECD, Paris, 13 March 2003, pp. 54–55.

24 *OECD Information Technology Outlook 2006, Information and Communication Technologies*, OECD Publishing, 2006, pp. 151–152.

The largest Chinese enterprises in the ICT sector are:

– Legend Holding (Lenovo Group)—computer equipment;

– BOE Technology—liquid crystal displays (LCD);

– TCL—television sets and mobile phones;

– Huawei Technologies—telecommunications equipment;

– ZTE Company—telecommunications equipment.

A majority of ICT enterprises operate in market segments where price competition is fierce. Only a few of them (e.g. Huawei and ZTE) are capable of developing their own original technologies and effectively compete in higher market segments.

Huawei's and ZTE's business in Europe

Among Chinese ICT enterprises operating on the European market Huawei and ZTE have been most successful. Their foreign expansion path was similar. At the beginning they exported a single telecommunications product to be subsequently involved in projects related to telecommunications infrastructure. Then they increased the range of products exported to finally expand the scope and forms of their activity through investment, establishment of research and development centres, joint venture agreements, mergers and acquisitions. In terms of directions of the expansion, in the initial phase it was to the Asian and African countries and Russia, then to Central and Eastern Europe and, ultimately, Western Europe and North America.[25]

Huawei Technologies is a private enterprise set up in Shenzhen in 1988 by a former officer of the Chinese People's Liberation Army who was involved in telecommunications research for the Chinese army. According to some sources, Huawei maintains close contacts with the Chinese army which is an important client for the company, a political patron and a partner in it's his research activity.[26] Huawei is a supplier for the Chinese telecommunications enterprises, such as China Telecom, China Unicom and China Mobile, yet currently 72% of its revenue comes from sales abroad.[27] Thanks to the joint venture agreements concluded at the end of the 1990s with NEC and Siemens on the development of the third-generation mobile phones, and with Electronic Data System Corporation on marketing of Huawei equipment on the US market, the company upgraded its competition potential on the international market.[28]

The first important success in Europe for Huawei was the contract for the development of the 3G network, concluded with a Dutch KPN Telfort. KPN continues its co-operation with Huawei and enters into further contracts for telecommunications equipment, i.e. HSDPA cards[29] (HSDPA—High Speed Downlink Packet Access is a 3G mobile telephony communication protocol enabling faster (max. 14.4 Mbit/s) transfer of data in UMTS-based networks). However, the largest success of Huawei in Europe is its co-operation with British telecommunications enterprises which provided the latter with expansion opportunities in a number of European countries. In 2006, Huawei became a privileged supplier of telecommunications equipment for British Telecom (BT) and of mobile phone handsets for Vodafone (shareholder of the Polish Polkomtel). Co-operation with Vodafone further developed through, amongst others, contracts for the development of the UMTS network[30] in the Czech Republic and of the 3G network in Spain. In Germany Huawei co-operates with Versatel Holding Deutschland GmbH, operator of a fixed-line telephony, in the development of a fibre-optic communications network.[31] In December 2007, it was chosen by T-Mobile International to be a supplier of packet-switched core networks which were to replace the existing T-Mobile

25 C. Li, "China's Telecom Industry on the Move: Domestic Competition, Global Ambition, and Leadership Transition," *China Leadership Monitor*, no. 19, Hoover Institution, Stanford University, p. 9.

26 *A New Direction for China's Defense Industry*, Rand Corporation Report, 2005, p. 218.

27 *Huawei: Annual Report 2007,* p. 6, www.huawei.com/corporate_information/annual_report.do.

28 J. Child, S. B. Rodrigues, "The Internationalization of Chinese Firms: A Case for Theoretical Extension?," *Management and Organizational Review* 2005, no. 3, Blackwell Publishing, pp. 390–391.

29 "KPN Picks Huawei HSDPA Card," *Light Reading Europe* of 4 September 2006, www.lightreading.com/document.asp?doc_id=102813.

30 Universal Mobile Telecommunications System (UMTS) is a 3G mobile telephony standard, a successor of the GSM standard. Networks built based on UMTS and using HSDPA and HSUPA technologies enable voice connections, video chats, sending of text messages and transfer of data.

31 "Huawei wins first major German deal," *People's Daily* of 16 November 2006.

networks in five countries: Austria, Czech Republic, the Netherlands, Germany and United Kingdom.[32] In April 2008, O2 Germany signed a contract with Huawei for the co-operation in the replacement of the existing and development of new base stations in order to expand the GSM and UMTS networks using the technology supplied by the Chinese partner.[33] The company's growing expansion in Europe is evidenced by new contracts. Huawei's telecommunications equipment is already used by France Telecom (shareholder of the largest Polish telecommunications company TP SA), Telecom Italia, Magyar Telekom or the Bulgarian TransTelecom.[34]

Also in Poland Huawei co-operates with telecommunications enterprises. In July 2005, the company won a tender valued at PLN 9.5 million for a development of a DWDM[35] solution for Telefonia Dialog.[36] And in 2006 it signed a EUR 150 million contract for the supply of a complete UMTS solution for P4 (formerly Netia Mobile). The Chinese vendor won with Ericsson, Alcatel and Siemens. Under the contract Huawei is to deliver complete end-to-end solutions for the UMTS network, based on the HSDPA technology, comprising a system of UMTS base stations, core network, intelligent 3G mobile network, 3G mobile data service platform and 3G mobile phones.[37] Another company that entered into co-operation with Huawei is Polska Telefonia Komórkowa (PTK Centertel), a mobile phone services provider. In July 2007, PTK signed a framework agreement with Huawei Polska Sp. z o.o. on the implementation and maintenance of a 3G radio network in southern and western Poland (Katowice and Poznań districts), with an expected value of purchases of PLN 169 million in 2007–2009. Two months later another agreement was signed for UMTS/HSPA equipment, this time for the Orange network, thanks to which the operator's clients would have access to the state-of-the-art 3G mobile phone services and mobile Internet.[38] In June 2007, Polkomtel concluded a strategic agreement with Huawei. It provides for a development of innovative telecommunications solutions and products to enable broad dissemination of modern and user-friendly multimedia services, information and entertainment services as well as mobile Internet on the Polish market.[39] In addition, Telekomunikacja Polska signed a framework agreement with Huawei on the supply of data transmission subscriber routers for corporate clients.

ZTE (Zhongxing Telecommunication Equipment Company) was established in the 1980s based on state-owned enterprises on the initiative of the government which intended to enhance the country's capacities with regard to a production of telecommunications equipment. Since 1997 it has been a public company (its shares are listed on the stock exchanges in Shenzhen and Hong Kong) and the major supplier of telecommunications equipment for Chinese operators. For a few years the company has been expanding its business outside China.

ZTE develops its co-operation with European partners, although not yet on such a scale as Huawei does. In the United Kingdom it became a partner of BT in the implementation of network solutions. In France, together with Alcatel, it develops a new system of mobile telephony (CDMA[40]) and supplies ADSL[41] equipment to France Telecom. In 2005, the company entered into an agreement with France Telecom on the research and development co-operation in the mobile phone segment. Using such a form of co-operation ZTE intended to better understand the nature of the European market as well as its customer

32 "Huawei to build European Packet Switched Core Networks for T-Mobile International," *Huawei Europe* of 11 December 2007, www.huawei.com/europe/en/catalog.do?id=324&page=3.

33 "O2 Germany Forms Partnership With Huawei to Expand Its Net-works," *Huawei Europe* of 23 April 2008, www.huawei.com/europe/en/catalog.do?id=866.

34 See: *Huawei Europe*, www.huawei.com/europe/en.

35 Dense Wavelength Division Multiplexing (DWDM) is a technology of multiplication of digital signals on a single optical fibre by using different wavelengths to carry each signal.

36 R. Jakubowski, "Chińskie Huawei podbija polski rynek telekomunikacyjny," 15 February 2006, www.computerworld.pl/news/89016.html.

37 "P4 wybiera firmę Huawei na dostawcę systemu telefonii komórkowej trzeciej generacji," 7 February 2006, http://media.playmobile.pl/notatka_79445.html.

38 "Huawei Wins HSPA Contract," *Light Reading Europe* of 19 September 2007, www.lightreading.com/document.asp?doc_id=134307.

39 "Polkomtel ma umowę z Huawei," 4 June 2007, www.telepolis.pl/news.php?id=8585.

40 Code Division Multiple Access (CDMA) is a technology applied in mobile telephony, enabling servicing of multiple users at a time thanks to a broadband method of data transmission.

41 Asymmetric Digital Subscriber Line (ADSL) is a technology that enables asymmetric access to the Internet (transfer of data to the network user is faster than in the reverse direction) and thanks to the use of a digital signal it allows a much faster transfer of data than it is the case for technology of telephone modems where signals have to be converted from digital into analogue form and vice versa.

expectations.[42] Also in 2005 it concluded an agreement with Portugal Telecom (PT) which provided for a joint development of telecommunications products and services. That agreement is expected to allow ZTE to expand its business on the markets PT is engaged in (in Latin America, Africa or in Hungary) and where Hungaro Digitel KFT, supplier of corporate services and a company PT holds shares in, operates. On the other hand PT gained a partner for the sale of its products on the Chinese market.[43] Moreover, the company operates also in Greece and Germany where it supplies ADSL equipment and telecommunications networks, whereas in Sweden it established its European Research Institute. In Poland the company that entered into co-operation with ZTE is Polkomtel. According to the official communication, the agreement provides for a development of innovative telecommunications solutions and products to allow broad dissemination of state-of-the-art and user-friendly multimedia services, information and entertainment services and mobile Internet on the Polish market.[44]

Huawei and ZTE achieved a level of technological advancement that they are capable of competing in the quality of the equipment and services offered with the world's leaders: Cisco, Lucent, Alcatel or Ericsson. The roots of their success in the attracting of partners on the European markets lie, in the first place, in the 20–30% lower price of their offers. Furthermore, the offer is not limited to favourable price terms, but also provides opportunity of support to the European partner upon the latter's entry onto the Chinese market. An additional factor of considerable importance while negotiating contracts in Europe is the possibility of its financing by the Chinese partner. This has been the case, for example, for the agreement between P4 and Huawei; a credit for the project thereof would be granted to Huawei by China Development Bank. Favourable terms and conditions of financing are among the key methods applied by the Chinese government to support expansion of Chinese enterprises on foreign markets. Another form is a refund of the VAT charged on components and services related to production for export. Although the government is gradually changing its policy of tax rebates on exported goods, yet these changes do not apply to enterprises operating in the high technologies sectors, including the ICT sector. Such a policy allows Huawei and ZTE to place attractive offers in terms of the price and to win new contracts.

Nuclear power

Nuclear power in China

Electricity in China is produced, in the most part, from fossil fuels (82.6%), mainly in coal-fired power plants. Hydro power plants account for 15.2% of the total electricity output, whereas nuclear power plants for 1.9%.[45] Rapid growth of demand for energy in China results in frequent power cuts, while a large share of coal-fired power plants in the country's electricity generation leads to considerable air pollution. Therefore, in order to meet the rising demand for energy, the Chinese government decided to increase the number of nuclear power plants, which was reflected in the white paper China's Energy Conditions and Policies, issued in December 2007.[46]

The first nuclear power plants in China were built in the 1980s. Technologies used in their construction came from France, Canada, Japan and USSR, and development of China's own technologies was based on French elements. One of the two first power plants, Daya Bay near Hong Kong, was based on French technologies. Fromatome supplied the reactors in which turbines produced by Alston were installed. The company responsible for the construction of the power plant was Electricity de France (EDF), supported by Chinese engineers. Also the Lingao power plant in Guangdong province was built with the use of Framatome technologies. Suppliers of technologies for the construction of other nuclear power plants included Atomic Energy of Canada, Japanese Mitsubishi, Russian Rosenergoatom and Siemens-Areva. At present, eleven nuclear reactors for electricity generation are in operation in China, further seven are under construction and

42 "FT, ZTE Team on R&D," *Light Reading* of 6 December 2005, www.lightreading.com/document.asp?doc_id=85282.

43 R. Le Maistre, "ZTE Hooks Up with Euro Carrier," *Light Reading* of 14 January 2005, www.lightreading.com/document.asp?doc_id=66027.

44 "Polkomtel SA rozpoczyna współpracę z ZTE Corporation," www.polkomtel.com.pl/pl/?nfl=1&viewId=viewAktualnosci&scrn=newsView&nid=397.

45 "Electricity Balance Sheet," *China Statistical Yearbook 2007*, National Bureau of Statistics of China, www.stats.gov.cn/tjsj/ndsj/2007/indexeh.htm.

46 See: *China's Energy Conditions and Policies*, Information Office of the State Council of the People's Republic of China, December 2007, www.ccchina.gov.cn/WebSite/CCChina/UpFile/File229.pdf.

further fourteen are to be commenced by 2010. In a few years to come further reactors are planned to be built in order to implement the plan of enhancement of the nuclear power plants' capacity from the current level of above 8 GWe to 40 GWe[47] by 2020. In recent months that target has, however, been revised and, according to the information dated August 2008, China plans to increase the electricity generated in nuclear power plants by up to 5%, which means that the capacity should rise to 70 GWe[48] by 2020.

In China nuclear power plants might be owned and managed exclusively by three state-owned enterprises: China National Nuclear Corporation (CNNC), China Power Investment Corporation (CPI) and China Guangdong Nuclear Power Corporation(CGNPC). Other entities may hold only a minority share therein.[49]

Table 3. Nuclear power plant reactors in operation in China

Unit	Province	Reactor technology	Power (in MWe)	Commercial operations	Operator
Daya Bay-1 & 2	Guangdong	French	944	1994	CGNPC
Qinshan-1	Zhejiang	Chinese (Japanese elements)	279	1994	CNNC
Qinshan-2 & 3	Zhejiang	Chinese	610	2002, 2004	CNNC
Lingao-1 & 2	Guangdong	French	935	2002, 2003	CGNPC
Qinshan-4 & 5	Zhejiang	Canadian	665	2002, 2003	CNNC
Tianwan-1 & 2	Jiangsu	Russian (French elements)	1000	2007	CNNC
Total: 11			**8,587**		

Source: *Nuclear Power in China*, World Nuclear Association, July 2008, www.world-nuclear.org/info/inf63.html.

Table 4. Nuclear power plant reactors under construction and which construction is planned to be started in China by 2010

Power plant (no. of reactors)	Province	Power (in MWe)	Reactor technology	Operator	Construction start	Planned completion of construction
Lingao-2 (3–4)	Guangdong	2x1080	French	CGNPC	5/2005, 5/2006	2010, 2011
Qinshan 4 (6–7)	Zhejiang	2x650	Canadian	CNNC	4/2006, 1/2007	2011, 2012
Hongyanhe 1 (1–4)	Liaoning	4x1080	French	CGNPC	8/2007, 4/2008, 3/2009, 7/2010	2012, 2014
Yangjiang 1 (1–2)	Guangdong	2x1080	French	CGNPC	9/2008, 2/2009	2013, 2015
Ningde 1 (1–2)	Fujian	2x1080	French	CGNPC	2/2008, 9/2008	2012, 2013
Sanmen 1 (1–2)	Zhejiang	2x1100	US	CNNC	3/2009	2013, 2014
Haiyang (1–2)	Shandong	2x1100	US	CPI	9/2009	2014–2015
Taishan 1	Guangdong	2x1700	French	CGNPC	8/2009, 1/2010	2013, 2015
Shidaowan	Shandong	200	Chinese	China Huaneng	beginning of 2009	2013
Fangjiashan (Qinshan 5)	Zhejiang	2x1000/1080	Chinese, French	CNNC	6/2009	2013–2014
Total: 21		**22,260**				

Source: *Nuclear Power in China*, Word Nuclear Association, July 2008, www.world-nuclear.org/info/inf63.html.

47 *Nuclear Power in China*, Word Nuclear Association, July 2008, www.world-nuclear.org/info/inf63.html.

48 "China ups targeted nuclear power share from 4% to 5% for 2020," *Xinhua* of 5 August 2008.

49 *Nuclear Power in China, op. cit.*

The government's policy aims at the maximisation of the domestic participation in the process of construction, equipping and management of nuclear power plants, although entities involved in nuclear power industry are also encouraged to engage in international co-operation. Also R&D activity is supported; the leading unit is the Institute of Nuclear Energy Technology (INET) at the Qinghua University in Beijing. Research conducted by INET resulted in a construction, in co-operation with German engineers, of a high temperature gas-cooled reactor (HTGR), the commercial version of which, namely HTR-PM (high temperature gas-cooled reactor pebble-bed module) is to be installed in the planned Shidaowan power plant. Furthermore, priority projects for the near future include construction of a large third-generation pressurized water reactor (PWR).[50] However, given both the fact that the work on China's own original technologies is time-consuming and that a construction of approximately twenty new reactors is planned in the next a dozen or so years, the country will still have to rely on foreign technologies.

The major competitors attempting to win contracts for the construction of nuclear power plants in China are the French Areva and the American Westinghouse. It cannot be ruled out that in the future China will attempt to build power plants using only selected technology to reduce the costs of construction and operation of the power plant, and to implement standards that can be applied countrywide. This seems to be corroborated by the decision to build four reactors in the Sanmen and Haiyang power plants. The choice of the contractor for a project in such a strategic sector as nuclear power industry depends on a number of factors, such as technological advancement, involvement of local entities in the process of project implementation, or transfer of technologies. After many months of the tender process and despite the support provided by French president Jacques Chirac, the contract was awarded to Westinghouse which offered a much broader scope of a technology transfer. The choice of the US offer is also of strategic importance for the development of the nuclear power industry in China. It not only provides access to a technology other than the French one, already known in China, but also helps to negotiate better terms and conditions of co-operation in the future, thus making the competition between Areva and Westinghouse even more fierce. The choice of the US company in 2006 did not mean, as it turned out thereafter, the discontinuance of the co-operation with the French company, this being evidenced by the contract concluded with Areva a year later. China's objective is to co-operate with foreign partners to ensure the broadest possible transfer of technologies related to the designing, construction and operation of nuclear power plants in order to become self-sufficient in this respect in the future.

Cooperation of European enterprises with China

Among the European enterprises, the largest contribution to a development of nuclear power in China has been made by French companies. Areva, the world's leading conglomerate in the nuclear power sector, has conducted its business activity in China for more than 20 years, taking part in a construction of 9 nuclear power plants. In 1986, Framatome (now: Areva) signed a contract with Guangdong Nuclear Power Joint Venture Company for a construction of two reactors in Daya Bay and, subsequently, in 1995 for a construction of two reactors in Lingao. In 1992, Areva entered into an agreement with China National Nuclear Corporation on a transfer of technologies used in the construction of the Daya Bay power plant and the technology related to the equipment of the reactor coolant system, which was subsequently applied by the Chinese partners in the construction of the Qinshan 2 power plant. In 1995, Areva concluded another agreement on the technology transfer (this time with China Guangdong Nuclear Power Corporation), providing for a full access to the technology of the newest French N4 reactor. Under the agreement the role of Areva changed from a supplier into a partner that provided Chinese entities with data related to the design, manufacturing, assembly, start-up and maintenance of nuclear facilities. Furthermore, Areva co-operates with Chinese companies in the area of supply of nuclear fuel, carrying out inspections and maintenance of equipment, production of cooling pumps, as well as transmission and distribution of electricity.[51] The largest contract in the history of nuclear power industry, valued at EUR 8 billion, was concluded by Areva, in the presence of presidents Hu Jintao and Nicolas Sarkozy, in November 2007. Under the agreement with CGNPC Areva will supply two state-of-the-art reactors (EPR—European Pressurised Reactors) to be installed in the newly-built power plant in Taishan and will provide support in the start-up and maintenance of the plant. Both enterprises will also co-operate in a development of civil

50 *China's Energy Conditions and Policies*, *op. cit*.

51 *Areva in China*, Press Kit.

nuclear power industry in China through, *inter alia*, joint research on the engineering technologies of nuclear reactors and recycling of used nuclear fuel.[52]

Alstom is a supplier of: steam turbine generator sets for Daya Bay and Lingao power plants, electrical control system and engineering services as well as of emergency fuel generators for the Daya Bay, Lingao, Qinshan and Tianwan power plants. Thanks to the contract signed in 2007 with CGNPC and Dong Fang, Alstom will also supply steam turbines to the newly-built nuclear power plants in Hongyanhe, in the Liaoning province. Another French company, Electricite de France (EdF) is a provider of consulting services to the Daya Bay and Lingao power plants.[53] Currently, EdF negotiates a new project of nuclear power plant construction with China Datang and Hunan Huayin Electric Power Corporation.[54] However, the most important contract concluded by EdF is the joint venture agreement with CGNPC, giving Electricite de France 30% of shares in the nuclear power plant in Taishan currently built using Areva's technology. The agreement also provides for a development of other joint projects in the area of nuclear power engineering.[55]

Other European enterprises sporadically engage in a co-operation with China. Examples include Spanish ENSA which supplied steam generators to and provided training for the staff of the Qinshan power plant. Siemens, on the other hand, was a supplier of the instrumentation and control systems to the Tianwan power plant, and a co-producer of steam turbines for the Lingao power plant.[56]

The co-operation between European and Chinese enterprises in the area of nuclear power is related primarily to the Chinese programme of development of the nuclear power sector and construction of power plants on the territory of China. Thus far, there have been no specific plans of co-operation on projects located outside China. However, a co-operation agreement signed in 2007 by Areva and EdF with China Guangdong Nuclear Power Corporation provides for an implementation of joint international projects.

Civil aviation

Institutional aspects of co-operation

In 1998, the European Union commenced implementation of the EU–China Civil Aviation Cooperation project. The project's objective was to improve safety of civil air transport in China and to enhance co-operation between China and the EU in the aviation industry through establishment of common technical standards. Main activities consisted of the organisation of seminars, workshops and training sessions related to a management of air traffic, production in the aviation industry and airlines, and of training for pilotage instructors. The project had been implemented until 2006 and its total budget exceeded EUR 21 million, of which more than one-half was paid by the EU.[57]

In 2005 was held the first meeting as part of the dialogue between the EU and China related to civil aviation. Both parties declared the opening of bilateral negotiations on the agreement between the European Union and China regulating air transport services, and on the agreement on technical co-operation in civil aviation, covering such issues as safety and management of air traffic.[58]

Co-operation of Airbus and EADS with China

Co-operation between Airbus and China started in 1985 when the first A310 aircrafts were delivered to the Chinese carrier China Eastern Airlines. At present, the number of Airbus planes operated by ten Chinese

52 "China, France sign 8 bln euro nuclear energy deal," *Xinhua* of 26 November 2007, http://news.xinhuanet.com/english/2007-11/26/content_7148749.htm.

53 X. Ye, "Nuclear energy brings closer ties," *China Daily* of 9 September 2004.

54 "China Datang, France's EDF to co-operate in China nuclear power project," *Forbes* of 23 September 2007, www.forbes.com/markets/feeds/afx/2007/09/23/afx4146460.html.

55 "EDF sign Chinese nuclear deal with CGNPC," *Energy Business Review* of 27 November 2007, www.energy-business-review.com/article_news.asp?guid=3ACD942E-4E5F-44C7-8F4D-80CCFAB723FA.

56 See: www.nti.org/e_research/profiles/China/Nuclear/5535.html.

57 See: www.delchn.cec.eu.int/en/Co-operation/Civil%20Aviation.doc and: www.asd-aero.eu/eu-china.

58 Joint Declaration by Mr. Yang Yuanyuan, Minister for Civil Aviation of China, and Mr. Jacques Barrot, Vice-President of the European Commission, on EU–China Co-operation in Civil Aviation signed at the occasion of the EU–China Aviation Summit, Beijing, 29 June–1 July 2005.

airlines exceeds 300. In the near future it will increase thanks to an agreement concluded in October 2006 between Airbus and China Aviation Supplies Import and Export Group Corporation (CASGC) on a supply of 150 A320 family aircrafts and 20 A350XWB aircrafts.[59]

Airbus set up its first office in Beijing in 1990. Now it employs 260 of staff, of which 80% are Chinese. In 1998, in co-operation with CASGC, it established a training centre equipped with two simulators for the A320 and A330/A340 aircraft. The centre provides training for engineers, mechanics, pilots and flight crew.[60]

Airbus co-operates not only with airlines, but also with Chinese enterprises operating in the aviation industry. More than one-half of the Airbus planes, currently in operation worldwide, are equipped with components supplied by Chinese subcontractors. Chengdu Aircraft Corporation supplies rear passenger door and components for the nose part of the A320 family. Shenyang Aircraft Corporation produces emergency exit doors, fixed leading edges, wing interspar ribs, cargo doors and skin plates for A320 family. Xi'an Aircraft Company produces electronic bay doors for the A320 and A330/A340 aircrafts, fixed trailing edges on wings for the A320 family and the brake blades and medium air ducts for the A330/A340 family. The Hong Yuan Aviation Forging & Casting (HYFC) produces titanium forging parts to mount power plants on to wings, whereas The Guizhou Aviation Industrial Group produces maintenance jigs and tools for Airbus planes.

Airbus conducts several programmes related to a transfer of technologies, such as one providing for a production of complete wings for A320 in China and employment of 200 Chinese engineers in the Airbus regional engineering centre by 2008.[61] Furthermore, it offered the Chinese aviation industry 5% share in the programme of construction of a new model of the A350 aircraft.[62]

The largest project carried out by Airbus in China is a construction of a factory in Tianjin. The factory (Tianjin Binhai New Area) will be the third, following Toulouse and Hamburg, location where the aircraft final assembly will take place. It was supposed to start operation in August 2008 and as of 2011, 44 planes per year are to be assembled there. Airbus' share in the project will be 51%. The remaining portion will be held by: Tianjin Zhongtian Aviation Industry Investment Co., in which some investment share is held by Hafei Aviation Industry Co., and Jiangxi Hongdu Aviation Industry Co., entities associated with China Aviation Industry Corp. Two (AVIC II), Tianjin Bonded Zone Investment Co. and China Aviation Industry Corp. One (AVIC I).[63]

EADS (The European Aeronautic Defence and Space Company) will implement, in co-operation with a Chinese partner, the project of construction of a new EC175 helicopter. The relevant agreement between Eurocopter[64] and AVIC II was signed in 2005. Eurocopter's co-operation with China goes as far back as the 1960s, when the first supplies of Alouette III helicopters took place.[65] Now, the company's Chinese partner is Harbin Aircraft Industry Group (HAIG) which has produced Z9 helicopters (Chinese version of Dauphin) since 1980 and co-operates in a production of Eurocopter EC120 Colibri helicopters.[66]

Co-operation with Europe and China's plans for development of the aviation industry

China is the most prospective market in terms of the growth of demand for passenger aircraft. However, the demand for new planes will be almost wholly satisfied by foreign suppliers. Therefore, the ambition of the Chinese government is to develop domestic aviation industry and construct a large passenger aircraft (150–200 passengers) by 2020.

Earlier, China produced planes modelled on Russian aircraft, yet these did not provide top quality in terms of safety. Current plans for the development of the Chinese aviation industry are based on the broadening co-operation with the major foreign manufacturers. The most promising seems to be the co-operation with Airbus, the world leader (next to Boeing) in a production of large passenger aircraft. The

59 "Airbus Signed Agreement With CASGC For Largest Single Transaction Ever—170 Aircraft," EADS, Toulouse, 26 October 2006, http://eads.com/1024/en/pressdb/archiv/2006/20061026_airbus_cascg.html.

60 See: www.airbus.com/en/worldwide/airbus_in_china.html.

61 *Ibidem*.

62 "Airbus plays a China car," *Asia Times Online* of 6 December 2005.

63 "Construction to start on Airbus A320 China Assembly line," *Xinhua Online* of 16 May 2007.

64 Eurocopter is a wholly-owned subsidiary of EADS, whereas EADS' shareholding in Airbus is 80%.

65 F. Bordonaro, "EADS China deal raises concerns," *ISN Security Watch* of 20 December 2005.

66 A. Goldstein, "The Political economy of Industrial Policy of China: The Case of Aircraft Manufacturing," *William Davidson Institute Working Paper*, no. 779, OECD Development Center, July 2005.

Tianjin factory will offer China best opportunities to learn the technical details of a construction of a large passenger plane. However, it is not only Airbus that Chinese engineers can learn from. Also the Brasilian Embraer has its factory in China, Chinese subcontractors supply components for the Boeing, and the Canadian Bombardier co-operates with AVIC I in a construction of the ARJ21-900 aircraft. In China there are also regional centres for aircraft maintenance, repair and overhaul.[67]

In recent years the key project of the Chinese aviation industry has been the construction of the ARJ21 regional passenger aircraft (below 100 seats). The decision was made in 2002 and the project implementation, partially financed from the state budget, was entrusted to AVIC I Commercial Aircraft Company (ACAC), a consortium composed of six enterprises and research institutes operating in the Chinese aviation industry.[68] The first ARJ21 plane left the assembly line at the Shanghai Aircraft Manufacturing Factory in December 2007. Test flights were scheduled for March 2008, yet due to technical reasons were postponed until November. Until March 2008 orders had been placed for 181 ARJ21-700 planes, one of which was from abroad, submitted by GE Capital Aviation Services (for 5 planes).[69] Although ARJ21 is the original Chinese product, the key components of the aircraft are manufactured abroad. For the purposes of the project implementation an open tender procedure for the supplies of the key elements of the aircraft was employed. And thus, for example, engines are supplied by General Electric, and the navigation system elements—by Rockwell Collins.[70]

The priority project for China for the several years is the construction of a large passenger aircraft. Plans of the plane construction had been mentioned for a long time, yet the government decided to include the project into its official programme as late as in 2007 and in 2008 the first specific implementation steps were undertaken. In May a special enterprise, Commercial Aircraft Corporation of China Ltd. (CACC), was established to conduct research, development and production of the planned aircraft, and to carry out marketing activities. Its capital is RMB 19 billion and the major shareholder is the state. Other shareholders include not only enterprises operating in the aviation industry, such as AVIC I and AVIC II, but also Shanghai Guosheng Co. Ltd., Aluminium Corporation of China, Baosteel Group Corporation and Sinochem Corporation. Although the Chinese aviation industry has many years of experience gained thanks to the implementation of smaller projects or supplies of components for Boeing or Airbus, it still lacks its own core technologies which are crucial for the construction of a large aircraft. And technical solutions in the area of aerodynamics, avionics, compound materials or design of jet engines, strictly protected by foreign enterprises, are still unavailable to China.[71]

Agreements and projects implemented by Airbus and Eurocopter give rise to concerns about a possible access for China to their core technologies. In addition the location of the factory in Tianjin and co-operation in the construction of the EC175 helicopter can enhance the Chinese partners' capabilities of building planes and helicopters. Airbus will have to reconsider its strategy for the co-operation with China. Until now, the Chinese aviation industry has played the role of a supplier of components, but as the programme of construction of its own aircraft commenced, it became a potential competitor for Airbus. The existing co-operation allowed the Chinese partners to learn a number of technological solutions applied in the A320 aircraft, while participation in the A350 programme will provide an opportunity to get acquainted with more technical details. Airbus will have to make every effort to ensure that the most strictly protected technical secrets are not disclosed to the future Chinese competitor.[72]

What can pose a problem is the possible application of the know-how and technologies obtained thanks to the co-operation with European enterprises for other than civilian objectives. In this way China would evade the still valid embargo imposed by the European Union on the exports of military equipment to China. It cannot be ruled out that some technical solutions and technologies acquired thanks to the co-operation with European partners will be employed in the Chinese aerospace programme. However, it can hardly be

67 A. Radishofski, "China Targeting Boeing and Airbus?," *Manufacturing.net* of 26 June 2007.

68 The consortium is composed of: Shanghai Aircraft Research Institute, Xi'an Aircraft Design and Research Institute, Chengdu Aircraft Industry Group (responsible for the construction of the nose part of the aircraft), Shanghai Aircraft Company (responsible for the final assembly), Shenyang Aircraft Corporation (responsible for the construction of the tail part of the aircraft) and Xi'an Aircraft Company (responsible for the construction of the wings and the fuselage).

69 "1st Chinese homegrown regional jet delays maiden flight," *Xinhua* of 29 March 2008.

70 See: ARJ21 Regional Jet Aircraft, China, www.aerospace-technology.com.

71 "China's Large Aircraft Readying for Take-Off," *Forbes* of 25 April 2007, www.forbes.com/entrepreneurs/2007/04/25/boeing-airbus-china-ent-manage-cx_kw_0425whartonaircraft.html.

72 B. Perrett, "Airbus Looks at New Strategies in China," *Aviation Week* of 15 June 2008, www.aviationweek.com/aw/generic/story_generic.jsp?channel=awst&id=news/aw061608p3.xml.

expected that China would be able to catch up with Europe in the next few years with regards to the advancement of the aviation technologies and to produce planes and helicopters matching the European or American ones. Even if China manages to implement the project of construction of a large passenger aircraft by 2020, it will still have to spend many years on a marketing campaign to earn the reputation of reliable supplier, the confidence of the airlines, and to be able to compete with Airbus and Boeing.

Global satellite navigation system

EU–China co-operation in satellite technologies

Co-operation between European entities and China in the field of satellite technologies goes back to the 1980s when it was initiated by the European Space Agency (ESA). In 2001, ESA signed an agreement with the China National Space Administration (CNSA) on a joint implementation of the Double Star programme which was a follow-up of the previous Cluster programme. Its objective is to observe the impact of the Sun on the Earth. The Chinese participation consists of the placing of its two own satellites on the orbit and collection of information on changes in the magnetic field simultaneously with the Cluster satellites.

The French Space Agency signed an agreement with CNSA in 1994. Representatives of both these institutions regularly meet to discuss possible areas of co-operation. One of them is the identification and management of the risk of natural disasters. Topics under consideration include also possible co-operation in the observation of space objects approaching the Earth in order to identify possible dangers.

Also European private entities are engaged in a co-operation with China. In 1984, the French Alcatel for the first time supplied components to be installed in the Chinasat 1 satellite and in 1998 it delivered the Sinosat 1 satellite. Moreover, it entered into a contract with China Aerospace Science and Technology Corporation for a production of a communication satellite. Alcatel intends to continue its co-operation with the Chinese partners in the area of communication satellites, meteorology, satellite navigation and components for satellites. Another European enterprise co-operating with China was EADS (Sinosat 1 satellite), however, given EADS' business pursued in the United States, the company is cautious about engaging in a too advanced co-operation with Chinese partners.[73]

Galileo programme

On 18 September 2003, China signed an agreement with the European Union on the former's participation in the Galileo programme. China offered a financial contribution of EUR 200 million, which represented approximately 6% of the project's total budget, of which EUR 60 million was to be earmarked for the development and launch of the system, whereas EUR 140 million for the deployment of the satellites on the orbit. The Chinese partner in the Galileo project, responsible for the programme implementation in China, is National Remote Sensing Center of China (NRSCC), an organisational unit of the Chinese Ministry of Science and Technology. In 2004, a special consortium China Galileo Industries (CGI), comprising China Aerospace Science & Industry Corporation, China Electronic Technology Corporation, China Satellite Communication, China Academy of Space Technology and Shanghai Galileo Industries, was established. Since 2005 CGI has been the prime contractor in the Chinese involvement in the Galileo programme and is expected to become a future licensee responsible for the implementation and operation of the system in China. Its principal tasks include: commercialisation of civilian application of the system, development of an intelligent transport system based on satellite navigation, as well as co-operation with other Chinese enterprises specialising in space, electronic and satellite technologies.[74] Thus far, CGI has signed contracts for a delivery of 10 projects related to a development of the space, terrestrial and application segments.[75]

Development of Galileo, the European satellite navigation system, is intended to enable independence from the US-made GPS system. From the point of view of the European Union, co-operation with China is

73 *Aerospace co-operation between Europe and China*, Report submitted on behalf of the Technological and Aerospace Committee, Assembly of Western European Union, The Interparliamentary European Security and Defence Assembly, Document A/1853, 3 June 2004, www.assembly-weu.org/en/documents/sessions_ordinaires/rpt/2004/1853.pdf.

74 "China's state company obtains contract to develop Galileo technologies," *People's Daily* of 10 March 2005.

75 For more information on projects delivered by China Galileo Industries see the following website: www.chinagi.com.cn/yw/more.asp?typeid=21.

attractive as it will facilitate access to the prospective telecommunications and transport market. China is also interested in the co-operation due to the possible civilian and commercial application of the system. Likewise in the other East Asian countries, in China there is a huge demand for technical novelties and many customers purchase equipment incorporating satellite navigation, such as mobile phones, notebooks or private cars. A wide-scale application of the system can not only revolutionise the market of consumer electronic goods, but also improve safety of the air traffic.[76]

Although the Galileo satellite navigation system is developed only for civilian and commercial purposes, there is a risk that it might be used for military purposes. Thanks to the installation of transmission devices on missiles, using the signal sent by Galileo satellites, the ability to launch a precise attack will be largely enhanced. Furthermore, the satellite navigation system can improve co-ordination of movement of the army troops on the battleground. Both China and the European Union are aware of the potential military application of the Galileo system, so is the United States which is reluctant towards the project, not only since it is competitive to GPS, but also as it can enhance the military capability of the Chinese army. In 2005, the European Union, in order to protect itself against China's tendency to copy foreign technologies, reserved itself the right not to make some segments of the satellites available to the Chinese partners. However, while continuing the co-operation under the Galileo programme, the EU will find it difficult to prevent a transfer of the most advanced satellite technologies to China. Hence objections are raised to the EU on grounds that it supports the Chinese army and, in fact, evades the EU's embargo on the transfer of military technologies to China. The EU precludes, however, the possibility of any military use of Galileo by China and emphasises the fact that the most precise signal, the Public Regulated Service (PRS), is to be encrypted and available only to the particular entities, among them Europol, civil protection services, Maritime Safety Agency or the European peace-keeping.[77] Nevertheless, it is not certain whether it would be possible to selectively switch off the signal sent by the Galileo satellites to the countries participating in the project.

From China's perspective, its co-operation under the Galileo programme is perfectly in line with the national autonomous space programme. *China's Space Activities, a White Paper* issued in 2000 (updated in 2003), assumes the development of an independent satellite navigation system and its applications.[78] Prior to the signing of the agreement on the participation of China in the Galileo programme, three Chinese geostationary satellites had already been in the orbit and further two were deployed in subsequent years. The Chinese satellite navigation system Beidou (Compass) is intended to comprise 35 satellites and offer commercial positioning services with a measuring accuracy of approx. 10 metres and licensed services similar to the European PRS or encrypted GPS signal.[79] Yet, what China still lacks is the key technologies, such as the relevant integrated circuits or timing technology, which decide on the precision of the satellite navigation system. Although work on the atomic clock capable of operating in the outer space has been conducted for a number of years, the outcome is limited. Hence China sought the opportunity to acquire technologies of that type. In 2006, it placed an order with a Swiss company Temex for rubidium atomic clocks; these, however, are three times less precise than the clocks used in Galileo.[80] Despite all this, China aspires at a development and application of its own technologies in projects of this type. The co-operation with the EU under the Galileo programme certainly provides an excellent opportunity to gain knowledge on sensitive satellite technologies thanks to which China can find its own technological solutions to be employed in a development of a satellite navigation system competing with the European one.

Conclusions

The policy of technology transfer, pursued consistently for many years, has brought about measurable results to China in the area of modernisation and economic development of the country. Thanks to the import of high-tech goods and the policy towards foreign direct investment, where the priority importance has been attached to technology transfer, China has developed a considerable potential for the production

76 F. Bordonaro, "Galileo takes off," *ISN Security Watch*, www.isn.ethz.ch/news/sw/details.cfm?ID=14607.

77 J. C. Matias, *EU–China Partnership on the Galileo Satellite System*, Power and Interest News Report, 17 July 2007, www.pinr.com.

78 *China's Space Activities, a White Paper*, China National Space Administration, www.cnsa.gov.cn/n615709/n620681/n771967/69198.html.

79 J. van Haaften, *China's Beidou Navigation Project*, 23 February 2007, www.geoinformatics.com.

80 J. Pollpeter, "To Be More Precise: The Beidou Satellite Navigation and Positioning System," *China Brief* 2007, no. 10, The Jamestown Foundation, p. 6.

of high-tech goods and has become one of the world's leading exporters of such products. Their availability to Chinese consumers as well as the application of technologically advanced solutions in the economy have become widespread, although not in all areas China is capable of competing with foreign countries. As regards the areas where it is unable to find its own technological solutions, China has sufficient resources to be able to import the relevant goods or technological solutions from abroad, which often involves a requirement to transfer technology in various forms (a joint venture with a Chinese partner, required co-operation with a Chinese subcontractor, construction of a factory on the territory of China, disclosure of technical details in the public tender process, establishment of a foreign research and development unit in China). Such actions are in line with the Chinese government's strategy which aims at a stimulation of development of endogenic innovation in order to limit, to the largest possible extent, dependence of the Chinese economy on foreign technologies.

China made the most remarkable progress in the sector of information and communication technologies, which developed, to a considerable extent, thanks to the activities of European enterprises, such as: Alcatel, Nokia or Ericsson. However, for a few years the level of technological advancement of some Chinese enterprises has been so high that it has made them capable of expanding their business activities onto foreign markets. Here, the leaders are Huawei and ZTE, which can successfully compete with the major transnational corporations operating in the sector while, at the same time, dynamically developing their activities also on the European market.

Another area where China has attained a high level of technological advancement is satellite navigation. Recent successes in the conquest of the outer space, among them three successful manned flights, the outer space programme currently implemented, or commercial factors, have resulted in China becoming an attractive partner for the European Union under the programme of development of the Galileo satellite navigation system. One should remember, however, about the risk associated with such a co-operation, namely of a possible application of the system for purposes other than civilian ones and of a transfer of technologies which might be used in the development of an autonomous Chinese satellite navigation system.

In the other areas—nuclear power industry and civil aviation—China relied and still has to rely on foreign technologies. Although for many years it has co-operated with foreign entities, among them the leading European enterprises, and has developed its own technological potential on this basis, one should not expect that in the immediate future it would be able to achieve such a level of advancement that would enable it to satisfy the needs of the internal market (using exclusively Chinese technologies) or commence any expansion on foreign markets.

From the point of view of the European Union, development of the economic co-operation with China, including one involving technology transfer, is advantageous as it enables European enterprises to use their competitive advantages in their expansion onto the most prospective market. Yet such a co-operation entails a risk related to the tendency on the part of Chinese entities to imitate and adapt new technologies without sufficient protection of the industrial property. In such a situation the advantages referred to above can be lost to the benefit of the Chinese competitor who did not incur any expenditure on the development of new technologies and, thanks to the implementation of third-party's technologies in the production process, can successfully (mostly in terms of the price) compete with European enterprises. For this reason, what is of priority importance to the EU is the improvement of the protection of industrial property (patents and inventions, utility patterns, industrial designs and trademarks) by China. Expectedly, in the few years to come it is the area the European Union's activities in its economic relations with the Peoples' Republic of China will focus on, including under the High Level Economic and Trade Dialogue Mechanism started in April 2008.