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China

Zhang Guoliang and Deng Jianguo

Total population	1.321 billion (as of December 2007)
Literacy rate	Adult literacy: 9.08%
	Adult male: NA
	Adult female: 4.13%
GDP per capita	USD 2,707.2
Computers per 100 inhabitants	64.1 (Internet accessible)
Fixed-line telephones per 100 inhabitants	28.1 (as of 2006)
Mobile phone subscribers per 100 inhabitants	39.23 (as of March 2008)
Internet users per 100 inhabitants	16.15 (as of November 2007)
Domain names registered under .cn	9 million (as of November 2007)
Broadband subscribers per 100 inhabitants	4.4 (as of April 2007)
Internet domestic bandwidth	321Gbps (as of June 2007)
Internet international bandwidth	368,927 Mbps (as of November 2007)

(Sources: China Statistics Press 2007; CNNIC 2007a)

TECHNOLOGY INFRASTRUCTURE

In 2007, China's national cellphone penetration rate was 41.6 percent, 6.3 percent higher than in 2006; the number of Internet users reached 210 million, a 70 million increase over 2006; computer penetration among urban residents was 59.7 personal computers (PCs) per 100 households, a 15 percent increase; and colour TV penetration was 151 sets per 100 households, a 5 percent increase.

Investment in national informatization accounted for almost 10 percent of the nation's total infrastructure investment. E-Commerce expanded, accounting for 40 percent of the sales of large and medium-sized ICT enterprises.

According to a survey report on Internet development in rural China (CNNIC 2007c, p. 7), by June 2007, the rural netizen¹ population had reached 37.41 million, about a third of the urban netizen population of 125 million. Indeed, there is a remarkable gap in terms of Internet development between the rural and urban areas. Among the 737 million rural residents, Internet users account for 5.1 percent, while among the 580 million urban residents, Internet users reached 21.6 percent. Internet-related infrastructure in rural China is relatively weak. In 2005, the average number of computers was 2.7 per 100 households in the rural areas, far lower than the 47.2 PCs per 100 urban households.

Theoretically speaking, Internet access in rural areas can be made readily available. Compared to December 2006, the number of fixed phone lines per 100 rural families has increased to 26 and the number of mobile phones to 3.8. More than 50 percent of Chinese families have fixed or mobile phones (CNNIC, 2007c).

Low family incomes account for the low penetration rate of computers and the Internet in the rural areas. In 2007 the annual net income for the average rural family was only RMB 3,587 (USD 520), equivalent to the price of a low-end desktop computer. This partly explains why more than half (53.9 percent) of rural netizens surf the Internet at Internet cafés. This figure is much higher than the national average of people who surf the Internet at Internet cafés (37.2 percent) (CNNIC, 2007c). There is a lower proportion of Internet access from homes in the rural areas also because an Asymmetric Digital Subscriber Line (ADSL) connection requires a fixed telephone line and there are fewer fixed telephone lines in the rural areas than in the urban areas.

Lack of computer facilities and lack of computer and Internet literacy are the two most important factors preventing rural residents from going online. Most rural residents (84.7 percent) get information mostly from the television. There are some efforts to expand rural Internet use, including increasing rural residents' income and computer literacy and deploying more affordable Internet facilities.

INSTITUTIONS AND ORGANIZATIONS DEALING WITH ICTS

The main administrative body for information and communication technology (ICT) development in China is the Ministry of Information Industry. Founded in March 1998, the Ministry makes and enforces national information industry policy, and laws

and regulations on electronic product manufacturing, telecommunications, and computer software. It is also charged with the allocation of radio frequency, satellite orbit setting, telecommunication network series numbers, and domain names and addresses. Coordinating, promoting, and popularizing the national informatization process are also among the Ministry's responsibilities.

An important body under the Ministry of Information Industry is the China Internet Network Information Center (CNNIC). Founded as a non-profit organization and as the state network information centre in June 1997, the CNNIC is administratively operated by the Chinese Academy of Sciences. This Academy has formed a steering committee called the Computer Network Information Centre to supervise and evaluate the structure, operation, and administration of the CNNIC. The steering committee is a working group composed of well-known experts and commercial representatives in the domestic Internet community.

The CNNIC's responsibilities include providing services such as domain name registry, Internet Protocol (IP) address allocation, database service, and research on Internet adoption and use in China. As of December 2007, a decade since its founding, the CNNIC had carried out 21 nationwide Internet surveys. The survey reports have been cited as an authoritative source on China's Internet development. Some of the CNNIC's survey findings have been used in the computation of the National Informatization Quotient (NIQ), calculated based on 20 indicators covering six areas of China's informatization efforts, including resources development level, information network construction, information technology adoption and application, information products and services, information human resources, and information development environment.² The CNNIC also provides Internet technical query services and certification training, and issues website page view certifications. It maintains a cooperative relationship with many international Internet communities.

Another key institution dealing with ICTs in China is the Secretariat of the Internet Policy and Resource Committee under the Internet Society of China (ISC). The aim of the committee is to research, develop, and administer the domestic Internet, and advise the legislature on Internet-related matters. It also facilitates the development and application of Internet resources and relevant technologies.

ICT AND ICT-RELATED INDUSTRIES

China is a major importer of IT services but it is also experiencing rapid growth in the export of IT services. Since 2004, China has changed the structure of the IT industry and raised the share

of IT services (16 percent in 2006). As a result of rising computer sales and Internet usage in recent years, an increasing number of local companies (Levono, Digital China, etc.) are attempting the transition from being equipment manufacturers to being professional service providers.

In 2007, China's ICT-related industries continued to expand. By the end of 2007, the ICT industry consisted of 27,569 enterprises, 53 percent of which are manufacturers and 47 percent are software makers. In 2007, the industry had a total sales revenue of over RMB 1,000 billion (USD 147 billion) and profits of RMB 50 billion (USD 7 billion). The ICT industry accounts for 5.27 percent of the nation's total GDP.

Most key ICT products, including cellphones (14 percent), microcomputers (29 percent), digital cameras (11.9 percent), integrated circuits (22.6 percent), and colour TVs (0.7 percent), saw a steady production growth in 2007. Sale-production ratios for cellphones, computers, and colour TVs reached over 98 percent and profits in the computer, home AV, and electronic components manufacturing sectors increased by over 20 percent.

ICT exports reached USD 459.5 billion in 2007, a 26.2 percent increase over 2006 figures and 37.7 percent of the nation's total exports. ICT imports reached USD 345.2 billion, a 20 percent year-on-year increase and 36.1 percent of the nation's total imports. Leading the imports were computer and electronic components.

This expansion of trade in ICT products may be partly attributed to the nation's 'Go-out' strategy in which the government encourages Chinese enterprises to actively pursue international technological cooperation and exchange through favourable taxation and investment policies. A few domestic enterprises have set up research and development (R&D) centres overseas, bringing Chinese enterprises closer to the world in terms of technology advances.

KEY ICT POLICIES, THRUSTS, AND PROGRAMS

In 2001, the Ministry of Agriculture released the 10th Five Year Plan (2000–2004) Rural Market Information Service Action Plan, which aims to build an information system that would collect and communicate agricultural product information to farmers in a more timely and accurate manner. The plan envisions a system encompassing TV, radio, newspapers, and the Internet in most counties, key agricultural enterprises, and intermediary agencies within 3–5 years.

China's 11th Five Year Plan (2005–2010) stipulates as one of the government's major tasks bridging the urban–rural development gap by raising living standards, the level of welfare, and the capacity for self-development in rural communities.

Since 2006, the construction of a ‘new socialist countryside’ has become a principal task. The strategy focuses on rural informatization and agriculture modernization to boost rural productivity, improve rural infrastructure construction, and raise the living standards of farmers. Government subsidies are also available for the provision of dedicated government and Party networks and emergency communication services.

Relatedly, the central government issued in January 2007 its No. 1 Directive on Proactively Building a New Socialist Rural China, which explicitly requires that agricultural informatization be pushed forward. Under the plan and the directive’s framework, work in four aspects has been ongoing (Jiaping 2007):

1. Construction of rural ICT infrastructure, including hardware (an information transmission network) and software (a comprehensive agricultural content database and application software like poultry or husbandry disease expert diagnosis system and systems for predicting yield, etc.).
2. Agriculture information services such as agriculture monitoring, produce and production materials market monitoring, agriculture science and technology, job market, legal consulting, and the like.
3. Information literacy for rural residents through practical offline and online training.
4. Cultivation of an informatization-friendly environment by increasing investment, breaking information monopolies and blockades, cracking down on agricultural disinformation and misinformation, regulating information services, and offering inexpensive quality services.

Various projects are being implemented at national, provincial, city, and county levels to expand rural Internet use. So far, there have been at least four models for expanding Internet use in China’s western rural areas: a government-led model, an enterprise-sponsored model, a *laissez-faire* model, and a mixed-development model. Chinese scholars (Jingsu et al. 2008) researching Internet adoption in west rural China have concluded that to expand rural Internet use, an external push is important, but it cannot solve all of the problems; the most important approach is to cultivate a fitting social environment for Internet adoption; and neither the Internet nor any other technology by itself can work miracles overnight to make the rural areas as developed as the coastal areas.

Researchers have pointed out that the ‘farmer Internet cafés’ set up in villages face an identity crisis between being a public interest/non-profit service and being a for-profit (though small) Internet access provider. Usually run by a few innovative villagers, such cafés were set up in accordance with government’s preferential policies in the name of public interest, which

means they are largely not-for-profit. But to survive, the cafés often have to take in some for-profit business. This has caused the commercial Internet service provider (ISP) regulator to crack down on these farmers’ Internet cafés. After a short period of operation, many of the cafés had to close (Jingsu et al. 2008). For ICT investors in rural informatization, the problem is how to ensure returns on investment in the face of expensive infrastructure construction and lack of content that is attractive to farmers.

China’s National Informatization Development Strategy 2006–2020 stipulates that informatization legislation in infrastructure construction, e-commerce, e-government, information security, government information transparency, and personal data protection will be pushed. It also says that other relevant laws concerning copyright, protection of minors, and electronic evidence will be modified accordingly.

China’s informatization legislation started in 1991 with the Computer Software Protection Regulation. By December 2005, there were 108 laws and regulations and 423 documents and circulars (Jiang 2007). National-level informatization laws and regulations include the Electronic Signature Law, Radio Management Regulation, Computer Software Protection Regulation, Internet Online Service Places Management Regulation, Internet BBS Service Management Regulation, Software Product Management Regulation, Telecommunications Services Supervision Management Regulation (Interim), China Internet Domain Name Management Regulation, and Electronic Certifying Regulation. There is also a variety of local rules and regulations on informatization.

Although laws and regulations on informatization are not lacking, there are gaps, as follows:

1. There is no overarching law on informatization.
2. Current ICT rules and regulations are too abstract, so much so that most of them cannot be enforced effectively.
3. The content of current rules and regulations overlap, while newly emerging fields such as personal privacy, governmental information disclosure, and e-transactions are not adequately regulated.
4. Most current ICT rules and regulations concentrate on developed areas of the country. Where ICTs need most development, the laws are insufficient.

To address the first gap, the Information Technology Application Law has been drafted and it is expected to be promulgated soon. Other measures taken to address the gaps include learning more from the legislative practices of developed countries, strengthening related research, and establishing an efficient and comprehensive feedback system on the enforcement effect of these laws and regulations.

DIGITAL CONTENT

By November 2007 youth under 25 years old accounted for 50.9 percent (1.07 million) of the 21 million netizens in China. As the dominant group of netizens in the country, they are considered ‘the hope of China’s Internet’. This generation has been very active in creating online content. According to a survey (CNNIC 2007b), in November 2007 China had 72.82 million Weblogs and 47 million bloggers, more than double the number of bloggers in China in August 2006 (17.5 million). This means that one of every four Internet users in China is a blogger. Blog contents cover nearly every aspect of life, including studies, work, travel, culture, the military, and the economy. The survey showed that 43 percent of the bloggers are male and 57 percent are female. Among the total population of netizens, males comprise 55 percent while females comprise 45 percent. This could mean that female netizens find less useful or less interesting content on the Internet compared to male netizens, and they prefer to create their own content using blogs (Sina.com 2007).

In early 2006, there were only about 30 Web video providers in China. But by the end of the same year, the numbers had reached more than 250. In April 2007, daily views of 56.com, the country’s biggest Web video provider, reached 8 million, as opposed to 100 million daily worldwide views of Youtube. According to a report by iResearch, a media research consultancy

firm in China, more than half of the Chinese netizens viewed Web videos in 2006. The sharp increase of Web video providers in China was spurred by the influx of venture capital, which has reportedly infused USD 100 million to start Web video companies.

Given the current low penetration of digital video recorders in China, the country’s Web video providers take more video content from traditional TV broadcasters than from individual amateur videographers. This often infringes upon the copyright of the TV broadcasters, who are calling for regulation. Some video sites offer pornographic and violent content, while others have their own video host people, reporters and programming, often without licence or permission from the broadcast regulator. Licences have been given to only about 180 traditional TV broadcasters. Most online video providers are unlicensed (Xiaoqiao 2007).

In addition to consumer-driven online content creation, the Chinese government has taken measures to enrich the Internet with content that meets the needs of rural residents. The Ministry of Culture and the Ministry of Finance have started the China Cultural Resource Sharing Project, which will invest RMB 2.47 billion (USD 0.36 billion) between 2007 and 2010 to support digital content creation in western villages and counties. Province-level investment will also be increased to strengthen ICT content development (see ‘Online Wisdom Debunks Bogus Tiger’).

Online Wisdom Debunks Bogus Tiger

On 12 October 2007, Xinhua News Agency reported that a farmer in central China’s Shaanxi Province had spotted a South China tiger believed to have been extinct for 20 years, and that he had captured it on film.

The news was soon publicized widely by the local government, who released one picture of the tiger to the public. But one day after the photo hit the Internet, netizens began speculating that the ‘tiger’ was actually a paper model doctored with Photoshop. Some accused officials of using fake photography to promote tourism. The farmer and the Shaanxi Provincial Forestry Bureau, however, insisted that the photo was real. The farmer was in fact given a sizable reward by the Forestry Bureau which is responsible for sustaining endangered species and for promoting tourism.

Later, a team of graduate students at the National University of Defense Technology in Hunan Province released a comprehensive analysis of the photos. The team concluded that the tiger in Zhou’s photos is 99.86 percent identical to an image on a wall hanging. In answer to the objection that Zhou’s tiger ‘blinked’ in certain photos, the team convincingly demonstrated that any eye movement was simply the result of motion blur.

The ensuing online firestorm pushed the national media to investigate for possible fraud. Finally, higher forestry authorities stepped in and after a probe admitted that the tiger was bogus. One blogger wrote that the incident showed that ‘the government agency’s credibility is on the edge of extinction in China’. The Southern Metropolis Daily noted that ‘the era when people blindly believe what the government tells them is over. Likewise, the era when the people are too afraid to speak out is also over’.

(Source: Duerme 2007)

ONLINE SERVICES

During the 10th Five Year period, e-government was given emphasis to help improve the efficiency of government, economic restructuring, market regulation, and social administration. However, current e-government services focus mainly on providing public information and not on streamlining internal processes. Moreover, each government is building its own network and system, thus making cross-governmental information sharing difficult. The hope is that by 2010 a national e-government network and governmental information sharing system will be built, to enable 50 percent of government administrative licencing and approval work to be completed online.

As for e-commerce, China’s e-commerce transaction volume in 2006 totalled RMB 1,500 billion and e-procurement by the nation’s 9,267 large and medium-sized enterprises reached RMB 592.8 billion (iResearch 2007). But e-commerce among small and medium-sized enterprises, which totalled over RMB 30 million in 2006, has been somewhat underdeveloped, with only 28 percent of them having used e-commerce in 2006. This means that there is a huge growth potential for e-commerce in this sector.

In the first 10 months of 2007, e-commerce sales by individuals accounted for 0.8 percent of the country’s total retail sales, representing a threefold increase over 2006 figures (iResearch 2008).

ICT-RELATED EDUCATION AND CAPACITY-BUILDING PROGRAMS

China began to consider software engineering as a serious discipline around 1982. The program to improve Chinese software engineering practices is in full swing in the universities. Chinese officials recognize that for China to become a major outsourcing alternative for the rest of the world, its software professionals must be able to communicate in their customers’ native language, usually English.

China is now the world’s largest computer hardware producer and it hopes to consolidate its local innovation work. This in turn means it has an increasing demand for workers with consummate knowledge and computer literacy. However, there are significant hurdles. Statistics show that 40 percent of China’s rural labour force has had only primary schooling or less and only 12 percent has reached senior high school level. Ninety-two percent of China’s illiterate population is in the rural areas where there is poor education infrastructure (Qi 2008). In 2004, computer application in the nation’s primary and secondary schools was 36 percent and only 16 percent of teachers had taken

ICT training. Through a number of pilot programs, the Chinese government is aiming to provide 90 percent of elementary and secondary schools with Internet access and for them to offer at least one ICT course for all students by 2010.

China’s ICT-related education and capacity-building programs fall into two categories: widespread institutionalized distance education, and small pilot programs pushed by concerned governmental departments. The development of distance education in China has undergone three phases: correspondence education, TV and radio education (mostly conducted by China Central TV University), and ICT-based distance education. In 1998, the Ministry of Education pilot-tested Internet-based distance education in four universities. This was soon expanded to 45 universities and by 2004, the volume of distance education enrolment equalled the volume of full-time student enrolment. In recent years recruitment has increased 150 percent to meet the growing market for distance education.

But despite the impressive expansion in student enrolment, China’s distance education provision is challenged by low computer penetration, slow Internet speeds, expensive Internet use fees, and poor quality broadband multimedia course provision. Other problems include lack of learner engagement and lack of laws, such as a Distance Education Law, that will regulate the distance education market, which now has more than 70 players offering courses of varying quality (Jianfang 2007). Program discrepancies and differences are among the factors that prevent wide recognition of distance education in China.

The Ministry of Agriculture has 16 projects for farmers of which 10 are concerned with farmer training and rural ICT development. The China Central Organization Department will pilot test distance education for rural party-member cadres in nine provinces with the aim of putting in place a rural party-member cadre distance education network by the end of 2010. The training programs for the agricultural sector aim to increase the information literacy of rural residents using practical textbooks and flexible methods combining face-to-face interaction with distance education and ICT-supported learning. Literate and entrepreneurial farmers wanting to use ICT to gain an edge in their business are core trainees in these programs. This group of trainees, who are mostly opinion leaders, are expected to set an example for other rural residents.

OPEN SOURCE/OPEN CONTENT INITIATIVES

Internet developers and researchers have long been working to develop China’s own computer operating system, but with little success. A breakthrough is being sought via open source software.

Currently there are two organizations pushing the open source software movement in China: the China Open Source Software Promotion Association and the Linux University Promotion Association. On 17 December 2005, the FLOSSWorld Annual World Conference was held at Tsinghua University, Beijing. Twenty Chinese open source software experts spoke at the conference about the open source situation in China. The conference reached a consensus that integrating open source software with next-generation Internet is an effective way to make China's voice heard in global technology development.

According to Professor Ni Guangnan (*Guangming Daily* 2006), an academician of the China Engineering Academy, the challenges to open source software use in China include how to build open source software communities to supplement the development by enterprises, how to create a viable business model for enterprises using open source software, and how to make full use of open source software to succeed in start-ups.

Meanwhile, the open content movement is being pushed online mostly by bloggers and podcasters. Chinese netizens are still in the early stage of knowing about Creative Commons (CC) licencing. According to a survey released on 12 December 2006, most Chinese respondents know little about CC agreements or of the existence of a Chinese version, while 27 percent of the respondents said they didn't know them at all (Yang and He 2008).

Current efforts to introduce CC licencing have run across three major challenges. First, the CC agreement was originally created to fight innovation stifling copyright overprotection in the United States, whereas copyright protection in China is weak rather than strong. Second, in China, CCs are used mostly in the blogging and podcast spheres where quality content is still lacking, so CC adoption may not spur as much innovation as expected. Third, CC licencing can be abused by unauthorized parties and thus incur legal risks for CC content users (Yang and He 2008).

ICT RESEARCH AND DEVELOPMENT

The state council indicated in December 2005 that efforts should be exerted to enhance capabilities in innovation, importation, absorption, and re-innovation, and to develop the core industries such as integrated circuits and software. Furthermore, the 11th Five Year Plan enshrines China's new economic policies of relying on rural development and scientific and technological innovation.

In line with these policies, R&D expenditures will be increased annually to 2.5 percent of Gross Domestic Product

(GDP) by 2020. A set of incentive policies favouring innovation-oriented start-ups and knowledge-based enterprises was issued in February 2006. Among others, it provides for the deduction of R&D expenditures from annual tax returns at a rate of 150 percent, and it gives priority to China-made innovative technologies and products in government procurement.

For some time now China has been working on its own proprietary computer chips. In 2007 the Loongson microchip designed and manufactured by the Computer Institute of the China Science Academy was purchased by ST Microelectronics (ST), the world's fifth largest semiconductor company. The company is authorized to produce and sell the chip globally. The deal signals the successful integration of the Loongson chip in the global chip production chain (Jongo and News 2007a). The Loongson CPU is a 64-bit Microprocessor without Interlocked Pipeline Stages (MIPS) III Reduced instruction set computer (RISC) processor. It works with only 5–7 W power (4.07 W in recent tests), which is a fraction of the power needed to run AMD or Intel products.

Meanwhile, China is set to unveil the first ultra mobile PC using domestic microprocessor technology with chip design technologies transferred from the US firm AMD (Jongo and News 2007b).

CHALLENGES AND OPPORTUNITIES

In 2007 China's economy underwent significant changes as evidenced by the rapid appreciation of the Chinese currency; the promulgation of the new Contract Law; the unification of taxes leveled on domestic and foreign enterprises; and the adjustment of export tax rebates. All of these changes have nearly cancelled out the comparative cost advantages enjoyed earlier by China's exports, 85 percent of which consisted of electronic products (Industry 2008). The changes have also caused the affected enterprises to adjust their trade methods or shift investments to other counties such as the Philippines and Vietnam.

Another challenge for China's ICT industry has to do with the shift of outsourcing to and increasing integration of manufacturing and non-core services. Chinese enterprises, most of which have rather narrow business scopes, need to integrate their resources in the face of heightened competition.

A third challenge is the need for Chinese manufacturers of electronic and information products to meet eco-design of energy-using products (EUP) requirements. The European Union (EU) is the biggest importer of China's electronic and information goods, importing over USD 60 billion worth of such products (including colour TVs, computers and monitors,

electricity chargers, and printers) in 2007. Over a third of these exports to the EU will now be subject to EUP requirements (Industry 2008), which will certainly bring more pressure on Chinese manufacturers to increase product quality.

Other challenges include lagging after-sale services caused by rapid product updates, and electronic waste recycling.

On the other hand, a number of opportunities are available for China’s ICT industry. For one, the third generation (3G) licence issued to three major telecommunications operators in January 2009 will boost infrastructure construction and user consumption. Second, with the opening up of China’s financial industry since 2006, more foreign-owned banks are coming into China to set up branches and financial networks. This will give momentum to ICT development in China. Third, the 2008 Olympics in Beijing resulted in heavy investment in digital TV, MTV, and 3G technologies, as well as brick and mortar infrastructure construction (Enet.com 2007).

History has repeatedly proven that change and even crisis can speed up technology adoption. China is in a period of transition, with its economy, society, and politics undergoing dramatic changes. As China becomes more market-oriented, business organizations will adopt ICTs and boost information processing. The country now has 2.1 billion Internet users. The habituation of e-life in the years ahead will push the informatization process forward.

NOTES

1. According to the definition by CNNIC, a netizen refers to any Chinese citizen who uses the Internet more than one hour on average per week.
2. In 2007, the China Network Information Center changed its definition of netizen from ‘any Chinese citizen who uses the Internet more than one hour on average per week’ to ‘any 6-year-old or above Chinese citizen who used the Internet within the past six months’.

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