

5-1-2004

# China's ICT: Progressing toward Maturity From a Global Perspective

James W. Gabberty Ph.D.  
*Pace University*

Linda Jo Calloway Ph.D.  
*Pace University*

Follow this and additional works at: [http://digitalcommons.pace.edu/csis\\_faculty\\_papers](http://digitalcommons.pace.edu/csis_faculty_papers)

---

## Recommended Citation

Gabberty, James W. Ph.D. and Calloway, Linda Jo Ph.D., "China's ICT: Progressing toward Maturity From a Global Perspective" (2004). *Faculty Papers*. Paper 3.  
[http://digitalcommons.pace.edu/csis\\_faculty\\_papers/3](http://digitalcommons.pace.edu/csis_faculty_papers/3)

This Article is brought to you for free and open access by the Ivan G. Seidenberg School of Computer Science and Information Systems at DigitalCommons@Pace. It has been accepted for inclusion in Faculty Papers by an authorized administrator of DigitalCommons@Pace. For more information, please contact [rracelis@pace.edu](mailto:rracelis@pace.edu).

# China's ICT: Progressing toward Maturity From a Global Perspective

James W. Gabberty, (E-Mail: [JGabberty@Pace.edu](mailto:JGabberty@Pace.edu))

Linda Jo Calloway, (E-mail: [L.Calloway@Pace.edu](mailto:L.Calloway@Pace.edu))

## Abstract

*This paper assesses the information and communications technology (ICT) factors governing China's economic expansion and its ability to sustain this expansion in the context of competing nations with similar infrastructures. This assessment utilizes a variety of selected metrics that capture the status of ICT capability in China. It provides a glimpse into the country's ability to become a significant force in the global knowledge economy by highlighting the nation's overall competitiveness rankings, juxtaposed to the standings of other nations. The timeliness of this work is noteworthy, since the success of China's transition towards economic and societal advancement is underpinned, to a large extent, by its total ICT investment. If a positive outcome is achieved, Chinese manufacturers will be able to adroitly weave themselves into the global supply chain by leveraging the country's burgeoning ICT infrastructure.*

## Introduction

China is one of the fastest-growing economies in the world since it embarked on its path toward market socialism in the late 1970s. According to statistics from the World Bank, its gross domestic product grew during the period 1978 through 2001 at an average annual rate of 9.55% while the economies of Japan, Germany, and the United States grew at rates of 2.84, 1.98, and 3.06, respectively. Foreign multinational corporations (MNCs), attracted by the nation's vast pool of inexpensive labor and state sponsored special economic zones (SEZs), poured billions of dollars into the country to attain competitive advantage made possible by outsourcing labor-intensive production to lower-cost suppliers. China's ability to sustain large foreign direct investment (FDI) inflows has increased steadily and, from 1991 through 2001, averaged annual inflows in excess of \$35 billion. This is an astonishing feat, considering that prior to 1982, that nation received no FDI inflows and, in the period 1993 through 1998, subsequently skyrocketed to the number two global position of FDI investment, topped only by the United States.

From the perspective of information and communication technologies (ICT), the number of Internet users in China, for example, has increased by more than six times from 1997 to 1999, reaching an estimated 8.9 million at the end of 1999; as of 2004, it rose ten more times to 80 million (Luo, 2000; Layman, 2004). The success of China's intended transition towards economic parity with other developed nations depends on its investment in ICT (Gabberty, 2004). If executed correctly, Chinese manufacturers will be able to weave their firms into the global supply chain, thereby enhancing the nation's chances of realizing its goal of becoming the world's workshop (Spencer, 2003).

From the economic and infrastructural perspectives, Asian and Western MNCs are eyeing China's progress from two perspectives: the first is concerned with the myriad of marketing opportunities to a massive consumer populous clamoring for world-class branded products; the second relates to the development of strategic partnerships that leverage China's vast labor pool (Lardy, 1992).

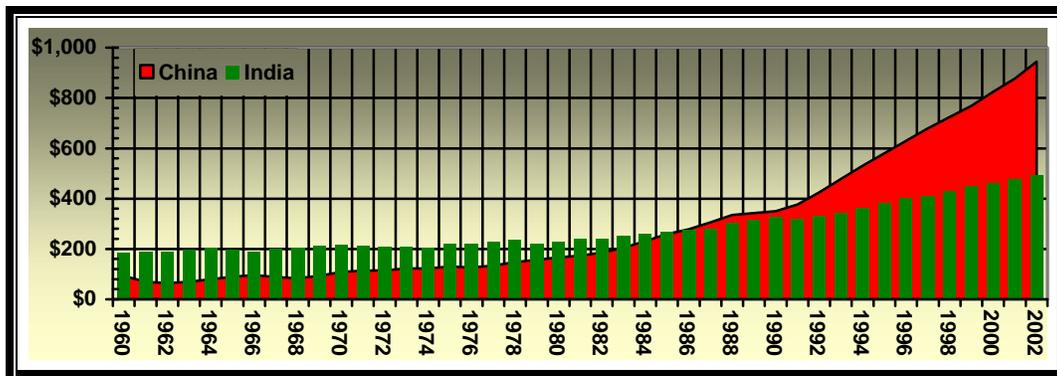
This feat of bringing China out of its fragile and decrepit past and into an era of a thriving and invigorated economy poses formidable challenges to the nation's leaders. From this purview, China is at a crossroads. If successful, it may indeed reclaim its former position as the world's largest and most extensive economy. It is not surprising, therefore, that China has thrown open the doors to foreign investment to exploit substantial knowledge transfer agreements and to leverage the continued expansion of the global economy. This assumes however, that China possesses the cumulative ability of maximizing technological absorption and the technical capacity to catch up with the knowledge-based economies in the West and in other Asian countries such as Japan and Singapore.

## China in Historical Context

“Poverty is not socialism. It’s glorious to get rich...Let some people get rich first” said Deng Xiaoping following the historic visit to China by President Nixon in the mid-1970s (Dela Rosa, 2002, page 1). Shortly thereafter, a series of negotiations opened the country up to Western trade, technology, influence (limited) and access to money that provided the nation with a path toward prosperity. Since 1979, China has been engaged in efforts to reform its economy. One of the ways the nation is accomplishing this task is through foreign business ventures. Characterized by limited liability agreements in which both partners are responsible for the day-to-day operations of the firm, at least 25 percent of the equity of any joint venture belongs to the foreign investor. In the case of high-tech ventures where corporate governance policies are less likely to give up any control to Chinese business leaders (owing to the sophistication of the product mix), China established a special classification of wholly foreign-owned enterprises (WFOEs), which, although they only account for a small percentage of Chinese business ventures, numbered 24,000 with a combined value of \$39 billion in 1996 (Ho, 1990; Grub & Lin, 1991, Weidenbaum & Hughes 1996).

Further, China’s “Golden Initiatives” ICT project, announced during the 16th national Congress of the Communist party of China in 2002, is proclaimed by the government to be the decisive factor that will move China into the set of knowledge economies of the 21st Century (Dahlman & Aubert, 2001). Continuing its preference for ten-year economic growth strategies, China’s declared strategy is to build and deploy a manufacturing environment leveraging all that the knowledge-based economy has to offer, through (a) updating economic and institutional regimes, (b) upgrading education and learning, and (c) creating and deploying a sound information infrastructure.

The resulting rate of growth in China has also caused the largest human migration in recorded history. Workers from the hinterland are streaming toward the busy coastal cities, placing severe strains on an outdated and inefficient civilian infrastructure. Although historically at parity with other developing nations such as India, China’s economic progression has doubled this comparative ratio in 2001 (to \$878 compared with India’s level of \$477), as illustrated by *figure I*.



**Figure I: Per Capita GDP of China and India  
(Constant 1995 US\$)**

Source: Table NY.GDP.PCAP.PP.CD World Development Indicators 2004, Washington: World Bank

## The Export Dependence of China

The magnitude of China's dependence on its exports is illustrated in *figure II*. This chart demonstrates in comparative context the bi-directional dependencies of the U.S. with two of its most important imbalanced trade partners, Japan and the U.S. Both China and Japan maintain huge trade surpluses with the U.S. From the Chinese perspective, China's marked increase of exports to the U.S. illustrates its trade reliance on the U.S. especially since its exports to the U.S. are approximately 50% of its total exports. The view from the U.S. indicates that trade with China has also grown in significance. Goods imports usually consisting of textiles, apparel, and personal computer components and represent around 10% of total U.S. imports.

In contrast, trade between Japan and the U.S. has eroded somewhat in recent years to less than 30% (from a high of 40%) of Japan's exports. Likewise, U.S. imports from Japan are falling, and by 2000 they were at 10% or one-quarter of the Chinese level. Clearly, Japan's reliance on its perpetual trade deficit with the U.S. virtually guarantees the dollar value of its exports to the American market will continue to be sizeable, but China nonetheless has a greater dependency level on the U.S. in terms of its total global trade to sustain its economic growth.

Recent calls by senior-level U.S. politicians and trade union representatives for the nation to devalue its currency, while its trade surplus figure concomitantly exceeds \$100 billion, provides additional evidence that China's overarching dependence on continuance of its export-orientation trade policy is a reality. So, while Japan in historical context shunned inward FDI, China has not only attracted but indeed become dependent on foreign investment.

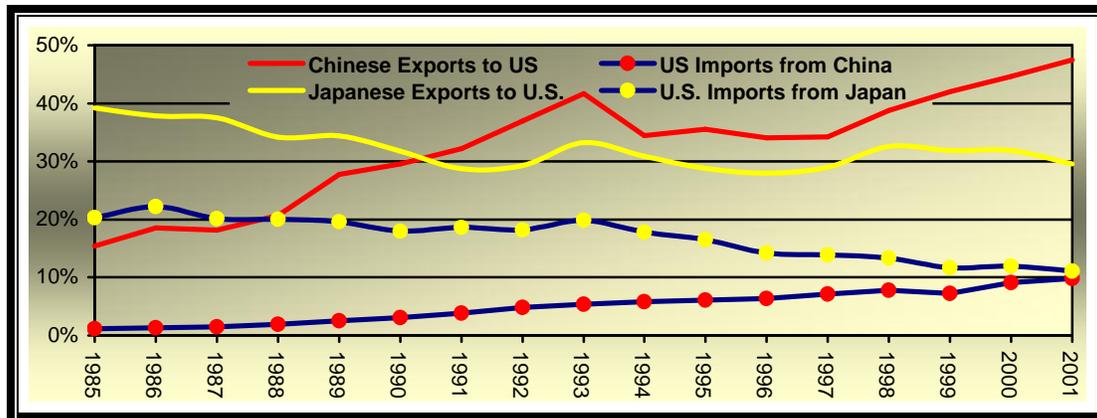


Figure II: Bi-Directional Share of Chinese vs. U.S. Goods Exports & Imports

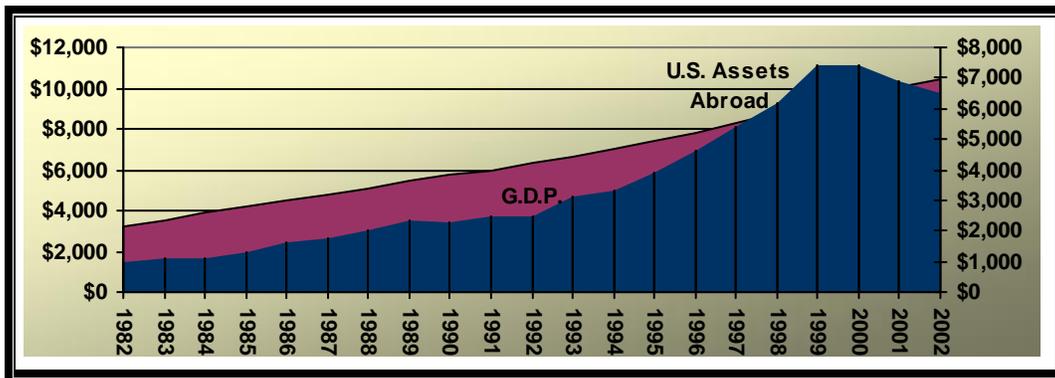
Source: U.S. Census Bureau at <http://www.census.gov/foreign-trade/balancel> and <http://www.bea.doc.gov/bea/newsrel/trad1302.pdf>; Table No. 1328 from *Statistical Abstract of The United States 2000*, Table No. 1328, and Tables BX.GSR.MRCH.CD, BM.GSR.MRCH.CD, *World Development Indicators*, Washington: World Bank

## China's Need to Innovate

The rapid technological change witnessed during the 1990s helped bring about the enormous leap in output by Western nations, notably the United States. Technological leaps in telecommunications (email, networked systems, the Internet), hardware (personal computers, client-server architectures) and software (distributed databases, middleware) have made it possible for domestically-based U.S. manufacturers to spread their production assets globally. This expansive geographic positioning leverages the inherent value of globally-dispersed network linkages that underpin the corporate expansion, contraction, and relocation of worldwide production and R&D centers that have helped the U.S. gain sustainable competitive advantage.

China, in contrast, lagged technologically until the 1990s. However, in the 1950s, the Soviet Union maintained an advisor residency in the new People's Republic of China, and computer science technology was transferred into the compounds maintained by the Soviets. As a result of these investment programs, the Soviet Union endowed China with what was then state of the art computer technology. When the Soviet advisors left in 1960, advances in computer science ended as well. For the next 30 years, China's ICT advances were few.

With more than \$6 trillion in assets divested globally (see *figure III*), the U.S. stands alone as the unchallenged world leader in terms of magnitude of its domestically-produced ICT assets as competition increases. China, having witnessed the capabilities that ICT infrastructures are capable of delivering, is bent on building out its infrastructure to mimic the successful MNCs multinationals so as to leverage its labor resources and advance its economy.



**Figure III: U.S.-Owned Assets Abroad**

Source: U.S. Bureau of Economic Analysis, Table 2 - International Investment Position of the United States at Year end, U.S. Commerce Department, Washington: World Bank

As innovation has become a major determinant of the competitiveness of a nation such as China, its domestic producers seek to leverage the global workforce through ICT strategies, firm-level endeavors that seek to exploit the systemic characteristics of new technologies and products increase. Multinational corporations, by virtue of their ability to extend their competitive advantage beyond borders and compete in foreign markets with domestic firms, carry with them a sophisticated array of skills, technological knowledge and organizational structures to operate ICT efficiently and effectively and to carry out required processes of technological change. Infrastructural technologies, in particular, offer far more value when shared than in isolation (Carr 2003).

From the national perspective, China's need to innovate resonates with the tenets of competitiveness espoused in the World Economic Forum's 2003 *Global Competitiveness Report* by Harvard's Michael Porter, who, besides serving as co-chair of this report, is on the U.S. Council on Competitiveness. He posits that a nation's prosperity is created, not inherited, and that a nation's competitiveness depends on the capacity of its industry to innovate and upgrade. Further, he argues that countries also gain competitive advantage because of pressure and challenge. They benefit from having strong domestic rivals, aggressive home-based suppliers, and demanding local customers. As international trade flourishes, innovation becomes paramount. Porter believes that innovation is what drives and sustains competitiveness, and a firm must avail itself of all dimensions of competition (Porter, 1990).

## Is China's Strategy Working?

Although China's move toward matching information and communications technology (ICT) parity with Western nations is not yet a reality, the nation achieves high marks in various quantitative and qualitative scores that place its ICT maturation development on an upward trajectory. This section demonstrates some areas, in terms of similar export-driven countries, where China is better poised to take advantage of ICT maturity to help sustain economic growth and other areas where China lags.

The findings and prescriptions for China's policy initiatives offered in this section are based on juxtaposing data that captures China's rankings in the contexts of both the 75 nations global competitiveness survey results from the 2003 World Economic Forum (WEF) and the 41 export-oriented countries ratings from the National Asia Pacific Economic and Scientific Database (NAPES, 2001). The NAPES ratings are a comprehensive database of long-term economic indicators for the Asia-Pacific region covering bilateral trade, economic and industrial research and development, and patents. The country selection criteria are simply those nations that have embarked on a path of economic development through trade, and they are shown in *table I*.

<i>Australia</i>	<i>Germany</i>	<i>Korea</i>	<i>Spain</i>
<i>Austria</i>	<i>Greece</i>	<i>Malaysia</i>	<i>Sri Lanka</i>
<i>Bangladesh</i>	<i>Hong Kong</i>	<i>Mexico</i>	<i>Sweden</i>
<i>Belgium-Luxembourg</i>	<i>Hungary</i>	<i>Netherlands</i>	<i>Switzerland</i>
<i>Canada</i>	<i>Iceland</i>	<i>New Zealand</i>	<i>Thailand</i>
<i>Chile</i>	<i>India</i>	<i>Norway</i>	<i>Taiwan</i>
<i>China</i>	<i>Indonesia</i>	<i>Philippines</i>	<i>Turkey</i>
<i>Denmark</i>	<i>Ireland</i>	<i>Poland</i>	<i>UK</i>
<i>Finland</i>	<i>Italy</i>	<i>Portugal</i>	<i>US</i>
<i>France</i>	<i>Japan</i>	<i>Singapore</i>	<i>Vietnam</i>

**Table I: Select NAPES Countries**

Part of the data analysis used to test the relative maturity of China's ICT is based on the WEF (2003) Global Competitiveness Report for 2001-2002. A component of this report is the Executive Opinion Survey, the results of which are derived from the responses of key executives surveyed from each country. These responses are organized into the ten categories illustrated in *table II*.

<i>Macroeconomic environment</i>
<i>Technological innovation and diffusion</i>
<i>Information and communications technology</i>
<i>General infrastructure</i>
<i>Public institutions: contracts and law</i>
<i>Public institutions: corruption</i>
<i>Domestic competition</i>
<i>Cluster development</i>
<i>Company operations and strategy</i>
<i>Environmental policy</i>

**Table II: Executive Opinion Survey Responses**

Executive expert opinion is used in these and similar rankings to assess the relative capabilities of countries to compete in global markets and are considered as harbingers of executive actions. Without appropriate executive

direction ICT expenditures continue to remain money spent rather than productivity gained. ICT investments create productivity when they are implemented in the context of other, complimentary investments such as new work systems, organizational redesign and business process reengineering (Brynjolfsson and Hitt, pages 1 – 2 )<sup>1</sup>.

Forty-eight metrics that specifically characterize aspects of ICT capability were isolated from the Global competitive Index of the World Economic Forum (WEF)<sup>2</sup>. To clarify the differences of executive opinion on the set of components selected, the ratings scores for all 75 countries from the WEF dataset were ranked and the rating scores for the 41 country from the NAPES/WEF subset were also ranked. China’s rankings amongst the NAPES countries highlight expert opinion about ICT capabilities relative to the set of economies that will compete with China for knowledge-based trade. China’s rankings amongst the complete WEF set of countries shows the opinion scores relative to a larger and more diverse set of countries. A juxtaposition of these two sets of data serves to demonstrate differences in the importance of these components in the contexts of the different set sets of countries.

Survey data is inherently ordinal and differences in the minds of the respondents might exist among likert values. To normalize these rating scores we computed the means and standard deviations for each component relative to each country set. We devised the following method whereby the data has a coarser granularity, but more likely to reflect actual differences among the various country rating scores for a component: The standard deviation for the country sets was added to or subtracted from each rating score. If this modified score was greater than the mean value of the set plus one standard deviation, it was assigned a score of 3. If it was less than the average value minus one standard deviation, it was assigned a score of 1. Otherwise, it was assigned a default score of 2 (see *table III*).

<p><i>Component Mean + Standard Deviation &gt; = rating score, assign a 3</i></p> <p><i>Component Mean – Standard Deviation &lt; = rating score, assign a 1</i></p> <p><i>Otherwise, assign a 2.</i></p>
--

**Table III: Rating Assignment Methodology**

*Appendix A* is a list of the component metrics selected to represent ICT capability. A comparative analysis of these data identifies factors that may put China at greater risk than previously identified in its efforts to move from an export-driven manufacturing economy into a knowledge-based economy. The majority of the normalized rating for both WEF and NAPES data were assigned a 2, indicating that the rating score for that country is within one standard deviation of the mean. Of the 48 factors selected to represent ICT capability, fifteen factors had rating scores of 2 for the WEF set and 1 for the NAPES set. A value of 1 indicates that the score is more than one standard deviation below the mean. The component is actually ranked lower within the set of economies that will compete with China for knowledge related trade. If the NAPES and WEF rankings were less than 10% apart, the data was considered spurious. Some factor ratings were the same for more than one country and some factor ratings were close to the boundary between standard deviations making differences specious. The surviving twelve components along with their rating scores and relative rankings are presented in *Table IV*.

These twelve factors emerge as those where China is at significant risk of misjudging what actions are required to develop future ICT capability and to continue the ascent into the information driven global economy. China’s ranks for every one of these twelve components are unusually low when the focus is framed by the export driven economies. Most are in the lowest 15<sup>th</sup> percentile. More importantly, the extent of these disadvantages was hidden when framed within the larger WEF country set.

As a cursory validation measure we performed the same ranking computations for the set of 10 countries in the Asia Pacific Economic Cooperation group used by Bui, Sebastian, Jones and Naklada (2002) to rate e-commerce

<sup>1</sup> Milgrom and Robetts (1990), Malone and Rockart (1991), Bresnahan and Trajtenberg (1995), Greenwood and Jovanovic (1997), and Bresnahan (Brynjolfsson and Hitt, 2002).

<sup>2</sup> For a complete list of factors rated for all 75 countries, please see the references in the bibliography for the WEF *Global Competitiveness Report 2001–2002 (GCR)*.

readiness in East Asian economies<sup>3</sup>. In the APEC study, China ranked 8<sup>th</sup> among the 10 countries for overall e-readiness (page 26). China's average rank using the current WEF/NAPES method for the APEC country set also put China in the low 20<sup>th</sup> percentile.

### **Conclusion and Suggestions for Further Study**

From an economic and infrastructural perspective, both Asian and Western MNCs eye China's progress from a bifurcated perspective: the first concerned with marketing to a nation having a massive consumer market that is beginning to accumulate discretionary cash and the second relating to the development of strategic partnerships to leverage the labor pool that China has to offer. This feat of bringing China out of its fragile and decrepit past and into an era of revitalization poses a formidable challenge to its leaders. From this purview, China stands at a crossroads in its history and is poised to reclaim its former position of being the world's largest economy.

Our study provides a launch point for subsequent development of a body of work that could complement Dewan and Kraemer's work on targeting ICT policy towards countries with the appropriate development profile (2002), the seminal firm-level work of Brynjolfsson and Hitt (2003), and the regional level studies suggesting a "marked spatial distribution" benefit of IT investment by Hicks and Nivin (2000). Here are some possible approaches:

1. China's leaders recognize that IT has a positive correlation with that nation's policy towards economic expansion. Subsequent research that builds on the work of Kraemer et al. and Bassanini, for example, may find that IT investment is best focused on the more developed coastal provinces of China, while more basic production factors are better investments in rural China. Coupling this research with income and development disparity studies (e.g., Chang 2003 and Wang 2003) may create possibilities for using the data presented herein to establish policy guidelines for ICT investments in the Coastal vs. Hinterland (i.e., low performing) Provinces in China.
2. It may be possible to predict or assert which segments of China develop fastest or slowest and the extent to which this development may advance based on how the current data for China fits with existing research profiles. The spatial-distribution studies of Hicks and Nivin, for example, could provide an analytical starting point for decisions on ICT location deployment along with Dewan and Kraemer's 2000 study.

This paper provides an introduction for developing methods for measuring GDP growth (export-driven) juxtaposed with IT infrastructure to guesstimate which points along the IT maturation path are critical for China to pursue to minimize the risks that IT poses to that nation while concomitantly maximizing those aspects of IT which generate higher overall returns. A theoretical model may be constructed that helps academics, strategic planners, and political leaders to benchmark the monumental effort of bringing China up to the economic standards of the West over the next 50 years.

---

<sup>3</sup> The ten APEC countries are, Chinese Taipei, Hong Kong, Indonesia, Malaysia, and Peoples Republic of China, Philippines, Singapore, South Korea, Thailand and Vietnam.

## References

- Bassanini, Andrea and Scarpetta, Stefano, "Growth, technological change, and ICT diffusion: Recent evidence from OECD countries" in *Oxford Review of Economic Policy*, New York: Oxford University Press, Volume 18, Issue 3, 2002, page 324.
- Brynjolfsson, Erik and Hitt, Lorin M., "Computing Productivity: Firm-Level Evidence". MIT Sloan Working Paper 4210-01, *MIT Sloan School of Management*, June, 2003.
- Bui, Tung X., Sebastian, Ina M., Jones, Wayne and Naklada, Sizemore, "E-Commerce Readiness in East Asian APEC Economies - A Precursor to Determine HRD Requirements and Capacity Building", Working Paper by the APEC Study Center, University of Hawaii at Manoa, Honolulu, USA, 2002.
- Carr, Nicholas G., "IT Doesn't Matter", *Harvard Business Review*, May, 2003, page 6.
- Chang, Gene H, "The Cause and Cure of China's Widening Income Disparity", *China Economic Review*, New York: Elsevier, Volume 13, 2002, pp. 335-340.
- Dahlman, Carl J. and Jean-Eric Aubert, "China and the Knowledge Economy - Seizing the 21<sup>st</sup> Century", *The International Bank for Reconstruction and Development*, the World Bank, 2001.
- Dela Rosa, Fred, "To Get Rich is Glorious", *The Manila times*, November 8, 2002, [www.manilimes.net](http://www.manilimes.net).
- Gabberty, James, "Revving the Innovation Engine in China, Japan, and the U.S.", *Journal of Innovation: Management, Policy & Practice*, Volume 6, and Issue 1. April, 2004.
- Grub, Philip Donald and Jian Hai Lin, *Foreign Direct Investment in China*, New York: Quorum, 1991, page 72.
- Hicks, Donald A. and Steven R Nivin, "Beyond Globalization: Localized Returns to IT Infrastructure Investments", *Regional Studies*, Volume 34, Number 2, ABI/INFORM Global, April 2000, p. 115.
- Ho, Alfred K., *Joint Ventures in the People's Republic of China: Can Capitalism and Communism Coexist?*, New York, Praeger, 1990, 15 – 16.
- Lardy, Nicholas R., *Foreign Trade and Economic Reform*, New York: Cambridge University Press, 1992. Pages 69 – 73, 122 – 126
- Layman, Jay, *Internet Users in China Number Nearly 80 Million*, ECT News Network, 2004, E-Commerce Times (online), available at <http://www.ecommercetimes.com/perl/story/32610.html>, page 1
- Luo, Yadong, *Multinational Corporations in China: Benefiting from Structural Transformation*, Oxfordshire, UK: Copenhagen Business School Press, 2000, pages 196-198.
- NAPES (2001). National Asia Pacific Economic and Scientific Database: Data Ranges, Indicators and Countries. <http://napes.anu.edu.au/nph/dbrange.html#mp>
- Porter, M. E., *The Competitive Advantage of Nations*, New York: Free Press, 1990.
- Dewan, Sanjeev and Kraemer, Kenneth L. "Information Technology and Productivity: Evidence from Country-level Data", *Journal of Management Science*, Volume 46, Number 4, ABI/INFORM Global, April 2000, p. 548.
- Spencer, J.W., "Global Gatekeeping, Representation, and Network Structure: A Longitudinal Analysis of Regional and Global Knowledge-Diffusion Networks", *Journal of International Business*, Volume 34, Issue 5, September, 2003, pages 428 – 442.

Wang, Can, *China's GDP: Examining Provincial Disparity*, Luxemburg, Austria: International Institute for Applied Systems Analysis, 2003.

Weidenbaum, Murray and Samuel Hughes, *The Bamboo Network: How Expatriate Chinese Entrepreneurs are Creating a New Economic Superpower in Asia*, New York, The Free Press, 1996, pages 122 – 123.

World Economic Forum [WEF] *Global Competitiveness Report [GCR] 2001-2002*, 2003.

Category	Title	Difference in rank: WEF/NAPES	WEF category	WEF % rank of 75	NAPES category	NAPES % rank of 41	APEC % rank of 10	Description
<b>Technological innovation and diffusion</b>	Availability of Scientists and Engineers	16%	2	79	1	95	80 +-10	Scientists and engineers in your country are (1=non-existent or rare, 7=widely available)
<b>Information and communications technology</b>	Speed and Cost of Internet Access	13%	2	77	1	90	80 +-10	Lease-line or dial-up access to the Internet in your country is (1=slow and expensive, 7=as fast and cheap as anywhere in the world)
	Quality of Competition in Telecommunication Sector	16%	2	77	1	93	90	Is competition in your country's telecommunications sector sufficient to ensure high quality, infrequent interruptions and low prices? (1=no, 7=yes, equal to world's best)
	IT Training and Education	11%	2	84	1	95	90	Your country's IT training and educational programs (1=lag far behind most countries, 7=are among the world's best)
	Laws Relating to ICT Use	12%	2	71	1	83	80	Laws relating to electronic commerce, digital signatures, and consumer protection are (1=non-existent, 7=well-developed and enforced)
<b>Public institutions: contracts and law</b>	Quality of Public Schools	14%	2	66	1	80	70 +-10	Public (free) schools in your country are (1=of poor quality, 7=equal to the best in the world)
	Intellectual Property Protection	10%	2	80	1	90	70 +-20	Intellectual property protection in your country is (1=weak or non-existent, 7=equal to the world's most stringent)
<b>Cluster development</b>	Buyer Sophistication	23%	2	65	1	88	90	
<b>Company operations and strategy</b>	Production Process Sophistication	19%	2	56	1	75	70 +-10	Production processes generally (1=use obsolete technology, 7=employ the world's best and most efficient technology)
	Extent of Staff Training	12%	2	78	1	90	90	In your country, companies general approach to human resources is to invest (1=little in training and development, 7=heavily to attract, train and retain staff)
	Quality of Management Schools	18%	2	72	1	90	90	Management schools in your country are (1=limited and of poor quality, 7=among the world's best)
	Internet Effects on Business	10%	2	80	1	90	90	To what extent has the Internet improved your firm's ability to coordinate with customers and suppliers to reduce inventory costs (1=no change, 7=huge improvement)

**Table IV: Extant Components with Rating Scores and Relative Ran**

## Appendix A: Select ICT Components that Influence National Export Competitiveness

Category	Title	Description
<b><i>Technological innovation and diffusion</i></b>	Technological Sophistication	Your country's position in technology (1=generally lags behind most countries, 7= is among the world's leaders)
	Firm-Level Innovation	In your business, continuous innovation plays a major role in generating revenue (1=not true, 7=true)
	Firm-Level Technology Absorption	Companies in your country are (1=not interested in absorbing new technology, 7=aggressive in absorbing new technology)
	FDI and Technology Transfer	Foreign direct investment in your country (1=brings little new technology, 7=is an important source of new technology)
	Company Spending on Research and Development	Companies' spending on research and development in your country (1=is non-existent, 7=is heavy relative to international peers)
	Subsidies for Firm-Level Research and Development	Direct government subsidies for firms conducting research and development in your country (1=never occur, 7=are widespread and large)
	Tax Credits for Firm-Level Research and Development	Government tax credits for firms conducting research and development in your country (1=never occur, 7=are widespread and large)
	University/Industry Research Collaboration	In its R&D activity, business collaboration with local universities is (1=minimal or non-existent, 7=intensive and ongoing)
	Government Procurement of Advanced Technology Products	Government decisions on the procurement of advanced technology products are based on (1=price alone, 7=technology and encouraging innovation)
	Availability of Scientists and Engineers	Scientists and engineers in your country are (1=non-existent or rare, 7=widely available)
<b><i>Information and communications technology</i></b>	Brain Drain	Scientists and engineers in your country (1=normally leave to pursue opportunities elsewhere, 7=almost always remain in the country)
	Speed and Cost of Internet Access	Lease-line or dial-up access to the Internet in your country is (1=slow and expensive, 7=as fast and cheap as anywhere in the world)
	Public Access to Internet	Public access to the Internet through libraries, post offices etc is (1=very limited, 7=pervasive -- most people have frequent access)
	Internet Access in Schools	Internet access in schools is (1=very limited, 7=pervasive -- most children have frequent access)
	Quality of Competition in Telecommunication Sector	Is competition in your country's telecommunications sector sufficient to ensure high quality, infrequent interruptions and low prices? (1=no, 7=yes, equal to world's best)
	High Skilled IT Job Market	Highly skilled information technology workers in your industry (1=must leave the country to find good jobs, 7=have their pick of well-paid, desirable jobs within the country)
	IT Training and Education	Your country's IT training and educational programs (1=lag far behind most countries, 7=are among the world's best)
	Quality of Competition in ISP Sector	Is competition among your country's Internet Service Providers sufficient to ensure high quality, infrequent interruptions and low prices? (1=no, 7=yes, equal to world's best)

	Government Prioritization of ICT	Information and communications technologies are an overall government priority (1=strongly disagree, 7=strongly agree)
	Government Success in ICT Promotion	Government programs promoting the use of ICT are (1=not very successful, 7=highly successful)
	Government On-line Services	On-line government services -- e.g. downloadable permit applications, tax payments -- in your country are (1=not available, 7=commonly available)
	Laws Relating to ICT Use	Laws relating to electronic commerce, digital signatures, and consumer protection are (1=non-existent, 7=well-developed and enforced)
	Legal Framework for ICT Development	The legal framework in your country supports the development of IT businesses (1=no, strongly impedes, 7=yes, significantly promotes)
<b>General infrastructure</b>	Overall Infrastructure Quality	General infrastructure in your country is (1=poorly developed and inefficient, 7=among the best in the world)
	Quality of Public Schools	Public (free) schools in your country are (1=of poor quality, 7=equal to the best in the world)
	Telephone/Fax Infrastructure Quality	New telephone lines for your business are (1=scarce and difficult to obtain, 7=widely available and highly reliable)
	Electricity Prices	The price of electricity per kilowatt-hour in your country compared to international standards is (1=much higher, 7=among the world's lowest)
<b>Public institutions: contracts and law</b>	Intellectual Property Protection	Intellectual property protection in your country is (1=weak or non-existent, 7=equal to the world's most stringent)
	Burden of Regulation	Administrative regulations in your country are (1=burdensome, 7=not burdensome)
<b>Domestic competition</b>	Intensity of Local Competition	In most industries, competition in the local market is (1=limited and price-cutting is rare, 7=intense and market leadership changes over time)
	Extent of Locally Based Competitors	Competition in the local market comes primarily from (1=imports, 7=local firms or local subsidiaries of multinationals)
	Entry into Local Markets	Entry of new competitors (1=almost never occurs in the local market, 7=is common in the local market)
<b>Cluster development</b>	Buyer Sophistication	Buyers in your country are (1=unsophisticated and choose based on the lowest price, 7=knowledgeable and demanding and buy innovative products)
	Local Supplier Quantity	Local suppliers in your country are (1=largely non-existent, 7=numerous and include the most important materials, components, equipment and services)
	State of Cluster Development	How common are clusters in your country? (1=clusters are limited and shallow, 7=clusters are common and deep)
	Extent of Product and Process Collaboration	Product and process development in your country is conducted (1=within companies or with foreign suppliers, 7=in collaboration with local suppliers, customers & research institutions)
	Local Availability of Components and Parts	In your industry, components and parts are (1=almost always imported, 7=almost always sourced locally)
	Local Availability of Process Machinery	In your industry, process machinery is (1=almost always imported, 7=almost always sourced locally)
	Local Availability of Specialized Research and	In your industry, specialized research and training services are (1=not available in the country, 7=available from world-class local institutions)

	Training Services	
	Local Availability of Information Technology Services	In your industry, specialized IT services are (1=not available in the country, 7=available from world-class local institutions)
<i>Company operations and strategy</i>	Value Chain Presence	Exporting companies in your country (1=are involved primarily in production, 7=conduct not just in production but also product development, distribution and marketing)
	Capacity for Innovation	Companies obtain technology (1=exclusively from foreign companies, 7=by pioneering their own new products or processes)
	Uniqueness of Product Designs	Product designs are (1=copied or licensed from abroad, 7=developed locally)
	Production Process Sophistication	Production processes generally (1=use obsolete technology, 7=employ the world's best and most efficient technology)
	Extent of Staff Training	In your country, companies general approach to human resources is to invest (1=little in training and development, 7=heavily to attract, train and retain staff)
	Quality of Management Schools	Management schools in your country are (1=limited and of poor quality, 7=among the world's best)
	Breadth of International Markets	Exporting companies from your country sell (1=primarily in a few foreign markets, 7= in virtually all international markets)
	Internet Effects on Business	To what extent has the Internet improved your firm's ability to coordinate with customers and suppliers to reduce inventory costs (1=no change, 7=huge improvement)