Technology in Society 30 (2008) 429–436

Contents lists available at ScienceDirect

Technology in Society

journal homepage: www.elsevier.com/locate/techsoc

A comparison of institutional systems affecting software advancement in China and India: The role of outsourcing from Japan and the United States

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ARTICLE INFO

Keywords:
Institutional systems
Innovation
Software
Co-evolution
Outsourcing
China
India
Japan

ABSTRACT

The emergence of new innovation depends on co-evolution with institutional systems. Innovations will stagnate if they cannot adapt to institutions, as illustrated by the rise and subsequent fall of some Japanese innovations in the 1980s and 1990s. Similarly, conspicuous software advancements in China and India can be attributed to their unique institutional systems. While both countries share certain similarities that enable them to develop advanced software that attracts leading countries, the outsourcing partners of the two countries—China with Japan, and India with the US—are related to disparities in their institutional systems that have an impact on their software development. This paper undertakes a comparative analysis to identify such similarities and disparities. Since innovation is shifting from developers' sites to a process of diffusion and utilization with broader interactions with institutional systems, this analysis can provide important insight into the development of science and technology in a global context.

1. Background

Information and communication technology (ICT) has brought on a worldwide revolution, especially since its accelerating emergence in the 1990s. Among ICT-related industries, the software segment has undergone especially conspicuous development, and continues to be the fastest-growing segment. Software is "very strange merchandise" since it is both "embodied" when put into operation in a computer system, and "disembodied" when commercialized as a stand-alone product [1]. Software is ubiquitous in our economic and social life, and the rapidly developing software industry has become a global strategic business in an information society.

In software development, outsourcing has recently become a core business method with new importance. The development of software in widely distributed geographic locations is one of the most conspicuous characteristics of the software industry, and it has inevitably stimulated the further development of outsourcing. An increasing number of ICT functions are being outsourced, and outsourcing is now an established management practice. Outsourcing decisions have shifted from an emphasis on cost savings to a focus on how firms can meet their growth and profit objectives by satisfying customer requirements for functionality and solution-oriented development. Consequently, providers of outsourcing services have realized that their best option is to strive not so much for price differentiation via existing technologies but for innovation and increased competitiveness. With booming development and widespread growth, the market for

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doi:10.1016/j.techsoc.2008.04.020

outsourcing induces many countries and entrepreneurs to seek a share of this enormous market by providing qualified software development resources.

India is famous as an outsourcing service provider in software development, and many consider India to be the most successful software exporter among developing countries [2]. And since the mid-1990s, China has made significant progress in accelerating the development of its software industry, with the goal of developing a solid software industry with export potential. Ultimately, China hopes to become the most competitive provider in this market.

It is worth noting that the outsourcing partners for these two countries are quite distinct. While Japan is China's main outsourcing service export destination, the US has been India's main customer from the outset. Although the Indian software industry, and software industries in developing countries, have been discussed in a variety of papers [3–6], few analyses have been undertaken from the perspective of institutional systems, or with a specific focus on the outsourcing party's relationship with its customer countries.

The institutional structures of industrial activities have gained increasing attention in recent years. National industries tend to succeed in environments where the local institutions are amenable to and conducive of that success. The rise and subsequent fall of Japan's innovations in the 1980s and 1990s is a good example. North defined institutions as "the humanly devised constraints that structure human interaction. They are made up of formal constraints, informal constraints, and their enforcement characteristics. Together they define the incentive structure of societies and specially economies" [8]. Watanabe et al. have conducted intensive analyses of the behavior of institutional systems [9]. They define institutional systems as a three-dimensional system consisting of (1) national strategy and a socioeconomic system, (2) an entrepreneurial organization and culture, and (3) historical perspectives. We use this definition as the basis for the comparison analysis in Section 3 of this paper. In certain circumstances, in order to support the emergence of an industry, for instance, a network of institutions and policies must be available that includes all public agencies concerned with industrial issues, regulates interest intermediation, triggers social dynamics, develops technology paradigms, and defines the direction of innovation.

Institutional systems play a prominent role in industrial progress, and a thorough analysis should include an examination of the institutional environment in order to properly characterize industrial dynamics and advantages/disadvantages. By comparison and analysis of software development, with special focus on outsourcing relationships with Japan or the US, we can identify the similarities and disparities of the institutional systems that influence the development of the software industries in China and India. Discussion of sustainable development and industrial development of the software industry can provide significant insights into the development of science and technology in a global context.

2. Overview of the software industries in India and China

2.1. Strategic positioning

The strategic positions of software firms make it possible to summarize the positions of the software industries in India and China. Five strategic positions can be taken for software firms in developing countries, including China and India (see Fig. 1).

India's export of services, shown as position ***A***, is well known. The most obvious feature of the Indian software sector is its export orientation [3]. Thus, the domestic market is comparatively neglected, which may be risky in the long run. In China's case, it is more difficult to mark its position clearly. Since China began promoting its software industry in the mid-1990s, the industry is on an accelerating path toward becoming a core industry, with a solid industrial base and export potential chiefly in outsourcing services. Compared to India, the Chinese domestic market is a huge demand market with many opportunities and incentives, which plays a crucial role. Outsourcing services are extremely important, especially since China plans to use its accumulated know-how derived from its Japan-oriented outsourcing services to promote its

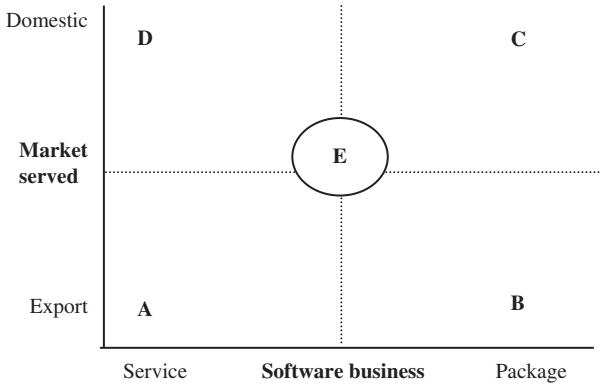

Fig. 1. Strategic positions for software firms. *Source*: Ref. [6], adapted by authors.

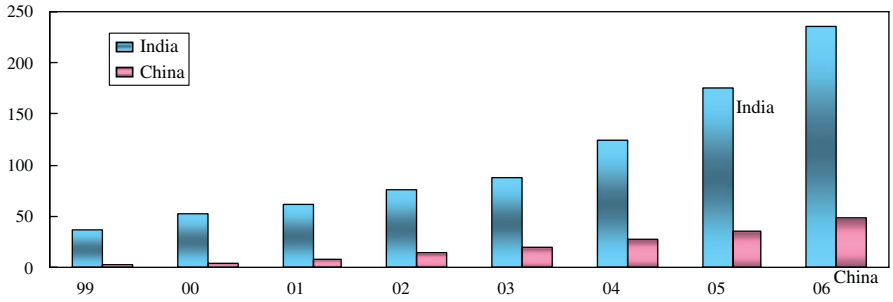

Fig. 2. Software exports in India and China (in US$100 million). *Sources*: Refs. [12,13].

functional development and to activate further innovation. In a word, China's goal can be identified as position ***E***, a balanced position that is beneficial for sustainable industry development.

2.2. Software development in China and India

In general, China is ahead of India in terms of most economic and technological indicators. The one exception is that China has not yet caught up with India's software industry [10]. While China is considered to be a flourishing destination for software outsourcing, its competitive threat to India is not yet established.

Among major indicators relevant to the software industry, such as ICT utilization, academic papers in the software field, university education, information technology (IT) skills, and language skills [11], it is easier to point out China's advantages over India at the level of total research and ICT utilization, which play a role in the whole development context. However, India holds the advantage in university education, IT skills, and language skills, which are directly related to the software industry. A university education is deemed to be excellent if meets the needs of a competitive economy and guarantees needed talent resources. Large-scale software firms, readily available IT skills, and good language skills are critical to the success of the Indian software industry and its outsourcing services. In addition, industry data are persuasive. India, already famous for its excellent outsourcing services and long history of software development, continues to leave China far behind in software exports. Fig. 2 highlights the differences of software exports between India and China.

Compared with China's software exports from 1999, Indian software exports have shown a dramatic increase over the last two decades. While the discrepancy between the two rates is diminishing, India, with its developed base, has still maintained a strong advantage in terms of absolute value. According to a NASSCOM report [13], the Indian IT-ITES (IT enabled service) sector (including the domestic and exports segments) is expected to exceed US$47.8 billion in annual revenue in 2007, a 28% increase from the previous year. Its contribution to GDP is estimated to be 5.4%, up from 4.8% the preceding year. Service and software exports remain the mainstay of the sector, contributing US$31.3 billion. From these data, there is no doubt that India remains the king of outsourcing in the current world software market.

For its part, the Chinese software industry has been undergoing major structural shifts in terms of market, participants, technology, focus, and products [10]. Since its development potential is obvious and enormous, it may not be long before China catches up with India.

As noted earlier, almost 60% of the outsourcing services of the two countries goes to a specific country: to the US for India, and to Japan for China [14]. These contrasting partnerships can be attributed to the different institutional systems in both countries. We suggest that India and China each have certain institutional characteristics that enable explicit co-evolution between their software development capacity and their outsourcing endeavors. At the same time, their institutional systems incorporate explicit functions that support the co-evolution of outsourcing dynamism with different selected partners. This dual co-evolution is the source of both countries' rapid advancement in software. While the co-evolution to outsourcing is similar in both countries, the co-evolution to different trading partners can be attributed to the differences in the country's respective institutional systems.

3. Institutional systems in China and India

China's gradual transition from a planned economy to a market-oriented economy began in 1978. Since then, its GDP has experienced remarkable growth, and it is expected that China's economy will continue its growth momentum. Its remarkable economic growth provides a number of opportunities and promotes the development of the Chinese IT industry. The economic reforms started in 1991 marked a turning point in India's economic history.

The Indian government has undertaken several initiatives to ensure that India becomes part of the global economy [15], including an open and progressive economy that encourages more foreign investment and draws wealth from services and

industry [16]. Generally speaking, the macro-context in India and China guarantees a healthy environment for industrial development.

Based on the definition of institutional systems introduced in Section 1, the sections below discuss the similarities and differences of the institutional systems in China and India, and their impacts on software outsourcing.

3.1. Framework for comparison

The current and rapid development of the Chinese and Indian software industries can be attributed to their unique institutional systems. Therefore, we conducted comparisons of the two institutional systems based on the three dimensions outlined earlier: (1) national strategy and socioeconomic systems, (2) entrepreneurial organization and culture, and (3) historical perspectives. Table 1 summarizes the comparisons of institutional systems between these two countries.

India obtained early government support in 1984, and China stepped forward to promote the software industry in the middle of the 1990s. China's first government support policy, "The Policy for Promoting the Development of the Software Industry and Integrated Circuit Industry" (usually called the "No. 18 File") was initiated in 2000. Although China started later, its development has been accelerated by a series of important government policies. The Tenth Five-Year Plan (2001–2005) placed a priority on innovation, which strengthened the innovation capacity and self-innovation in software technology. Thereafter, "The Action Program for Vitalization of the Software Industry (2002–2005)" was initiated in 2002, which triggered strong support of exports in the development of the software industry. Table 2 summarizes this program.

3.2. Comparison of institutional systems

From Table 2, we note that China's actions included a series of policy initiatives in finance, tax, education, employment, and IP, which led to structural changes that accelerated the development of the software industry. The action program envisioned the following goals, which were realized by 2005:

- total sales from the information service industry: 250 billion Yuan;
- increase in global market share (realized in 2004): from 1.2% to 3%;

Table 1
Comparison of institutional systems

Dimension	Comparison
Government support policy[1]	I: since 1984 C: drafted policies in 2000, *great effect*
Industrial cluster[1]	I: export promotion zones; software technology parks C: high-tech park; software development park
Intellectual property[1]	I: strict software protection C: suitable IP protection
Education[2]	I: special SE training; pay attention to practice C: text base, lack of practice; industry–academia cooperation
Firms[2]	I: big ones focusing on outsourcing service; e.g., Tata, Infosys C: smaller scale
Project/Quality management[2]	I: pursue international standard; CMM passing firms C: lack of experience in large-scale project; shift from cost to quality
Historical points[3]	I: English as official language corresponds to international market C: open economic reforms, opportunities; culture match with Japan
Globalization[3]	I: facing international market C: high development in ICT; good infrastructure, more investment
On demand[3]	I: increased for outsourcing C: huge domestic market; tap new market

Notes: I, India; C, China.
[1, 2] and [3] represent the three dimensions of institutional systems.

Table 2
Policy initiatives for accelerating the software industry in China

Item	Contents
Financial support	• Venture capital investment • Infrastructure maintenance by the government • Export-oriented support
Tax system	• Repayment of value-added tax (over 3% of value) • Exemption of customs, value-added tax on imports • Corporations exempt from income tax • Deduction from employees' salary for education costs
Financial environment	• Arrange for venture capital • IPO standard
Expand educational institutions	• Enforce adult education • Permit for social educational organizations • Expand software colleges within universities • Systems for studying abroad, overseas internships
Employment	• Performance-related pay; emphasis on ability • Encourage stock options
IP right	• Protection of copyright • Fight against piracy

Source: Authors' summary based on Ref. [14].

- increase of domestic products in domestic market: from 32% to 60%;
- export revenues: US$5 billion;
- software development professionals: 800,000 people.

These goals gave the entire software industry incentive to develop rapidly. Outsourcing services also increased during the period. Adopting the slogan, "Industrialized by Informatization," the information industry, as a core industry, was given high priority for its own development as well as to promote the development of other industries. As a key sector, software was expected to develop more innovative products that would compete in the global market. By encouraging software exports, software development resources improved in ways that contributed to enlarging the domestic market as a mature sector.

3.2.1. Industrial clusters

Because of China's export-oriented policy, the government tried to increase exports by establishing industry clusters and encouraging firms to be more active in software exports. An industry cluster is defined as a geographic concentration of industries that gain performance advantages through co-location [17]. Since 2001, the Chinese government has launched 11 national-level software industry bases in different cities. These regional clusters played a prominent role in the early development of the software industry. India also set up export promotion zones and software technology parks in the early years of the software industry development. Bangalore, famous as an IT outsourcing service center, is a good example.

3.2.2. Intellectual property rights

As the industry matures, more attention is being paid to the intellectual property aspects of software. Substantial laws provide greater guarantees that will fuel further development.

Many foreign customers are worried about not receiving adequate legal guarantees in the current Chinese market environment. In 2004, Japan passed a law addressing the issue of private data protection. China must also put new restrictions on data protection in order to gain the trust of its customers.

3.2.3. Quality management

Quality management is another consideration in outsourcing decisions. India is famous for the high quality of its services. Many Indian software firms have achieved level 5 of the Capability Maturity Model (CMM, international standards for management of software production). The number of software firms passing CMM5 is increasing in China, and more Chinese software firms are beginning to focus on quality instead of cost.

3.2.4. Documentation management

Documentation management is another crucial part of project management. Compared to India, the typical Chinese firm, including capital and number of employees, is smaller, which explains why Chinese software firms are not yet able to

manage large-scale projects. The Chinese government and local industry clusters have attempted to make the Chinese software industry more competitive by fostering larger firms, and new policies based on the No. 18 File will be initiated soon [18]. As a result, there will be an increased focus on improving industrial innovation as well as investment support for international management and R&D among domestic software firms.

3.2.5. Human resources

Human resources are indispensable to the software industry because of its skill-intensive nature. Therefore, enhancing human talents is one key to competitiveness. China should strengthen both its project development and English communications skills in IT education to guarantee the quantity and quality of its talent pool. Although India employs one million people in ICT, in order to create a thriving labor market it will be required to sustain its economic growth [16]. As English is an official language in India, it has given India an advantage in the international markets, and enables India to focus more on the US or EU markets. However, India must also compete against other low-wage and English-speaking countries.

At the same time, a lower PC and Internet penetration, coupled with poorly constructed infrastructure, have been bottlenecks for software development in India. From 1998 to 2005, annual investments in hard infrastructure averaged 4% of real GDP in India, compared with 8.2% in China, which invested early and heavily to construct a world-class infrastructure that attracts foreign money and continues to spur economic growth [16]. Strong development of ICT is another catalyst. In addition to outsourcing services, the huge Chinese domestic market provides excellent opportunities for progress in the Chinese software industry.

When comparing the outsourcing partners of India and China, Figs. 3 and 4 show that China's institutional systems encompass a well-constructed infrastructure, abundant human resources, an understanding of Japanese, and reasonable cost and closeness to Japan as its comparative institutional advantages for providing outsourcing services to Japan. Good skills in English communication, quality and quantity of IT engineers, and quality of work incorporated in Indian institutional systems are key factors for India's success in providing outsourcing service to the US.

In addition to common institutional factors that help co-evolve software development and outsourcing endeavors, the various institutional factors in each country play an important role in deciding who will be an outsourcing partner to help achieve co-evolutionary dynamism.

3.3. Co-evolutionary dynamism through outsourcing

As noted earlier, the development of ICT is crucial to a nation's competitiveness, and its development largely depends on advances in software technology. Thus, many nations have actively pursued throughout the world the most qualified resources for software development. The outsourcing of software development from the US to India is a typical example. Similarly, outsourcing from Japan to China has increased dramatically in recent years, resulting in a virtuous cycle between ICT and economic development and increased mutual benefit. Cheap labor in India and China was not the key issue

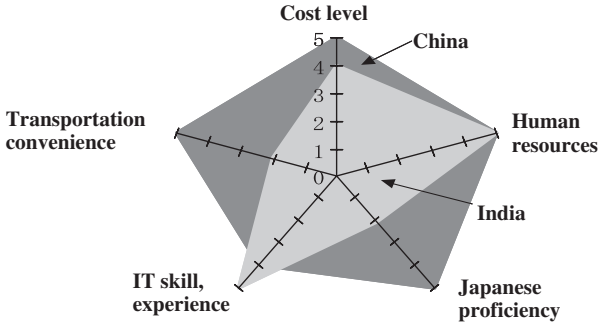

Fig. 3. Factors in Japan-oriented software exports. *Source*: Ref. [14], adapted by authors.

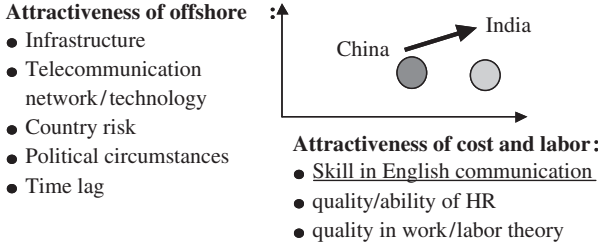

Fig. 4. Attractive factors in outsourcing. *Source*: Ref. [13], adapted by authors.

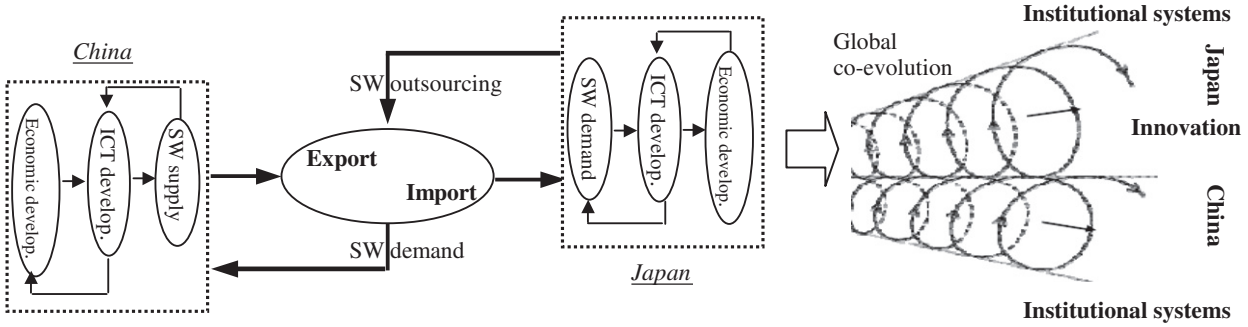

Fig. 5. Co-evolutionary dynamism between Japan and China through outsourcing. *Source* of detailed analytical analyses: Ref. [19].

underlying this trend; rather it was the availability of qualified software resources developed by means of indigenous institutional systems in these countries. A co-evolutionary dynamism can be observed in outsourcing that has engendered mutual benefits and established long-term partner relationships between outsourcers and vendors. Fig. 5 illustrates the relationship with Japan and China.

Since the place where innovation occurs is shifting from developers' sites to a process of diffusion and utilization with broader interactions with institutional systems, Fig. 5 also implies the importance of co-evolutionary dynamism between innovation and institutional systems. The slowdown of Japan's innovation systems in the 1990s was caused by its inability to adapt to the institutional systems during the paradigm shift from an industrial society to an information society [20]. Only innovations that have a co-evolutionary relationship with institutional systems will be effective. Science and technology development that induces innovation should take institutional systems into account, and the role of institutional systems should not be neglected.

4. Discussion

In this paper, we have made some comparisons of the software industries in India and China, focusing specifically on outsourcing. Recently, with dramatic advancements in the Chinese software industry, discussions involving China's threat to India's status in the outsourcing world are becoming more credible. Will India retain its position as a software export leader? The question is not who will be the winner—although it is true that the country with more competitive advantages will be at the frontier. For developing countries like India and China, developing a high-technology industry and stimulating innovation is an excellent way to activate low-level manufacturing industries.

China is trying to develop more value-added products, including domestic software, to create substitutes for its labor-intensive processing industry. Innovative domestic software is evaluated every year in China and utilized in more and more fields. Furthermore, Chinese software, such as "Yongzhong Office," has now entered the global market [14]. Facing the global environment and international labor, both China and India are climbing up to higher rungs on the ladder. When outsourcing service, work has shifted from simple programming or coding to system design, system integration, consulting services, and customized services.

The different institutional systems of India and China lead to different competitive advantages. In order to tap new markets and sustain development, some institutional changes are indispensable. China should learn from India's experience and the technical skills it has acquired as a result of its outsourcing relationship with the US. The Chinese government is also interested in establishing policies that will encourage software firms in both countries to cooperate more. At present, based on cultural similarities between Japan and China, and advantages such as convenient transportation and geographic closeness, Chinese software vendors are the largest outsourcing service providers in the Japanese market. Thus, India should not neglect the advantage China enjoys with its Japan-oriented outsourcing. Indeed, Indian software firms have now established a few R&D centers or branches in Japan as well as in China in order to utilize the know-how accumulated in Japan-oriented outsourcing in Chinese software firms. Complementary engagement, with cooperation based on similarities and differences, is expected to induce further development.

Software development is skill-intensive rather that capital-intensive. Both China and India should improve their educational systems and provide sufficient professionals, because human resources are critical. In addition, China should focus on solving the weaknesses in its laws and improving private data protection systems, since they are a crucial factor in outsourcing decisions. India's infrastructure, including ICT penetration and transportation systems and roads, should be improved as soon as possible, as they are—in their current state—impeding foreign investment. In a word, the keys to sustainable industrial development are to build a better infrastructure, develop sophisticated technical skills, educate human resources, and strengthen the communications environment. These are competitive advantages that both India and China began to develop earlier than many other emerging countries.

In summary, both India and China have incorporated institutional characteristics that enable explicit co-evolution between their software development capacity and their outsourcing endeavors. In addition, their unique institutional systems imply other explicit functions that will lead to a co-evolutionary outsourcing dynamism with selected partners, like China with Japan, and India with the US. This dual co-evolution is the source of obvious advancements in software industry development in China and India.

Given that the place where innovation occurs is shifting from developers' sites to a process of diffusion and utilization with broader interactions among institutional systems, innovations will develop better if they can adapt to the institutional systems. With science and technology support, institutional changes will gradually reshape industrial development and make it more competitive. Faced with globalization, institutional characteristics and appropriate science and technology policies that are consistent with institutional systems will play a decisive role in innovation, industrial development, and economic growth.

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