Offshoring of Software Development from Japan to China

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Abstract: This article discusses recent development of offshoring in information technology industry in Japan. With interviews to several Japanese ICT companies, we reveal the present condition and problems of offshoring software development, which cannot be recognized from its macro data. Japanese firms must expand offshoring because of increasing competition within Japan, although offshoring brings about outflow of technology and know-how to foreign firms. This outflow fosters their prospective foreign competitors, especially in China. Those firms are raising technology by the outflow. Japanese small and medium-sized software companies which don't have excellent technology will face competition for survival against foreign firms in the near future. The income gap among Japanese software engineers will also increase.

Section 1 Introduction

Offshoring of software development has been increasing in Japan. A lot of tasks of coding are transferred from Japan to China, India and other countries. Offshoring covers not only computer systems for banks and companies, but also packaged software and embedded software. Many Japanese ITC companies conduct transaction with software companies in China, India or other countries, and establish subsidiaries or invest money into firms in the areas. BPO (Business Process Outsourcing) to China and India are also increasing.

Development of ICT industry in India and China has already been written in literature, such as Saxenian (2002), Banerjee (2004), D'Costa and Sridharan eds. (2004), Tschang and Xue (2003), and Gregory *et al.* (2007). Regarding its effect on Japanese software industry, Kubo (2000), Ohtsuki (2001), and Kojima (2004) address the relationship between Japan and India. Kyo (2005), Umezawa (2005), and Asai (2005) discuss the relationship between Japan and China. Kin (2005) interviewed Japanese-affiliated firms in China.

On the other hand, there is very little research about how each Japanese ICT firm evaluates offshoring. Several years ago, Japan Information Processing Development Corporation (2003) conducted interview with several Japanese companies. Their conclusion was that the hollowing out of Japanese software industry would not happen, because foreign engineers didn't understand the Japanese language and its unique business customs. In other words, the Japanese language, culture and business customs are nontariff barrriers in the Japanese market. So the paper forecasted offshoring would occupy only a small part of the Japanese market.

However, the present situation has changed from that time. Our interview reveals that Chinese programmers have become able to read Japanese specification sheet and understand Japanese business customs with several years' experience. Therefore, entry barriers have becoming smaller.

In addition, many Japanese firms feel concern about the outflow of technology and know-how to foreign companies. Although total offshoring in Japan has been expanding, a company with which we interviewed has been reducing the scale of offshoring. One of the major reasons is that they are worried about outflow of technology to foreign companies.

We obtain the following conclusions. First, expansion of offshoring reduces unit price of software development. As a result, Japanese ICT firms must expand offshoring because of increasing competition within Japan, although offshoring brings about outflow of technology and know-how to foreign firms. This outflow fosters their

prospective foreign competitors, especially in China. Those firms are raising technology by the outflow. Japanese small and medium-sized software companies which don't have excellent technology will face competition for survival against foreign firms in the near future. Therefore, Japanese firms and government must intensify their efforts to improve their technology and know-how.

Second, as the range that foreign software firms substitute for their Japanese counterparts expands, the income gap will increase among Japanese software engineers. Engineers who have high ability and manage more difficult projects will continue enjoying high income, and those who have normal skills will endure lower income or change their careers.

It is often said that development of ICT in Japanese society is desirable. However, development of ICT is closely related with globalization. Japan must face the negative side of globalization; competition for survival with foreign firms or expanding income disparities.

This paper is organized as follows. In Section 2, we explain the present condition and reasons for the increase of offshoring in the Japanese software industry. In Section 3, we reveal some facts about offshoring from our interview with Japanese companies. Then, we analyze effects of offshoring on Japanese ICT firms. Section 4 discusses effects on Japanese software engineers. Section 5 concludes the paper.

Section 2　Expansion of offshoring in Japan

In this section, we explain the present condition and reasons for the increase of offshoring from Japan to China, India and other countries.

Recently, Japanese information service industry realized remarkable growth. The sales of the industry are 14.5 trillion yen (120 billion dollars) in 2004, which is 2.3 times of the number in 1995 (Ministry of Economy, Trade and Industry, 2005). In 2006, orders of system development for banks and other big companies surged, so the demand for software development exceeds the supply. Under this situation, many Japanese companies cooperate with firms in China, India or other countries, or establish subsidiaries in those countries for offshoring and BPO. Foreign companies also establish their subsidiaries in Japan. They take orders of software development in Japan, and its coding is conducted by their parent companies in their home countries.

There are no data of the total amount of offshoring in Japan. So we'll see its trend through a survey conducted by Japan Information Technology Service Association and other associations.

Table 1　Offshoring of information service in Japan

In 2002, n=58. In 2003, n=58. In 2004, n=77.　(million yen)

Countries		Year			Year to year comparison in 2004
		2002	2003	2004	
1	China	9,833	26,280	33,241	126%
2	USA	3,260	4,988	5,147	103%
3	India	1,908	6,312	4,255	67%
4	Australia	0	2,626	3,133	119%
5	UK	20	1,827	2,126	116%
6	Philippines	1,864	2,494	2,117	85%
7	South Korea	1,952	1,871	1,415	76%
8	France	0	834	548	66%
9	Canada	496	616	262	43%
10	Vietnam	30	30	216	720%
Others		888	1,082	237	22%
Sum		20,251	48,960	52,697	108%

Source:　Japan Information Technology Service Association *et al.* (2005), Table 3(2).

77 firms, which is 24% of 213 respondents, conducted offshoring directly or indirectly with foreign software companies in 2004. The sum is 52.7 billion yen (440 million dollars), which is 2.6 times greater than two years ago. Respondents of this research are limited to members of the associations, and percentage of replies is low. Therefore, the total amount of offshoring in Japan would be several times larger than this value.

It is striking that China occupies 63% in 2004, and that many Asian countries are include in Table 1. For example, offshoring to Vietnam is small, but increased sevenfold yearly.

Table 2 Prices of the work which an Japanese engineer does in a month

(10,000 yen)

Countries	Japan	Korea	India	China	Vietnam
Price	90~100	80	40~50	25~30	15~20

Source: Kin (2005), Table 5.

The main reasons why offshoring is conducted in Japan is cost reduction and lack of engineers. As Table 2 shows, prices of the work in India and China are less than half of that of Japan. However, offshoring incurs additional costs. Either (or both) companies must use their foreign languages. Foreign companies sometimes misunderstand the direction of Japanese firms. Culture and business customs are much different between Japan and foreign countries. So communication isn't easy and troubles often happen. In addition, Japanese companies have to test and adjust what foreign companies made. As a result, cost reduction is about 10~30% of the projects budget.[1]

China is the largest receiver of Japanese offshoring. The reasons are its low wages, adjacency to Japan, and many Japanese-speaking people. In addition, because many Chinese and Japanese characters are in common, Chinese programmers have become able to read Japanese specification sheet with several years' experience (See our interview with Company B in Section 3). Japanese companies send Japanese specification sheet to China without translating it.

However, software development in China has many deficits. Technological ability of Chinese companies isn't high. The size and maturity of offshore development in China is said to be running ten years behind India. In addition, turnover is high. Many workers switch companies easily, so Chinese companies cannot retain their technology and know-how. Piracy is also a big problem in China. This stems from inadequate understanding of intellectual property rights among Chinese firms.[2] Some Japanese in the ICT industry are worried about outflow of technology and know-how to China.

In the 1990s and early 2000, Japanese firms faced many troubles about offshoring. In 2003, NEC tried to develop software for distribution of goods, but the software which the Chinese company made was inadequate. So NEC lost 2 billion yen (17 million dollars). Many Japanese firms had the similar experiences and learned a lot from them. As a result, quality of software by offshoring improved. Japanese biggest IT venders, such as NEC, Fujitsu, Hitachi, Nomura Research Institute, and NTT Data planned to increase the amount of offshoring in 2006. In addition, some Japanese small and middle-sized software companies advertise low cost by offshoring. This means that the reputation of software development in China has improved.

Hereafter, not only coding but also other processes will be offshored to foreign countries. In 2006, NTT Data said "So far, we entrusted Chinese companies coding of software for business users, but from now on, we will extend entrustment of processes from design to various tests."[3]

Section 3　Effects on Japanese ICT firms

In the previous section, we described that offshoring involves many problems, but it has been increasing. We now focus on how Japanese ICT firms evaluate this issue. So we interviewed several Japanese companies. We'll here describe the result of interviews with four different types of companies.

The four firms receive orders of system development from banks, manufacturing firms, and so on. They conduct processes of requirement definition and design for software. As regarding coding, they do it by themselves in some cases and entrust it to other companies in other cases. When they entrust it to foreign companies, this is offshoring. All interviews were conducted in August 2006.

Company A

This company is one of the biggest IT venders in Japan. They receive orders of system development and design them, but don't conduct coding. They entrust it to their subsidiaries or other companies. In some cases, they commit tasks to foreign companies (direct offshoring). In other cases, companies who received orders from Company A commit some tasks to foreign companies (indirect offshoring).

This company started offshoring in full scale around 2003, but had conducted it before. Now they have a subsidiary of coding in China. They also invest money into an Indian firm for developing middle software and ERP, and for BPO. They also develop software in South Korea and Vietnam, but its size is very small. The reason of offshoring is the low cost. Besides, Chinese firms are advantageous because they can communicate in Japanese.

The ratio of offshoring among the whole tasks (measured by the amount of work) is about one-sixth.

This company didn't positively conduct offshoring before. However, because rival companies have been going with it, this company must do it. The current policy of this company is that they'll increase it.

This company had undergone various troubles with offshoring. Now both they and their foreign business partners learned a lot from the experiences. Foreign companies and engineers have understood Japanese cultures and business customs. Therefore, projects which go into the red have been decreasing.

Ability of foreign programmers isn't low. Troubles arise from communication or how to go about projects.

This company is anxious about outflow of specification sheet and other confidential documents to China. From this viewpoint, Indian companies are more preferable.

Unit cost of orders this company receives hasn't been reducing.

Company B

This company is a subsidiary of one of the biggest IT venders in Japan. Most of the orders they receive come not from customers directly, but from their parent company and another subsidiary of the parent company. Company B conducts coding by themselves in some cases, and entrusts it to their subsidiary in China in other cases. The Chinese subsidiary was established nine years ago and now has 15 employees, 13 of whom are engineers. Some of them communicate with Company B in Japanese, and transfer the instruction of Company B to other engineers.

Chinese programmers have become able to read Japanese specification sheets with working experience of several years. This is because many Chinese and Japanese characters are in common. Ability of Chinese programmers is higher than that of rookie Japanese programmers.

The wage in China is lower than that of Japan. However, Company B incurs additional costs. They have to test and revise software which the Chinese subsidiary produced. So offshoring doesn't decrease production cost drastically. One of the reasons of revising is that Chinese engineers produce software just according to the content of the specification sheet. Company B must revise the software according to their customers' requests which aren't written in the specification sheet. Another reason is that Chinese engineers sometimes misunderstand the specification sheet.

In the initial stage of the Chinese subsidiary, communication between Company B and it wasn't easy. Workers of both companies had a lot of arguments. Through the arguments, they have understood each other's way of thinking.

The capital of the Chinese subsidiary is above 20 million yen (167 thousand dollars). The equipment of start-up is personal computers, telephones, faxes and internet. They don't need expensive machines.

Unit price of system development is deceasing.

Company C

This company is a telecom-related large company whose sales are by far larger than 1 billion dollars. This company develops software for their own products and for other companies. Company C conducts coding by themselves in some cases, and they entrust it to other firms in other cases.

This company contracts with foreign firms and entrusts coding of some projects. As a result, this company conducts offshoring to China and Sri Lanka. They did it to India

before, but don't do it now because of high cost (Hourly wages are some $12.5-15 in China, $16.7 in Sri Lanka, and $25 in India). The ability of Chinese engineers is almost the same as that of Japan.

This company communicates in Japanese with Chinese companies and in English with Sri Lankan companies. It isn't easy to communicate with each other. In addition, face-to-face communication is dispensable in some cases. Therefore, this company feels that working with Japanese engineers makes things go more smoothly.

This company had been increasing offshoring. But they changed their policy several years ago and have been decreasing it since then. The reasons are that they are worried about outflow of technology to foreign companies, and that they cannot manage systems which they didn't develop by themselves.

Unit cost of software development has been falling recently.

Company D

This company is the Japan subsidiary of a multinational corporation which provides management consulting and technology service for other firms. The multinational corporation established a Chinese subsidiary in 2003. Company D takes advantage of this Chinese office for offshoring and BPO.

This company communicates with the Chinese office in Japanese or English. The advantage of the Chinese office is that they can communicate directly with Company D's customers in Japanese.

Company D rarely revises software which the Chinese office produced. This is because this multinational corporation share their way of thinking, so the Chinese side understands the demand of the Japanese side.

Chinese engineers aren't good at new technology, but their level of basic computer languages is better than that of Japanese engineers. The deficits of Chinese engineers are that engineers sometimes don't work overtime even when the date of delivery is approaching, and that they don't care about the consistency of their products with other parts of the whole system.

Offshoring will reduce the cost of system development by 30~60%. So they can supply their products with cheaper prices.

Interviewee personally thinks that Chinese engineers who speak Japanese fluently would be able to work out basic design of software (though this company does not hire such engineers).

These interviews reveal several important facts. First, Chinese companies, whether

they are Japanese companies' subsidiaries or not, correspond in Japanese, understand Japanese specification sheet, and communicate successfully with Japanese companies. Besides, technical ability of Chinese engineers is on a par with their Japanese counterparts. Second, fear of Japanese companies about outflow of technology and know-how is large enough to make a large company decrease offshoring. Many other firms are also anxious about it. Third, three of the four Japanese firms say unit price of software development has been falling. It seems that unit price has been falling in the market.

The first fact shows that entry barriers for foreign firms, such as Japanese language, culture, and business customs, have been diminishing gradually. Several years ago, Japan Information Processing Development Corporation (2003, Ch.6) argued "the Japanese business environment such as language, ambiguous specification sheets, unique business process, and culture is, as it were, a nontariff barrier for foreign engineers and firms. So entry in the Japanese market isn't easy. Chinese firms won't occupy a majority in the Japanese market."

Compared with coding, you need more communication skill for requirement definition and design. In these fields, Japanese engineers have an advantage over foreigners in conducting transaction with Japanese customers. So it will never happen that foreign companies substitute for all Japanese firms. However, entry barriers aren't as large as before. Some Japanese ICT firms, such as NTT Data, will extend entrustment of processes from design to various tests. Besides, as the interviewee of Company D said, Chinese engineers who speak Japanese fluently would be able to work out basic design of software.

The second fact, fear of outflow of technology and know-how, is large, as we mentioned. There are many reasons why the outflow occurs. First, Japanese firms need to transfer technology and know-how to Chinese firms during their business. Without such transfer, Chinese firms cannot develop software which suits the business style of each Japanese customer. Besides, Japanese firms must improve the ability of their China subsidiaries to get high return. So offshoring inevitably involves outflow of technology and know-how. Secondly, frequent job hopping of Chinese engineers brings about the outflow to many other Chinese firms. Thirdly, piracy causes the outflow. As a result, Chinese firms advance their technology by legal and illegal outflow of technology and know-how. This means that Japanese software companies are fostering their prospective competitors.

The above analysis shows that offshoring offers good opportunity for Chinese companies to catch up with Japanese firms. In the near future, the range that foreign

software firms substitute for their Japanese counterparts will expand.

As for falling unit prices, there is no wide-ranging research. But a survey also reports that unit price has been falling (Information Service Industry Association, 2006, p. 277). There are several reasons of unit price decline: Customers intensify selecting projects according to cost-benefit performance and try to reduce the total sum of order, and competition in software industry is fierce. We assume offshoring accelerates these tendencies. That is, offshoring makes price competition in the Japanese market fiercer. Besides, increases in low cost projects strengthen discount demand by customers.

As offshoring increases hereafter, unit price will fall furthermore. Therefore, just as Company A said, Japanese companies must expand offshoring to compete with their Japanese rivals even if it generates outflow of technology and know-how.

In the Japanese information service industry, there is a huge subcontracting system, like that of construction industry. A big project of system development has an even six-tier pyramid, that is, tasks of the project are divided and subcontracted six times. Some of small software firms in the lower levels of the pyramid don't have high skills. They receive orders just because their unit price of works is cheap. These firms will face fierce competition with foreign companies in the near future.

What Japanese firms ought to do in this situation is to develop higher technology and know-how. "To strengthen international competitiveness and to avoid hollowing out, we need to grow highly talented people of IT" (Ministry of Education and Science, 2005, p.5). So the Ministry of Economy, Trade and Industry established the Software Engineering Center to cope with "hollowing out of software technology due to an escalation of price competition and the rise of software firms in China, India and other Asian areas" (Information Service Industry Association, 2005, p.49). Japanese firms and government must intensify their efforts to improve their technology and know-how.

To sum up, unit price of software development falls due to expansion of offshoring. As a result, Japanese companies must expand offshoring furthermore, although they are fostering their prospective competitors in China through outflows of technology and know-how. Japanese small and medium-sized software companies which don't have excellent technology will face competition for survival against foreign firms in the near future. Japanese companies and government must develop greater technology and know-how.

Section 4　Effects on Japanese software engineers

As we explained before, Japanese small and medium-sized software companies will face competition for survival against foreign firms. In this section, we analyze effects of

this competition on Japanese software engineers by reviewing American experience.

In 2001, the United States had a recession, which intensified selection and concentration in business management. Hence, outsourcing of IT increased, and the ratio of offshoring among IT related spending augmented from 12% in 2000 to 28% in 2003.[4] Lay-offs of IT engineers due to offshoring often happened. This shows that offshoring is an important factor which hinders employment of IT engineers.

To verify this issue, we focus on Silicon Valley. In Silicon Valley, the average wage in the software industry in fiscal year 2005 is $141,972.[5] What is striking is that the average wage in the industry rose by 5% during fiscal years 2002-2005, but the number of employees in the industry decreased by 11% during the same period. Furthermore, there is the same tendency in many other manufacturing sectors in Silicon Valley (Joint Venture Silicon Valley Network, 2006, pp.8, 24).

In August 2003, San Jose's Office of Economic Development warned that “In the next five years, technology jobs paying $40,000 to $80,000 a year in Silicon Valley will be a ‘vanishing breed.’” (*The San Jose Mercury News*, August 26, 2003). Offshoring would be one of its major reasons. That is, jobs of engineers of those wages are transferred to foreign countries. So the numbers of engineers decreased and the average wages rose in each industry.

In brief, on the one hand, excellent engineers receive high income. On the other hand, engineers with normal skills lose their jobs. Besides, many foreign engineers go back home and some of them continue working with half of the previous wage to get green cards or citizenship. So income gap among engineers in Silicon Valley has augmented.

We may now proceed to the discussion of the effect on Japanese software engineers,[6] in reference to American experiences. Offshoring in Japan hasn’t increased compared with America, but will expand as we described before. This expansion would affect Japanese software engineers a lot.

There are 850 thousand IT engineers in Japan. Ten thousand of them are freelance engineers. Now that the demand for system development exceeds supply, many firms lack engineers. Offshoring serves to ease the excess demand. In other words, it plays the role of making human allocation efficient in Japanese ICT industry.

However, in the near future, the range that foreign software firms substitute for their Japanese counterparts will expand. Then, it may happen that the excess demand in the Japan market disappears and the unit price of software development becomes even lower. At that time, the similar experiences faced in the United States will occur in Japan. Excellent engineers who can manage difficult projects will continue enjoying high income, but engineers with normal skills will have to take on projects of lower

prices. In addition, companies will reduce the number of engineers with normal skills. Most Japanese firms try to avoid layoff as eagerly as possible even when they are in the red. So they transfer redundant engineers to marketing, consulting, maintenance and so on. At that time, wages for regular workers in Japanese companies won't change so long as they continue working for their companies. However, freelance engineers and engineers who changed companies will receive lower income as long as they retain normal skills. Some engineers will have to change their occupations with lower income. As a result, the income gap between Japanese engineers will increase.

Section 5 Conclusion

Paul Krugman wrote “The accelerated pace of globalization means more losers as well as more winners; workers' fears that they will lose their jobs to Chinese factories and Indian call centers aren't irrational” (Krugman, 2004). The effect of globalization is larger in the software industry than manufacturing, because software companies don't need expensive equipments. They only need skilled workers. So entry barriers aren't large in this industry.

As offshoring expands, Japanese small and medium-sized software companies which don't have excellent technology will face competition for survival against foreign firms in the near future. The income gap among Japanese software engineers will also increase.

Offshoring has various problems as we described. However, it brings an increase of national wide employment. Large cost savings in the United States due to offshoring of software development generated more investment in IT and other areas. It produced inter-industrial effects which many industries enjoyed. According to their estimation, in the United States in 2003, offshoring reduced 104,000 IT engineering jobs, and created 194,000 jobs in all sectors, so the net increase was 90,000 jobs. In addition, if offshoring expands at an annual 26% from 2003 to 2008, the net increase will be some 320,000 jobs. The indirect effects of offshoring contribute mainly to industries such as construction, marketing, transportation services, education, health care (Global Insight, 2004). We'll have to estimate this effect on the Japanese economy.

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[2] As an example of inadequate understanding of intellectual property rights, a survey among Chinese software companies shows that 90% of the respondents had bought or used pirated software (Chinese Software Industry Development Research Committee ed., 2004, p.175). However, the Chinese government has been enforcing intellectual property right. In 2004, the Supreme Court and the Highest Prosecutor Office jointly issued "Judicial Construal on Incidents of Violation of Intellectual Property Rights."

[3] "Offshore Development of NTT," *Business Communication*, 2006, Vol.43, No.1, p.95.

[4] Internetnews.com, March 19, 2003, http://www.internetnews.com/ent-news/article.php/2118191.

[5] In 2002, the average annual wage of IT engineers in the United States is $68,330. That of all private workers is $36,520 (U.S. Department of Commerce, 2003, p.23).

[6] The average annual income of IT engineers including management positions in Japan

of persons 55 years of age and older is 9.93 million yen, and that of persons 40-45 years of age is 7.69 million yen (Information Service Industry Association, 2003, Table 3-41). According to an outplacement service company, average annual income of 40-year-old engineers in 2006 is 4.85 million yen for programmers, 6.36 million yen for program architects, and 8.16 million yen for system consultants.