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Japan's Software Industry and Its International Competitiveness

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Abstract
Most Japanese software products are supplied to the domestic market, whereas few are supplied to the foreign market. Some authors discussed reasons why Japan's software industry lacks international competitiveness. However, those studies do not explain why those reasons occur. This article shows several reasons of the lack of international competitiveness in the Japanese software industry. Then, we focus on the relationship of these reasons and analyze the relationship between the reasons. In addition, this study indicates that the multi-subcontracting system hampers the development of products for international competitiveness.
Keywords: Japan's software industry, International competitiveness, Multi-subcontracting system
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1. Introduction

The market size of the Japanese software industry was the second largest in the world next to that of the USA. In 2004, the sales of customized software development and software products1 were 6.786 billion and 1.5067 billion yen, which were 2.2% and 4.3% larger than the year before, respectively (Ministry of Economy, Trade and Industry, 2005). Although the Japanese software market size was large, it is thought that "their products are less competitive or losing competitiveness in the world market except for those related to the embedded software and game software" (Ministry of Internal Affairs and Communications ed., 2007, p.113).

Most Japanese software products are supplied to the domestic market, whereas few are supplied to the foreign market.2 On this issue, Mr. Tomoo Matsubara said that Japanese software engineers lack "creative idea and products" (Matsubara, 2001, p.79). In addition, Anchordoguy (2000) stated that major Japanese computer companies failed to develop creative software products for Japanese political and economic systems. Maegawa (2004) discussed that the Japanese multi-subcontracting system3 hampered the improvement of the quality and productivity of software development. Alternatively, the Japanese software market is said to have few venture companies owing to lack of venture creating system.

These discussions show the reasons why Japan's software industry lacks international competitiveness. However, the studies above do not explain why those reasons occur and how those reasons are related to each other. Japan's software industry has not improved their international competitiveness for a long time. Thus, a comprehensive analysis of these reasons and their relationship is significant.

This article focuses on the relationship of these reasons and analyzes the relationship between the reasons. In addition, this study shows that the multi-subcontracting system hampers the development of products for international competitiveness.

This article is organized as follows: Section 2 examines the reasons for the lack of international competitiveness. Section 3 shows that the multi-subcontracting system of the Japanese software industry interferes with the adoption of new software development methods. Finally, Section 4 concludes the paper.

2. Reasons for the lack of international competitiveness

One of the reasons why Japan's software industry lacks international competitiveness is the lack of strategy in the industry (Hayashi, 1993). Until the early 1990s, large Japanese computer manufacturers had developed both the hardware and software of the computers and sold them together. At that time, software was treated like an additional service of the hardware. Thus, clients did not fully understand the value of software. In addition, many software firms became subcontractors of large Japanese computer manufacturers and produced software at low cost. These software firms did not pay attention to the technological improvement or education of their employees (Hayashi, 1993, pp.23–24).

Since the middle of the 1990s, the sales of hardware and software of computers have separated. However, even now, the software does not seem to be appropriately priced.

One of the reasons why this situation has not changed is the attitude of the clients. "The management personnel of the clients do not understand the complexity of the software" (Matsubara, 2001, p.79). In addition, most Japanese clients do not have development teams within their companies, so they cannot evaluate the value of the software. They continue treating software as an attachment of hardware even today.

Software companies also lack the attitude of trying to develop creative software. Thus, they cannot make a

proposal on offering an expensive software program.

This fact shows that the lack of strategy of software firms is caused by the idea that software is an attachment of hardware. This tendency leads to a situation where the value of software is not appropriately evaluated.

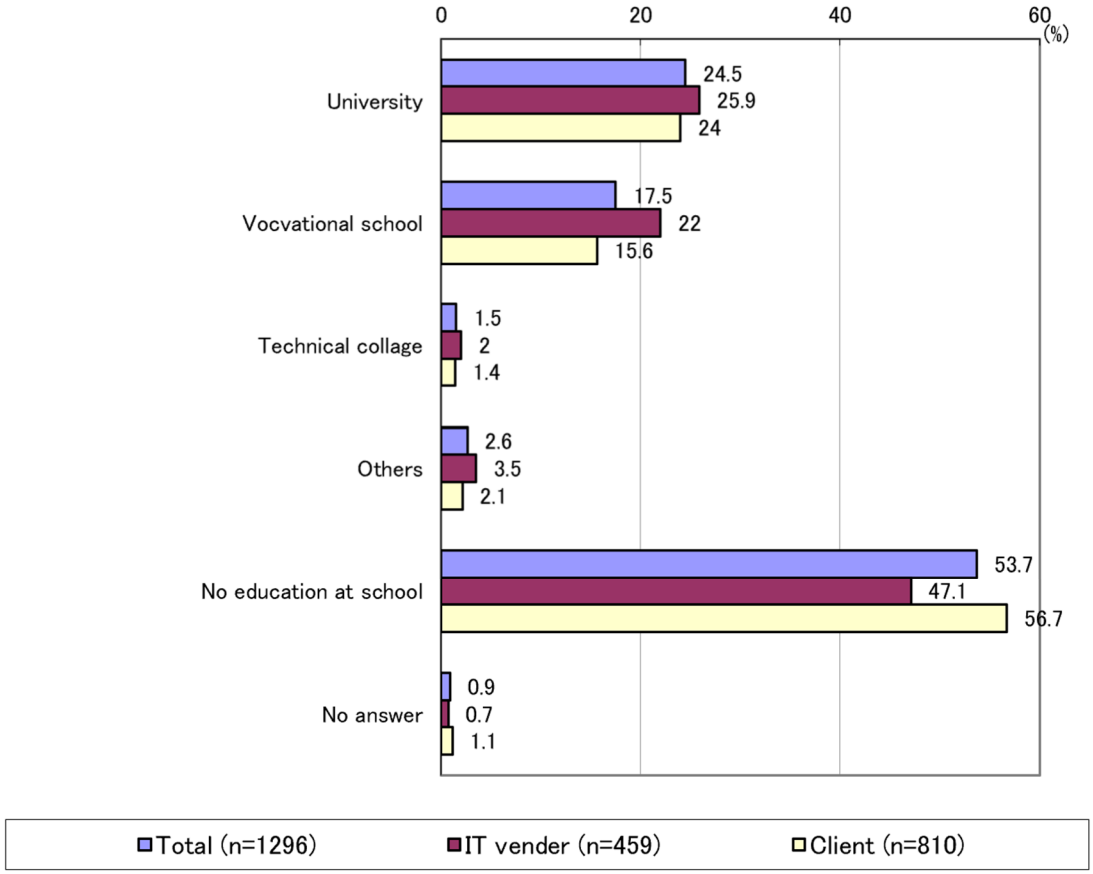

Figure 1. School of IT education for engineers
Source: Japan Information Management and Development Association ed. (2002)

Contrarily, the inappropriate evaluation of software affects the human capital management of small and mid-sized software firms. College students with a major in IT prefer working for high-salary firms such as banks, brokerage firms, trading companies, or large IT firms. Consequently, small and mid-sized software firms hire many non-IT-major college students or students from IT vocational schools. Based on a research in 2001, among the IT engineers, 24.5% were college graduates (including IT-major and not-IT-major students), 19% were graduates of vocational schools or technical colleges, and 53.7% did not receive any IT education at school (Figure 1). This means that majority of the Japanese IT engineers didn't receive IT education at school.

The Japanese software industry takes advantage of this situation using the multi-subcontracting system where many small software firms exist. They are subcontractors of the large software industry and develop software with cheaper wages compared with those of the large software firms (Maegawa, 2004, p.132). These small software firms do not have high technology or skills and try developing software for as economically as possible.

Therefore, the inappropriate evaluation of software resulted in a multi-subcontracting system, which is another reason for the lack of international competitiveness of the Japanese software industry. This means that one reason causes another reason.

The multi-subcontracting system hampers the improvement of the quality of software and productivity in developing software. Companies in the lower level of the multi-subcontracting system receive their incomes based on their working hours. Thus, these firms do not attempt to reduce the number of working hours. “The contractual method of the multi-subcontracting system is one of the reasons that hampers the improvement of productivity” (Maegawa, 2004, p.170).

3. The industrial structure and development method

This section focuses on the multi-subcontracting system of the Japanese software industry and shows that this system prevents Japanese firms from adopting new development methods.

In Japan, the waterfall model is the most used software development model, which follows the following

phases in order: requirements definition, design, coding, testing, operations, and maintenance. This model does not have a feedback.

However, Japanese clients do not always decide all designs in the beginning; instead, gradually make the decisions through the development process (Kitajima and Ban, 2006, p.170). As a result, in most development projects, designs are greatly modified, which causes lengthening of the development period and increase in the development cost. As a result, engineers have long overtime works, which causes a bad image on the software industry (Information Service Industry Association, 2007). This image seems to have a negative impact on the recruitment of potential workers in the Japanese software industry.

Other models, such as prototyping, incremental, and spiral, are also used in Japan. For prototyping, the prototype of the system is produced in the beginning. After, the requirement definition, design, coding, testing, and other processes are done. With the incremental model, requirement definition is formed in the beginning, and the system is then divided into several subsystems. The most important subsystem is first developed and other subsystems are added later. Thus, the processes from design to test are repeated. Finally, the spiral model repeats the sequence of requirement definition, design, coding, and test.

However, agile development does not need requirement definition and design in the beginning. Agile development includes XP, Scrum, FDD, and few other models. Here, the system is divided into many small functions. In one development process, only one function is produced. By repeating this development process, the development team adds the functions one by one. Therefore, instead of making a minute design the teams decide the design gradually. Agile development puts priority on the adjustment to the change of the development plan.

Which model is most used in software development projects? In Western countries and in India, the common models used are those where the requirement definition and design are not completely decided. However, in Japan, the waterfall model is most used. Sixteen among thirty Japanese projects used the waterfall model (Kusumano, 2003, p.37). Among customized software development projects in Japan, more than 90% would use the waterfall model. According to the author's research, most companies use this model. 36% of the Japanese development projects in embedded software use this model. This ratio is the second highest next to China (Figure 2).

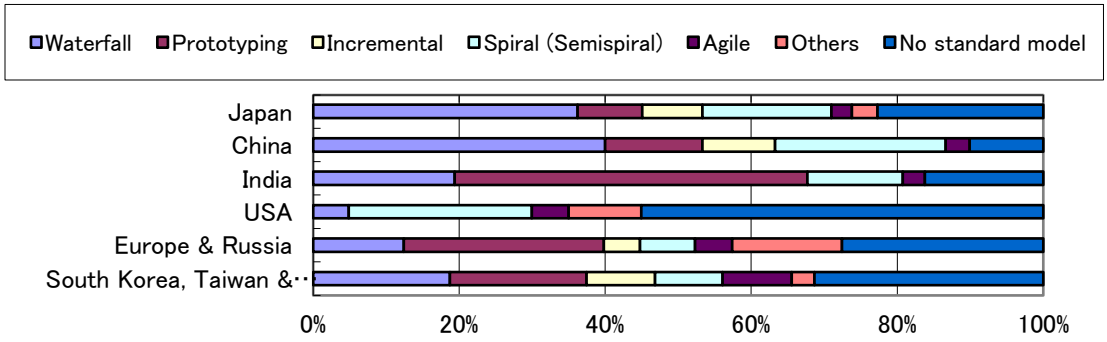

Figure 2. Model for embedded software development projects
Source: Made by author based on Ministry of Economy, Trade and Industry, Bureau of Business Information Policy (2005) p.22

These data show that many firms in Japan use the waterfall model. The rationale is discussed below..

First, the waterfall model fits the industrial structure of the Japanese software industry. In most Japanese development projects, the original contractor implements the requirement definition and design, and the subcontractors implement coding and tests. This business model is suitable to the waterfall model.

Second, the bureaucratic attitude of Japanese software companies is a reason. With the waterfall model, the role of design and that of coding is clearly divided. When a developed software is different from its original design, blames are placed on the coders and not the designers, which makes this system convenient for the designers. Thus, the original contractors prefer the waterfall model.

Last, the waterfall model is useful when the team is tasked to develop a similar type of software. The team exploits the experience of the first project in the second project, which is useful especially when the team has many low-skilled engineers.

These reasons show that the waterfall model is not used for efficiency. Consequently, development projects using the waterfall model have various problems including the delay in development period, increase in cost, and lack of few functions of the software being developed.

4. Conclusion

This article analyzed the reasons why Japan's software industry lacks international competitiveness. This analysis showed that the multi-subcontracting system prevents the Japanese firms from adopting new development methods. Many Japanese firms still use the waterfall model.

What should we do to promote the use of new development methods in Japan? First, Japan's software industry needs to increase the number of software engineers who can create both the design and code. In Japan, some software engineers only make the design, whereas others only create the required code of the software. For the agile development and other new development methods, engineers must implement both the design and coding. Thus, Japanese software companies have to recruit engineers who are equipped with both skills.

In Japan, the wages of an IT architect or analyst are higher than that of the coder. Therefore, the wages of engineers who implement both the design and coding would still be higher. When a software firm hires these highly paid engineers, their development project has to take some measures to reduce the whole cost of the project. One of the measures is to complete the project in a shorter period. Whether the project can take these measures or not will decide if a Japanese software firm can successfully introduce a new software development method.

These discussions show future research directions. First, we should analyze whether new software development methods, such as agile development, would change the multi-subcontracting system in the Japanese software industry. Second, Japanese universities and the Japanese software industry must foster able engineers who implement both the design and coding. We should search how to realize that.

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Notes

1. Package software for business user, game software, software for large computers, and things like that.
2. In 2000, the export of software is 9.0 billion yen and the import of software is 918.9 billion yen (Electronic Information Technology Industry Association et al. 2002). According to the questionnaire of an industrial association to their member companies, in 2004, the export of software is 32.0 billion yen and the import of software is 364.6 billion yen (Electronic Information Technology Industry Association et al. 2005).
3. Offshore outsourcing to foreign countries, such as China, Vietnam and India, is an alternative software development method for the Japanese multi-subcontracting system. The recent situation is described by Hanh (2023) and Vietnam Times (2021).