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Technology Transfer toward Upper Stream of Supply Chain Aiming to Construct a Homogeneous Management System

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Abstract

Technology transfer is performed between enterprises in a Supply Chain to construct a SCM system. By giving interviews to Japanese enterprises expanding their business to China, it has been found that a technology transfer is mainly carried out from assembler enterprises toward the upper stream of the Supply Chain. The assembler enterprise aims to construct a management system which is homogeneous over the Supply Chain. The SC management system will be founded on their corporate management philosophy.

Key Words: Technology transfer, Supply Chain Management System

1. Technology Transfer over Supply Chain

When an assembler enterprise with a high quality of technology extends their business to a foreign country, they may start business with parts-suppliers in the local area. A lot of Japanese assembler enterprises conduct business with local parts-suppliers in China. At the beginning of their business, the gap in the technology quality between the assembler and the parts-suppliers may bring about some technical problems which should be solved in the

manufacturing of high quality products. The assembler would make a technology transfer to developing parts-suppliers to improve their technological quality. The technology transfer concerned with backward spillover has been studied in terms of corporate economical finance [1], [2].

From the viewpoint of Supply Chain Management, the present authors have investigated the technology transfer over a Supply Chain of about 10 Japanese assembler enterprises in China [3], [4]. It has been found that the technology is transferred by a 4-step process in this order: transfers of Equipment Development, of Production Technology, of Production Management and of Information Technology. This paper discusses how the technological quality of the parts-suppliers gets improved by the technology transfer, which flows from an assembler toward the upper stream of a Supply Chain. The technology transfer is performed by the assembler enterprise to construct a homogeneous Supply Chain management system which is founded on their corporate management philosophy.

2. Mismatching of Technological Quality in a Supply Chain

Table 1 describes schematically how mismatched the technological quality of enterprises was in the initial stage of the Supply Chain. In the Table, only Assembler enterprise A and Parts-supplier enterprises S1, S2 and S3 are shown. The technological quality of these enterprises is shown by a mark ○ for high quality and by × for low quality. If Assembler A and Parts-supplier S are assigned ○ and ○, we say that the technology levels of these enterprises are fairly well matched. If the Assembler is assigned ○, but a Parts-supplier is assigned × contrarily, their technology levels are mismatched. You see that the technology levels of the enterprises shown in Table 1 are clearly mismatched. To the Parts-suppliers with mismatched technological quality, Assembler A might set about transferring technology to improve the matching of their technological quality.

Table 1 Matching of technology levels between Assembler enterprise A and Parts-Suppliers S1, S2 and S3 in a Supply Chain is shown in terms of the four technological items, i.e. equipment development, production technology, production management and information technology. Their technological quality is shown by the mark ○ for high quality and by × for low quality.

Enterprises	Equipment Technology	Production Technology	Production Management	Information Technology
S1	×	×	×	×
S2	○	×	×	×
S3	○	○	×	×
A	○	○	○	○

It is shown in Table 2 that the technology quality of the Parts-supplier S1 (assigned as S) is improved by the 4-step transfer process of technology, i.e. Equipment Development, Production Technology, Production Management and Information Technology. The technological quality of the Parts-supplier stays temporarily in a stationary state after each of the 4 steps of technology transfer is performed. We assign these temporarily stationary states as Phases. The technological quality improvement of the Parts-supplier proceeds through the phase transitions from Phase 1 to Phase 5.

Table 2 The time-ordered improvement of the technological match between the Assembler and Parts-supplier is shown. The technological match is improved step by step in the transfers of technology, Equipment Development, Production Technology, Production Management and Information Technology through the phase transitions from Phase 1 to Phase 5.

Phases	Enterprises	Equipment Development	Production Technology	Production Management	Information Technology
Phase 1	S A	× ○	× ○	× ○	× ○
Phase 2	S A	○ ○	× ○	× ○	× ○
Phase 3	S A	○ ○	○ ○	× ○	× ○
Phase 4	S A	○ ○	○ ○	○ ○	× ○
Phase 5	S A	○ ○	○ ○	○ ○	○ ○

The authors interviewed Japanese Assembler enterprises in China. As for the technological quality of their Parts-suppliers in the local area, the assemblers were asked to evaluate the matching percentage of the technological levels between the Assembler and the Parts-supplier in terms of each of the 4 technological items, i.e., equipment development, production technology, production management and information technology. The evaluated values of matching percentage for the four technological items are assigned as Matching 1, Matching 2, Matching 3 and Matching 4, respectively. We also introduced the weight of the 4 technological items, which are assigned as Weight 1, Weight 2, Weight 3 and Weight 4. In terms of these evaluated values of Matching and Weight, we calculated the degree of technological mismatching between the Assembler and Parts-supplier;

$$\text{Technological Mismatching} = \sum_{i=1}^{4} \text{Weight}_i \times (1 - \text{Matching}_i).$$

The authors compiled the values of Matching_i and Weight_i evaluated by the assembler enterprises. The technological mismatching calculated in terms of the Matching and Weight is visualized in Fig. 1, which shows how the technological mismatching between Assembler and Parts-supplier is removed by the technology transfer to the Parts-supplier. It should be noted that each of the temporarily stationary states is terminated by a sudden increase of mismatching. This short-lived increase of technological mismatching is caused by the confusion of the enterprises in preparing for another step of technology transfer.

Fig. 1 shows how the mismatching of technological quality between the Assembler and Parts-supplier is removed by the technology transfers. The matching is improved by the 4-step process of technology transfer, i.e. Equipment development, Production technology, Production management and Information technology. The technological quality of the Parts-supplier stays temporarily in a stationary state assigned as Phase after the transfer of one of the 4 technological items is performed.

By means of these efforts, the Parts-supplier finally reaches Phase 5, where their technological quality becomes equivalent to that of the Assembler. Now the Parts-supplier can cooperate efficiently in the Supply Chain as a member of the management system.

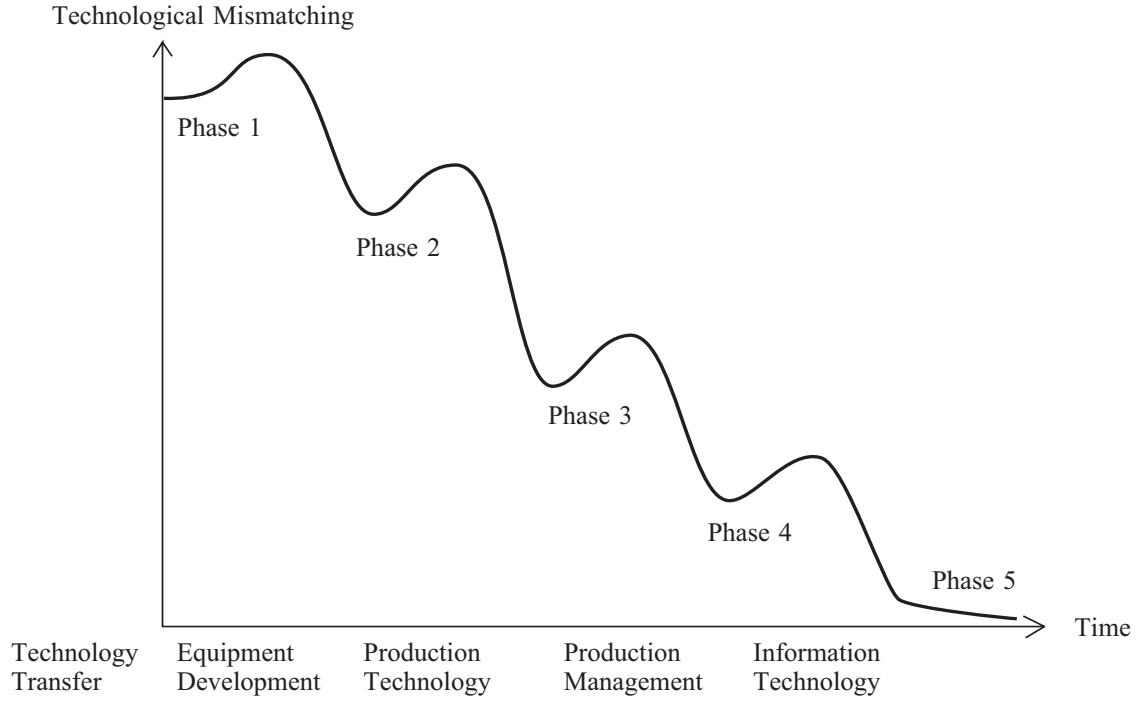

Fig. 1

3. Construction of a Homogeneous Management System of a Supply Chain

Generally, assembler enterprises have the responsibility for the good quality production of products. If an assembler enterprise produces substandard products, they have to trace back the origin of the mistakes. The assembler, applying their knowledge in removing the failure, makes a technology transfer to the unskilled parts-supplier. In this way, technology transfer flows from an assembler toward the upper stream of a Supply Chain [3].

Every enterprise has its own corporate management philosophy and production management. By means of technology transfer, the assembler enterprise pursues the construction of a homogeneous management system for the Supply Chain. In this way, the management system of the Supply Chain gets characterized by the corporate management philosophy of the assembler enterprise. Typical examples of homogeneous management systems are seen in the Supply Chains of Toyota and Panasonic. The group enterprises in the Supply Chain of these assembler enterprises worship the corporate management philosophy established by the founders of the assembler enterprises.

4. Concluding Remarks

By interviewing Japanese enterprises expanding their business to China, it has been found that technology transfer is mainly performed by assembler enterprises toward the upper stream of a Supply Chain. The assembler enterprises aim to construct a homogeneous management system which is founded on their corporate management philosophy. The authors will extend interviews to other assembler enterprises and further compile data on the tech-

nological matching between assembler and parts-supplier which can be improved by technology transfer. The result of more quantitative analysis on this subject will be reported in another context.

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