

A Study on a Diffusion Mechanism for the Knowledge-based Service Industry in Later-comer Countries: The Case of ASYCUDA

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지식집약서비스산업의 저개발국 확산 메커니즘 연구

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Abstract

Recently, a wide variety of research on the knowledge-based industries, which are considered a key area of social science research, has been conducted. In this light, this study examines a case of knowledge diffusion taken from the IT service field. The IT service industry has been considered difficult to diffuse due to its unique technological regimes and sophisticated market demand. In particular, the established public service systems have limited markets and encompass national characteristics, thereby making their international diffusion difficult. However, despite these limitations, the automated customs system ASYCUDA has been distributed successfully and is now operating in about 100 countries, making the case very unusual. Using various industrial innovation models, and an analysis of lead markets, with regard to ASYCUDA, this research examines patterns of technological learning activities by actors, characteristics of the lead markets, and paths of technology transfer. The findings indicate that when active technology providers attempt to streamline and standardize the technology to make it suitable for the characteristics of the initial technology application areas(lead markets), this helps to diffuse the technology to passive recipients and the surrounding nations. The findings also confirm that south-south cooperation in the acquired technologies was of considerable help in sharing knowledge among the passive technology recipients, and that the active technology providers' programmed, well-organized technology assistance was a key driving force behind technology transfer and diffusion between the surrounding nations.

1. Introduction

This study focuses on the IT service industry, the key area of the knowledge-based industries. Specifically, the study examines the diffusion course of the customs information system ASYCUDA (Automated SYStem for CUstoms DAta). Despite the difficulties in diffusion attributed from their characteristics of the knowledge-based service industries, the use of ASYCUDA has gradually spread from 1981 to 2008, and is now operating in about 100 nations, making its case very unusual.

This paper examines how the characteristics of technologies and markets influence the international diffusion of IT systems, and how various industrial innovation systems change from the perspective of the technological economics of neo-Schumpeterism, in a bid to provide strategies and guidelines for the actors, technology providers, and technology recipients of technology diffusion. Unlike the existing researches, this study, using the industrial innovation system concept, examines technology diffusion and technological learning among the later-comer countries.

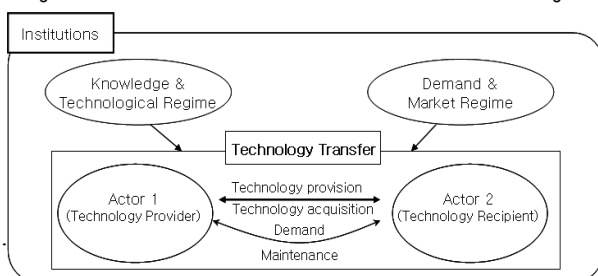
2. Literature Review

This study thus examines the ASYCUDA case from the aspect of the international diffusion of the IT service technology. There are researches that examine the diffusion and innovation of technologies in the information system area. In addition to the existing innovation acceptance model (Rogers), Moore and Benbasat (1991) examined such elements as voluntariness, comparative superiority, compatibility, ease of use, result demonstrability, testability, and visibility. Also, after the theory on the innovation and diffusion of information systems appeared, diverse researches found that considered important in accepting innovation were technical compatibility or related advantage, technical complexity or ease of use, and perceived needs. (Bradford and Florin (2003), Crum et al. (1996), Agarwal and Prasad (1998), Cooper and Zmud (1990)) These researches reflected in the discussion on diffusion the characteristics of information communication technologies being different from those of other industries, and comprehensively the innovation acceptance factors on the part of the technology recipients, but limited the diffusion of information innovation to areas between corporations, within certain nations, and within systems, failing to consider their international diffusion.

3. Methodology

This study adopts as its basic theoretical framework the sectoral system of innovation (SSI), which takes into total consideration the variables of technologies, markets, and institutions, and actors, and adds several variables to the framework in a bid to reflect the aspects of the suppliers and the recipients in the IT service field concerned. [1]

<Figure 1> International diffusion model of IT service technologies



<Figure 1> shows the relationships between various factors in order to produce a possible scenario of international diffusion. First, the actors in the diffusion consist of a technology provider and a technology recipient. The international diffusion herein is achieved by the result of technology trading and interaction between technology providers and technology recipients. Second, the patterns of technology recipients' technology learning are seen as influenced by the characteristics of technology presumably because, in fields with high technological opportunity and low appropriability of innovation, technology recipients may actively learn about the technology, and because in the case of high technological opportunity and high appropriability of innovation, technology recipients may learn less actively. [2] Third, to promote technology diffusion, not only the characteristics of technology but also those of markets should be considered, because technological success does not necessarily lead to the diffusion of technology in the markets. To explain the initial diffusion of technology, it is important to examine the specifics of regional markets, and in this respect we pay attention to the concept of the lead market, which Marian Beise introduced to his study on the diffusion of mobile technologies in Northern Europe. Fourth, regimes are environmental variables that influence technology, markets and actors as a whole, promoting or inhibiting technology diffusion between actors. Lastly, we examine trading conditions between actors on the basis of the hypothetical scenario outlined above. The issue of trading conditions, to a certain degree, is attributable to the characteristics of information technology such as high technological opportunity. To boost the global diffusion of technology, the IT service industry emphasizes a continued upgrading of the existing systems, making it different from technology transfer in other industries.

4. Case Study : ASYCUDA

The ASYCUDA (Automated SYstem for CUsToms DATA) system was established in 1981 after the West African Economic and Monetary Union (WAEMU) asked UNCTAD (United Nations Conference on Trade

and Development) to develop the system in order to investigate and manage trade statistics among its members. As such, the electronic system deals with customs clearance, charges collection, cargo management services, and so forth.

In an effort to further modernize customs clearance procedures under this system, UNCTAD has formed an exclusive team to conduct development projects and operate the program. ASYCUDA was further developed from its initial 1981 version into the ASYCUDA++ and ASYCUDA WORLD versions.

5. Diffusion Mechanism of Knowledge-based Services

5-1. Technology learning patterns by Actors

As regards the technological regime aspect, Brechi et al. (2000) argue that the learning patterns of recipients of external technologies are determined according to the characteristics of knowledge and technology, which means that the technological regime refers to a combination of fundamental factors relating to technology or knowledge, and that industry-specific patterns of learning or innovation activities are created according to the characteristics of technological regimes by industry.

Public customs information systems are more sensitive to functions rather than to cost. However, if a technology recipient (a system-importer nation) has a poor IT environment and low technological capabilities, it will have limitations as regards accommodating or imitating a high-function product. Due to these technological characteristics, underdeveloping nations as technology recipients are not expected to conduct active learning activities in the customs information system field.

ASYCUDA has been taken up by many nations due to UNCTAD's policy of spreading the system actively rather than as a result of the technology recipients' active learning activities in the early stage. UNCTAD adopted a strategy to develop a simple system that could be operated in a micro-computer, in consideration of the small trade volume, low IT infrastructure levels and low learning levels, because the system was supposed to be spread to underdeveloping nations.

5-2. Attributes of the lead market

Regarding the major concept of the lead market (Beise, 2005), this paper examines demand advantage and transfer advantage as major explanatory variables.[3] First, from the demand advantage aspect, in consideration of underdeveloping nations' low-level network infrastructures and IT operation technologies, ASYCUDA was designed and developed into a simple, low-function system. In the 1980's, many nations which structured an electronic government system had a mainframe system which required manning by engineers, but ASYCUDA was developed into a system that could operate on a low-specification system, because UNCTAD envisaged a modular software which would enable system operation with a smaller number of personnel, and the addition of more functions with the expected spread of computers in the future. Such an initial market made it easy for underdeveloping nations to introduce the system.

Second, various innovation models explain that diverse government regulations, laws and standards have different effects on industrial innovation, while they include contracts directly binding on corporations, official patent laws and anti-trust laws, and unofficial traditions and cultures.(Malerba, 2002) In this context, the aspect of transfer advantage in this case study is examined; a low-end system was developed by reflecting the peculiarities of underdeveloping nations, and the system consisted of various functional modules to reflect a wide variety of needs. Also, best practices were introduced through BPR/ISP, while compliance with the international customs administration standard reduced the risk of introducing and diffusing other nations's systems. Individual underdeveloping nations were each performing different customs processes, so the introduction of a system with the application of international standard work processes helped improve their existing customs work practice.

5-3. Diffusion of services and delivery paths

From the aspect of service system delivery paths, unlike the existing information services, ASYCUDA was developed into an open, modular system. The existing total system development method increases the budget burden on the system recipient nations, thereby delaying

the decision making on the project. However, the modular development method is used to design and analyze the information system, create and establish its common components, assemble them by work function, and then develop them into modules. As such, this method can cut the development period dramatically.

UNCTAD focused on developing a package encompassing essential customs clearance functions. The package consists of three modules - general office user module, specialist office user module, and system maintenance and reporting module. In the sub-categories, detailed functional modules are established, allowing the system to be reassembled to meet the recipient nations' needs. This modular method makes it beneficial to spread and diffuse the system by streamlining the procedure into consulting, application and operation steps.

5-4. Technical Assistance

It is essential to transfer technology and operation know-how from the IT system developer and provider to the actual user. Following the introduction of the system, it is important to localize and continue to upgrade the system according to technological changes and any changes in the user work environments. Unlike the ordinary diffusion pattern, the technology provider played an important role in diffusing the system. UNCTAD provided a systematic support program for the introduction of the system at all stages, ranging from the preparation phase and pilot implementation phase to the roll-out phase and post-installation assistance. These efforts prompted the diffusion of the system to neighboring nations with similar levels of technical infrastructure. The technical assistance program for the introduction of ASYCUDA provided technical and functional training and education, as well as education on the relevant laws and institutions, thereby effectively transferring technology and knowledge to the recipients.[4] UNCTAD enabled the ASYCUDA recipient nations to use the technological capabilities acquired during the installation stage in diffusing the system. It also implements the Train-the-Trainer program to facilitate peer group training as a means of diffusing knowledge. Also, by using a pool of experts who participated in the development of ASYCUDA, it provides technical

assistance for neighboring nations. This cooperative system bolsters the South-South Cooperation, thereby serving as a major mechanism for the continuing exchange of technical information and diffusion of the system among underdeveloping nations.

6. Conclusion

This study, using various industrial innovation models and the concept of the lead market, explained the diffusion of the knowledge-based public service system in underdeveloping nations. In this study, in the channel of transferring knowledge and technology, we confirmed the effects of the market regime and technology regime on learning patterns of the technology donor and recipient. In particular, we found that in the knowledge-based service industries with high technological opportunities and appropriability of innovation, the technology donor's active technology transfer played a very important role in diffusing technology. We also confirmed that the characteristics of the lead market were crucial when the application of technology led to its diffusion.

This study is significant in that it examined which mechanism worked in the case of limited market structure and non-diffusion service products to boost the diffusion. Unlike the manufacturing sector which seeks diffusion, spread and competition through R&D, such limitations are attributable to the characteristics of IT services as public goods. Thus, this implies that the existing typical marketing analysis methods and mix strategies may not be properly suitable for the diffusion of goods and services with a limited diffusion of knowledge and technology, or for the diffusion of public goods.

[Reference]

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