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# Using AHP to determine intangible priority factors for technology transfer adoption

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ABSTRACT

Technology has characteristics of inducing changes under competitive environment due to its dynamic property of being modified and accelerated over time. In order to improve profitability, the evaluation of technology transfer adoption (TTA) is very important for determining the weights of TTA factors, the influence of the organizational factors (i.e., the measures of TTA dimension) such as chief executive officer (CEO)' mind and capacity, commercialization, and technology licensing office (TLO)'s competence on the profitability of emerging technologies (ET), and the size of these organizational factors in suppler and buyer.

This research investigates the important intangible priority factors for the transfer of technology through analytic hierarchy process (AHP) method and correlation analysis. The study is based on three phases: (1) Phase 1: selection of TTA factors and the measures of ET, TTA, and bargaining power (BP) dimension; (2) Phase 2: correlation analysis between the measures of ET and TTA dimension (evaluation of TTA dimension based on the measures of ET); (3) Phase 3: evaluation of TTA dimension based on the measures of BP dimension. The quantitative weights of criteria, TTA factors and sub-factors are provided and they indicate the order of priority and the degree of importance for TTA. The results are interpreted in terms of the ET and BP dimensions of measures that need to be considered in order to provide assistance at the time of decision-making on adoption of technology transfer by companies.



## 1. Introduction

The technology transfer can be defined as the transfer of new knowledge, products or processes from one organization to another for business benefit (Wittamore et al., 1998). Technology transfer projects are often considered as joint R&D activities involving the recipient firm and the university. Technology transfer is the application of information into use, and encompasses a source of technology that possesses specialized technical skills, and the transmission to receptors who do not possess them and who cannot or do not want to create the technology themselves. The complex and dynamic behavior associated with technology transfer business processes combined with the technological risk involved in the participating small firms, has resulted into a lack of business process definition and improvement in this area (McAdam, Keogh, Galbraith, & Laurie, 2005). Technology transfer adoption in South Korea has been displaying trend of continuous increase since the commencement of technology transfer induced by the public announcement of law on the introduction of foreign capital (The South Korean Law, 1962). Technology transfer adoption from public institutions (research institutes and universities) to domestic enterprises has reached 19.6% in 2006. In particular, the production capacity of information technology (IT) industry in Korea was approximately US$ 19.7 billion in 2007, making Korea a global IT power with ranking of fourth in the world, which is led by countries in the order of USA, China, and Japan (The Year Book of World Electronics Data, 2007). Along with such rapid growth, the overall adoption of advanced technology in Korea is increasing by more than 20% per annum.

Such increase in adoption of technology transfer is being utilized as one of motive power for enhancing business competitiveness of small and medium venture enterprises in their efforts towards globalization. However, entry barrier into new market is immense for small and medium venture enterprises with insufficient in-house R&D infrastructure. Accordingly, such enterprises are coping to reinforce their competitiveness through adoption of technology transfer. Small and medium enterprises, however, are confronted with limitations at the time of decision making in pursuing adoption of technology including the need to determine the appropriate price for the technology to be purchased due to the limited resources of the enterprise, and the need to assess whether the technology to be purchased is coherent with the management strategy of the company. The key for the success of technology adoption is to assess the proper cost to be paid as technology

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royalty. It exerts immense influence on cost superiority strategy of the company by acting as factor for the initial cost incurred. Accordingly, rational decision making that induces minimization of burden on initial cost by having the technology transferred from the technology provider at appropriate price is highly important in guaranteeing sustained profit growth. However, there are difficulties for the chief executive officer (CEO)'s of small and medium sized enterprises in determining the core factors and their order of priority in order to make decisions on whether to purchase technology for investment into new business. It is evident that an order of priority has decisive effect on the establishment of management strategy of the company.

In order to improve profitability, the evaluation of technology transfer adoption (TTA) is very important for determining the weights of TTA factors, the influence of the organizational factors (i.e., the measures of TTA dimension) such as CEO' mind and capacity, commercialization, and technology licensing office's (TLO) competence on the profitability of emerging technologies (ET), and the influence of these organizational factors on bargaining power (BP). This research investigates the important intangible priority factors for the transfer of technology through analytic hierarchy process (AHP) method. The quantitative weights of criteria, TTA factors and sub-factors are provided and they indicate the order of priority and the degree of importance for TTA. Further, it is necessary to suggest the measures of TTA dimension which significantly affect the profitability of ET. Finally the measures of TTA dimension are evaluated in terms of the measures of BP dimension. The size of the measures of TTA dimension is determined in suppler and buyer. The results are interpreted in terms of the ET and BP dimensions of measures that need to be considered in order to provide assistance at the time of decision-making on adoption of technology transfer by companies.

## 2. Research background

### 2.1. Technology transfer

Due to rapid changes in globalization and convergence of high-tech industry, technology transfer has become an important factor in securing sustainable growth engine for further progress and development of country and companies. Winebrake (1992) defined technology transfer as "process of adaptation in which technology, knowledge or information developed by particular organization for particular purpose is applied to different purpose in different area by different organization". Boer (1999), with regards to the differences between technology and science, defined technology as adaptation of knowledge for practical purposes while stating that 'technology is created by adding new technological elements or scientific knowledge to existing technology. In addition, Roessner (2002) defined technology transfer as movement of know-how, knowledge and technology from one institute to another institute. On the other hand, Friedman and Silberman (2003) defined the process of technology transfer, by focusing on public research institute in particular, as "the movement of know-how, technical knowledge, or technology from one organizational setting to another," that is, the series of processes in which invention or industrial intellectual rights of public research institute is licensed or assigned to profit organization. Pérez and Sánchez (2003) investigated the evolution of the technology transfer practices used by university spinoffs during their early years and the effect of innovation networks on the dynamics of technology transfer. Daghfous (2004) investigated how learning activities and prior knowledge of the recipient firm increase the benefits to that firm from a university–industry technology transfer project. McAdam et al. (2005) examined how potential business and management inputs can be used to improve the technology licensing process and the business building process. Anderson, Daim, and Lavoie (2007) considered that technology transfer offices (TTOs) are considered by many to be key stakeholders to determine a university's overall success and examined the efficient and inefficient TTOs within US universities using data envelopment analysis. Bruque and Moyano (2007) investigated the organisational variables that may influence information technology adoption and implementation in cooperative and family SMEs. Llor (2007) examined the statistical distribution of the delays between patent filings and their corresponding transfer agreements in a major public research organization. Narayanan and Bhat (2009) suggested based on the analysis of technology sourcing that the older, the moderately integrated, and the firms with foreign presence are exerting more technological efforts than their counterparts. Lin, Fang, Fang, and Tsai (2009) examined the impacts of network embeddedness on technology transfer, as well as the moderating effects posed by firms' willingness and ability to learn.

The trend in adoption of technology in Korea is illustrated by the rapid increase in the cost of adoption of technology incurred from US$ 2722 million in 2002 to US$ 4838 million in 2006, an average annual increase rate of 15.5% (KOITA; Korea Industrial Technology Association, 2007). Adoption of technology in the area of IT accounts for approximately 50% of all import of technology. Additionally, the current status of technology transfer of public institute in Korea, which will be dealt with in this research, illustrates substantial increase from 1580 cases in 2005 to 2073 cases in 2006, and average royalty paid for technology during the same period increased from US$ 53 million to US$ 63 million.

Enterprises wishing to adopt technology, in alignment with the trend of globalization and convergence of technology, must review business feasibility for creation of new Blue Ocean on the foundation of the new technology to be purchased. Ultimately, purchasing activities are aimed at increasing the profits of the company. In order to carry out such business feasibility analysis, one needs to perform analysis on whether to make investment into new business through economic evaluation through cash-flow, which is used mainly in economics, that is, through indicators such as net present value (NPV) and internal rate of return (IRR). Such methods generally include average rate of return (ARR) method, payback period method, IRR method, discounted cash flow (DCF) method and current value index (profitability index) method (Richard, Stewart, & Alan, 1995). On the other hand, the DCF method is used to compute the NPV of the annual cash flow in accordance with the scale of investment proposal. CEO will purchase the necessary technology through outsourcing and pursue new business project if IRR is analyzed to reach the expected level.

However, how to determine the value of the technology to be purchased under the modeling of new investment business project is a domain that requires more than the financial point of view. In economics, the characteristic of CEO is thought to determine the success of the enterprise. Therefore, it is anticipated that the characteristics of engineers who will be in charge of technology being transferred and CEO who is the decision maker in adoption of technology will impart substantial influence on the increase in profitability.

### 2.2. Analytic hierarchy process

AHP is a research method to support rational decision making on several qualitative factors (Saaty, 1971). AHP is a highly outstanding management tool for complex multi-criteria decision problems and was developed as a methodology that can present flexible solution on qualitative and quantitative problems. The hierarchy structure of criteria and factors in AHP is depicted in Fig. 1.