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전문가설문을 이용한 기술 라이센싱 결정요인 분석

Identification of Factors Affecting Technology Licensing via Expert Survey

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목 차

국 문 요 약

본 연구는 기술 라이센싱 계약 체결을 결정하는 요인들이 무엇인지 살펴보고, 이들 요인들에 대한 상대적 중요도를 살펴보는 것을 목적으로 진행되었다. 이를 위해 본 연구에서는 기술 라이센싱에 영향을 미치는 다양한 요인들을 기술적 요인과 환경적 요인으로 구분하고, 국내 전문가들을 대상으로 계층적분석과정(Analytic Hierarchy Process)을 실시하였다. 분석 결과, 기술적 차원에서는 해당 기술의 상업적 성공 가능성과 기술이전 시 함께 이전되는 권한이 기술이전에서 매우 중요하게 작용함을 확인하였으며, 동시에 환경적 차원에서는 기술을 이전받는 기업 내부의 기술활용능력 및 학습능력이 매우 중요한 결정 요인임을 확인하였다. 또한 기술공급자와 기술도입자가 기술이전 시 중요하게 고려하는 요인이 다르다는 사실을 확인할 수 있었으며, 이러한 결과들을 바탕으로 기술이전을 촉진하기 위해 기술공급자와 기술도입자의 인식의 차이를 줄이기 위한 정책적 함의들을 논의하였다.

핵심어 : 기술 라이센싱, 계층적분석과정, 전문가설문

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ABSTRACT

This research investigates the determinant factors of technology licensing contracts and the relative importance of each factor. To accomplish this objective we classify various factors affecting technology licenses into two categories, technology and environment, and conduct an Analytic Hierarchy Process (AHP) with a Korean expert survey. From the AHP results, we find that the possibility of commercial success, as well as the scope and levels of exclusive rights which are transferred together with technology to the licensee, are very important among technological factors in technology transfer. Moreover, we conclude that the technology utilization capacity and the learning capabilities of the licensee are also important environmental factors. Finally, we conclude that the factors which the licensor and licensee consider in technology transfer are different from each other. Based on this result, we discuss implications with regard to reducing this factor gap between the licensor and licensee as a means of promoting and improving technology transfer in the Republic of Korea.

Key Words : technology licensing, AHP, expert survey

Ⅰ. Introduction

The definition of 'technology transfer' is different based on the academic area and the purpose of research. Most Korean researchers follow the definition provided by Korean technology transfer law enacted in 2000. In general, technology transfer is the transfer process of a systematic and productive knowledge related to technology which is developed by some organization or system, to another organization or system.

Technology transfer is often considered to be synonymous with the term 'technology commercialization' which term covers technology transfer, new product development and production in a broad perspective (Lim and Lee, 2007). One should keep in mind, however, that commercialization generally involves those technologies that are intended to be developed for a commercial purpose, from research and development (with the latter term referring both to the technology and the commercial application of such technology) through transfer, via some market transaction (sale, license, investment into a third-party enterprise or otherwise). Generally, internal transfers (between divisions, for example) are not referred to as commercialization, but can be included under 'technology transfer' per se. In other words, transfer is more inclusive than commercialization. In addition, 'research' is more expansive than implied by the term 'research and development', since much research is conducted that is not intended for development, in a commercial sense.

As international technology-based competition becomes increasingly severe, various kinds of policies have been introduced to promote technology transfer (in a commercial context) in order to increase the efficiency of national research and development (R&D) projects and maximize technology spillovers from the public sector to the private sector for enhancement of national competitiveness in Korea. Through the result of these efforts, the cumulative number of domestic technology transfers from public research institutes to private companies increased up to 8,754 instances at the end of 2005. The cumulative technology transfer ratio, which is defined as the number of technology transfer transactions divided by the total technology owned by public research institutes (as identified as discrete technologies by such institutes), was 20.7% in 2005 and this ratio rose to 22.4% in 2007. However, this domestic technology transfer ratio remains at a relatively low level compared to that of advanced countries,

so the policies and national systems that promote technology transfer remain important agenda items for the Republic of Korea (Ministry of Commerce, Industry and Energy, 2006).

Although much research has been conducted regarding the promotion of technology transfer transactions, most such research in Korea tends to focus on the related laws and regulations, rather than their effect in practice, on a transaction or entity-level. This means that it is very hard to find research which simultaneously considers factors affecting technology transfer, such as the characteristics of the underlying technology, the main interests or viewpoints of the licensor and licensee and the environment for technology transfers. The reason for this is that it is difficult to analyze technology transfers using econometric methodology imposed on actual technology transfer data because of an insufficiently organized system to gather relevant technology license data. Furthermore, anecdotal case studies of successful technology transfers are not sufficient in quantity to empirically distinguish the factors essential for the increased efficacy of technology transfers.

The main purpose of this research is to identify determinant factors affecting technology transfers and their relative importance. This research uses an Analytic Hierarchy Process (AHP) with expert survey, which is proposed as a useful methodology under the current Korean situation in which transfer systems are not well organized so that exact data regarding technology transfers is not readily available. In particular, this research considers various kinds of factors including internal/external technological and environmental factors via AHP. Finally, we discuss what kinds of policies are needed to promote technology transfers based on the opinions of experts as revealed by the AHP analysis.

This paper is organized as follows: Section 2 introduces previous literature dealing with factors affecting technology transfer as well as an introduction to the patents underlying most license agreements and the general terms and conditions for such license agreements, and Section 3 describes the AHP methodology and determinant factors, as well as the hierarchical structure used in this research. Section 4 provides empirical AHP analysis and policy implications based on results, and Section 5 closes with a discussion of the implications and limitations of this research, as well as a consideration of the practical aspects of licensing, at the party/counterparty level.

II. Background

1. Previous Literature

Previous literature on the determinant factors of technology transfer could be broadly divided into two streams, based on entity types: technology transfer between private companies and technology transfer from public research institutes or universities to private companies.

First, we consider research which investigates the reason why private companies trade their technology, a representative intangible asset, with other private companies in the market, from a theoretical perspective. These works explain the reasons for technology transfer between private companies with respect to an entrance deterrence effect, vis-à-vis a competing company (Gallini, 1984; Eswaran, 1994), the expansion of sales (Katz and Shapiro, 1987), a stimulation of demand (Hepard, 1987) and collusion (Lin, 1996). However, empirical analyses regarding the technology transfers between private companies is very limited because of the relative lack of technology transfer data for such transactions, which are by nature private, for the most part. Therefore, most of these studies are based on survey data for a specific industry such as the chemical industry (Grindley and Nickerson, 1996) or the electronic industry (Grindley and Teece, 1997).

Anand and Khanna (2000) performed an empirical analysis on chemical, pharmaceutical, mechanical and electronic industries using technology licensing data from 1990 to 1993. With regard to the licensor's determinant factors of technology transfer, Kim and Vonortas (2006) use panel data for all industries of United States (U.S.) from 1990 to 1999. They conclude that a company as licensor considers level of technological knowledge it owns, its past experiences with technology licenses, the growth rate of industry, patent protection levels, technological characteristics and synchronicity of purpose as important factors in technology licensing. On the other hand, theoretical research regarding the licensee's perspective in technology transfers between private companies tends to focus on governance-related aspects. This is because many companies that introduce a lot of technologies from the outside via various transaction types such as licensing, joint R&D or straight purchase, do so with

the consideration of a number of determinant factors, which may depend on the types of technology at issue, as well as the options available for a particular transaction. One of most representative theories is the transaction cost theory[1] suggested by Williamson (1985). Moon (1997) uses the transaction-cost approach to investigate the choices of the mode of technology transfer. In this research, the author concludes that technological change and the innovative capacity of the licensee are important factors in the mode of technology transfer. Steensma & Fairbank (1999) perform empirical analysis, which is based on transaction cost theory, to investigate the factors affecting the types of governance modes using posted information of U.S. stock market data from 1993 to 1994.

On the other hand, research on technology transfer from universities or public institutes to the private sector has been broadly and actively conducted since it is believed that the social spillover of technology developed by universities and public institutes is important for national competitiveness. These beliefs are actualized through the Bayh-Dohl Act in the United States, and it is worthwhile to study this act in a bit of detail, since in my opinion, Korea has yet to promulgate an act of equal scope, scale or impact. The Bayh-Dole Act, or the University and Small Business Patent Procedures Act, is the legislation dealing with intellectual property arising from federal government-funded research in the United States. Adopted in 1980, Bayh-Dole is codified in 35 U.S.C. § 200-212, and implemented by 37 C.F.R. 401. Inter alia, it gives US universities, small businesses and non-profits clear control of their inventions and other intellectual property that resulted from such funding. The Act, sponsored by two senators, Birch Bayh of Indiana and Bob Dole of Kansas, was enacted by the United States Congress on December 12, 1980.

Major provisions of the Bayh-Dole Act include: non-profits, including universities, and small businesses may elect to retain title to innovations developed under federally-funded research programs; universities are encouraged to collaborate with commercial concerns to promote the utilization of inventions arising from federal funding; universities are expected to file patents on inventions they elect to own; universities are expected to give licensing preference to small businesses; the

1) Transaction cost theory explains the governance mode of organization, and its main idea is that performing economic activity with the hierarchy of organization is more efficient than with the function of market from the perspective of transaction cost.

government retains a non-exclusive license to practice the patent throughout the world; and the government retains march-in rights.

In my opinion, the most important effect of Bayh-Dole was that it reversed the presumption of title. Bayh-Dole permits a university, small business, or non-profit institution to elect to pursue ownership of an invention in preference to the government. The Bayh-Dole Act therefore allows for the transfer of exclusive control over government funded inventions to universities and businesses operating with federal contracts for the purpose of further development and commercialization. The contracting universities and businesses are then permitted to exclusively license the inventions to other parties. The primary contrasts with the laws of Korea lie in the exclusivity and clarity of the control issues.

One should note, however, that the federal government, however, retains "march-in" rights to license the invention to a third party, without the consent of the patent holder or original licensee, if it determines the invention is not being made available to the public on a reasonable basis. In other words, the government retains the power to issue a compulsory license.

Theories which are applied to technology transfer between private companies can also be successfully applied to public technology transfer. Two main research areas regarding technology transfer from public to private institutions are 1) about problems which occur during the transfer process for intangible knowledge assets (patents) which are developed by nonprofit institutions such as universities and public institutes and 2) about policies or national innovation systems to promote technological development in the public sector and technology transfers from the public to private sectors.

Mowery and Shane (2002) introduced several problems that occurred in the commercialization of technology and transfers to private companies by universities. Kim, Moon, and Sohn (2003) summarizes the situation of technology transfer in Korea and abroad, and they describe obstacles and related promotion strategies for technology transfer in Korea. Kwon and Noh (2007) uses three types of obstacle factors such as technical, environmental and structural factors, and identify the obstacle factors which occurred in technology transfer. Yang and Kim (2008) use survey data, and analyze problems of technology transfer of R&D institutes as a licensees. In this research, the authors conclude that the lack of fair technology valuation and the non-existence of a specialized department or team are main problems in technology transfer.

Sine, Shane, and Di Gregorio (2003) regard the university as licensor and provide results supporting that the performance of technology transfer from a university is directly proportional to the reputation of that university. Thursby, Jensen, and Thursby (2001) perform empirical analysis on the relationships between performance, the characteristics of a university, the purpose of technology transfer, and so on, based on 62 U.S. universities and find that the size of the technology transfer office, the existence of a medical college, the standards of professors and the completeness of technology affect positively on successful technology transfers.

Thursby and Thurby (2000) and Shane (2000) regard technological uncertainties and market uncertainties as key factors in determining the success of technology transfers and try to provide a theoretical background for empirical analysis, because as Jensen and Thursby (2001) and Thursby, Jensen, and Thursby (2001) point out, the technology developed by a university tends to be in the early stage of technological innovation so that only a small part of that technology is proven, and that it is this unproven technology that is licensed by universities, usually based on a patent right.

Kim, Hyun, and Choi (2006), Kim and Hyun (2006) examine factors affecting the licensor and licensee in technology commercialization focusing on the university as a licensor. One of the main findings of Kim, Hyun, and Choi (2006) is that the licensee should have a patent and research capacity which is related to the technology transferred together with a specialized department or team for technology licensing to achieve successful technology licensing. Kim and Hyun (2006) concludes that monetary payoff impacts insignificantly on technology commercialization and the number of patents which the university has shown has positive impact on technology commercialization.

Park and Yong (2000) empirically investigate factors affecting technology transfer in the Korean electronic industry, and find that the character of the project manager, technology life cycle stage, and joint technology development affect on the success of technology transfer. Park et al (2006) investigate effective factors for defence technology transfer with survey data. In this research, authors classified factors affecting technology transfer into five subcategories - licensor's factors, licensee's factors, interactive factors, technological factors, and environmental factors, which are similar to the factors classified within this study. Park et al. (2002) approaches technology transfer with the game theory model of economics and addresses important issues such as royalty rates,

incentive system, balancing between an initial payment and a running royalty, etc.. Moon and Cho (2001) introduce various kinds of technology transfer models with figures and Kim (2004) analyzes determinants of international licensing behavior with the regression method.

2. Status of Korean Technology Transfer

Basically, a patent is an exclusive right granted by law to applicants or assignees, which right enables them to make use of and exploit their inventions for a limited period of time, generally 20 years from the date of filing. The holder has the legal right to exclude others from the commercial exploitation of his invention for this period. In return for this exclusivity, the applicant is obliged to disclose the invention to the public in a manner that enables others to replicate the invention. This system is designed to balance the interests of the applicants with respect to exclusive rights with the interests of society as a whole, with respect to the disclosure of the invention.

The number of patents in force worldwide is estimated to be about 6.1 million (WIPO, 2008). The largest number of patents in force is in the United States, at 1.8 million. More than half of the patents in force were filed between 1997 and 2003. One should note, however, that not all inventions are patented, as alternative protections are afforded by law (as trade secrets or technical know-how, for example). Furthermore, the patent systems vary across countries and industries, and a direct comparison of patent statistics is ill-advised. One needs to be particularly careful about confusing applications with patents granted, since the former is a matter of filing and paying the fees, while the latter usually, but not always, involves some review of the application with respect to the invention. In this regard, one should note that the Korean patent office, as the result of an intensive effort coordinated by the government, has the lowest pendency time for first office action in the world, and this number has decreased over the period 1999 to 2006 (WIPO, 2008). This fast response time results in large Korean application numbers, and this should be kept in mind when comparing Korean data with that of other countries, which may have longer pendency times.

As mentioned, patent rights are conferred to the inventor for a limited period, generally 20 years, and the holder must pay maintenance or renewal fees at specified intervals to the appropriate patent office in order to keep the patent in force. In the United States, these intervals are 3.5 years, 7.5 years and 11.5 years, for example, but these periods vary across offices around the world. A minority of patents are maintained for the full term of 20 years from filing.

Worldwide patent applications increased by 4.9% between 2005 and 2006, mostly due to increases in filings by applicants from China, Korea and the United States (WIPO, 2008).

For Korea, this number was 6.6% for that year. Korea's share of worldwide applications was 3.5% for the period 2000 to 2006, and the number of patents granted to applicants has grown from 2000 to 2006 by 23.2% on an annualized basis. The Korean patent office received 166,189 applications in 2006, and the number of filings at this office has increased by 8.5% per year (average annual growth rate) from 2000 to 2006. These growth numbers exceed those of all reported European and North American countries. Finally, one should note that two of the top twenty patent cooperation treaty (PCT) applicants worldwide are LG Electronics and Samsung Electronics.

These numbers hold true even when reviewing "triadic patent families" in order to take into account "home bias" which can result from applicants' propensities to file in their home countries. Triadic patent families were developed by the OECD in order to reduce the weaknesses of traditional patent indicators, and these families are defined as a set of patents (that protect the same invention) taken at the European Patent Office, the Japan Patent Office and the US Patent and Trademark Office. Under this analysis, Korea showed nearly 160 patent families per billion dollars in industry-financed R&D expenditures for the period from 1995 to 2005 (OECD, 2007).

It is important also to recognize that, with respect to the license and other transactions that occur around technology, there are micro-level details that are obscured when reviewing the overall statistics. In particular, I note that with respect to licensing transactions based on patents, there are various signs of strengths and weaknesses that a relatively quick review of a particular patent can reveal.

While it is often difficult to generalize about patent documents, the following two lists of the possible strengths and weaknesses of a patent cover the basics. With

respect to the possible signs of strength, one needs to consider whether the patent uses different independent claims formats of varying scope (from broad to narrow), many nested dependent claims, many embodiments in the body of an application, an old filing date, a detailed and lengthy prior art section, lengthy search classifications, or a series of patents clustered around a particular technology/ product. In my opinion, with respect to this nuanced approach to patents, Korean patent filings are "weaker" in that the clustering of patents as well as nesting of claims with many embodiments are less important than sheer volume. In other words, the Korean system, as distinguished from the US system, for example, has evolved with an emphasis on quantity rather than quality. Our research takes this into account by using factors of importance for technology transfer rather than the patent itself.

Possible signs of weaknesses include whether the patent contains very few claims, only long independent claims, only short independent claims, a very brief detailed description or a relatively recent filing date.

With regard to license agreements, key terms and conditions include: boundaries on grant and/or territory; sublicense provisions; reservation of rights; term and renewals; payments, including sublicensing payments; provisions regarding late payments and audit rights; warranties and indemnifications; intellectual property protection; provisions regarding exploitation; provisions regarding samples and quality control; insurance; confidentiality; provisions regarding termination and rights post-termination; survival; provisions regarding assignment; provisions regarding rights with respect to new inventions and improvements as well as grant back of improvements; service provisions including those regarding installation, technical assistance, training and development; and acceptance provisions regarding deliveries.

It should be noted that, in my experience as a practicing lawyer, Korean contracts (not just licenses) tend to be much "simpler" than American contracts, for example, in that they contain a relatively smaller number of terms and conditions and rely greatly on the default conditions of the Korean commercial code. In other words, Korean contracts tend not to spell out each and every contingency in detail, and can be vaguely worded as compared to US contracts for similar transactions. While it's beyond the scope of this paper to go into great detail on this point, suffice it to say that, in the US, the approach to unrealized commercial risk involves the use of written contracts where "gentlemen's agreements" once controlled, as in Korea. Such

agreements are fine, as long as everyone behaves as gentlemen but the risk is realized when, due to circumstances as developed over time, whether exogenous or endogenous, something has happened so that breach of the gentlemen's agreement becomes attractive to either or both parties. Typically, Korean companies then renegotiate the agreement at that moment. Such negotiations naturally skew towards a solution favoring the party with better positioning at the time of renegotiation. In many cases, however, it's more efficient, and strategic, for the parties to agree on a framework ex ante, with the possibility of renegotiation and amendment expressly hard-wired into a contract at the initial moment of agreement. On a process-level (for the organization), this documentation step also provides for a clearer view of the risks involved by making explicit the assumptions inherent in the contract.

With respect to contract matters, based on my practice experience, it's my considered opinion that Korean parties value flexibility and mistakenly believe that memoranda of understanding (or no written agreements at all) maximize their options. Furthermore, Koreans value speed and correctly believe that memoranda of understanding (MOUs) are easier and faster than full-blown agreements. However, MOUs are dangerous because they don't cover problems, and gentlemen's agreements don't cover ungentlemanly conduct. Technology transfer contracts such as licenses need to move beyond the MOU to contract quickly, and Korean transfer transactions are developing more sophistication as the transactions themselves become more international. Perhaps because of a history of government officials focusing on the MOU as a means of memorializing agreements, Korea has developed an almost unique appreciation of the MOU as a means of memorializing an ambiguous and often unrealized business transaction, simply for form rather than substance. Our analysis attempts to capture this by being explicit with questions regarding the determinant factors used in the AHP survey.

Finally, one must also consider contract conflicts with other agreements, including other license agreements, and also with respect to co-ownership or joint inventor agreements; corporate and stock agreements; employment agreements; loan agreements; nondisclosure agreements; option agreements; evaluation agreements; outsourcing or manufacturing agreements; partnership agreements and representation agreements.

Ⅲ. Methodology

1. AHP

AHP, as suggested by Prof. Thomas Saaty in the early 1970s, is one of the representative multi-criteria decision-making models for future forecasting, policy establishment and strategy development. It has been widely used in decision making, especially for cases in which data vagueness presents difficulties for the methodological usage of traditional econometrics (Lim, 2006). In general, AHP is used to measure relative importance or weighting of factors which are considered in the analysis using qualitative knowledge, experience and intuition based on surveys. As its underlying theory is relatively simple, clear and easily applied, there have been various applications such as decision-making in policy (Lee, Nam, and Oh, 2003), consumer preference analysis (Iş ı klar and Büyüközkan, 2006), product choice (Park and Lee, 2003) and health tourism (Kim, Moon, and Boo, 2008).

AHP proceeds by following several steps from 1) establishing the research purpose, criteria and factors (or alternatives), 2) setting out a hierarchical structure, 3) conducting surveys, 4) pair-wise comparisons regarding alternatives by criteria 5) derivation of importance levels (weights) for each criterion, 6) performing consistency tests, 7) conducting feedback processes with respondents for consistency, and 8) derivation of global importance levels (weights). Hierarchical structures consist of purpose, criteria and alternatives. The purpose is located at the highest level, criteria at the various mid-levels and alternatives at the lowest level in the hierarchical structure. The highest criterion is estimated by the purpose, and alternatives are estimated by the upper criterion. When the hierarchical structure consists of lots of hierarchies or levels, each criterion located at mid-level is estimated by the relationship of criteria, and the criterion at the lowest level is estimated by the upper criteria. (Park and Lee, 2003)

The pair-wise comparison between criteria or alternatives is one of the important characteristics of AHP analysis. The respondent indicates his/her subjective importance for each alternative from the lowest level by comparing two alternatives, and the collected relative importance becomes an element of a matrix, which is called the pair-wise comparison matrix. At this stage, it is very important for the respondent to

keep consistent when they compare alternatives and criteria. The consistency of each respondent is measured by the maximum eigenvalue of the pair-wise comparison matrix. Satty (1983) suggests that a consistency ratio (CR) which is lower than 0.1 is sufficient for consistency and CR higher than 0.1 and lower than 0.2 is an affordable level. However, Ko and Lee (2001) argue that absolute criteria of CR for consistency could be approached based on the number of hierarchies (levels), types of responses and acceptable error ranges.

Global importance is derived by the mathematical integration of the pair-wise comparison matrix of each respondent. In general, three different methods are used: the geometric average of elements for all pair-wise comparison matrices, the arithmetic average of weights for all respondents and the geometric average of weights of all respondents. First, the geometric average of elements of all pair-wise comparison matrices means that each element of pair-wise comparison matrix is averaged geometrically with the weight of all respondents and summed up into one element of a unified pair-wise comparison matrix. An arithmetic average of weights of all respondents and the geometric average of weights of all respondents are derived from weighting vectors based on the eigenvalue of each respondent. Integrated weighting vectors are calculated by the averaged weighting vectors of all respondents through the arithmetic or geometric method respectively. However, it is, in general, said that these three methods provide a similar result.

2. Hierarchical Structure for AHP

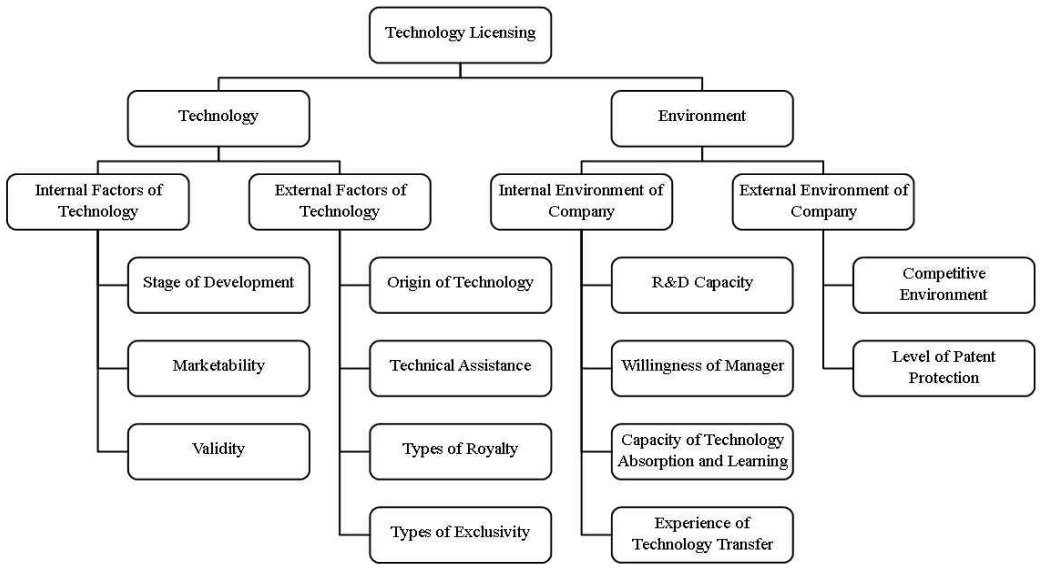
To investigate the relative importance of factors affecting technology transfer from the perspective of a private company as a licensee, we summarize factors which are generally regarded to affect technology transfer from the previous literature mentioned above. However, consideration of all the factors is not possible due to the characteristics of the AHP and survey, so the classification of similar factors into one category was made by brainstorming with professors and researchers of Seoul National University who specialize in technology transfer. After this stage, we finally classify factors affecting technology transfer for private companies into two sub-categories, technological factors and environmental factors. Technological and environmental factors

are again divided into two sub-groups, internal and external, which constitute the second hierarchy.

Factors for each hierarchy considered in the identification of determinant factors affecting technology transfer are listed in 〈Table 1〉, and the hierarchical structure used in this study is illustrated in (Figure 1).

〈Table 1〉 Determinant Factors of Technology Transfer

Purpose	Hierarchy 1	Hierarchy 2	Hierarchy 3
Determinant Factors of Technology Licensing	Technology	Internal Factors of Technology	Stage of Development
			Marketability
			Validity
		External Factors of Technology	Origin of Technology
			Technical Assistance (Scope and Level)
			Types of Royalty
			Types of Exclusivity (Scope and Level)
	Environment	Internal Environment of Company	R&D Capacity
			Willingness of Manager
			Capacity of Technology Absorption and Learning
			Experience of Technology Transfer
		External Environment of Company	Competitive Environment
			Level of Patent Protection



(Figure 1) AHP Hierarchical Structure for Technology Licensing

3. Factors Affecting Technology Transfer[2)]

1) Technology

'Technology' includes all factors relating to technology which is transferred. This is classified into internal and external factors, and the 'internal factors of technology' include the characteristics of the technology itself and 'external factors of technology' covers other factors relating to the technology such as the relationship between the licensee and licensor, as well as the contents of the contract between them.

For 'internal factors of technology', the 'stage of development' indicates the current development status or completeness of the technology which is transferred. In general, technology development takes several stages, from basic research, prototype, test production, commercialization testing, and so on, and it can be said that the possibility of market success is increasing as the current stage proceeds to the commercialization test stage. In other words, from a technical perspective, a new product embodying the technology which completes the commercialization test can be introduced into marketplace. The second factor, 'marketability', means the contribution of the technology on the competitiveness of the licensee. Application of transferred technology can open up a new market to the licensee, or can increase the competitiveness of the licensee through cost leadership or price leadership in the preexisting market. Finally, 'validity' indicates remaining technological life cycle and obsolescence speed of the technology which is transferred, and it also means that there is no legal apparent problem in the usage of technology in its application.

'External factors of technology' indicate the relation and content of the licensing contract between the licensor and licensee, and it includes the 'origin of technology', 'technical assistance', 'types of royalty' and 'types of exclusivity'. The 'origin of technology' means the institution where the technology is developed, and it includes universities, public institutes and private companies. In general, a university and public institute performs R&D practices related to basic technology, much of which could be developed into an important and also promising new technology. However, they tend to work in the initial stage of development so that most of their technologies are not

2) For the definition and description of factors considered in this study, we refer to work of Park (2002) and Lim and Lee (2007) cited herein.

proven in the market.

The second technological factor 'technical assistance' indicates whether there is technical assistance from the licensor. Actually, most contracts for technology transfer contain additional supports such as guidance, training, the education of the licensee, and their scope and levels are determined by contract. In general, when the technology is licensed, related documents, detailed finishing works and related technical resources should be transferred in conjunction with the technology, in order to enable its application. In the stage of preparing for actual production, the support of specialized human resources from the licensor is frequently needed.

The third factor, 'types of royalty', indicates transaction types for technology, with respect to payment streams. These vary by type of transaction, and in general, lump sum charges apply in the sales of technology, lump sums such as initial, annual, percentage and running royalties apply in the license of technology, shares or dividends apply in an investment context. These varying types of royalties can affect the relationship between the licensor and licensee.

Finally, 'types of exclusive right' indicates the scope and level of the license in terms of use of the transferred technology, and it includes exclusive rights and nonexclusive rights with respect to usage, sales and other usages of the technology. Exclusive rights in a license generally mean that the patent holder permits the licensee to practice the patent exclusively and at the same time the patent holder does not use his own technology which is licensed to the licensee for contract period. In other words, the holder does not compete with the licensee. In a license with exclusive rights, the licensee can license the patent exclusively within the purview of contract and also can have a right to indemnity for damages and infringement. Nonexclusive rights indicate a license in which the licensor gives a limited right to the use of the transferred technology within an agreement. A specified exclusivity means a license in which the licensor grants a license to licensee in a specific area while also agreeing not to grant another an overlapping license. On the other hand, a non-exclusive license means the rights can be granted by licensor to another.

2) Environment

'Environment' includes the licensee's internal capacity and market situation. The 'Internal environment of company' means the licensee's ability to utilize the

technology, the negotiation power of the parties to the technology licensing contract and the ability to achieve access to the information regarding technology which is necessary to apply it. On the other hand, the 'external environment of company' includes the competitive structure and characteristics of the market or industry which the licensee faces.

In addition, the 'internal environment of company' includes four factors which are 'R&D capacity', 'willingness of manager', 'capacity of technology absorption and learning' and 'experience of technology transfer'. First, the 'R&D capacity' indicates the ability of a company to develop new technology. In general, when the R&D capacity of the licensee is higher, they can develop the technology which is assumed to be transferred from outside by themselves and they can utilize the transferred technology more efficiently. Therefore, the company decides whether it will develop technology by itself or license the technology from outside of the company, based on the overall costs incurred in technology transfer, so that the licensee with high R&D capacity can hold a dominant position in the negotiation of technology licensing. 'Willingness of manager' means the eagerness which is needed in the commercialization of the product in which transferred technology is applied. In general, it gives great influence on the effective practice of a business plan for the transferred technology. The third factor, 'capacity of technology absorption and learning', indicates the ability and culture of the licensee to absorb transferred technology into their unique know-how. In general, licensees with a strong economic and technological position can digest technology very quickly and effectively, so they can increase their market competitiveness and consequently increase the market share as well. The final factor, 'experience of technology transfer' indicates whether the licensee has previous experience with respect to technology transfer. The licensee with technology transfer experience, in most cases, indicates that they have a network related to technology transfer, which higher accessibility and internal diffusion with respect to the technological information, so they can reduce the transaction costs incurred in technology transfer.

'External environment of company' includes 'competitive environment' and 'level of patent protection'. 'Competitive environment' refer to the competitive structure for the product market and industry in which the licensee operates. For example, when the licensee competes with the licensor in the same product market or industry, the difficulty in technology transfer is greatly increased. 'Patent protection level' indicates

the level of protection on the transferred technology. Generally, the level and scope of protection for the technology are different from industry to industry in a single country. In particular, when one transfers technology from other countries, the costs for the patent infringement could be increased due to the weak exclusivity of the technology afforded by the level of patent protection of various countries and these decreases in turn could result in severe market competition due to the free entrance of competitors.

IV. Empirical Analysis and Policy Implications

1. Empirical Analysis

For the identification of factors affecting technology transfer, the AHP survey was conducted with 14 domestic experts in June and July, 2008[3], and we exclude 2 responses for which the CR exceeds 0.2. For the calculation of the global importance of factors, we use a geometric average of elements for all pair-wise comparison matrices, and we use the program 'Expert Choice 2000', which is widely used in AHP analysis.

(Figure 2) shows the local importance for each criterion and factor described in the previous section, as derived from the total sample. First, in comparing 'technology' and 'environment', respondents gave more importance to the 'technology' which captures the features of the technology which is transferred. Between internal and external factors of technology, the importance levels of the 'internal factors of technology' are about 1.91 times higher than those for 'external factors of technology'.

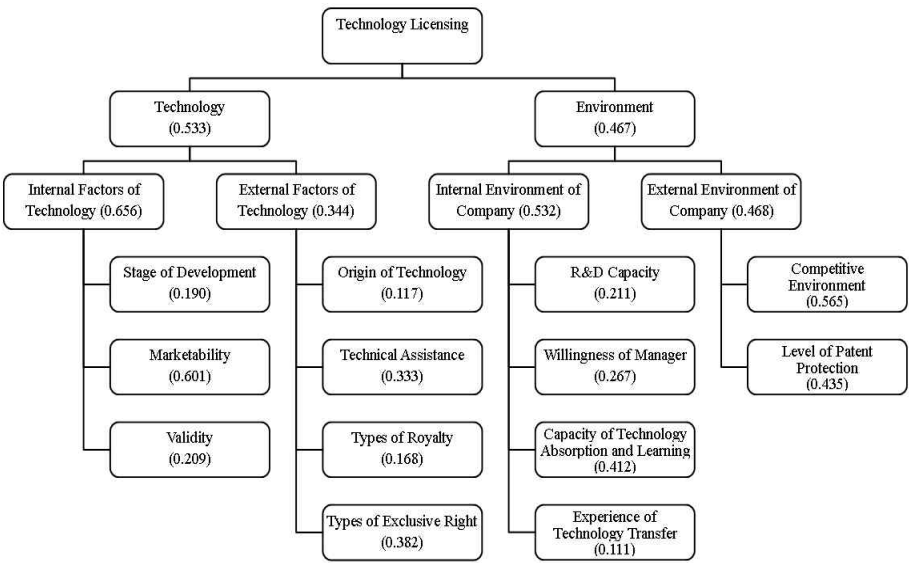
Among the considered factors, 'marketability' is considered to be more important than any other factor in the 'internal factors of technology', and 'types of exclusive right' and 'technical assistance' are important 'external factors of technology'. This means that the licensee pays attention to whether it is possible to create profit through the application of the transferred technology, whether it is guaranteed to protection with respect to the right of technology application, and whether there is enough

3) AHP survey was conducted with 7 professors of Seoul National University and 7 researchers of Intellectual Property Research Center and the Industry-Academy Collaboration Foundation of Korea University.

technical assistance from the licensor for successful commercialization, more than where the technology is originated from, what kinds of methods for royalty are contracted and how much is the technology valid. In other words, the overall conditions and full preparations for commercialization of technology are regarded as the relatively important factors, as compared to the others.

For the 'environment' factors, internal environment is regarded as more important than external (0.532〉0.468). Among factors considered, 'capacity of technology absorption and learning' is considered to be more important than any of the other factors in 'internal factors of environment', and the 'competitive environment' in 'external factors of environment' is considered to be important, as well.

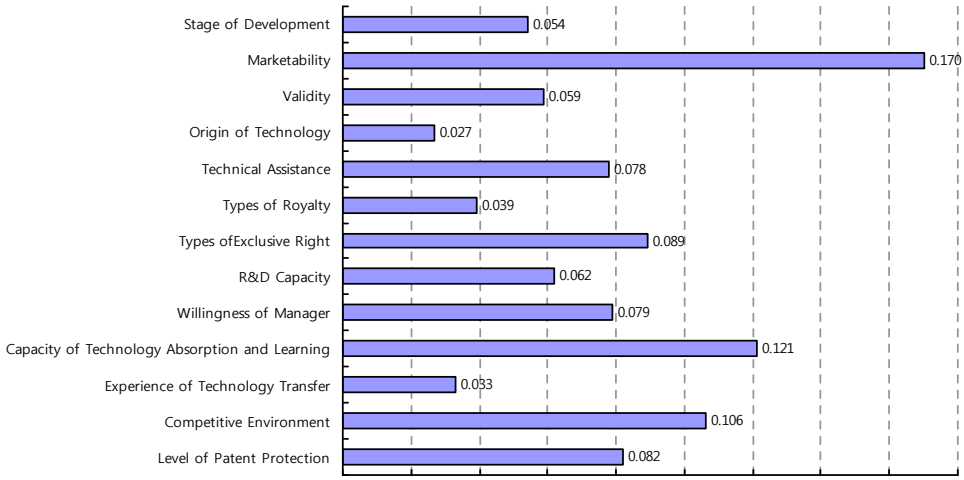
When we consider this result with the technological factors, we can derive some useful implications for successful technology transfer. First, from 'marketability' which shows high importance for 'technology' and 'competitive environment', we can infer that the technology should be profitable to the licensee at its introduction for a successful technology transfer. Adding to this technological condition, the licensee should have capability to fully utilize the technology which is newly introduced and there should be enough technical support from the licensor and guarantees of the exclusive rights for the success of technology transfer.



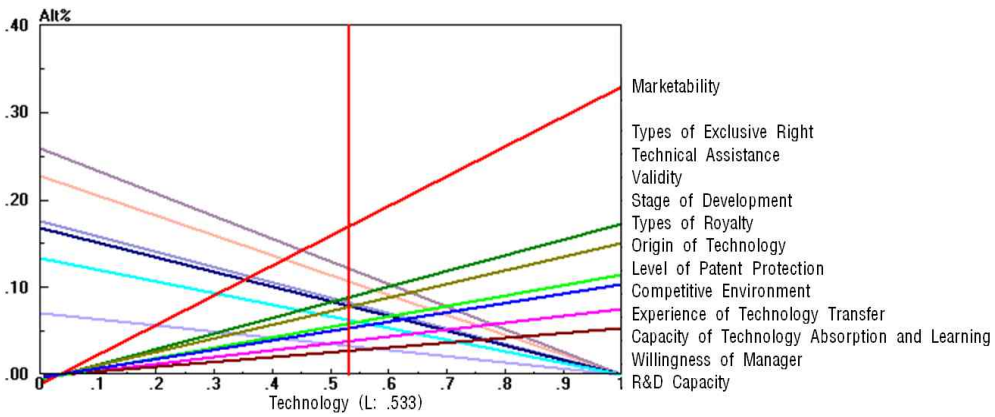
(Figure 2) Local Importance of Factors for Technology Transfer (Total Respondents)

The global importance for determinant factors of technology transfer derived from total respondents is shown in (Figure 3). Among all factors, 'Marketability' shows the highest global importance value with 0.170, followed by 'capacity of technology absorption and learning' and 'competitive environment' with 0.121 and 0.106 respectively.

From this result, we can infer that the possibility of commercial success and the contribution to the licensee are important factors in technology transfer for a private company and that the capacity to use the technology for commercial success is also considered as an important factor.



(Figure 3) Global Importance of Determinants for Technology Transfer (Total Respondents)



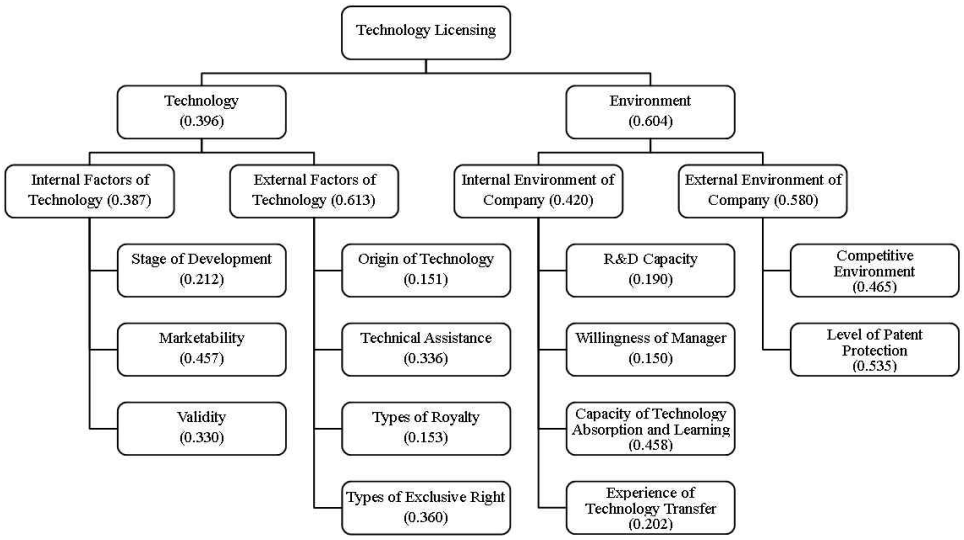
(Figure 4) Sensitivity Analysis of Determinants (Total Respondents)

(Figure 4) shows the result of a sensitivity analysis based on the result derived from the total respondents. The sensitivity analysis is performed to investigate the change of priority order among factors as the weight of each criterion is changed. From (Figure 4), we find that 'capacity of technology absorption and learning' becomes more important than 'marketability' when the importance of 'technology', which shows a local importance of 0.533, is reduced below 0.45.

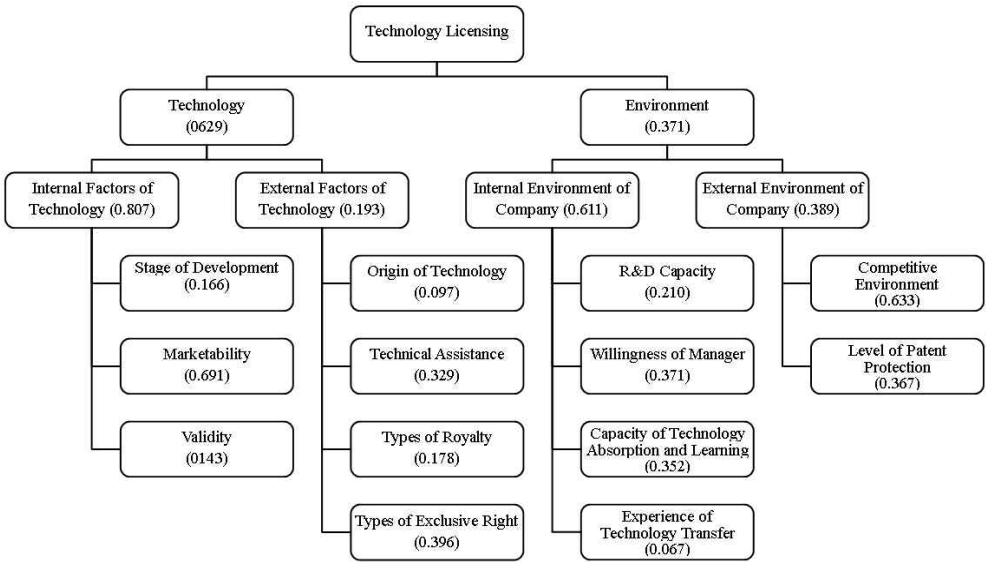
Next, we divide respondents based on type of institutes they work for into university and industry-academy collaboration foundations, and repeat the AHP analysis. (Figure 5) and (Figure 6) show the local importance levels of factors for university and industry-academy collaboration foundations, respectively. One interesting finding in (Figure 5) and (Figure 6) is that there is a difference of opinions between university and industry-academy collaboration foundations. The university respondents regard the 'environment' (0.604) to be more important than 'technology' (0.396) while industry-academy collaboration foundation respondents give more importance to 'technology' (0.629) as compared to the 'environment' (0.371). Furthermore, the important factor in 'technology' is also different between the two types. University respondents indicate that 'external factors of technology' are more important than 'internal factors of technology' and vice-versa for the industry-academy collaboration foundation respondent. However, the most important elements for internal and external factors of technology are 'marketability' and 'types of exclusive right' for both parties.

For the environment factors, two parties think that the 'internal environment of company' is more important than the external, and the industry-academy collaboration foundation respondent gives more importance to the internal environment than the university does. In terms of factors for the 'internal environment of company', two parties chose 'capacity of technology absorption and learning' as the most important factor. On the other hand, the university respondents give similar importance to the 'competitive environment' and 'level of patent protection' for factors in the 'external environment of company' but the industry-academy collaboration foundation respondents think that 'competitive environment' is much more important than 'level of patent protection'. This may be for a number of reasons, including a reflection "cherry-picking" of more the viable technologies (vis-à-vis commercialization) by university respondents, or difference of mission, with respect to the foundation respondents (who are generally charged with marketing of the technologies) favoring the more popular

technologies demanded by the market. Furthermore, with respect to the university respondents, they are more likely to be involved with a project over the long-term (with respect to license "after-service") whereas the foundation respondents are "off the hook" once the license in underway.

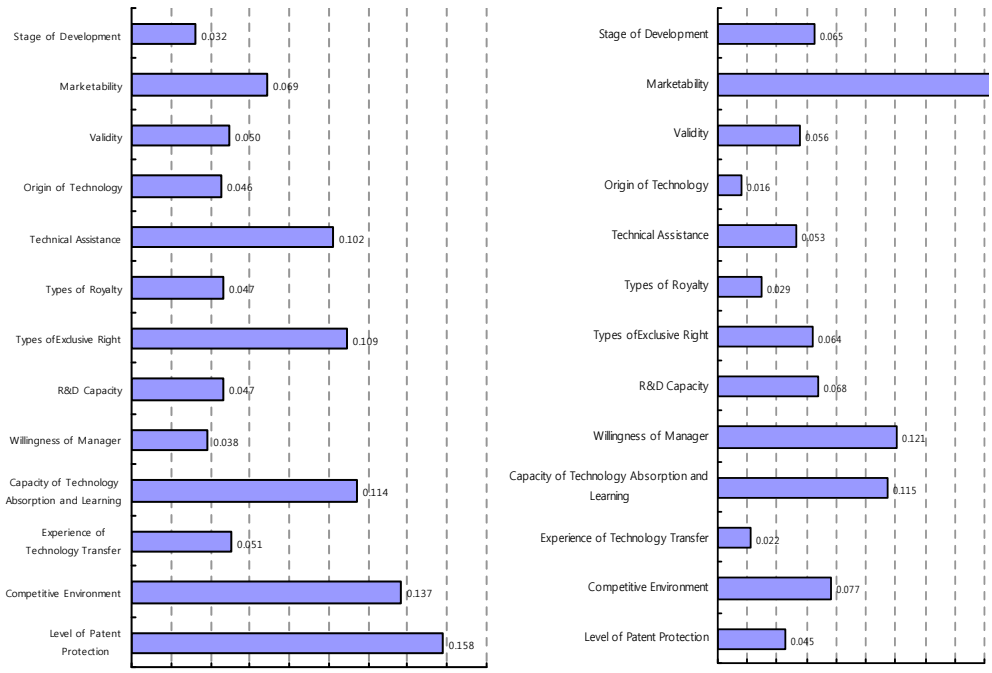


(Figure 5) Local Importance of Factors of Technology Transfer (Universities)



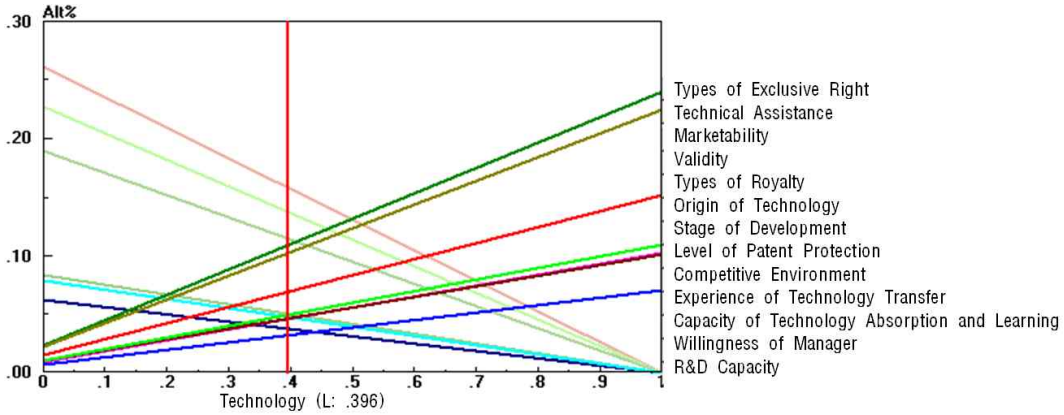
(Figure 6) Local Importance of Factors of Technology Transfer (Public Institutes and Industry-Academy Collaboration Foundations)

To investigate the difference between two parties for technology transfer, we derive the global importance of factors and perform a sensitivity analysis. It can be seen from (Figure 7) that there is a difference between the two parties. Universities think that 'level of patent protection', 'competitive environment', and 'capacity of technology absorption and learning' are important while industry-academy collaboration foundations give more importance to the 'marketability', 'willingness of manager' and 'capacity of technology absorption and learning'. This is because that most of respondents from the universities are professors in the field of engineering, and they are more closely allied to the licensor than the licensee. Therefore, it seems that they think the social protection system and related rights protection for their technology are important. On the other hand, public institutes and industry-academy collaboration foundations approach the technology transfer from the viewpoint of private companies (to whom they market the technologies), or the licensees, so it seems that they give more weight on the possibility of commercial success and willingness of managers, which are factors that are important for the buyers of the technologies.

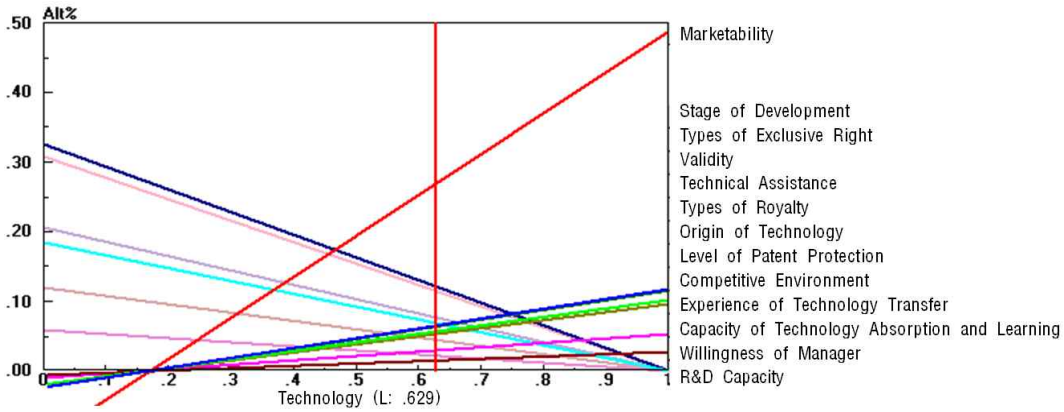


(Figure 7) Global Importance of Technology Transfer (Left: Universities, Right: Institutes and Industry-Academy Collaboration Foundations)

When it comes to sensitivity analysis, a difference between the two parties also exists. It is easily seen from (Figure 8) that 'types of exclusive right' and 'technical assistance' could be more important than 'level of patent protection' if the importance of 'technology' becomes more than 0.5. On the other hand, the 'capacity of technology absorption and learning' and 'willingness of manager' would be regarded as more important than 'marketability' by industry-academy collaboration foundations when the importance of 'technology' becomes lower than 0.45.



[Universities]



[Public Institutes and Industry-Academy Collaboration Foundations]

(Figure 8) Sensitivity Analysis of Determinant Factors

2. Policy Implications

When we examine the AHP results of universities and public institutes as well as industry-academy collaboration foundations, the important factors at the lowest criterion are not different from each other. They all regard 'marketability' as the important factor in 'internal factors of technology', and 'types of exclusive right' and 'technical assistance' in 'external factors of technology', as well as 'capacity of technology absorption and learning' in 'internal environment of company'. However, there are differences apparent in the first and second criteria and 〈Table 2〉 shows these differences. As mentioned above, this difference could be partly explained by the fact that professors at universities approach technology transfer from the position a position of licensor, but specialists in public institutes and industry-academy collaboration foundations from more closely allied to the licensee, as a result of their functions, which include promotion and deal-making activities, which are more objective, in that they are required to view the technologies from the perspective of the market. This means, of course, that there are differences of viewpoints between the licensor and licensee concerning technology transfer, and the implication is that within a particular institution, this should be harmonized.

From the perspective of the licensee, the questions include whether the patented subject matter will be adaptable to the licensee's products, services, and/or processes; what effect the protected process or features will have on the quality and marketability of the licensee's product; what activities are ongoing at competitors that may lessen the value of the obtained protected process/feature to the licensee; whether the patented subject matter can be adapted to other products manufactured by the licensee, whether there is a right to both exclude others from the practice as well as to practice without infringement upon the rights of others; whether there is an opportunity to license the intellectual property to others; whether competitors are developing next-generation products or have intellectual property that will lessen the impact or relevance of the acquired intellectual property; and whether there key engineering or manufacturing individuals working for the licensor who are critical to the success of implementing the patented technology at the licensee company. For the licensor, the questions include: whether the seller has a good understanding of all of the intellectual property being licensed as a part of the transaction; and whether other subsidiaries or divisions of the licensor currently utilize the intellectual property.

〈Table 2〉 Important Factors by Institution

Institute	University	Public Institute and Industry-Academy Collaboration Foundation
1st criterion	Environment	Technology
Technological Factor	External Factors	Internal Factors
Environmental Factor	External Environment	Internal Environment
Most Important Factor	Level of Patent Protection	Marketability

With respect to the market orientation of the aforementioned institutions, this reflects an increasing tendency to view licensing programs from a business perspective. This perspective, reflecting the market nature of a particular transaction, is captured in the terms and conditions of license agreements, as well as the patents themselves, and the contractual context (with respect to other agreements) set forth in the introductory section of this paper.

Universities or other institutions considering whether to develop an out-licensing activity rarely find that a specific circumstance or event that prods them to act. Usually there is a growing awareness of circumstances that leads to a collective acceptance of the concept of extracting portfolio value corporately as contrasted with simply extracting value from patents individually. This acceptance typically includes the concept of developing an out-licensing activity to capture the extra value, but it does not necessarily include agreement on the kind of activity that should be established. In my opinion, this is the stage that we are currently at, with respect to the development of Korean technology transfer offices for universities in particular: agreement on the importance of the function, with no clear idea of how to establish the function so that it can be effective.

The awareness and acceptance of a university's need or at least willingness to out-license may itself be triggered from outside the university. For example, by observing that other universities are obtaining profits from their portfolios, or by noticing new opportunities on the business landscape. In my opinion, this is the case for Korea, as it compares its universities technological output with its global competitors, based on publications, patents and licensing revenue. I note that it's in the last instance that Korean universities fall behind most significantly.

Alternatively, the awareness can arise from within the university when it becomes aware of the existence of many non-strategic technologies in its portfolio that could be turned into profits with relative ease. Regardless of the stimulus, awareness and eventually acceptance are necessary conditions for any decision to create an out-licensing office or activity.

In short, a university or institute's specific purpose for mounting an out-licensing activity has a major impact on the nature and kind of office that is established. Purposes arise from situation, which in turn provide the reason why universities decide to move into out-licensing. Purposes can be institutional in two ways: directly with respect to the goals of the institution itself, or indirectly with respect to the environment and support system that the institution wants to create for its inventors.

The purpose for out-licensing can be expected to have a direct effect on office size, structure and constituency. There may be multiple purposes that overlap one another. In the following, for each purpose we briefly discuss the underlying rationale and the implications of that purpose for the kind of office established:

Universities interested in out-licensing their core technology developments (as opposed to developing them as ventures either at the institutional level or with respect to the inventors personally) are interested in obtaining the best possible measure of income and competitive advantage, and so they are active seekers of licensing partners. For such institutions, the process of finding partners as very much like combing the sea floor for buried treasure, and just as it takes a lot of staff resources to find the treasure so too does it take a lot of staff to identify and pursue licensees who are both interested in the core technology and willing to pay a premium price. The implications of this include the fact that such an office will require a relatively large number of staff, both legal and business professionals.

Universities interested in licensing out non-core technologies see their technology as a byproduct of academic activity. They are fundamentally interested in picking up income from the sale of technologies but they do not believe that this is fundamental to their purpose. Universities in this position usually are interested in maximizing income but only if they can minimize their investment in obtaining the income. The analogy here is that they wish to wade into the river and capture those fish that happen to come to the surface. This purpose usually means that the firm will invest a minimum amount into the out-licensing activity, and the implications for execution are

a small out-licensing office, although this does not mean that out-licensing non-core technologies is an inexpensive enterprise.

On the contrary, there will be significant expenditures of management and technical staff time in determining which of the firm's technologies are core and which are not. The major expenditures for universities in this category are the costs of developing and maintaining an internal decision process that initially decides which technologies are to be classified as non-core. Offices developed for this purpose usually are staffed mostly with business professionals.

Some universities and institutes may anticipate the out-licensing activities as a major profit center, and institutions developing an out-licensing office for this reason tend to move slowly. They often are unsure of the amount of revenues or profits that might be expected from out-licensing their technologies, so they create a very small activity at first, using a wait-and-see attitude. If the activity begins to generate income and profits, they consider increasing the investment. Universities with this purpose in mind tend to bootstrap their out-licensing offices, making them pay for themselves while they grow, and this is the predominant approach in Korea, where universities begin with a very small out-licensing activity and monitor its activities and progress closely. If it begins to produce revenues and income, the university can be expected to respond favorably to requests for increased funding. If it develops revenues or profits slowly, the university will also respond slowly to requests for growth in funding. The skill mix for this purpose should be relatively balanced between legal and business professionals.

V. Concluding Remarks

This research is performed to identify determinant factors of technology transfer when the licensee is a private company. For this, the present study use AHP analysis using survey data with universities, public institutes, and industry-academy collaboration foundations. Based on the results, we find that 'marketability', which represents the possibility of market success by the application of technology and 'types of exclusive rights' which are licensed to licensees are regarded as the important factors with respect to technological factors. Among the environmental factors, the 'capacity to

absorb the licensed technology' is considered as important, followed in importance by the competitive environment faced by the licensee. Although the main factors affecting technology transfer identified in this study are similar to the previous literature, it is somewhat contrary to our expectation that 'types or royalty' is relatively not a important factor in technology transfer.

One of the important findings from the AHP analysis is that the perspectives of the licensor and licensee are different in that the factors considered in technology transfer are different. The licensor believes that the environmental factors, especially the level of patent protection, determine technology transfer while the licensee focuses on technological factors, especially marketability, as important in technology transfer. To promote technology transfer and consequently realize technological innovation, efforts to harmonize the difference of viewpoints of the two parties are essential, as are institutional out-licensing infrastructures.

Specifically with respect to the harmonization of viewpoints with regard to the marketability of technology, it should be noted that universities in particular have “optimized” their technology transfer functions for patent application processing and management according the legal and institutional constraints in which they operate. The actual marketing of the technology has not traditionally been a focus of the technology transfer function in universities, and it may be that we should begin with the recognition of the importance of marketing the technology that has been protected and packaged by patents. In other words, the technology transfer function can be bifurcated into technology protection, via patents for the most part, and then transfer via licenses, but with respect to the latter process, the work involved in the identification of potential counterparties and negotiation with those parties for a fruitful outcome (a technology transfer contract, or license) is as important as the culmination and documentation of that agreement, and the technology transfer function can be viewed as a combination of legal, managerial and marketing activities.

However, this research uses somewhat limited survey data, based on interviews with representatives from universities, public institutes and industry-academy collaboration foundations. We do not include managers or specialists in private companies, who actually experience technology transfer, in this research due to the lack of data availability and this is one of major limitations of our approach, which should be addressed in further studies.

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Columbia Law School에서 법학박사를 취득하고, 현재 법무법인 한얼에서 변호사로 재직하고 있다. 관심분야는 기술이전, 기술경영, M&A, 기업/기술 가치 평가 등이다.