

# An Examination on Factors Influencing Patent Valuation and their Effects on Business Management Performance

Young-Ki Kim<sup>1</sup>, Seong-Taek Park<sup>\*2</sup>

<sup>1,\*2</sup>Department of MIS, Chungbuk National University, Chungdae-ro 1, Seowon-gu, Cheongju, Chungbuk, 28644, South Korea

ykkim@cbnu.ac.kr<sup>1</sup>, solpherd@cbnu.ac.kr<sup>\*2</sup>

Corresponding author : Phone: +082-010-7212-7256

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## Abstract

**Background/Objectives:** This paper is to identify the factors influencing the patent valuation, i.e. technology, marketability, business feasibility, technology management and human resources, and their causal effects on product and business management performance, unlike previous studies.

**Methods/Statistical analysis:** This study used PLS, PLS was used here on the grounds that it is widely used in social sciences to analyze the causality between variables despite it having not been fully verified in theory, and that its requirements are not as strict as other SEM techniques

**Findings:** The findings of this study highlighted that technology and marketability exerted significant effects on the product performance, which in turn had significant effects on the management performance. Technology will have significant effects on product performance. Marketability will have significant effects on product performance. Business feasibility will have significant effects on product performance. Technology management and HR will have significant effects on product performance. Technology will have significant effects on management performance. Business feasibility will have significant effects on management performance. Product performance will have significant effects on management performance.

**Improvements/Applications:** Technology, marketability and business feasibility, as variables, and analyzed their causal effects on the product and management performance. The findings may be applicable in practice as a guideline.

**Keywords:** Patent, Patent Valuation, Patent Valuation Factor, Business Performance, Product Performance, PLS.

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## 1. Introduction

The accelerating transition to knowledge-based economy underlines the

increasing importance of utilizing and managing the intellectual properties as the key components of corporate survival and

competitiveness. Intellectual properties including patents are used in close relation to corporate management strategies and technological innovation strategies in diverse areas.

Multinational corporations in advanced countries have enhanced their hegemony in world economy based on the preemption and protection of competitive intellectual properties. Leading global companies can maintain their competitiveness and develop persistently as they have produced innovative products to preempt the market whilst applying optimal patent strategies to retain their monopolistic advantage in the market. That is, patents serve as the pivots for building business management strategies conducive to creating national and corporate wealth.

As a rule, a successful company should be equipped with three components, i.e. human capital, intellectual capital and health capital [1]. Human capital refers to the sum of all employees' skills. Intellectual capital refers to the aggregate knowledge of a company including its knowhow and R&D, and represents its innovative competence. Health capital indicates the fitness of employees. As the term implies, intellectual capital is considered to override the other two in the knowledge-based economy.

That is because the knowledge-based economy is a paradigm that values knowledge more than any other components of production, and the intellectual capital means the amount of knowledge a company has. Also, intellectual capital determines innovation, which is the core competence that decides the survival of a company. Intellectual properties are included in intangible assets. Corporate assets are classified into tangible and intangible assets. Valued in industrial economy, tangible assets include production facilities and real estate [1].

Highlighted in knowledge-based economy, intangible assets include corporate reputation, awareness and

intellectual property of a company. Intellectual properties are composed of patents, trademarks and copyrights, amongst which patents determine the technological prowess of a company [2].

Technological advancement is characterized by continuity and accumulateness. Modern scientific technology is built on previous technologies that have been researched and accumulated, and develops further by utilizing those. Such innovative technologies need be protected as intellectual properties.

Research on patent valuation mostly used to focus on methodologies of how to assess the value of a patent. Research on methods of patent valuation focused on the application of methodologies and the methods of calculation for valuation. Currently, government-designated valuation entities and a few leading companies and research institutes acknowledging the importance of patents are using the independently developed methods of patent valuation [3].

However, the absence of standardized guidelines leads to the low consistency and reliability in the valuation results. Also, the low inter-connectivity limits the sharing and application of valuation results, failing to win clients' confidence. Universal and relevant valuation components need be selected first for a more rational patent valuation. In addition, previous studies revolve around cost, market and income approaches to the valuation of intangible assets [4].

Hence, the purpose of this paper is to identify the factors influencing the patent valuation, i.e. technology, marketability, business feasibility, technology management and human resources, and their causal effects on product and business management performance, unlike previous studies.

## **2. Theoretical Background**

### **2.1. Technology assessment**

Technology assessment refers to determining the technological superiority of complex or component technologies, where the primary assessment components are technological levels, technological applicability, technological impacts and mass producibility of products/services, and the purpose of assessment is taken into account to adjust and apply the criteria and levels of each component of assessment [1, 4].

Alternatively, technology assessment is defined as determining the technical aspects of a given technology, where they verify its technological utility and assess its technological superiority and competitive advantage as well as the stability of its implementation; viability and impact of alternative technologies; and statutory rights of its legal ownership.

In the latter case, the components of assessment include technological differentiation, its stage in the technology life cycle, ease of imitation, technological completeness and self-sufficiency, technological applicability and scalability, industrial impacts, stability of rights, and scope of rights.

### **2.2. Business assessment**

Alternatively, business feasibility assessment is defined as estimating the profitability of a given technology or business idea, where the components of the business feasibility assessment include the availability of the capacity to create profits in terms of the production base, productivity, marketing strategies and profitability, all of which directly and indirectly influence the capability to encase the technology [1, 4].

The production base involves such components as available production facilities, workforce, raw materials and parts. The productivity assessment involves such components as the capability of generating added value out of the outcomes of production activities, cost

advantage, and labor productivity in terms of profitability per employee.

### **2.3. Marketability assessment**

Marketability assessment refers to estimating the effects of a given technology on the related market by analyzing the projected changes in the entire external elements and environment including the market. Specifically, marketability assessment involves the scope and characteristics of the products applying the given technology, status of its industry, and its market outlook. The primary components of marketability assessment are the size and growth rate of the market, import substitution and export potential [1, 4].

Alternatively, the marketability assessment is defined as identifying the profitability of a technology business in terms of the condition, characteristics and structure of its market and estimating its growth potential with minimal business risks.

In the marketability assessment, overall market structure of existing and similar competitors, the growth potential of the market and achievable market share are considered in order to estimate the growth potential of a given technology product, while in the assessment of the market and industrial conditions, barriers to market entry, intensity of competition among market participants, trends of related industries and policy facilitators/constraints are taken into account in estimating its survivability in the market [1].

### **2.4. Assessment of technology management and human resources**

The assessment of technology management and human resources is concerned with assessing the system factors and the workforce composition in pursuit of the ultimate implementation or commercialization of a given technology and the resultant value added [1,4].

Rather than the management's

credibility or the rationality of organizational management, management's experience or knowledgeability in relation to the technology, efficient management of technology-related workforce, and potential for technology development are taken into account to estimate the viability for minimizing the risks of the projected technology commercialization, and for guaranteeing the potential profitability.

That is, the assessment of technology management and workforce involves the assessment of management, technology workforce and external technological condition relevant to the implementation

or commercialization of the technology item. The primary components of the foregoing assessment are the technology management capacity, HR and R&D capacity, and technology development environment.

### 3. Research Methods and Hypothesis

#### 3.1. Research model

Therefore, the proposed model involves such independent variables as technology, marketability, business feasibility, technology management and HR, and the dependent variable, performance (Figure 1).

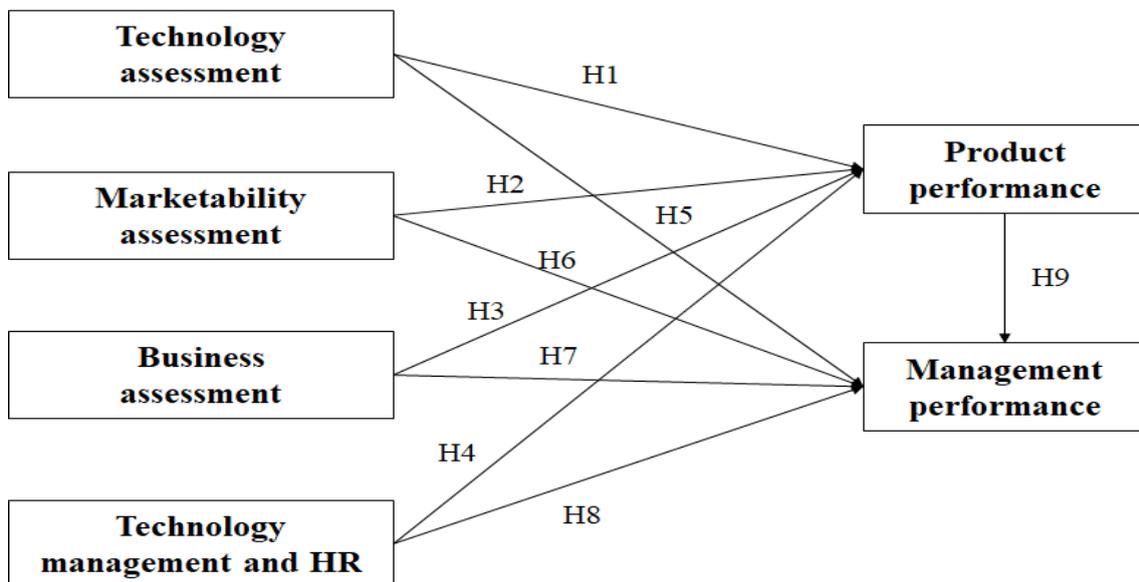


Figure 1. Research Models

#### 3.2. Hypothesis

Technology is a universal measurement variable indicating the value of a patent. Particularly, the superiority, level and applicability of a given technology item have positive effects on the product performance of a company. Also, the marketability of a given technology plays important roles as a variable used to predict the extent to which the patent thereof will succeed in its market [5-7].

The business feasibility is a variable relevant to the extent to which a given technology or the patent thereof will create

profits. The technology management and HR are core components in adding value to a patent. Thus, the technology, marketability, business feasibility, technology management and HR germane to a patent will have positive effects on its product performance. In that sense, the following hypotheses were set up.

*Hypothesis1. Technology will have significant effects on product performance.*

*Hypothesis2. Marketability will have significant effects on product performance.*

*Hypothesis3. Business feasibility will*

have significant effects on product performance.

*Hypothesis4. Technology management and HR will have significant effects on product performance.*

Technology involving a patent may have positive effects on the product performance, and also ultimately on the corporate management performance. Especially, superior or higher-level technology exerts greater effects on the management performance. Likewise, marketability and business feasibility play important roles in the corporate management performance [7-9]. In addition, the technology management and HR are indispensable components for the management performance. In that respect, the following hypotheses were developed.

*Hypothesis5. Technology will have significant effects on management performance.*

*Hypothesis6. Marketability will have significant effects on management performance.*

*Hypothesis7. Business feasibility will have significant effects on management performance.*

*Hypothesis8. Technology management and HR will have positive effects on significant performance.*

The positive effects of product performance on management performance have been well-documented. In particular, the effects of technology, marketability and business feasibility involving a patent on product performance ultimately lead to the positive effects on the management performance. In that sense, the following hypotheses were set up.

*Hypothesis 9. Product performance will have significant effects on management performance.*

## 4. Results

PLS 2.0 was used for the purpose of this study. Although PLS, AMOS and LISREL are generally used for SEM, PLS was used here on the grounds that it is widely used in social sciences to analyze the causality between variables despite it having not been fully verified in theory, and that its requirements are not as strict as other SEM techniques [10].

### 4.1. Characteristics of Sample and Analysis method

Experts specializing in patent valuation responded to the questionnaire survey. The respondents were limited to those in charge of R&D or patent valuation in the field. The survey was conducted from November 1st to 25th, 2018. Out of 120 copies distributed, 102 copies were analyzed, excluding 8 copies including insincere responses.

The demographics of the respondents is as follows. 75% and 25% of respondents were males and females, respectively. 5%, 30% and 20% of respondents were bachelors, masters and PhD holders, respectively. 40% and 30% of respondents had been working in their fields for less than 5 years 30% or 5–10 years 50% and more than 10 years 20%, respectively.

### 4.2. Validity Analysis of measurement Factor

The PLS analysis requires the verification of a model. The proposed model was therefore verified in terms of internal consistency, convergent validity, and discriminant validity. First, for the internal consistency, the composite reliability and reliability were analyzed.

**Table 1: Discriminant Validity Analysis**

	Factor Loading	Composite Reliability	AVE	Cronbachs' Alpha
TE1	0.7745	0.8097	0.5865	0.6488

TE2	0.7652			
TE3	0.7579			
MA1	0.8845	0.805	0.6751	0.5292
MA2	0.7535			
BU1	0.7318	0.7681	0.6247	0.4047
BU2	0.8449			
TMH1	0.7661	0.837	0.6315	0.7105
TMH2	0.7847			
TMH3	0.8318			
PP1	0.7838	0.8487	0.6517	0.7334
PP2	0.792			
PP3	0.8447			
MP1	0.7868	0.7957	0.5652	0.6181
MP2	0.7453			
MP3	0.7219			

The analysis indicated the composite reliability exceeded the reference point 0.7 [11], and Cronbach's alpha was greater than the reference value 0.7. As for the convergent validity, the AVE suggested by Fornell & Larcker (1981) and Chin (1995) exceeded the reference point 0.5 [12, 13],

whilst the factor loadings were all greater than the reference point 0.7 <Table 1>.

As for the discriminant validity, the least value 0.7517 of the square roots of the AVE was greater than the largest correlation coefficient 0.7183 <Table 2>.

**Table 2: Correlation between Latent Variable**

	BU	PP	MP	MA	TE	TMH
BU	0.7903					
PP	0.3401	0.8072				
MP	0.3555	0.7183	0.7517			
MA	0.3107	0.4610	0.3969	0.8216		
TE	0.0789	0.2609	0.2827	0.3154	0.7658	
TMH	0.3412	0.4290	0.3241	0.3488	0.2601	0.7947

### 4.3. Hypothesis Testing

Also, the confirmatory factor analysis was used to verify the discriminant validity, where the questionnaire items were found to meet the requirements <Table 3>. The explanatory

power of a path model is referred to as the explained variance, denoted as R<sup>2</sup> [14]. As for the analysis of R<sup>2</sup>, the explanatory power of the product performance was 32.3%, and that of the management performance was 54.1%.

**Table 3: Hypotheses Testing**

		Coefficient	t-value	Results
H1	TE -> PP	0.0901	2.3805**	Accept
H2	MA -> PP	0.2974	6.7286***	Accept
H3	BU -> PP	0.1557	3.652***	Accept

H4	TMH -> PP	0.2487	5.8172***	Accept
H5	TE ->MP	0.101	2.4886**	Accept
H6	MA -> MP	0.0406	1.0242	Reject
H7	BU -> MP	0.1279	3.1123***	Accept
H8	TMH -> MP	-0.0369	1.1142	Reject
H9	PP -> MP	0.6455	11.4881***	Accept

\*\*\* p<.001, \*\* p<.01, \* p<.05

The analysis result of the proposed model is outlined in <Figure 2>.

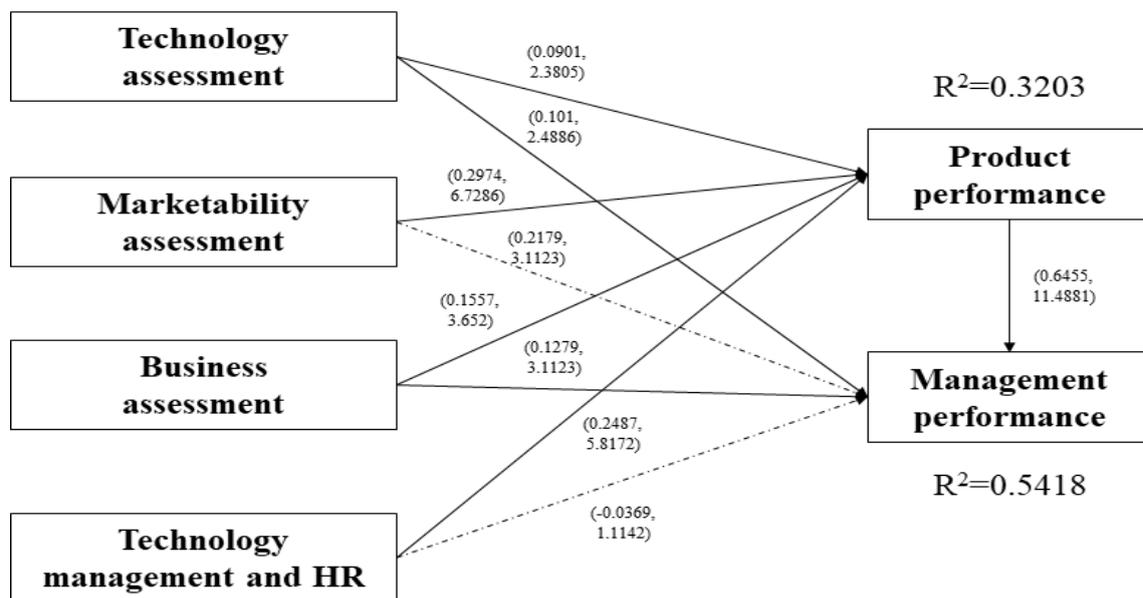


Figure 2. Hypotheses Testing

The sample was used to calculate the path coefficients of the structural model, and Bootstrapping was used to calculate the t values of the paths <Table 3>. The analysis indicated all the hypotheses were accepted except H6, H8.

## 5. Conclusion

Businesses are engaged in fierce competition in the fast-paced and competitive market environment, where big data, AI, 3D printing and IoT emerging on the verge of Industry 4.0 are projected to benefit business organizations. Still, it is essential to apply and win patent rights for core technologies, and to enter the market based on the valuation of the patents secured. That is, the value of a

patent, i.e. its technology, marketability and business feasibility need be taken into account as those factors are important variables influencing the performance.

The findings of this study highlighted that technology and marketability exerted significant effects on the product performance, which in turn had significant effects on the management performance.

As for the implications of this study, given that there is a paucity of systematic theories and relevant scholarly research on patent valuation, this study has an academic implication in that it adopted the widely used components of patent valuation, i.e. technology, marketability and business feasibility, as variables, and

analyzed their causal effects on the product and management performance. The findings may be applicable in practice as a guideline.

Despite the foregoing implication, this study has limitations. Above all, despite the different characteristics and importance of patent valuation across industries and products, this study did not consider such differences. Thus, further studies need to include more diverse variables and analysis methods.

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