Evaluation Method for Nature of Basic Invention by Patent Analysis

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***Abstract*--The acquisition of so-called basic inventions which can cover a broader scope is one of most important purposes in research and development of companies and research institutions. However, there have been little quantitative studies on the nature of basic invention. The authors have explored evaluation method for the nature of basic invention. The authors found that claimed inventions can be categorized into two types according to the description of specification regardless of technical fields. . One is the invention which has a patent claim based on quantitative and factual description of embodiment of specification while the other is the invention which has a patent claim based on qualitative description of embodiment. The former is referred to as "Quantitative Embodiment Type" while the latter is referred to as "Qualitative Embodiment Type". The two types are closely related to number of limitation terms (L) included in the patent claim, which function as terms providing limitation to the scope of the patent claim, and number of specifying words (S) included in the patent claim, each of which specifies a term that has already appeared in the patent claim. Compared to Qualitative Embodiment Type, Quantitative Embodiment Type has patent claim including extremely fewer L and S. This indicates that Quantitative Embodiment Type has a broader scope than Qualitative Embodiment Type.**

I. INTRODUCTION

So-called basic inventions or basic patents have been to considered to be patents or inventions which have prominent influences and impact on ensuing technologies or industries. Specifically, such invention is both preceded and succeeded by less important patents within the same technological area [1] and spawns an industry [2]. Such patent puts limits on a wide range of technologies [3] or are frequently cited as references during their examinations [4]. As just exemplified, their meanings vary delicately according to individual.

In this connection, there have been many previous studies on quantitative evaluation of patent value from an economic or financial point of view [5][6][7][8][9][10][11]. Most of these studies relate to indicators extracted from bibliographic information such as forward citations, backward citations, science linkage, the number of inventors, and family size. Reitzig shows that the probability of an opposition against a patent can be an indicator of its value [12].

In contrast to this, we have conducted studies from the perspective of competitiveness of a patent. This is because significance of competitiveness of a patent for companies has grown due to increased competition among them. Patents necessary to manufacture products are prone to be owned by multiple patentees especially in the fields of key industries such as semiconductors and electronics of which products require various technologies for their production. This situation is called a "patent thicket" [13]. Market participants worry that their new products could infringe on patents issued after these products are designed and go on sale. Cross-licensing has been a natural and effective method to cut through the patent thicket. Nagaoka and Kwon have found cross-licensing plays an important role especially in the electronics industry of Japan [14], where the number of patents has been emphasized [15]. However, the cross-license business approach has begun to be interfered with increased competition among firms. A major factor which has brought the fierce competition is the growth of industry of developing nations. An important contributor to the growth of industry in developing nations is the rise of "Fabless", short for "fabrication-less", which refers to a company that has no manufacturing facilities [16]. The fabless industry has grown remarkably in the past decade by specializing in the design and sale of products and putting new products into markets quickly, utilizing the mobility of the fabless industry in addition to competitive prices to great advantage. In fact, fabless industry has begun eating away at market shares of traditional manufacturing companies having production facilities. The fabless industry accords priority to the swift evolution of a product over the establishment of a patent portfolio, which requires many years. Many of the traditional manufacturing companies are facing a greater need for enforcement of patent rights than ever before, in order to secure their business and profits in this emerging business environment. Enforcement of patent rights often leads to conflicts with other parties, so it is crucial for companies to own a so-called "competitive patent" rather than a great number of patents. The terms "competitive patent" or "competitiveness" refer to patents that bring the plaintiff a win or a high possibility of winning in a patent infringement lawsuit. A competitive patent enables the holder to dominate the maximal technological scope of the invention, and to exclude competitors from the scope. Recent fierce competition has shifted the emphasis in patenting from macro-perspectives, such as the number of patents, to micro-perspectives such as the competitiveness of a patent. Therefore, we have studied patent competitiveness based on a quantitative analysis of claim structure of each patent. Claim structure is comprised of types of patent claim (e.g. independent claim, dependent claim) and numbers relevant to patent claims and claim categories. Claim structure relates to overlap among patent claims of a single patent, and operational breadth of patent claims. Analysis of claim structure using multiple parameters quantitatively visualizes the overlap and operational breadth of the claims of a patent.

It has been shown that there are close relationships between claim structure and patent competitiveness [17][18]. In patents determined in court to have been infringed (i.e. winning patents), the total number of independent claims increased with the number of prior inventions, but this did not apply to losing patents. This implies that, in order to construct patents winnable in patent infringement lawsuits, patent practitioners must prepare independent claims based on the number of prior arts. To accomplish this, patent practitioners must have a complete view of the technological state of the invention by thoroughly researching prior art. Claim structure focused on the number of claims including independent claims is a useful indicator for patent practitioners in obtaining patents that are winnable in patent infringement lawsuits.

We have also found that claim structure relates to competitiveness of a product in the market [19] [20]. Firms whose market shares are in the top positions in the markets of the respective business-to-business products such as analyzing and diagnostic devices file patent applications regarding the respective products of which average numbers of total independent claims are significantly greater than those of firms whose shares are 10% or smaller in their respective markets, which indicates that the number of total independent claims, which is one of important factors for the competitiveness of patent, strongly correlates with high market share [19]. Claim structures reflect competitiveness of a business-to-consumer product such as digital camera in each of stages of its product life cycle [20]. Specifically, the market leader of the early adopter stage filed patent applications having more independent claims of which the claim category is the product or the like compared to the rest of the participating firms, while the market leader of the late majority stage has more dependent claims, which implies that it is critical to cover a maximal scope of the invention by plural independent claims in the early adopter stage, while, in the late majority stage in which the technologies are highly matured, the total number of dependent claims are increased to protect the market leader's technologies against competitors and as a means of fallback options.

There have been a few quantitative studies on relationships between description of patent claim and patent competitiveness. In one of them, Abiko found a tendency for patent claims having fewer noun phrases to win more patent infringement lawsuits [21]. By not overly limiting the claims with qualifiers like the noun phrases, a broader scope for the patent rights could be interpreted. This tendency has been clearly observed for section B (performing operations, transporting) of International Patent Classification (IPC). However, the tendency was comparatively less pronounced for patents in section G (physics). Furthermore, the tendency was not observed for those in section H (electricity) of the IPC. A strategy for obtaining a competitive patent applicable to a wide range of technologies has yet to be defined clearly.

To take into consideration relationships among elements of patent claims additionally, we have also conducted studies based on parameters including the total number of words used for specifying an aforementioned term (specifying words, **S**) in addition to the total numbers of terms functioning as limitation (limitation terms, **L**) included in each of noun phrases [22]. On the whole, patent claims which have fewer **L** are advantageous in patent infringement lawsuits. Moreover, among patent claims that have more limitation terms (**L**) of the patent claims, those having more **S** are more likely to lead to winning lawsuits. From this study, we have established an evaluation method for degrees of broadness of scope of a patent description of complexity of the patent claim utilizing the parameters including the numbers of limitation terms (**L**) and specifying words (**S**).

As described in the beginning of this section, whether or not the invention or patent has nature of basic invention or patent has been measured by an ex-post fact such as subsequent influence on industries or other patents. Therefore, it has been difficult to pre-emptively utilize basic invention or patent for one's technologies and business or focus on acquisition of the patent right or according to degree of its importance. However, there have been few studies on objective criteria which can be utilized in real time for judging a basic invention or patent. A main aim of this study is to obtain an objective real-time criterion for judging a basic patent.

II. POINTS OF THIS STUDY

We focused on embodiments which support patent claims among descriptions of specifications of patent applications in order to comprehend basic–patent nature. We have discovered that patent claims can be categorized into two types based on the embodiments which support the patent claims. One is a type of patent claim which is supported by an embodiment that describes quantitative data obtained by an experiment while the other is that which is based on a qualitative description of the embodiment. In this paper, the former is "Quantitative Embodiment Type" or Type A while the latter is "Qualitative Embodiment Type" or Type B.

With regard to patents of "Quantitative Embodiment Type" and those of "Qualitative Embodiment Type", we analyzed descriptions of patent claims by using parameters. The parameters include the numbers of terms functioning as limitations of the patent claim (i.e. limitation terms, **L**), and the number of words like "the", "this", and "said" that denote a relationship between terms by specifying an aforementioned term in the patent claim (i.e. specifying words, **S**). It is of particular note in this study that a relationship between terms of a patent claim is taken into account. The above terms and words play key roles in determining the scope of a patent right.

This study analyses descriptions of patent claims for which courts in Japan identified the presence or absence of patent infringement. The paper is organized as follows: the following two sections outline the data and parameters used to analyse descriptions of the patent claims.

The fourth section presents results obtained by analysing descriptions of the patent claims of patents of "Quantitative Embodiment Type" and those of "Qualitative Embodiment Type". One of the main findings is that patent claims of patents of "Quantitative Embodiment Type" have the fewer limitation terms, (**L**) than those of "Qualitative Embodiment Type". The discussion section follows the results section, and the last section presents our conclusions.

III. DATA FOR ANALYSIS

In this study, in order to obtain results having greater accuracy by excluding cursory or less important patents, we collected patents involved in patent infringement lawsuits using precedent information retrieval system websites offered by Japanese courts [23] and the database of patent precedents in Japan offered by Patent Bureau Co., Ltd., [24] which list patent infringement lawsuits filed in trial courts in Japan during the period of 1967-2007. Patents whose applications had been filed after January 1, 1976 were extracted from the collected data. This was when the revised Japanese Patent Law, in which the original adoption of multiple claiming took effect, was enacted with the aim of clarification of patent right protection. At the beginning, 338 patents were extracted, excluding those patents judged to be invalid. The reason for excluding the invalid patents was that, properly speaking and in principle, validity is supposed to be already exhaustively examined by the Patent Office before a patent is litigated. In case that a patent infringement lawsuit is based on plural patent claims of one patent, a patent claim with the broadest scope or the broadest independent claim is chosen as an analysis object among the plural patent claims. In this way, 338 patent claims were collected for analysis of descriptions of patent claims.

Further, we specified an embodiment of specifications of the patent applications supporting each of the collected patent claims and categorized the extracted patents into patents of "Quantitative Embodiment Type" and those of "Qualitative Embodiment Type" based on descriptions of the embodiments. "Quantitative Embodiment Type" is a patent of which the broadest patent claim which is supported by an embodiment that describes quantitative data obtained by an experiment while "Qualitative Embodiment Type" is a patent of which the broadest patent claim is based on a qualitative description of the embodiment.

IV. PARAMETERS FOR CLAIM DESCRIPTION

Parameters used to analyse descriptions of the patent claims and the analyzing method are similar to those of our previous study [22]. The parameters are as follows:

the total number of terms functioning as limitations (limitation terms, **L**) of the patent claim;

the total number of words used for specifying an aforementioned term (specifying words, **S**) in the patent claim; and,

the total number of specifying words divided by the total number of limitation terms (**S**/**L**).

The following is a concrete example through which we explain limitation terms and specifying words.

Claim 1. A <device>, comprising:

a first <unit> that <detects> an <effective><value> of a < current> <supplied> to an <electrical>< machinery>;

a second <unit> that <memorizes> a <value> of a <coil> <current> of [the] <electrical> <machinery> <corresponding to> a <maximum><torque> of [the] <electrical> <machinery>;

a third <unit> that <calculates> a <ratio> of [the] <effective> <value> <detected> by [the] first <unit> to [the] <value> of [the] <coil> <current> <memorized> in [the] second <unit>, [the] third <unit> <outputting> <data> <corresponding to> [the] <ratio>;

a fourth <unit> that <controls> a <voltage> <applied> to [the] <electrical> <machinery> <based on> [the] <data>< outputted>by [the] third <unit>; and

a fifth <unit>that <smoothes> a <waveform> of [the] <voltage>.

Claim 2. The *<device> according to Claim 1, further comprising:

a sixth <unit> that <discerns> a <torque> of [the] <electrical> <machinery><based on> [the] <effective> <value> of [the] <current> <detected> by [the] first <unit> and [the] <value> of [the] <coil> <current> <memorized> by [the] second <unit>.

Claim 3. The *<device> according to Claim 1 or 2, wherein [the] <smoothed> <voltage> has <sinusoidal> <waveform>.

The terms in angle brackets "<>" are limitation terms while those in the square brackets "[]"are specifying words.

While Abiko had focused on the number of noun phrases [21], this study also uses limitation terms within predicates (e.g. verbs) and modifiers (e.g. adjectives, adverbs). This is because important terms or words are encountered not only in noun phrases, but also in predicates and modifiers, and they are the key to determining exact scope of the patent claim. Since modifiers such as the "electrical" of "electrical machinery" and the "corresponding to" of "data corresponding to the ratio" add limitations to "machinery" and "data", respectively, we count such terms that modify or limit other terms as limitation terms (**L**). In contrast, terms such as "first" and "second" in the phrases "a first unit" and "second unit" are regarded as descriptive only, since "first unit" and "second unit" are actually limited by the sentences following the relative pronoun "that". Such terms employed for convenience in claim description do not function as substantive limitations of the patent claims, and therefore are not counted as limitation terms in this study. In Claim 1 above, the total number of limitation terms is fifty-two.

The word "the" in phrases such as "the effective value" and "the ratio" specifies "an effective value" and "a ratio", terms that have already appeared within the patent claim. In this study, in addition to the word "the" just explained, words such as "said", "this", and "that" are regarded as specifying words. All of the specifying words counted in the analysed patent claims were used for defining relationships between already-appearing terms and other terms. Claim 1 of the above example includes thirteen specifying words. The study of Abiko did not investigate specifying words.

The total number of specifying words divided by the total number of limitation terms (**S**/**L**) denotes the frequency of specifying words per limitation term. Therefore, **S**/**L** provides an indication of frequency in the description of relationship between terms.

V. RESULTS

We categorized the extracted patents into "Quantitative Embodiment Type" (Type A) and "Qualitative Embodiment Type" (Type B) based on embodiments as explained above. Examples for the two types are provided below.

JP 2912249 is an example of "Quantitative Embodiment Type" (Type A) and the broadest patent claims is as follows.

Claim 1. A composition, comprising:
a coagulant of an inorganic salt to solidify a soy milk;
a polyglyceryl fatty acid ester; and
a fat.

JP 3548569 is an example of "Qualitative Embodiment Type" (Type B) and the broadest patent claims is as follows.

Claim 1. A supply system including a first computer that is installed at a order placement side, a second computer that is installed at a production side and configured to communicate with the first computer and a three-dimensional measurement device that is configured to communicate with the first computer,

wherein:

the first computer is configured that first data of a lens of an eyewear, a second data of a frame of an eyewear measured by the three-dimensional measurement device and third data required to pair the lens with the frame are inputted to the first computer, and an order for the eyewear is placed by sending fourth data required for the order to the second computer from the first computer;

the second computer is configured such that the second computer performs a processing required for an acceptance of the order by conducting an operation according to the fourth data;

the three-dimensional measurement device has a sensor of the three-dimensional measurement device moves along the frame three-dimensionally;

the second data is obtained by detecting a moving distance of the sensor with respect to each of angles moving; and

the fourth data includes a girth of the frame, a tilt of the frame and papillary distance estimated by the second data.

As will be noted from comparison between the above examples, there is tendency for a simple expression to be used for a patent claim of a patent of "Quantitative Embodiment Type" (Type A), compared to that of "Qualitative Embodiment Type" (Type B).

We analyzed patent claims of patents of "Quantitative Embodiment Type" (Type A) and those of "Qualitative Embodiment Type" (Type B) using the parameters explained in the fourth section.

Table 1 shows average values of the total number of limitation terms (**L**), the total number of specifying words (**S**), and the values **S/L** for patents of "Quantitative Embodiment Type" (Type A) and those of "Quantitative Embodiment Type" (Type B) and p-values from two-tailed t-test as a parametric statistical test, while Table 2 shows average ranks of the parameters **L**, **S**, and **S/L** for patents of Type A and those of Type B and p-values from Mann-Whiteney U test as a non-parametric statistical test. Statistically-significant differences between patents of Type A and those of Type B were observed for all of **L**, **S** and **S/L** at the $p \leq 0.0001$ level of significance. Tables 1 and 2 reveal that patents of Quantitative Embodiment Type (Type A) tend to have patent claims with remarkably smaller **L**, **S** and **S**/**L** compared to those of Qualitative Embodiment Type (Type B) regardless of whether parametric statistical test or non-parametric one or irrespective of the presence or absence of statistical assumption regarding the population.

We consider the parameter **L** to correspond to the level of a form of complexity in the description of the patent claim, which in turn may be a reflection of the technological complexity of the invention. Inventions which are described in a complicated manner use more specifying words such as "the", and in doing so give more importance to descriptions of relationships between terms within the patent claim(s). Simple description of patent claims implies that the patent has nature of basic patent. Accordingly, patents of Quantitative Embodiment Type (Type A) have nature of basic patents. To confirm this, citations of references by examiners in examination of patents of Quantitative Embodiment Type (Type A) are compared with those of Qualitative Embodiment Type (Type B).

TABLE 1.AVERAGE VALUES OF THE PARAMETERS **L**, **S**, AND **S/L** FOR PATENTS OF TYPE A AND TYPE B AND P-VALUES FROM TWO-TAILED T-TEST

	Number of Patents	Parameters		
		L	**S**	**S/L**
Type A	59	37.270	0.778	0.022
Type B	279	92.244	7.381	0.075
p-value	-	**0.000********	**0.000********	**0.000********

Note: ****** significant at $p \leq 0.0001$.

TABLE 2.AVERAGE RANKS OF THE PARAMETERS **L**, **S**, AND **S/L** FOR PATENTS OF TYPE A AND TYPE B AND P-VALUES FROM MANN-WHITENEY U TEST

	Number of Patents	Parameters		
		L	**S**	**S/L**
Type A	59	70.817	66.635	86.381
Type B	279	204.821	205.702	201.542
p-value	-	**0.000********	**0.000********	**0.000********

Note: ****** significant at $p \leq 0.0001$.

Table 3 shows numbers ($N_{x=0}$) of patents of which prosecution histories do not include citations of references by examiners (i.e., **x** = 0) and numbers ($N_{x \geqq 1}$) of patents of which prosecution histories include citations of references by examiners (i.e., **x** ≧1). The ratio of patents without citation of reference to the entirety or $N_{x=0}/(N_{x=0} + N_{x \geqq 1})$ for the patents of Quantitative Embodiment Type (Type A) is 0.356 while that for the patents of Qualitative Embodiment Type (Type B) is 0.219. The difference of the ratios between Quantitative Embodiment Type (Type A) and Qualitative Embodiment Type (Type B) is significant because the p-value regarding the difference is lower than 0.05. Accordingly, the patents of Quantitative Embodiment Type (Type A) have high novelty compared to those of Qualitative Embodiment Type (Type B). In other words, patents of Quantitative Embodiment Type (Type A) are considered to be more basic.

Table 4 shows average values of the parameters **L, S**, and **S/L** for patents of Type A and Type B of which prosecution histories did not include citations of references by examiners (i.e., **x** = 0) and p-values from two-tailed t-test, while Table 5 shows average ranks of the parameters **L**, **S**, and **S/L** for patents (**x** = 0) of Type A and Type Band p-values from Mann-Whiteney U test. Statistically-significant differences between patents of Type A and those of Type B were observed for all of **L**, **S** and **S/L** at the $p \leq 0.0001$ level of significance.

TABLE 3.NUMBERS OF PATENTS OF WHICH PROSECUTION HISTORIES DO NOT INCLUDE CITATIONS OF REFERENCES BY EXAMINERS (I.E., **X** = 0) AND THOSE OF WHICH PROSECUTION HISTORIES INCLUDE CITATIONS OF REFERENCES BY EXAMINERS (I.E., **X** ≧1)

	Number of patents		$N_{x=0}/(N_{x=0} + N_{x \geqq 1})$
	$N_{x=0}$	$N_{x \geqq 1}$	
Type A	21	38	0.356
Type B	61	218	0.219
p-value	-	-	**0.025***

Note: * significant at $p \leq 0.05$.

TABLE 4.AVERAGE VALUES OF THE PARAMETERS **L**, **S**, AND **S/L** FOR PATENTS (**X** = 0) OF TYPE A AND TYPE B AND P-VALUES FROM TWO-TAILED T-TEST

	Number of Patents	Parameters		
		L	**S**	**S/L**
Type A	21	34.650	0.500	0.018
Type B	61	87.852	5.720	0.057
p-value	-	**0.000********	**0.000********	**0.000********

Note: ****** significant at $p \leq 0.0001$.

TABLE 5.AVERAGE RANKS OF THE PARAMETERS **L**, **S**, AND **S/L** FOR PATENTS (**X** = 0) OF TYPE A AND TYPE B AND P-VALUES FROM MANN-WHITENEY U TEST

	Number of Patents	Parameters		
		L	**S**	**S/L**
Type A	21	17.875	19.400	24.100
Type B	61	45.852	48.082	46.541
p-value	-	**0.000********	**0.000********	**0.000********

Note: ****** significant at $p \leq 0.0001$.

Table 6 shows average values of the parameters **L, S**, and **S/L** for patents of Type A and Type B of which prosecution histories include citations of references by examiners (i.e., **x** ≥ 1) and p-values from two-tailed t-test, while Table 7 shows average ranks of the parameters **L**, **S**, and **S/L** for patents (**x** ≥ 1) of Type A and Type B and p-values from Mann-Whiteney U test. Statistically-significant differences between patents of Type A and those of Type B were observed for all of **L**, **S** and **S/L** at the $p \leq 0.0001$ level of significance.

Tables 4, 5, 6 and 7 reveal that patents of Quantitative Embodiment Type (Type A) tend to have patent claims with simple descriptions compared to those of Qualitative Embodiment Type (Type B) irrespective of the presence or absence of citation of reference by an examiner.

Table 8 shows average values of the parameters **L, S**, and **S/L** for patents (**x** = 0 and **x** ≥ 1) of Type A and p-values from two-tailed t-test, while Table 9 shows average ranks of the parameters **L**, **S**, and **S/L** for patents (**x** = 0 and **x** ≥ 1) of Type A and p-values from Mann-Whiteney U test. No statistically-significant differences between patents of **x** = 0 and those of **x** ≥ 1 was found for all of **L**. **S** and **S/L**. Tables 8 and 9 indicate that, with regard to Quantitative Embodiment Type (Type A), none of the parameters depend on the presence or absence of citation of reference by an examiner.

TABLE 6.AVERAGE VALUES OF THE PARAMETERS **L**, **S**, AND **S/L** FOR PATENTS (**X** ≥ 1) OF TYPE A AND TYPE B AND P-VALUES FROM TWO-TAILED T-TEST

	Number of Patents	Parameters		
		L	**S**	**S/L**
Type A	38	38.458	0.907	0.024
Type B	218	93.370	7.807	0.080
p-value	-	**0.000********	**0.000********	**0.000********

Note: ****** significant at $p \leq 0.0001$.

TABLE 7.AVERAGE RANKS OF THE PARAMETERS **L**, **S**, AND **S/L** FOR PATENTS (**X** ≥ 1) OF TYPE A AND TYPE B AND P-VALUES FROM MANN-WHITENEY U TEST

	Number of Patents	Parameters		
		L	**S**	**S/L**
Type A	38	54.012	48.547	63.767
Type B	218	156.710	157.704	154.954
p-value	-	**0.000********	**0.000********	**0.000********

Note: ****** significant at $p \leq 0.0001$.

TABLE 8.AVERAGE VALUES OF THE PARAMETERS **L**, **S**, AND **S/L** FOR PATENTS (**X** = 0 AND **X** ≥ 1) OF TYPE A AND P-VALUES FROM TWO-TAILED T-TEST

	Number of Patents	Parameters		
		L	**S**	**S/L**
x = 0	21	34.650	0.500	0.018
x ≧1	38	38.488	0.907	0.057
p-value	-	0.520	0.140	0.543

TABLE 9.AVERAGE RANKS OF THE PARAMETERS **L**, **S**, AND **S/L** FOR PATENTS (**X** = 0 AND **X** ≥ 1) OF TYPE A AND P-VALUES FROM MANN-WHITENEY U TEST

	Number of Patents	Parameters		
		L	**S**	**S/L**
x = 0	21	27.525	29.075	30.175
x ≧1	38	34.081	33.360	32.849
p-value	-	0.186	0.330	0.550

TABLE 10.AVERAGE VALUES OF THE PARAMETERS **L**, **S**, AND **S/L** FOR PATENTS (**X** = 0 AND **X** ≥ 1) OF TYPE B AND P-VALUES FROM TWO-TAILED T-TEST

	Number of Patents	Parameters		
		L	**S**	**S/L**
x = 0	61	87.852	5.720	0.057
x ≧1	218	93.370	7.807	0.080
p-value	-	0.134	**0.047***	**0.002*****

Note: * significant at p≤0.05; *** significant at p≤0.005.

TABLE 11.AVERAGE RANKS OF THE PARAMETERS **L**, **S**, AND **S/L** FOR PATENTS (**X** = 0 AND **X** ≥ 1) OF TYPE B AND P-VALUES FROM MANN-WHITENEY U TEST

	Number of Patents	Parameters		
		L	**S**	**S/L**
x = 0	61	142.943	125.516	122.336
x ≧1	218	151.808	156.275	157.090
p-value	-	0.186	**0.013***	**0.005****

Note: * significant at p≤0.05; ** significant at p≤0.01.

Table 10 shows average values of the parameters **L, S**, and **S/L** for patents (**x** = 0 and **x** ≥ 1) of Type B and p-values from two-tailed t-test, while Table 11 shows average ranks of the parameters **L**, **S**, and **S/L** for patents (**x** = 0 and **x** ≥ 1) of Type B and p-values from Mann-Whiteney U test. No statistically-significant differences between patents of **x** = 0 and those of **x** ≥ 1 was found for **L**. Statistically-significant differences between patents of **x** = 0 and those of **x** ≥ 1 was found for **S** and **S/L**. Tables 10 and 11 indicate that, with regard to Qualitative Embodiment Type (Type B), **S** and **S/L** among the parameters depend on the presence or absence of citation of reference by an examiner.

VI. DISCUSSION

This study shows that patents can be categorized into two types. One is Quantitative Embodiment Type of which patent claim is supported by an embodiment that describes quantitative data obtained by an experiment. The other is Qualitative Embodiment Type of which patent claim is supported by a qualitative description of an embodiment. In other words, the former can be considered to be fact-based or discovery-based patent while the latter can be considered to be artifice-based or improvement-based patent.

At least with regard to the analyzed patents which are considered to be important as is evident from the facts that all of the patents relate to patent infringement lawsuits, patents of Quantitative Embodiment Type have patent claims with remarkably small numbers of limitation terms (**L**) and specifying words (**S**), compared to those of Qualitative Embodiment Type as can been easily seen from Tables 1 and 2. This means that the patents of Quantitative Embodiment Type have patent claims with very simple description. In other words, despite such simple description, the patents of Quantitative Embodiment Type are judged novel by examiners or judges. This is because the novelty of such patents mainly depends on that of fact or discovery supporting the patent claims. This can be appreciated from the fact that no significant difference of the parameters between patents without citation of reference and those with citation of reference is observed as shown in Tables 8 and 9, which implies that the difference of the novelty (i. e., the presence or absence of cited reference in the examinations) do not reflect directly on the that of claim description.

Since the patents of Quantitative Embodiment Type have such fact- or discovery-based nature, those have relatively high novelty as noted from Table 3 which indicates that the ratio of patents without citation of reference to the entirety or $N_{x=0}/(N_{\mathbf{x}=0} + N_{\mathbf{x}\geqq 1})$ for the patents of Quantitative Embodiment Type is relatively high, compared to those of Qualitative Embodiment Type.

In contrast, the patents of Qualitative Embodiment Type require patent claims with more limitation terms (**L**) and complicated descriptions using specifying words (**S**) to be judged novel by examiners or judges. This is because the novelty of such patents mainly depends on degrees of complexity of descriptions the patent claims as shown Tables 10 and 11, which show the patents of Qualitative Embodiment Type with citation of reference (i.e., **x** ≧1) have patent claims having more specifying words (S), compared to those without citation of reference (i.e., **x** = 0).

So-called basic inventions or basic patents have been to considered patents or inventions which have prominent influences and impact on ensuing technologies or industries. Specifically, such invention is both preceded and succeeded by less important patents within the same technological area [1] and spawns an industry [2]. Such patent puts limits on a wide range of technologies [3] or are frequently cited as references during their examinations [4]. Patent values have been indentified with indicators extracted from bibliographic information such as forward citations, backward citations, science linkage, the number of inventors, family size and the probability of an opposition against a patent [5][6][7][8][9][10][11] [12]. In any event, whether or not the invention or patent is a basic or valuable is identified by long-term ex-post assessment as exemplified above and unable to be assessed in real time.

The categorization into Quantitative Embodiment Type and Qualitative Embodiment Type can be carried out based on the content of an invention at the time of creation of the invention. Accordingly, to an extent, nature of a patent or an invention can be assessed utilizing such categorization in real time.

VII. CONCLUSION

We obtained an objective real-time criterion for judging a basic patent by this study. We found that patents can be categorized into patents of Quantitative Embodiment Type and those of Qualitative Embodiment Type. The former is fact- or discovery- based patent and has nature of basic patent while the latter is artifice- or improvement-based patent. Patents of Quantitative Embodiment Type have remarkably few limitation terms (**L**), compared to those of Qualitative Embodiment Type. By utilizing the criterion, it is enable to precompetitively utilize basic patent for one's technologies and business or focus on acquisition of the patent right or according to degree of its importance.

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