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A New Indicator Of Patent Strength For Competitors Based On Technology-Function Matrix

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***Abstract*— A study of worldwide patent strength and patent comprehensive of competitors based on patent maps are presented in this paper. A worldwide developing technology, intelligent lighting system, was selected to demonstrate the analysis. The occupied nodes percentage on a technology-function matrix is an easily calculated indicator of patent comprehensive, the percentages occupied on technology or function of a company is an indicator of patent strength.**

Competitors in this study are from official database by USPTO, EPO, JPO, SIPO, and WIPO. Patent strengths of top six competitors based on technology-function matrix were calculated, the result shows that Osram has the most comprehensive patent on intelligent lighting system, Philips occupies the highest strength, both on technology and function.

Keywords—intelligent lighting; patent strength; patent comprehensive ; technology-function matrix;

I. INTRODUCTION

Patent right is an important asset of a company, modern companies own thousands of patents, and patent evaluation based on patent strength has gathered great importance in recent years. This paper introduces a new indicator of patent strength. More specifically, easily calculated indicators of patent strength and comprehensive based on a technology-function matrix.

Patent citation analysis to determine strength and value of a patent has been prosperous since 1990 in patent bibliometric, which is a mathematical and statistical study of patent quantity and quality based on patent documents. Researchers developed some indicators to evaluate quality of patents [1][2]. The basic concept of cited strength is that the higher number cited by later filing patents, the higher value of the patent. A fundamental patent in a technical fields usually has the highest number of citation as prior art by subsequent patents [3].

However, the numbers of citations are highly influenced by the periods after patent publications, a patent with high strength without high cited numbers is possible because of short period after publication. A complicated calculation or software is necessary to determine citing indicators. Patent strength evaluation based on citation is not so popular in practices.

Some indicators based on patent maps were introduced to determine patent strength and patent comprehensive[4][5]. Patent maps are useful tools to visualizes the distribution of patents, monitor the trend of technological changes, infer the strategy of patent portfolios, by statistical charts or diagrams. A technology-function matrix[6] is one kind of popular patent map, and it is very useful to R&D. The matrix is two-dimensional, using the functions and the technical means to be its two coordinate axes, and drawing each nodes proportional to the number of patents. A bigger node means higher patent density which is a popular and crowded technical problem and solution. On the contrary, a smaller node means lower patent density which is a neglected problem and solution.

Technology-function matrix could be used to show the patent comprehensive or breadth of a company. The occupancy in the matrix can be an indicator of patent comprehensive of an applicant.

An analysis of international patent strength based on technology-function matrix will be presented in this paper. A typical worldwide developing technology, intelligent lighting, was selected to demonstrate the analysis. We made patent search in the database of USTPO, EPO, JPO, and World Intellectual Property Organization (WIPO) individually, to get main applicants, patent strengths of top six competitors are calculated based on a new indicator.

II. METHODOLOGY AND DATA

The pool of patents in this study was gotten from official databases by organized search queries. Key words including: (lighting or illumination or light or led or lamp or dimmer) and (intelligent or smart), International Patent classification including: H05B33/00, H05B37/00, and H01L33/00, the filing date is between 2014 and 2016. We summarized main applicants in USPTO, JPO, EPO, and WIPO, to

get the top six competitors are: Philips, Lutron, Osram, Cree, Panasonic, and Toshiba.

The six competitors were searched in USPTO database, after labor screening of the search results, we got highly related patent numbers during application date 2014 to 2016 are shown in Table 1.

Table 1 Publication and issue numbers of main applicants in USPTO

	Nationality	publication	issue
Philips	EP	65	61
Lutron	US	65	21
Osram	EP	45	44
Cree	US	27	54
Panasonic	JP	27	71
Toshiba	JP	48	8

We got three groups and eleven subgroups technologies in intelligent lighting after detail reading of all patent documents. Three groups are lamps, control devices, and power sources. The first group includes: wavelength converting material, wavelength converting structure, semiconductor layout, physical structure, and special devices. The second group includes: environmental sensing system, communication or remote control, control circuitry. The third group includes: pulse-width modulated(PWH) control, triac-based dimmer, other circuitry.

Eight groups of functions are color compromised, special color, illumination wideness, illumination brightness, heat removing, lower consumption, overcurrent protection, and remote dimming.

III. ILLUSTRATION- PATENT STRENGTH

A. Technology-function matrix of main applicants in the US

Fig.1 is a technology-function matrix of Philips. The numbers in bubbles including publication and issue. Philips owns patents spread a lot of nodes in the matrix.

Fig.2 is a technology-function matrix of Lutron, who has patents on half technologies in the matrix, strong on illumination brightness and remote dimming functions. Lutron is empty on special devices, physical structure, semiconductor layout, wavelength converting structure, and wavelength converting material.

Fig.3 is a technology-function matrix of Osram. Osram owns patents in all technologies and functions. The biggest bubbles are control circuitry and sensing system with remote dimming function.

Fig.4 is a technology-function matrix of Cree. Cree has many patents on semiconductor layout to get all functions, control circuitry and other circuitry are another two technologies interested, but empty on triac-based dimmer and remote control, few patents on PWH control, sensing system, and special devices.

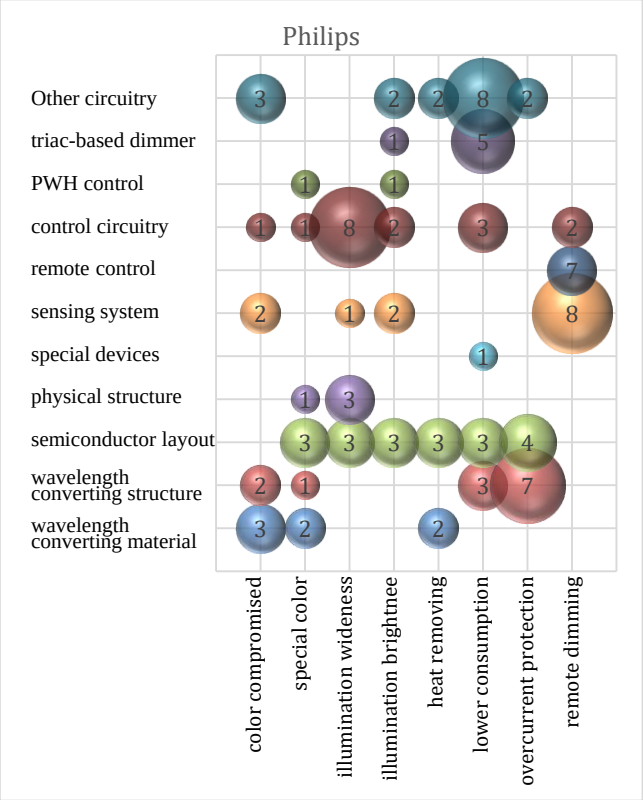

Fig. 1 Technology-function matrix of Philips

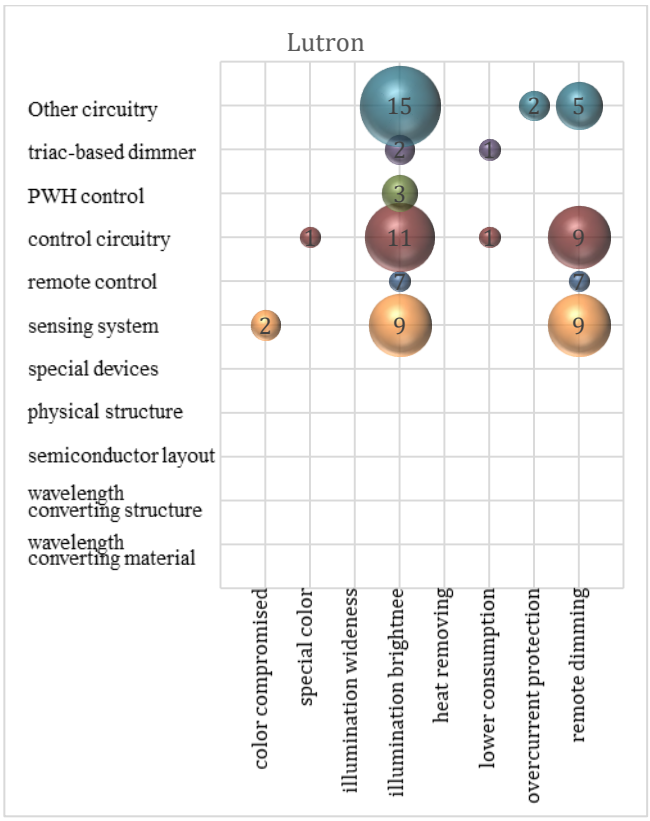

Fig. 2 Technology-function matrix of Lutron

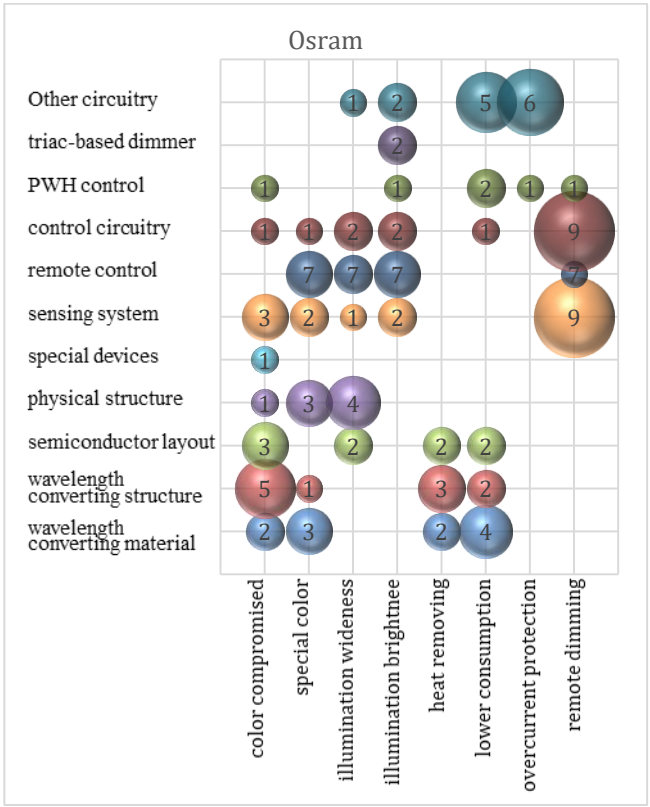

Fig. 3 Technology-function matrix of Osram

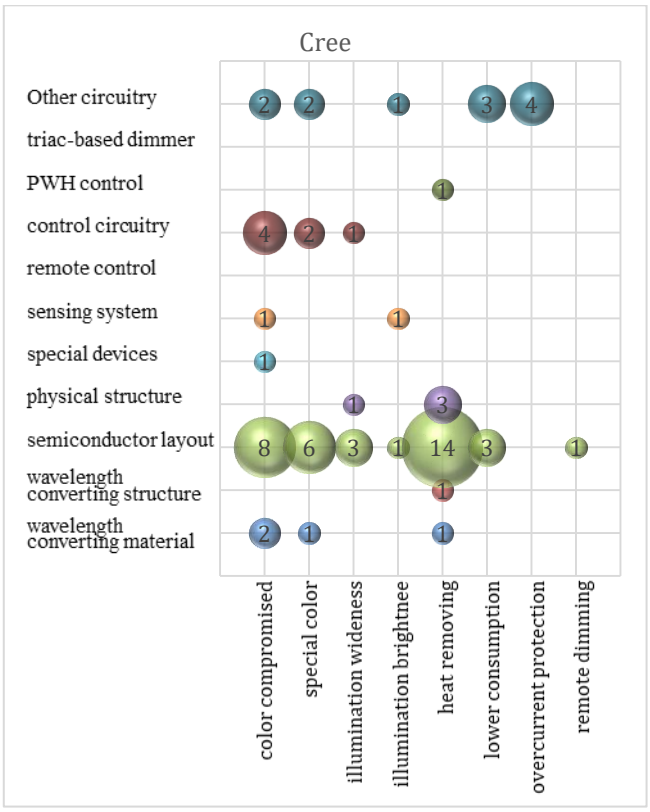

Fig. 4 Technology-function matrix of Cree

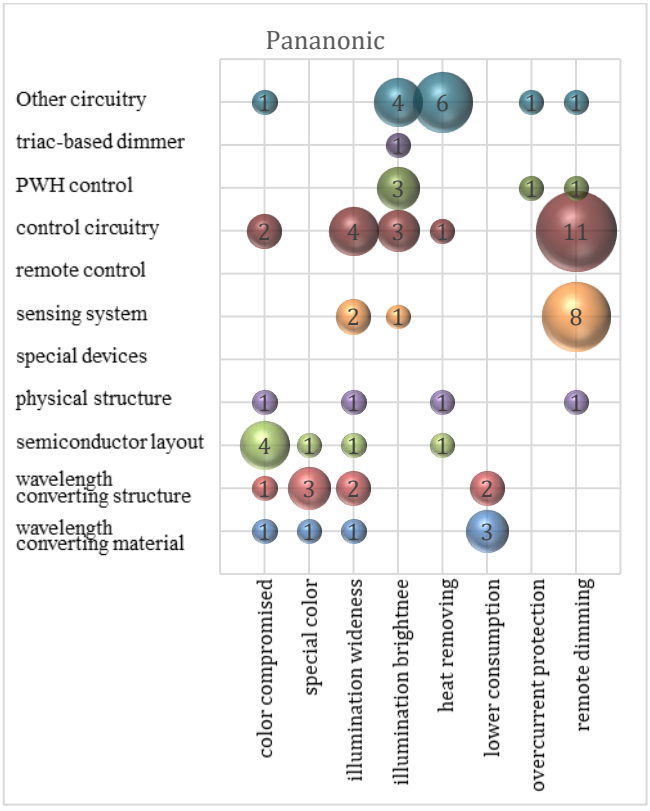

Fig. 5 Technology-function matrix of Panasonic

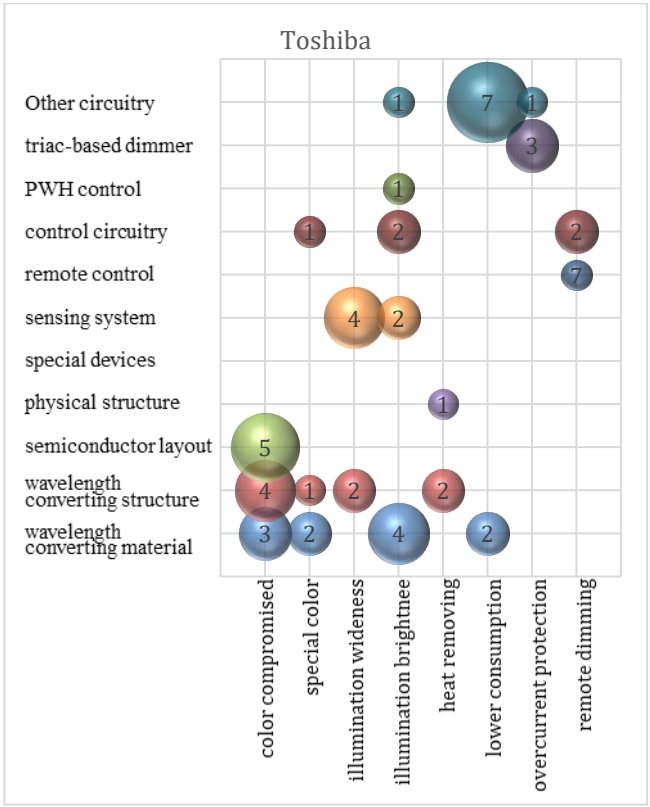

Fig. 6 Technology-function matrix of Toshiba

Fig.5 is a technology-function matrix of Panasonic. Panasonic has patents on almost technologies except remote control and special devices, and including all functions. The biggest bubble is control circuitry with remote dimming, similar to Osram.

Fig.6 is a technology-function matrix of Toshiba. Tohsiba focus on wavelength converting material and structure, and big bubbles on semiconductor layout with color compromised, other circuitry with lower consumption.

B. Patent comprehensive onTechnology-function matrix

If we regard the occupancy percentage in the technology-function matrix as an indicator of patent comprehensive, we can get that the indicator that Philips is 39.7%, Lutron is 17.0%, Osram is 47.7%, Cree is 28.4%, Panasonic is 37.5%, and Tohsiba is 23.9%.

Osram has the most comprehensive patent on intelligent lighting system, Lutron lag behind other companies. Osram can manufacture intelligent lighting products with powerful functions.

C. Patent Strength onTechnology

Patent strength on technology, a new indicator based on technology-function matrix, of a company is shown as follows:

$$\text{patent strength on technology} = \sum_{i=1}^{N} \frac{1}{N} \left(\frac{P_a}{P_{total}}\right)_i$$

where

i: specific technology

N: total number of technologies

P_a: number of patents on a technology

P_{total} : number of patents in total on a technology

Table 1 shows the number of patents on each technology for six companies. The total number of technologies N=11, the first technology, for example, wavelength converting material, has 42 patents in total.

Table 1 number of patents on technology for six applicants

	Philips	Lutron	Osram	Cree	Panasonic	Toshiba	Total
Wavelength converting material	8	0	12	4	6	12	42
Wavelength converting structure	12	0	10	1	8	10	41
Semiconductor layout	18	0	9	39	9	4	79
Physical structure	6	0	4	6	2	1	19
Special devices	1	0	1	1	0	1	4
Sensing system	20	24	16	3	11	6	80
Remote control	5	2	5	0	0	1	13
Control circuitry	20	18	2	6	22	6	84
PWM control	3	2	7	1	5	0	18
Triac-based dimmer	5	4	1	0	1	3	14
Other circuitry	23	9	14	11	15	9	81
Patent strength on technoloty	0.269	0.107	0.213	0.134	0.118	0.130	1.000

We can get the patent strength on technology of all companies. Philips has the highest strength of 0.269, and then Osram is 0.213, Cree is 0.134, Toshiba is 0.130, Panasonic is 0.118, and Lutron is 0.130. The indicators mean percentages of 100%, as shown in Fig.7.

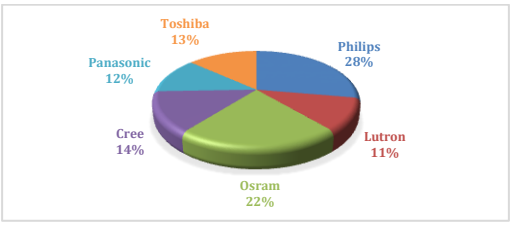

Fig. 7 Percentages of patent strength on technology

D. Patent Strength on Function

Patent strength on function of a company can be calculated by a similar equation but based on function:

$$\text{patent strength on technology} = \sum_{j=1}^{M} \frac{1}{M} \left(\frac{P_a}{P_{total}}\right)_j$$

where

j: specific function

M: total number of functions

P_a: number of patents on a function

P_{total} : number of patents in total on a function

Table 2 shows the number of patents on each function for six companies. The total number of functions M=8, the first function, for example, color compromised, has 67 patents in total.

Table 2 number of patents on function for six applicants

	Philips	Lutron	Osram	Cree	Panasonic	Toshiba	Total
Color compromised	14	2	19	19	1	12	67
Special color	11	1	15	10	8	4	44
Illumination wideness	21	0	11	6	14	6	58
Illumination brightness	12	41	11	4	11	10	89
Heat removing	11	0	9	22	8	3	53
Lower consumption	31	1	14	8	5	10	69
Overcurrent protection	7	1	9	5	2	4	28
Remote dimming	19	22	13	3	22	4	83
Patent strength on function	0.262	0.070	0.224	0.174	0.140	0.110	1.000

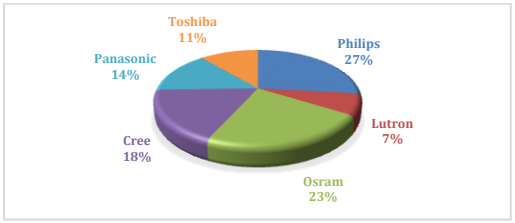

Fig. 8 Percentages of patent strength on function

The indicators of patent strength on function of all companies are: Philips is 0.262, Osram is 0.224, Cree is 0.174, Panasonic is 0.140, Toshiba is 0.110, and Lutron is 0.070. Fig. 8 shows the share of strength on function of six competitors.

Philips owns the highest strength, both on technology and function.

IV. CONCLUSIONS

Local companies may rely on a special technology, or manufacture part of a whole devices, but technology comprehensive is important for international companies to get market share and higher interests.

The technology-function matrix based on patents visualizes technical completeness and vacancies of main applicants. We can screen off rubbish patents during the matrix forming, the indicators based on technology-function matrix will be more near truth than indicators based on citation numbers.

In this study, Osram has the most comprehensive patent on intelligent lighting system, Philips occupies the highest strength, both on technology and function.

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