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Exploring Valuable Indicators for Classifying Strong and Weak Patents Based on Invalidation Reexamination Decisions

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Abstract

Based on 8,666 invalidation reexamined China invention grant patents of decision dates from 2000 to 2021, the effect and value of eight indicators for classifying strong and weak patents in nine technology areas, including overall technology and eight technology sections, was thoroughly analyzed via ANOVA. Two high valuable indicators including abstract word count and examination duration for classification were found, which respectively showed significance in five technology areas. Four less valuable indicators, including claim count, figure count, inventor count and IPC count, were found to respectively show significance in one or two technology areas. A valueless indicator of applicant count was found to show none of significance in any technology areas. The strong patents did not always show higher indicator means of significance. Especially for the high valuable indicator of examination duration, the strong patents showed lower means in any of five technology areas of significance. The finding of this research would contribute the state of art in evaluating patents and help patent owners improve their patent asset management strategy.

JEL classification numbers: C38, C46, G11, G12.
Keywords: Patent, ANOVA, Invention grant, Reexamination, Invalidation.

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1. Introduction

Patent is the most important outcome of innovation. China, showing outstanding technology capability, has been the largest domestic patent application country in the world for many years. China Intellectual Property Administration (CNIPA) is now the world's largest patent office. By the end of 2022, there have been more than 23 million accumulated grant patents by CNIPA.

With such huge amount of China patents, Li (2012) found that China patent subsidy programs induced an increase in patent propensity and the patent grant ratio increased after the implementation of subsidy programs. Dang and Motohashi (2015) proposed that China patent statistics are meaningful indicators because China valid patent count is correlated with R&D input and financial output.

When quantity achieved, quality is then more important. It has been a critical issue to find the indicator capable for identifying good patents, high quality patents, valuable patents, or strong patents. Boeing and Mueller (2019) proposed a patent quality index based on internationally comparable citation data from international search reports (ISR) to consider foreign, domestic, and self citations. They found that all three citation types may be used as economic indicators if policy distortion is not a concern.

Tsai, Che, and Bai (2021a) defined the technology variety by the number of International Patent Classifications and found that the Chinese A-shares having patents of the higher technology variety showed higher stock return rates. Tsai, Che, and Bai (2021b) further found that Chinese A-shares having invention grant patents of the longer examination duration showed higher stock return rates. Chen, Chu, Che, Tsai & Bai (2022) found that Chinese A-shares in the highest total drawing count groups of invention grant patents showed significantly higher stock return rates while the A-shares in the lower total drawing count groups showed significantly lower stock return rates. Chen, Chu, Che & Tsai (2022) further found that Chinese A-shares in the highest total drawing count groups of utility model grant patents showed significantly higher stock return rates while the A-shares in the lower total drawing count groups showed significantly lower stock return rates.

The invalidation reexamination patent database is another important valuable patent source. Patent invalidation reexamination is a challenge to the legality of granted patents, aimed at correcting possible erroneous patent issuing. Any entity or individual who believes that a granted patent does not meet the issuing conditions may request the patent reexamination department to declare the patent invalid. This ensures the accuracy and fairness of the patent system, and maintains fair competition in the market. The patents involved in invalidation reexamination could be regarded as high value patents because patent invalidation reexamination event usually accompanied with patent infringement lawsuits which impact on commercial merits. Galasso & Schankerman (2015) based on patent litigation at the U.S. Court of Appeals for the Federal Circuit, found that patent invalidation caused the patent holder to reduce subsequent patenting and the impact was large for small and medium-sized firms. Han, Zhu, Lei & Daim (2021) outlined a framework for mining industry level R&D trends from patents of patent applications and invalidated patents, then proposed a richer and more comprehensive analysis covering the full lifespan.

However, the characteristics of indicators of patents involved in invalidation reexamination is not yet discussed, especially for indicator variance between strong patents which survived from the invalidation reexamination and weak patents which failed in the invalidation reexamination. It is therefore the objective of this research to explore the aforementioned characteristics.

The managerial implication of this research comprises:

(1) enriching the understanding of China patents involved in invalidation reexamination, especially for China invention grant patents;

(2) Developing criteria for classifying strong patents and weak patents based on invalidation reexamined invention grant patents; and

(3) helping the patent owners improve their patent asset management strategy.

In the following paragraphs, section 2 presents the data and methodology including the delimitation and limitation, population and sample, the patent indicators defined and analyzed, and the principal of analysis of variance (ANOVA); section 3 presents the result and finding; section 4 presents the conclusion.

2. Data and Methodology

2.1 Delimitation and Limitation

The objective of this research is to explore the valuable patent indicators from the invalidation reexamined patents in the database of the reexamination and invalidation department of China Intellectual Property Administration (CNIPA), therefore, only China patents which received the final reexamination decisions are discussed.

Regarding the patent species, there are three issued patent species in China patent system including the invention grant, the utility model grant and the design grant. The design grant is a design application of a product which issued by overcoming the preliminary examination by having a distinct configuration, distinct surface ornamentation or both. The utility model grant is a utility model application of a product which issued by overcoming the preliminary examination. The invention grant is an issued invention application which overcoming not only the preliminary examination but also the substantial examination by having novel and distinct technical features over the prior arts. The invention grant in China is always regarded as the most valuable patent species because it has to overcome the hardest and longest examination process and cost much more money than the other patent species. It is therefore only the invention grant patent is discussed in this research.

2.2 Population and Sample

The population is the China patents which received the final decisions of invalidation reexamination from the reexamination and invalidation department of China Intellectual Property Administration (CNIPA). Considering the patent database integrity, finally 8,666 China patent samples are collected of which the final decisions of invalidation reexamination are made in the years from 2000 to 2021.

2.3 Instrumentation

2.3.1 Patent Indicator

There are eight quantitative patent indicators are discussed in this research as below:
(1) Applicant count
The applicant count is defined as the number of entities who owned the patent application when patent issued no matter the entity is an individual or a company, small or big, domestic or foreign. For example, if a patent is filled by three entities including a company, a university and an individual, the applicant count is 3 though the company might have dozens of employees and the university might have thousands of students and teachers. A patent of higher applicant count usually implies a higher level of collaborative Innovation.
(2) Inventor count
The inventor is defined as the natural person who substantially contributes the inventive feature(s) of a patent. The inventor count is defined as the number of inventors whose names shown on the patent certificate. A patent of higher inventor count usually implies a higher level of collective intelligence.
(3) IPC count
The International Patent Classification (IPC), established by the Strasbourg Agreement 1971, provides for a hierarchical system of language independent symbols for the classification of patents according to the different areas of technology to which they pertain. A patent is provided with at least one and usually several IPC codes, which specified by the examiner. The first IPC of a patent called the principal IPC indicates the principal technology area that the patent pertained. The IPC count is defines as the number of IPC codes shown on the issued patent specification. A patent of higher IPC count implies it pertaining more technology areas.
(4) Claim count
The patent claim including independent claim terms (sentences) and dependent claim terms (sentences) defines the scope of patent right. The claim count is defined as the number of claim terms comprised in a patent. A patent of higher claim count usually implies to have more rigorous scope of right.
(5) Figure count
The figure count is defines as the number of figures comprised in a patent specification. According to the patent examination criteria, the embodiment and/or inventive features has to be definitely supported by the figures and the description.

A patent of higher figure count usually implies to have more embodiments or inventive features.

(6) Description word count

The description provides the detailed illustration of inventive features and the resulting functions. The description word count is defined as the number of words comprised in a patent's description part while the abstract and the claim are excluded, wherein, the unit for calculation is thousand words. A patent of higher description word count usually implies to have more embodiments and inventive features.

(7) Abstract word count

The abstract is a clear and concise statement of a patent's technical disclosure. The abstract word count is defined as the number of words comprised in a patent's abstract. However, the value of the abstract is barely discussed.

(8) Examination duration

A China invention grant patent must successfully pass the examinations including the preliminary examination and the substantial examination. Though a patent is not issued immediately when it passed the substantial examination because some necessary administrative procedure steps cost time, however, the examination duration is defined as the time spent from the filing date to the issue date, wherein, the unit for calculation is month.

2.3.2 Technology Area

It is understood that patents in different technologies are somewhat different in drafting and content though the formats are similar. The indicators of patents in different technologies are also analyzed in this research.

Since IPC is a standard classification system for patents, therefore, IPC is applied in this research for classifying technologies. IPC is provided with a hierarchy structure of five levels including section, class, sub-class, group and sub-group. The section is the highest level of IPC hierarchy structure and divides IPC into eight sections as below:

A: human necessities
B: performing operations; transporting
C: chemistry; metallurgy
D: textiles; paper
E: fixed constructions
F: mechanical engineering; lighting; heating; weapons; blasting
G: physics
H: electricity

As described above, the principal IPC indicates the principal technology of a patent, hence all patents in this research are classified to eight technology sections by their principal IPCs. Finally, nine technology areas including overall technology and eight technology sections are analyzed.

2.3.3 Patent Group

In the invalidation reexamination decision, there are three types of claim validation, including all claims maintaining valid, claims partly remaining valid, and all claims invalid. In this research, two patent groups are therefore defined as below:
Group #S: The patents of which the invalidation reexamination decisions show either all claims maintaining valid or claims partly remaining valid. This group consisting of strong patents which survived from the invalidation reexamination procedure, is regarded as the strong patent group.
Group #W: The patents of which the invalidation reexamination decisions show all claims invalid. This group consisting of weak patent which failed in the invalidation reexamination procedure, is regarded as the weak patent group.

2.3.4 Analysis of Variance

Analysis of Variance (ANOVA) is applied in this research for exploring:
Is the variance of indicators between patent groups #W and #S significantly different or not? If yes, such indicator might be regarded as the valuable indicator for identifying strong patents and weak patents.
ANOVA is a statistical approach used to compare variances across the means of different data groups. The outcome of ANOVA is the “F-Ratio”.

$$F = \frac{MST}{MSE} = \frac{\sum n_j (\overline{x_j} - \overline{x})^2 / (k-1)}{\sum \sum (x - \overline{x_j})^2 / (N-k)} \tag{1}$$

This F-ratio shows the difference between the within group variance and the between group variance, which ultimately produces a result which allowing a conclusion that the null hypothesis H_0: $\mu_1 = \mu_2 = ... = \mu_k$ is supported or rejected. If there is a significant difference between the groups, the null hypothesis is not supported, and the F-ratio will be larger while the corresponding p value should be smaller than 0.05.

3. Result and Finding

3.1 Overall Technology

In 8,666 patent samples, the strong patent group #S comprises 5,974 patents while the weak patent group #W comprises 2,692 patents. Figure 1 shows the annual statistics of of patent counts in both patent groups by the invalidation reexamination decision date from 2000 to 2021. Though the patent counts do not steadily increase year by year, the trend of the patent count apparently shows a first jump to a first higher level in 2014 and a second jump to a second higher level in 2018.

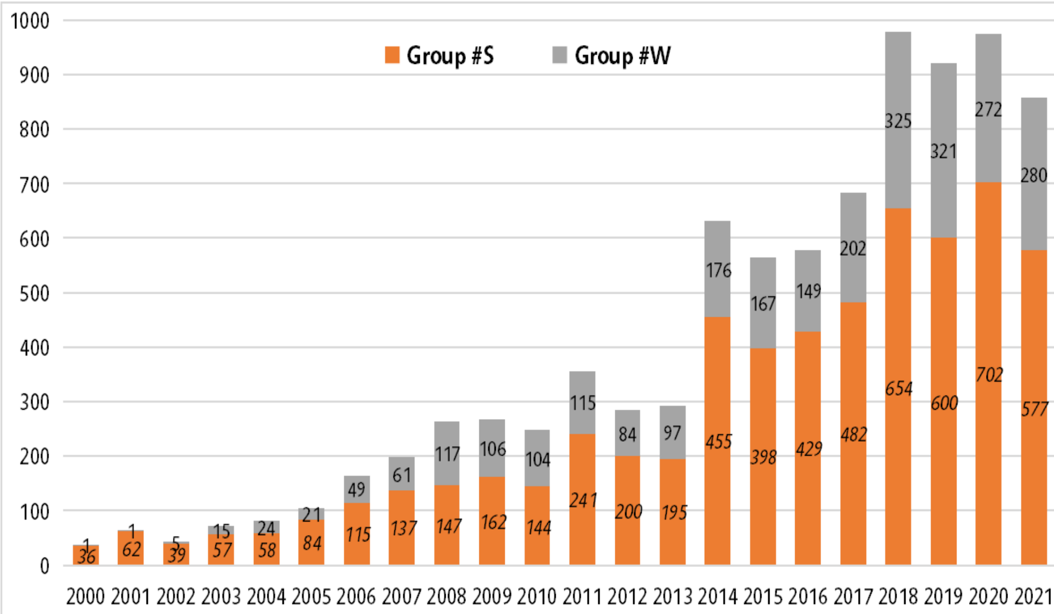

Figure 1: Patent counts from 2000 to 2021

Figure 2 shows the patent counts in both patent groups in eight technology sections. Technology section B (performing operations; transporting) of 1675 patents and technology section H (electricity) of 1666 patents are provided with higher numbers of patents while technology section D (textiles; paper) of 300 patents is provided with the lowest number of patents.

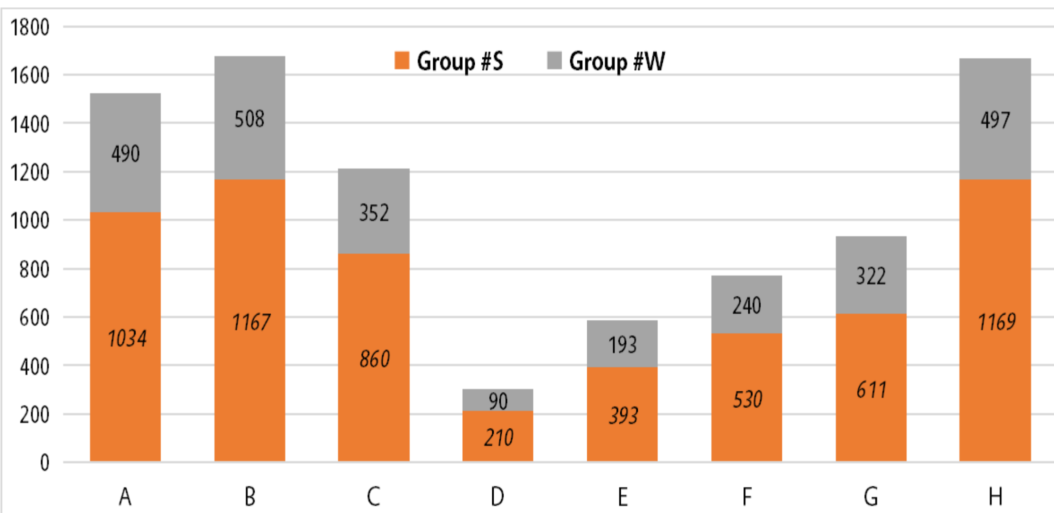

Figure 2: Patent counts in eight technology sections

Table 1 shows the descriptive statistics of indicators of two patent groups for overall technology. Four indicators, including inventor count, figure count, description word count, and abstract word count, of the strong patent group #S show higher means; whereas the other four indicators, including applicant count, IPC count, claim count, and examination duration, of the strong patent group #S show lower means.

Table 1: Descriptive statistics of indicators of patent groups (overall technology)

Indicator	Group	Patent	Mean	Standard deviation	Standard error
Applicant count	#W	2,692	1.212	0.506	0.010
	#S	5,974	1.200	0.498	0.006
	Total	8,666	1.204	0.501	0.005
Inventor count	#W	2,692	2.607	2.045	0.039
	#S	5,974	2.678	2.220	0.029
	Total	8,666	2.656	2.167	0.023
IPC count	#W	2,692	3.532	2.958	0.057
	#S	5,974	3.472	3.065	0.040
	Total	8,666	3.491	3.032	0.033
Claim count	#W	2,692	12.865	14.922	0.288
	#S	5,974	12.834	14.313	0.185
	Total	8,666	12.844	14.504	0.156
Figure count	#W	2,692	6.935	9.776	0.188
	#S	5,974	7.485	10.191	0.132
	Total	8,666	7.314	10.066	0.108
Description word count	#W	2,692	11.339	16.420	0.316
	#S	5,974	12.045	24.797	0.320
	Total	8,666	11.825	22.532	0.242
Abstract word count	#W	2,692	222.761	77.416	1.492
	#S	5,974	227.893	74.092	0.959
	Total	8,666	226.299	75.173	0.808
Examination duration	#W	2,692	35.452	29.551	0.570
	#S	5,974	31.951	24.267	0.314
	Total	8,666	33.038	26.072	0.280

Data Source: Author’s Calculation

Table 2 shows the results of ANOVA on indicators between the strong patent group #S and the weak patent group #W. The variance between two groups are of significance only for three indicators including figure count (p*<0.05), abstract word count (p**≤0.01), and examination duration (p***≤0.001); whereas the variances between two groups are free of significance for the other five indicators. Based on Tables 1 and 2, the strong patent group #S significantly shows higher figure count, higher abstract word count, but shorter examination duration.

Table 2: ANOVA on indicators between patent groups (overall technology)

Indicator		Sum square	Mean square	F	p
Applicant count	between groups	0.286	0.286	1.140	0.286
	within groups	2,172.645	0.251		
Inventor count	between groups	9.289	9.289	1.978	0.160
	within groups	40,693.971	4.697		
IPC count	between groups	6.659	6.659	0.724	0.395
	within groups	79,667.084	9.195		
Claim count	between groups	1.727	1.727	0.008	0.928
	within groups	1,822,904.721	210.400		
Figure count	between groups	563.034	563.034	5.559	0.018*
	within groups	877,478.726	101.279		
Description word count	between groups	924.327	924.327	1.821	0.177
	within groups	4,398,366.823	507.660		
Abstract word count	between groups	48,874.562	48,874.562	8.657	0.003**
	within groups	48,916,802.159	5,645.984		
Examination duration	between groups	22,745.104	22,745.104	33.586	0.001***
	within groups	5,867,347.565	677.210		

p*<0.05, p**≤0.01, p***≤0.001; Data Source: Author's Calculation

3.2 ANOVA for technology section A (human necessities)

Table 3 shows the descriptive statistics of indicators of two groups for technology section A (human necessities). The strong patent group #S shows higher means only for two indicators including figure count and abstract word count; whereas, it shows lower means for the other six indicators including applicant count, inventor count, IPC count, claim count, description word count, and examination duration.

Table 3: Descriptive statistics of indicators of patent groups (technology section A)

Indicator	Group	Patent	Mean	Standard deviation	Standard error
Applicant count	#W	490	1.204	0.599	0.027
	#S	1,034	1.195	0.479	0.015
	Total	1,524	1.198	0.520	0.013
Inventor count	#W	490	2.602	2.042	0.092
	#S	1,034	2.441	1.955	0.061
	Total	1,524	2.493	1.984	0.051
IPC count	#W	490	4.314	4.290	0.194
	#S	1,034	3.809	3.749	0.117
	Total	1,524	3.972	3.937	0.101
Claim count	#W	490	14.641	21.131	0.955
	#S	1,034	12.402	13.646	0.424
	Total	1,524	13.122	16.454	0.421
Figure count	#W	490	6.157	11.966	0.541
	#S	1,034	6.760	11.020	0.343
	Total	1,524	6.566	11.333	0.290
Description word count	#W	490	14.865	21.915	0.990
	#S	1,034	12.415	19.742	0.613
	Total	1,524	13.203	20.490	0.524
Abstract word count	#W	490	202.588	84.178	3.803
	#S	1,034	211.184	75.716	2.355
	Total	1,524	208.420	78.611	2.014
Examination duration	#W	490	35.568	29.820	1.347
	#S	1,034	30.375	22.731	0.707
	Total	1,524	32.044	25.335	0.649

Data Source: Author’s Calculation

Table 4 shows the results of ANOVA on indicators between the strong patent group #S and the weak patent group #W for technology section A (human necessities). The variance between two groups are of significance for five indicators including IPC count (p*<0.05), claim count (p*<0.05), description word count (p*<0.05), abstract word count (p*<0.05), and examination duration (p***≤0.001); whereas the variances between two groups are free of significance for the other three indicators. Based on Tables 3 and 4, the strong patent group #S significantly shows higher abstract word count, but lower IPC count, lower claim count, lower description word count, and shorter examination duration.

Table 4: ANOVA on indicators between patent groups (technology section A)

Indicator		Sum square	Mean square	F	p
Applicant count	between groups	0.025	0.025	0.093	0.760
	within groups	412.130	0.271		
Inventor count	between groups	8.621	8.621	2.191	0.139
	within groups	5,988.299	3.934		
IPC count	between groups	84.720	84.720	5.483	0.019*
	within groups	23,517.067	15.451		
Claim count	between groups	1,665.881	1,665.881	6.174	0.013*
	within groups	410,685.418	269.833		
Figure count	between groups	120.888	120.888	0.941	0.332
	within groups	195,475.418	128.433		
Description word count	between groups	1,995.144	1,995.144	4.763	0.029*
	within groups	637,480.628	418.844		
Abstract word count	between groups	24,565.420	24,565.420	3.983	0.046*
	within groups	9,387,131.814	6,167.629		
Examination duration	between groups	8,965.342	8,965.342	14.088	0.001***
	within groups	968,567.895	636.378		

p*<0.05, p**≤0.01, p***≤0.001; Data Source: Author's Calculation

3.3 ANOVA for technology section B (performing operations and transporting)

Table 5 shows the descriptive statistics of indicators of two groups for technology section B (performing operations and transporting). The strong patent group #S shows higher means for four indicators including applicant count, claim count, figure count and abstract word count; whereas, it shows lower means for another six indicators including inventor count, IPC count, description word count, and examination duration.

Table 5: Descriptive statistics of indicators of patent groups (technology section B)

Indicator	Group	Patent	Mean	Standard deviation	Standard error
Applicant count	#W	508	1.175	0.415	0.018
	#S	1,167	1.187	0.513	0.015
	Total	1,675	1.183	0.486	0.012
Inventor count	#W	508	2.325	1.939	0.086
	#S	1,167	2.303	1.884	0.055
	Total	1,675	2.310	1.900	0.046
IPC count	#W	508	3.222	2.314	0.103
	#S	1,167	3.117	2.277	0.067
	Total	1,675	3.149	2.288	0.056
Claim count	#W	508	10.809	13.155	0.584
	#S	1,167	11.091	11.658	0.341
	Total	1,675	11.005	12.128	0.296
Figure count	#W	508	5.967	7.374	0.327
	#S	1,167	7.797	9.752	0.285
	Total	1,675	7.242	9.134	0.223
Description word count	#W	508	7.241	9.396	0.416
	#S	1,167	7.230	7.977	0.233
	Total	1,675	7.233	8.430	0.205
Abstract word count	#W	508	232.925	72.106	3.199
	#S	1,167	240.449	69.921	2.047
	Total	1,675	238.167	70.654	1.726
Examination duration	#W	508	29.925	21.783	0.966
	#S	1,167	29.469	20.915	0.612
	Total	1,675	29.607	21.177	0.517

Data Source: Author’s Calculation

Table 6 shows the results of ANOVA on indicators between the strong patent group #S and the weak patent group #W for technology section B (performing operations and transporting). The variance between two groups are of significance only for two indicators including figure count (p***≤0.001), and abstract word count (p*<0.05); whereas the variances between two groups are free of significance for the other six indicators. Based on Tables 5 and 6, the strong patent group #S significantly shows higher figure count, but lower abstract word count.

Table 6: ANOVA on indicators between patent groups (technology section B)

Indicator		**Sum square**	**Mean square**	**F**	**p**
Applicant count	between groups	0.048	0.048	0.202	0.653
	within groups	394.684	0.236		
Inventor count	between groups	0.163	0.163	0.045	0.832
	within groups	6,042.024	3.611		
IPC count	between groups	3.906	3.906	0.746	0.388
	within groups	8,756.781	5.234		
Claim count	between groups	28.101	28.101	0.191	0.662
	within groups	246,202.850	147.162		
Figure count	between groups	1,185.775	1,185.775	14.327	0.001***
	within groups	138,465.300	82.765		
Description word count	between groups	0.038	0.038	0.001	0.982
	within groups	118,971.321	71.113		
Abstract word count	between groups	20,035.320	20,035.320	4.021	0.045*
	within groups	8,336,549.874	4,982.995		
Examination duration	between groups	73.641	73.641	0.164	0.685
	within groups	750,637.475	448.678		

p*<0.05, p**≤0.01, p***≤0.001; Data Source: Author's Calculation

3.4 ANOVA for technology section C (chemistry and metallurgy)

Table 7 shows the descriptive statistics of indicators of two groups for technology section C (chemistry and metallurgy). The strong patent group #S shows higher means for six indicators including applicant count, inventor count, IPC count, claim count, figure count, description word count; whereas, it shows lower means for the other two indicators including abstract word count, and examination duration.

Table 7: Descriptive statistics of indicators of patent groups (technology section C)

Indicator	Group	Patent	Mean	Standard deviation	Standard error
Applicant count	#W	352	1.222	0.519	0.028
	#S	860	1.226	0.478	0.016
	Total	1,212	1.224	0.490	0.014
Inventor count	#W	352	3.338	2.259	0.120
	#S	860	3.851	3.023	0.103
	Total	1,212	3.702	2.831	0.081
IPC count	#W	352	4.080	3.136	0.167
	#S	860	4.378	4.282	0.146
	Total	1,212	4.291	3.984	0.114
Claim count	#W	352	12.449	10.440	0.556
	#S	860	13.609	14.847	0.506
	Total	1,212	13.272	13.720	0.394
Figure count	#W	352	2.793	4.988	0.266
	#S	860	3.266	5.795	0.198
	Total	1,212	3.129	5.575	0.160
Description word count	#W	352	17.308	26.667	1.421
	#S	860	23.657	54.777	1.867
	Total	1,212	21.813	48.402	1.390
Abstract word count	#W	352	218.324	98.562	5.253
	#S	860	211.395	92.950	3.170
	Total	1,212	213.408	94.625	2.718
Examination duration	#W	352	33.547	27.794	1.481
	#S	860	31.339	26.816	0.914
	Total	1,212	31.980	27.111	0.779

Data Source: Author’s Calculation

Table 8 shows the results of ANOVA on indicators between the strong patent group #S and the weak patent group #W for technology section C (chemistry and metallurgy). The variance between two groups are of significance only for two indicators including inventor count (p**≤0.01), and description word count (p*<0.05); whereas the variances between two groups are free of significance for the other six indicators. Based on Tables 7 and 8, the strong patent group #S significantly shows higher inventor count and description word count.

Table 8: ANOVA on indicators between patent groups (technology section C)

Indicator		Sum square	Mean square	F	p
Applicant count	between groups	0.004	0.004	0.017	0.898
	within groups	290.953	0.240		
Inventor count	between groups	65.756	65.756	8.252	0.004**
	within groups	9,641.719	7.968		
IPC count	between groups	22.234	22.234	1.401	0.237
	within groups	19,199.953	15.868		
Claim count	between groups	336.343	336.343	1.788	0.181
	within groups	227,603.805	188.102		
Figure count	between groups	56.038	56.038	1.804	0.179
	within groups	37,581.883	31.059		
Description word count	between groups	10,069.503	10,069.503	4.310	0.038*
	within groups	2,827,098.261	2,336.445		
Abstract word count	between groups	11,989.989	11,989.989	1.339	0.247
	within groups	10,831,224.661	8,951.425		
Examination duration	between groups	1,217.729	1,217.729	1.658	0.198
	within groups	888,871.877	734.605		

p*<0.05, p**≤0.01, p***≤0.001; Data Source: Author’s Calculation

3.5 ANOVA for technology section D (textiles and paper)

Table 9 shows the descriptive statistics of indicators of two groups for technology section D (textiles and paper). The strong patent group #S shows higher means for three indicators including inventor count, claim count, and abstract word count; whereas, it shows lower means for the other five indicators including applicant count, IPC count, figure count, description word count, and examination duration.

Table 9: Descriptive statistics of indicators of patent groups (technology section D)

Indicator	Group	Patent	Mean	Standard deviation	Standard error
Applicant count	#W	90	1.222	0.514	0.054
	#S	210	1.152	0.398	0.027
	Total	300	1.173	0.437	0.025
Inventor count	#W	90	2.611	2.021	0.213
	#S	210	2.729	2.204	0.152
	Total	300	2.693	2.148	0.124
IPC count	#W	90	3.222	3.186	0.336
	#S	210	3.210	2.555	0.176
	Total	300	3.213	2.754	0.159
Claim count	#W	90	10.700	11.826	1.247
	#S	210	11.100	10.771	0.743
	Total	300	10.980	11.080	0.640
Figure count	#W	90	6.478	6.259	0.660
	#S	210	6.176	6.603	0.456
	Total	300	6.267	6.493	0.375
Description word count	#W	90	8.807	10.271	1.083
	#S	210	8.320	7.252	0.500
	Total	300	8.466	8.259	0.477
Abstract word count	#W	90	211.800	66.032	6.960
	#S	210	228.767	62.796	4.333
	Total	300	223.677	64.147	3.704
Examination duration	#W	90	29.593	24.247	2.556
	#S	210	28.960	20.295	1.400
	Total	300	29.150	21.517	1.242

Data Source: Author’s Calculation

Table 10 shows the results of ANOVA on indicators between the strong patent group #S and the weak patent group #W for technology section D (textiles and paper). The variance between two groups is of significance for only one indicator, i.e. abstract word count (p*<0.05); whereas the variances between two groups are free of significance for the other seven indicators. Based on Tables 9 and 10, the strong patent group #S shows significantly higher abstract word count for technology section D (textiles and paper).

Table 10: ANOVA on indicators between patent groups (technology section D)

Indicator		Sum square	Mean square	F	p
Applicant count	between groups	0.307	0.307	1.616	0.205
	within groups	56.679	0.190		
Inventor count	between groups	0.869	0.869	0.188	0.665
	within groups	1,378.917	4.627		
IPC count	between groups	0.010	0.010	0.001	0.971
	within groups	2,268.337	7.612		
Claim count	between groups	10.080	10.080	0.082	0.775
	within groups	36,695.800	123.140		
Figure count	between groups	5.730	5.730	0.136	0.713
	within groups	12,598.937	42.278		
Description word count	between groups	14.961	14.961	0.219	0.640
	within groups	20,381.380	68.394		
Abstract word count	between groups	18,135.670	18,135.670	4.458	0.036*
	within groups	1,212,215.967	4,067.839		
Examination duration	between groups	25.258	25.258	0.054	0.816
	within groups	138,405.827	464.449		

p*<0.05, p**≤0.01, p***≤0.001; Data Source: Author's Calculation

3.6 ANOVA for technology section E (fixed constructions)

Table 11 shows the descriptive statistics of indicators of two groups for technology section E (fixed constructions). The strong patent group #S shows higher means for five indicators including applicant count, inventor count, IPC count, figure count, and abstract word count; whereas, it shows lower means for the other three indicators including claim count, description word count, and examination duration.

Table 11: Descriptive statistics of indicators of patent groups (technology section E)

Indicator	Group	Patent	Mean	Standard deviation	Standard error
Applicant count	#W	193	1.119	0.355	0.026
	#S	393	1.183	0.532	0.027
	Total	586	1.162	0.481	0.020
Inventor count	#W	193	1.819	1.650	0.119
	#S	393	2.071	2.138	0.108
	Total	586	1.988	1.993	0.082
IPC count	#W	193	2.731	1.879	0.135
	#S	393	2.748	1.944	0.098
	Total	586	2.742	1.922	0.079
Claim count	#W	193	12.269	10.768	0.775
	#S	393	11.936	12.306	0.621
	Total	586	12.046	11.814	0.488
Figure count	#W	193	10.896	10.624	0.765
	#S	393	9.491	10.001	0.504
	Total	586	9.954	10.223	0.422
Description word count	#W	193	7.303	6.443	0.464
	#S	393	6.672	5.263	0.265
	Total	586	6.880	5.681	0.235
Abstract word count	#W	193	241.472	64.527	4.645
	#S	393	250.646	56.283	2.839
	Total	586	247.625	59.227	2.447
Examination duration	#W	193	28.591	24.435	1.759
	#S	393	24.056	18.856	0.951
	Total	586	25.550	20.947	0.865

Data Source: Author’s Calculation

Table 12 shows the results of ANOVA on indicators between the strong patent group #S and the weak patent group #W for technology section E (fixed constructions). The variance between two groups is of significance for only one indicator, i.e. examination duration (p*<0.05); whereas the variances between two groups are free of significance for the other seven indicators. Based on Tables 11 and 12, the strong patent group #S shows significantly shorter examination duration for technology section E (fixed constructions).

Table 12: ANOVA on indicators between patent groups (technology section E)

Indicator		**Sum square**	**Mean square**	**F**	**p**
Applicant count	between groups	0.531	0.531	2.295	0.130
	within groups	135.068	0.231		
Inventor count	between groups	8.258	8.258	2.084	0.149
	within groups	2,314.658	3.963		
IPC count	between groups	0.040	0.040	0.011	0.917
	within groups	2,160.051	3.699		
Claim count	between groups	14.357	14.357	0.103	0.749
	within groups	81,629.399	139.776		
Figure count	between groups	255.610	255.610	2.452	0.118
	within groups	60,882.146	104.250		
Description word count	between groups	51.578	51.578	1.600	0.206
	within groups	18,827.656	32.239		
Abstract word count	between groups	10,895.476	10,895.476	3.117	0.078
	within groups	2,041,219.930	3,495.240		
Examination duration	between groups	2,662.742	2,662.742	6.122	0.014*
	within groups	254,019.940	434.966		

p*<0.05, p**≤0.01, p***≤0.001; Data Source: Author's Calculation

3.7 ANOVA for technology section F (mechanical engineering, lighting, heating, weapons and blasting)

Table 13 shows the descriptive statistics of indicators of two groups for technology section F (mechanical engineering, lighting, heating, weapons and blasting). The strong patent group #S shows higher means for four indicators including inventor count, figure count, description word count, and abstract word count; whereas, it shows lower means for the other four indicators including applicant count, IPC count, claim count, and examination duration.

Table 13: Descriptive statistics of indicators of patent groups (technology section F)

Indicator	Group	Patent	Mean	Standard deviation	Standard error
Applicant count	#W	240	1.208	0.473	0.031
	#S	530	1.175	0.441	0.019
	Total	770	1.186	0.451	0.016
Inventor count	#W	240	2.408	1.694	0.109
	#S	530	2.466	1.837	0.080
	Total	770	2.448	1.793	0.065
IPC count	#W	240	3.271	2.380	0.154
	#S	530	3.464	2.656	0.115
	Total	770	3.404	2.573	0.093
Claim count	#W	240	10.008	9.276	0.599
	#S	530	9.721	7.795	0.339
	Total	770	9.810	8.280	0.298
Figure count	#W	240	6.650	5.777	0.373
	#S	530	7.362	8.145	0.354
	Total	770	7.140	7.491	0.270
Description word count	#W	240	5.802	4.505	0.291
	#S	530	6.626	5.452	0.237
	Total	770	6.369	5.187	0.187
Abstract word count	#W	240	232.883	68.188	4.402
	#S	530	233.849	69.550	3.021
	Total	770	233.548	69.086	2.490
Examination duration	#W	240	29.973	21.664	1.398
	#S	530	28.634	19.348	0.840
	Total	770	29.052	20.094	0.724

Data Source: Author's Calculation

Table 14 shows the results of ANOVA on indicators between the strong patent group #S and the weak patent group #W for technology section F (mechanical engineering, lighting, heating, weapons and blasting). The variance between two groups is of significance for only one indicator, i.e. description word count (p*<0.05); whereas the variances between two groups are free of significance for the other seven indicators. Based on Tables 13 and 14, the strong patent group #S shows significantly higher description word count for technology section F (mechanical engineering, lighting, heating, weapons and blasting).

Table 14: ANOVA on indicators between patent groups (technology section F)

Indicator		Sum square	Mean square	F	p
Applicant count	between groups	0.178	0.178	0.877	0.349
	within groups	156.264	0.203		
Inventor count	between groups	0.550	0.550	0.171	0.679
	within groups	2,471.872	3.219		
IPC count	between groups	6.174	6.174	0.932	0.335
	within groups	5,085.215	6.621		
Claim count	between groups	13.662	13.662	0.199	0.656
	within groups	52,708.655	68.631		
Figure count	between groups	83.807	83.807	1.494	0.222
	within groups	43,069.045	56.079		
Description word count	between groups	111.920	111.920	4.177	0.041*
	within groups	20,577.529	26.794		
Abstract word count	between groups	154.064	154.064	0.032	0.858
	within groups	3,670,134.658	4,778.821		
Examination duration	between groups	296.322	296.322	0.734	0.392
	within groups	310,210.320	403.920		

p*<0.05, p**≤0.01, p***≤0.001; Data Source: Author's Calculation

3.8 ANOVA for technology section G (physics)

Table 15 shows the descriptive statistics of indicators of two groups for technology section G (physics). The strong patent group #S shows higher means for three indicators including inventor count, claim count, and description word count; whereas, it shows lower means for the other five indicators including applicant count, IPC count, figure count, abstract word count, and examination duration.

Table 15: Descriptive statistics of indicators of patent groups (technology section G)

Indicator	Group	Patent	Mean	Standard deviation	Standard error
Applicant count	#W	322	1.307	0.560	0.031
	#S	611	1.224	0.506	0.020
	Total	933	1.253	0.526	0.017
Inventor count	#W	322	2.543	1.929	0.107
	#S	611	2.682	2.113	0.085
	Total	933	2.635	2.051	0.067
IPC count	#W	322	3.043	2.068	0.115
	#S	611	2.781	2.043	0.083
	Total	933	2.871	2.055	0.067
Claim count	#W	322	12.391	10.345	0.577
	#S	611	14.627	12.787	0.517
	Total	933	13.855	12.042	0.394
Figure count	#W	322	9.000	13.369	0.745
	#S	611	8.872	10.536	0.426
	Total	933	8.916	11.585	0.379
Description word count	#W	322	10.506	10.214	0.569
	#S	611	11.169	9.850	0.398
	Total	933	10.940	9.977	0.327
Abstract word count	#W	322	236.668	62.161	3.464
	#S	611	232.753	65.305	2.642
	Total	933	234.104	64.231	2.103
Examination duration	#W	322	35.794	27.229	1.517
	#S	611	32.882	21.512	0.870
	Total	933	33.887	23.667	0.775

Data Source: Author’s Calculation

Table 16 shows the results of ANOVA on indicators between the strong patent group #S and the weak patent group #W for technology section G (Physics). The variance between two groups is of significance for only one indicator, i.e. claim count (p**≤0.01); whereas the variances between two groups are free of significance for the other seven indicators. Based on Tables 15 and 16, the strong patent group #S shows significantly higher claim count for technology section G (Physics).

Table 16: ANOVA on indicators between patent groups (technology section G)

Indicator		Sum square	Mean square	F	p
Applicant count	between groups	1.461	1.461	5.295	0.022
	within groups	256.844	0.276		
Inventor count	between groups	4.075	4.075	0.969	0.325
	within groups	3,916.294	4.207		
IPC count	between groups	14.563	14.563	3.459	0.063
	within groups	3,920.003	4.211		
Claim count	between groups	1,053.851	1,053.851	7.317	0.007**
	within groups	134,085.615	144.023		
Figure count	between groups	3.437	3.437	0.026	0.873
	within groups	125,080.043	134.350		
Description word count	between groups	92.561	92.561	0.930	0.335
	within groups	92,674.340	99.543		
Abstract word count	between groups	3,231.789	3,231.789	0.783	0.376
	within groups	3,841,847.127	4,126.581		
Examination duration	between groups	1,788.841	1,788.841	3.201	0.074
	within groups	520,264.613	558.823		

p*<0.05, p**≤0.01, p***≤0.001; Data Source: Author's Calculation

3.9 ANOVA for technology section H (electricity)

Table 17 shows the descriptive statistics of indicators of two groups for technology section H (electricity). The strong patent group #S shows higher means for four indicators including IPC count, figure count, description word count, and abstract word count; whereas, it shows lower means for another four indicators including applicant count, inventor count, claim count, and examination duration.

Table 17: Descriptive statistics of indicators of patent groups (technology section H)

Indicator	Group	Patent	Mean	Standard deviation	Standard error
Applicant count	#W	497	1.225	0.502	0.022
	#S	1,169	1.210	0.538	0.016
	Total	1,666	1.214	0.527	0.013
Inventor count	#W	497	2.827	2.185	0.098
	#S	1,169	2.688	1.988	0.058
	Total	1,666	2.729	2.049	0.050
IPC count	#W	497	3.499	2.614	0.117
	#S	1,169	3.517	2.807	0.082
	Total	1,666	3.511	2.750	0.067
Claim count	#W	497	15.819	17.656	0.792
	#S	1,169	15.475	19.576	0.573
	Total	1,666	15.577	19.019	0.466
Figure count	#W	497	8.968	9.738	0.437
	#S	1,169	9.812	12.365	0.362
	Total	1,666	9.560	11.647	0.285
Description word count	#W	497	13.065	14.246	0.639
	#S	1,169	13.372	17.217	0.504
	Total	1,666	13.280	16.384	0.401
Abstract word count	#W	497	216.223	72.850	3.268
	#S	1,169	229.227	69.076	2.020
	Total	1,666	225.348	70.453	1.726
Examination duration	#W	497	48.483	39.289	1.762
	#S	1,169	40.480	29.584	0.865
	Total	1,666	42.868	32.973	0.808

Data Source: Author's Calculation

Table 18 shows the results of ANOVA on indicators between the strong patent group #S and the weak patent group #W for technology section H (Electricity). The variances between two groups are of significance for two indicators including abstract word count (p***≤0.001) and examination duration (p**≤0.01); whereas the variances between two groups are free of significance for the other six indicators. Based on Tables 17 and 18, the strong patent group #S significantly shows higher abstract word count but shorter examination duration for technology section H (Electricity).

Table 18: ANOVA on indicators between patent groups (technology section H)

Indicator		Sum square	Mean square	F	p
Applicant count	between groups	0.087	0.087	0.312	0.576
	within groups	462.413	0.278		
Inventor count	between groups	6.757	6.757	1.610	0.205
	within groups	6,982.154	4.196		
IPC count	between groups	0.109	0.109	0.014	0.904
	within groups	12,594.174	7.569		
Claim count	between groups	41.304	41.304	0.114	0.736
	within groups	602,225.208	361.914		
Figure count	between groups	248.416	248.416	1.832	0.176
	within groups	225,602.082	135.578		
Description word count	between groups	32.906	32.906	0.123	0.726
	within groups	446,893.587	268.566		
Abstract word count	between groups	58,966.638	58,966.638	11.958	0.001***
	within groups	8,205,495.137	4,931.187		
Examination duration	between groups	22,333.516	22,333.516	20.786	0.001***
	within groups	1,787,902.023	1,074.460		

p*<0.05, p**≤0.01, p***≤0.001; Data Source: Author’s Calculation

3.10 Summary

Table 19 shows the indicators of significance for nine technology areas including overall technology and eight technology sections. There are two indicators including abstract word count and examination duration respectively show significance in five technology areas including four technology sections and overall technology. These two indicators may be regarded as the high valuable indicators for classifying strong patents and weak patents. There is one indicator, i.e. description word count, shows significance in three technology areas. It may be regarded as the fair valuable indicator for classification. There are two indicators including claim count and figure count respectively show significance in two technology areas. There are two indicators including inventor count and IPC count respectively show significance in only one technology area. These four indicators, i.e. claim count, figure count, inventor count and IPC count, may be regarded as the less valuable indicators for classification. The indicator of applicant count, which does not show any significance in any technology areas, is regarded as the valueless indicator for classification.

Table 19: Indicator means of significance in nine technology areas

		Means of significance								
Technology		**overall**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**
Applicant count	#W									
	#S									
Inventor count	#W				3.338					
	#S				3.851					
IPC count	#W		4.314							
	#S		3.809							
Claim count	#W		14.641						12.391	
	#S		12.402						14.627	
Figure count	#W	6.935		5.967						
	#S	7.485		7.797						
Description word count	#W		14.865		17.308			5.802		
	#S		12.415		23.657			6.626		
Abstract word count	#W	222.761	202.588	232.925		211.800				216.223
	#S	227.893	211.184	240.449		228.767				229.227
Examination duration	#W	35.452	35.568	29.925			28.591			48.483
	#S	31.951	30.375	29.469			24.056			40.480

Data Source: Author's Calculation

As summarized in Table 19, technology section A (human necessities) is the technology area provided with the most indicators of significance, i.e. five indicators, while technology sections D (textiles; paper), E (fixed constructions), F (mechanical engineering; lighting; heating; weapons; blasting), and G (physics) are the technology areas provided with the least indicators of significance, i.e. one indicator. It means that it would be much easier and more accurate to classify the strong patents and the weak patents in technology section A (human necessities), whereas it would be more difficult and inaccurate to classify the strong patents and the weak patents in technology areas D (textiles; paper), E (fixed constructions), F (mechanical engineering; lighting; heating; weapons; blasting), and G (physics)

In addition, for the indicators showing significance, the strong patent group #S does not always show higher means. For IPC count and claim count in technology section A (human necessities), the strong patent groups #S show lower means. For description word count in technology section A (human necessities), the strong patent group #S shows lower mean, too. Especially for the high valuable indicator of examination duration, the strong patent group #S shows lower means in all technology areas of significance.

4. Conclusion

Based on 8,666 invalidation reexamined China invention grant patents, eight indicators, and nine technology areas, the effect and value of indicators for classifying strong patents, i.e. group #S, and weak patents, i.e. group #W, was thoroughly analyzed via ANOVA. Valuable indicators were successfully found.

8,666 invalidation reexamined China invention grant patents were of the invalidation reexamination decision dates from 2000 to 2001. Eight indicators comprise applicant count, inventor count, IPC count, claim count, figure count, description word count, abstract word count, and examination duration. Nine technology areas comprise overall technology and eight technology sections classified by principal IPC including A (human necessities), B (performing operations; transporting), C (chemistry; metallurgy), D (textiles; paper), E (fixed constructions), F (mechanical engineering; lighting; heating; weapons; blasting), G (physics), and H (electricity).

The following conclusions were arrived:

(1) Two high valuable indicators including abstract word count and examination duration were found for classifying strong patents and weak patents. These two indicators respectively showed significance in five technology areas including four technology sections and overall technology.

(2) One fair valuable indicator of description word count for classification was found. It showed significance in three technology areas.

(3) Four less valuable indicators, including claim count, figure count, inventor count and IPC count, were found for classification. Claim count and figure count respectively showed significance in two technology areas. Inventor count and IPC count respectively showed significance in only one technology area.

(4) The indicator of applicant count, shown none of significance in any technology areas, was regarded as the valueless indicator for classification.

(5) Technology issue was proved to be sensitive for applying indicator for classification. Technology section A (human necessities) was provided with the

most indicators of significance, i.e. five indicators, while technology sections D (textiles; paper), E (fixed constructions), F (mechanical engineering; lighting; heating; weapons; blasting), and G (physics) were the technology areas provided with the least indicators of significance, i.e. only one indicator. It means that it would be much easier and more accurate to classify the strong patents and the weak patents in technology section A (human necessities), whereas it would be more difficult and inaccurate to classify in technology areas D (textiles; paper), E (fixed constructions), F (mechanical engineering; lighting; heating; weapons; blasting), and G (physics).

(6) In 72 cells of the matrix of 9 technology areas * 8 indicators, there were 19 cells in which valuable indicator showed significant variance between strong patents and weak patents. The strong patents showed higher indicator means in eleven cells, whereas the strong patents showed lower indicator means in the other 8 cells. For IPC count and claim count in technology section A (human necessities), the strong patent group #S showed lower means respectively. For description word count in technology section A (human necessities), the strong patent group #S showed lower mean, too. Especially for the high valuable indicator of examination duration, the strong patent group #S showed lower means in any of five technology areas of significance.

In practice, claim is regarded as the most important part of a patent to construct the scope of right. However, claim count is found to be a less valuable indicator for classifying strong patents and weak patents because it showed significance only in technology sections A (human necessities) and G (physics).

In addition, patent attorneys usually regard the abstract as a less important part and pay less attention on it. It is quite interesting to find in this research that abstract word count is a high value indicator, while the strong patents have significantly higher abstract word count mean than the weak patents.

The significantly shorter examination duration, which is also a high valuable indicator, for the strong patents is another interesting issue. Though most attorneys comment that applicants always want to fight for valuable patents in examination procedure and it will result in longer examination duration. However, valuable patents might not be strong patents. The valuable patents usually imply richer commercial merit whereas the strong patents imply stronger patentability. The strong patents survived from invalidation reexamination are proved to have explicit novelty and nonobviousness over prior arts. Such explicit novelty and nonobviousness might cause shorter consideration when patent examiners analyzing the technical features over prior arts in the first patent application procedure. The shorter examination duration is therefore resulted.

The finding of this research would enrich the understanding of China invalidation reexamined patents. It would contribute the state of art in evaluating patents and help patent applicants and owners improve their patent asset management strategy.

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