Visualizing the Shape of Quality: An application in the context of Intellectual Property

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Abstract. The aim of this work is to explore how the concept of shape can be applied in the context of Intellectual Property Law (IPL). Despite the global nature of IPL, the system is plagued with considerable uncertainty, especially in the specific instrument of patents. We believe the shape concept can find a balance between the inventive ideas, patent claims and objects in the world. The outcomes of this can then be measured as a time-dependent expectancy that an invention will conform to legal rules when under examination by officials. Specifically, we establish an empirical-based benchmark which can be utilized to test whether shape (via visual figures) is useful in reducing the uncertainty (measured via number of examination actions) which an applicant might face in patenting technological ideas.

Keywords: Intellectual Property, Patent Quality, Shape, Claims, Diagrams.

1 Introduction

1.1 Overview

What does it mean to capture the value of something new? From taking a picture, through to writing for publication, individuals can use Intellectual Property Law to create value for society from new ideas. But how might shape fit into the picture? What is the meaning of shape within a mind/body information system and how might the insights gained (from the systematic study of 'shape') be applied to problems in the world? Scholars have begun to answer these questions [1] but many more remained to be answered. The main aim of this work is to initiate a methodological study of the meaning of shape within the context of Intellectual Property Law.

1.2 Message and Purpose

The main message of this work is that shape can be a useful concept to create a benchmark of the legal quality of new scientific ideas. The research question being addressed is: Which form of knowledge is most suitable for producing quality patents in the class of nanoscience? We identify the underlying problem as *uncertainty in the connection between words of patents and the invented thing,* or *"what the claim terms* *[of patents] mean"* [2] and how to communicate (give "notice") what you claim for your invention. [3]

Our working hypothesis is that the concept of shape, embodied in visual depictions of patent figures, will provide a useful means to reduce the uncertainty between the ideas (representations) of the inventor, the claims of the patent artifact and the related objects/processes in the world.

The main contribution offered by this work is a methodical approach and resulting descriptive statistics, which explore how the concept of shape (of patent figures) is utilized in describing inventions in the US patent database. Specifically, we present an empirical benchmark of the uncertainty (No. of amendments) faced during examination of patents, classified in the nanosciences[1].

First, we introduce the legal context and describe the related approaches in modeling the legal quality of patents and provide an initial look at our proposed approach. Second, the methodology and data collection is introduced. Third, our results are provided. Fourth, we discuss the limitations of re-conceptualizing patents in terms of 'Shape', and suggest how future work should approach the task. Finally, we give future directions of pursing our practical ideal type of a Quality Information Space for Intellectual Property. (QiSiP)

2 Background

2.1 What is legal context?

Intellectual Property Law (IPL) is situated in a global context. The World Intellectual Property Organization (WIPO) defines IP as *"creations of the mind: Inventions, literary works, symbols, names, images and designs used in commerce" [4]*.

The WIPO website goes on to suggest that there are five main types of IPL. These are Copyright, Trademarks, Patents, Designs and various others which we will deem hybrids. Whilst the shape concept might be able to shed light on other IP concepts, we limit our discussion to that of patents and designs, and refer the interested reader to [5] for further information about the basics of IPL from an Australian perspective.

According to [6], there is no such thing as a global patent. Instead, one must progress through a staged process, from a) Provisional or complete national application, b) Patent Cooperative Treaty (PCT) application or c) various processes taking place at national stages.

For the purposes of this work, the geographical context is an Australian individual seeking protection in the United States of America.

2.2 Related Approaches to Patent Quality

Patent Quality is typically approached from two different, though related disciplinary backgrounds, Economics and Law. Economists consider the qualities

[1] Class 977: Those inventions with at least one component at the scale of 1 to $100x10^{-9}$ metres.

(features/attributes) of patents, such as the number of times a patent is cited by other patents, [6] as a *source of data*, which can be fed into models for R&D success, economic growth or knowledge diffusion. Such models have been successfully correlated to the market value of firms. [7]

This differs from legal scholars, whom are concerned with *achieving a targeted level* of 'High/Good' Patent Quality, in accordance with various statutes and laws governing the usage of such rights. [8, 9]

We consider the two approaches to be complimentary, with the joint aim of bringing about a 'marketplace for ideas' [10], this work pursues legal quality, which we deem 'correctness' to avoid confusion arise from attribute/feature/quality/Quality labels. The state of the art in determining such legal correctness is presented in several statistical models [11, 12], whilst such models give many insights, especially into the required 'cooperation between the applicant and examiner', they fall short in applying their findings towards addressing the fundamental issues of uncertainty - the relationship between the inventor's ideas, the words of claims, and the objects in the world.

2.3 Our Approach

In utilizing a conceptual ternary diagram, previously introduced [13], our approach to patent quality is outlined in the figure below. Specifically, we believe a quality patent is one which is legally correct whilst maintaining a balance (maximum relative entropy[2]) between the inventor's internal idea, the structured patent artifact and the worldly object, brought into existence through the communication of such an idea/artifact. An idea this work looks at in terms of 'shape'.

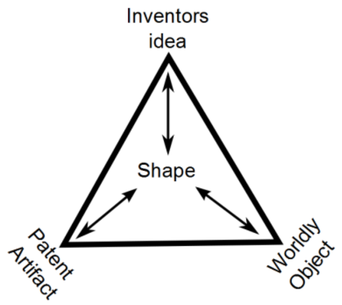

Figure 1. Shape of Patent Quality - Idea Artifact Object

[2] See [14] The specific meaning of which is still emerging in the authors (SGR) mind/thesis.

3 Methodology

3.1 Theory Development

New research fields, such as Cognitive Shape Processing (CSP), require broad exploration. There have been several attempts at formalizing such explorations as academic methods. Recent examples include grounded theory [14], mixed methodologies [15] and intermediary theory [16].

Due to its strong philosophical foundations and its suggested application to public policy – (a key aspect of global IP law), intermediary theory provides an interesting starting point to approach applications of shape, such as in IPL. An adapted outline of which is presented in table 1 below.

Table 2. A intermediary theory based research methodology.

Micro-framework	Research purpose	Possible techniques	Potential measurement
Working hypothesis	Exploration	Qualitative	Evidence based
Categories	Description	Content Analysis	Descriptive statistics
Practical ideal types	Gauging	Interviews	Expert opinion
Hypothesis / models	Explanation/prediction	Quantitative	Inferential statistics

Having pursued several working hypotheses with a purely exploratory purpose, in an earlier work [13] we develop these ideas by collecting data/providing an analysis of the key concepts/categories associated with IPL of patents.

3.2 Data collection

The sample data was collected from publicly available patent sources and manually codified by the author. Specifically, it involved 5 stages, detailed A-E

A. Search query design
The scope of the investigation can be limited (variables can be controlled) by the careful consideration of search query design. A screen shot of the USPTO search interface[3] is included in Appendix.
B. Bulk data collection
Patent data can be collected in a semi-autonomous manner, either from the results pages of database search engines or from bulk-storage.
C. Specific artifact analysis
Individual inventions can be analyzed to determine the codes (features) pertinent to empirical investigation. In particular, for this work, counts of textual patent claims and non-textual patent figures were obtained.
D. Establishing a benchmark[4]

[3] http://patft.uspto.gov/netahtml/PTO/search-bool.html (Last accessed 20-Sept-2011)
[4] Performed over a 2 month period from 01-Feb-2011.

Patent quality proxies (measurements of correctness) can be determined in terms of a time dependent process, during a patents national stage examination process. In a similar fashion as found in [17] we manually collected data from the publicly available databases of the USPTO (PAIR) and analyzed it for codes of office actions, Non-Final, Final, Continuations, Appeals etc.

E. Sample expansion

Repeating steps A-D can expand the sample, to facilitate statistical inference model construction.

4 Results

4.1 Initial Analysis

A manual conceptual analysis was performed on a small purposefully limited sample[5] of patents confined to the context of Australian inventors granted nanoscience inventions, occurring in the databases of the USPTO . Content analysis was selected as an initial approach. Such an approach has be proposed for legal analysis of judicial opinions [18] including those in patent law [19]. The analysis resulted in categorization of data fields into the 4 sections of Bibliography, Description, Claims and Drawings, as seen in table A of the appendix.

4.2 Historical Benchmark

The feasibility of an early stages/visual approach to patent quality was tested via the establishment of a benchmark. This included a search of the USPTO database to collect those patents whose inventors' country of origin was Australia and granted patents co-classified in the class of nanosciences. This returned 30 results. The results of data collection stage 3.4D are shown in the table below.

Table 3. Historical Australian Benchmark

n=29 patents Context	Total	Avgas/Patent	Range
Claims	555	19.06	6-40
Figures	627	20.00	0-231
Exam Actions[6]	63	2.17	0-11

[5] Sample size of n=28/29 is purposeful in that it represented the entire population of Australian Nano science inventions in the USPTO database, whilst still being considered 'random' from a global scale, amongst all US Patents (+8M) or relevant population of 3876 Nano patents since 2001.

[6] Based on transaction history of 29 of30 collected patents; Types of actions included – 3 first allowances, 37 Non Final; 13 Final and 10 Other (including Continuation and Appeals)

4.3 Modern Global Sample[7]

To extend the sample size in a controlled manner, the USPTO database was queried with an expression which controlled for the time (since June 2003), but broadened the international nature of the classification (both US and International classifications for ‘nano’ inventions). The results of the patent artifact analyzed were provided below.

Table 4. Modern Global Sample

n=45 patents Context	Total	Avg./Patent	Range
Claims	921	20.47	1-87
Figures	626	13.91	0-47
Exam. Actions[8]	118	2.62	0-8

4.4 Codes for Shape[8]

To establish what shape concepts are utilized in the broader patent database, (for eventual hypothesis test against the previous established benchmarks) we needed to codify shape into categories. We initially utilize codes in which the shape concepts can be made explicit, i.e. a linguistic label, which relates to a regular geometric shape.

To avoid coding for those whose meaning might be entangled within the interpretations i.e. Cupid “Heart” vs. ‘Cow Heart’ shaped. Hence, we chose to initially search for shapes with linguistic labels of established forms (i.e. Platonic Solids). The results of which are provided in the appendix, though not limited to such.

5 Discussion

5.1 Limitations

Whilst the underlying approach is interesting, the initial results presented should be approached with caution. That is, one can only draw the empirically informed inferences of *existence of shape codes* within the context of intellectual property law of patents. Other inferences, even the prominence of one shape (“Surface”) over another, are speculative until further analysis is undertaken.

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[7] Performed over a 1 month period from 07-Sept-2011. Though due to continuous pace of applications, later searchers may vary.

[8] Based on transaction history of 45 collected patents; Types of actions included –4 first allowances, 65 Non Final; 23 Final and 26 Other (including Continuation and Amendments and Appeals) [9] Product of Nature / Abstract Idea exclusions.

It should be emphasized that such existence does not suggest that the Quality of Ideas nor Quality of Shapes can be benchmarked in the field of IP law, but instead that shape can be used as a concept to explore the legal Quality of specific patents.

To clarify further, such evidence is not suggesting that individuals have invented and sought patent protection on the "Square" form of their invention, such an idea is counter to a fundamental statute of patent law[9]. But instead, the linguistic code 'Square' (which somehow relates to 'Shape') occurs in the textual content (strings of symbols in the database) and returns an invention.

Overcoming such limitations may require a concentrated look and the underlying representational issues associated with creating meaningful ontologies and representations [20, 21] insights into which might lie in the established field of diagrammatic representations [22].

5.2 Potential Insights

Limitations aside, a manual analysis of individual patents gave insights for future work. In particular, given but a small sub-set of carefully analyzed historic patents, it is possible to find language which makes rich reference to visual entities and shapes. Examples include, 'virus-like *particles* illustrated by western blot', and '*double end (16, 0) nanotube* synthesis…creating molecular structures' through to 'schematics of devices, characterized as "Quantum Diamonds'[10]. This initial evidence might lead one to believe the concept of shape, through the visuals of diagrammatic representations, might help inventors communicate their (claims of) new and inventive ideas in a manner which is clear and sufficient.

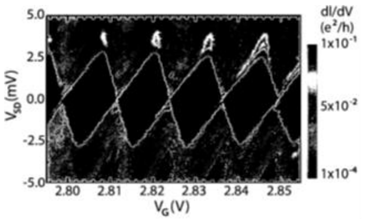

Figure 2: Spectrum of "Quantum Diamonds" of US7,755,078

6 Future directions

In following the intermediary theory methodology, the next step is to devise a practical ideal type. An obvious future direction (and one which is being explored) is to examine how the presence/absence/type of visual 'figures' alters the number of examination amendments. Specifically, the semiotic assumptions, including inter coder reliability, will have to be identified/addressed/overcome prior to performing statistically significant tests.[11]

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9 Product of Nature / Abstract Idea exclusions.
10 Extracts from sample patents US6,613,557; US6,940,088; US7,755,078 available at
11 Accepted to International Roundtable for Semiotics of Law, Brazil Nov 11-14th, 2011.

7 Appendix

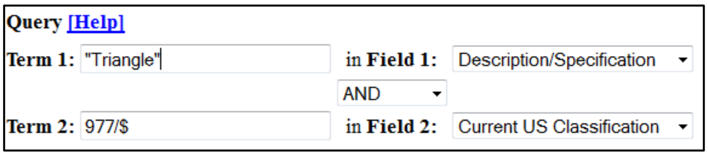

Figure 3A: Screenshot of USPTO Basic Search.

Table A. Structure of a sampled patent.

Bibliography	Description (Found in select patents)	Claims	Drawings
Title	Cross-References	Product	Figures of;
Inventor	Technical Field	Method	Sketch
US/Intl Classification	Background Art	Process	Drawings
Country	Disclosure	(Composition)	Charts
Filing Date	Brief Descript. Drawings	(Markush)	
Grant Date	Best Modes/Examples		
Assignment	(Tables)		
Text Abstract	(Molecular structures)		
Visual Images	(Gene Sequences)		
Cited documents	(References)		
Family documents			

Table B. Shape Codings – Platonic Solids

Code	In Description. (Nano Class)	In Claims (Nano Class)	In Desc. & Claims
Tetrahedron	40884 (173)	564 (3)	0 (0)
Cube	34342 (149)	4554 (14)	4101 (11)
Octahedron	2617 (11)	230 (--)	218 (0)
Dodecahedron	1049 (7)	153 (--)	149 (0)
Icosahedron	1	135 (2)	0 (0)

Table C. Shape Codes – Regular Polygons / Applied

Code	In SPEC (Nano)	In ACLM (Nano)	In Desc & Claims
Triangle	78431 (233)	11944 (20)	9736 (18)
Square	573056 (1727)	72422 (151)	65679 (144)
Pentagon	4706 (58)	593 (5)	471 (5)
Hexagon	16988 (128)	2138 (5)	1657 (4)
Heptagon	362 (18)	72 (4)	60 (4)

Octagon	5520 (9)	743 (2)	541 (2)
Nonagon	114 (3)	23 (1)	22 (1)
Decagon	262 (1)	30 (1) US6787768	(1) US6787768
Hendecagon	9 (0)	4 (0)	4 (0)
Dodecagon	277 (0)	35 (0)	33 (0)
Applied Code	**In SPEC (Nano)**	**In ACLM (Nano)**	**In Desc. & Claims**
Particle	349345 (2838)	81354 (822)	77416 (797)
Box	400060 (582)	60247 (26)	57060 (21)
Bulk	256705 (1777)	22696 (112)	21386 (106)
Sheet	622483 (1127)	171206 (138)	160881 (131)
Surface	2471826 (6416)	1247659 (3236)	1198585 (3215)
Stick	99090 (286)	9567 (11)	8769 (11)
Tube	723450 (2412)	186065 (270)	177589 (260)
Star	57119 (138)	6985 (19)	6563 (16)
Prism	69013 (227)	14391 (32)	13640 (31)
Cylinder	476097 (784)	145670 (56)	136096 (40)
Sphere	61966 (426)	8577 (36)	7177 (28)

8 References

1. AAAI. *Cognitive Shape Processing*. in *Spring Symposium* 2010. Stanford: AAAI Press.
2. Burk, D.L. and M.A. Lemley, *The Patent Crisis and How the Courts can solve it*. 2009: University of Chicago Press.
3. Bessen, J. and M. Meurer, *Patent Failure: How judges, Bureaucrats, and Lawyers put innovators at risk.* . 2008: Princeton University Press.
4. WIPO. *What is IP?* 2010 28-Sept-2009]; Available from: http://www.wipo.int/about-ip/en/.
5. Reynolds, R. and N. Stoianoff, *Intellectual Property: Text and essential cases*. 2008: Federation Press.
6. Hall, B.H., A.B. Jaffe, and M. Trajtenberg, *Market Value and patent Citations.* Rand Journal of Economics, 2005. **36**(1): p. 16-38.
7. Lanjouw, J.O. and M. Schankeman, *Patent quality and research productivity: Measuring innovation with multiple indicators.* Economic Journal, 2004. **114**(495): p. 441-465.
8. Popovich, T.E., *Patent Quality: An Analysis of Proposed Court, Legislative, and PTO adminstrative reform.* . Wisconsin Law Review, 1978(4): p. 1155-1194.
9. Wagner, P.R., *Understaning Patent-Quality Mechanism.* University of Pennsylvania Law Review, 2009. **157**(6): p. 2135-2174.

10. Gans, J., D. Hsu, and S. Stern, *The impact of uncertain intellectual property rights on the market for ideas: Evidence from patent grant delays.* NBER Working Paper, 2007. **W13234**.
11. Mann, R. and M. Underweiser, *A new look at Patent Quality: Relating patent prosecution to validity.* Columbia Law and Economics working paper, 2010. **No. 381**.
12. Nagata, K., et al. *Empirical Analysis of Japan Patent Quality*. in *International Association of Management of Technology* 2008. Dubai, UAE: IAMOT.
13. Rudduck, S.G. and M.A. Williams, *Conceptual ternary diagrams for shape perception: a preliminary approach*, in *AAAI 2010 Spring Symposium*, S. Bertel, Editor. 2010: Stanford, CA.
14. Glaser, B.G. and A.L. Strauss, *The discovery of grounded theory: Strategies for Qualitative Research*. 1967.
15. Johnson, R.B. and L. Christensen, *Mixed Research:Mixed Method and Mixed Model Research*. 2007.
16. Shields, P.M. and H. Tajalli, *Intermediate Theory: The missing link to successful student scholarship.* Faculty Publications - Political Science, 2006. **39**.
17. Lemley, M.A. and B. Sampat, *Examining patent examination.* Stanford Technical Law Review 2010. **2**.
18. Hall, M.A. and R.F. Wright, *Systematic Content Analysis of Judicial Opinions* California Law Review, 2008. **96**(63).
19. Schwartz, D.L., *Practice Makes Perfect? An Empirical Study of Claim Construction Reversal Rates in Patent Cases.* Michigan Law Review, 2009. **107**.
20. Williams, M.A., *Representation = Grounded Information*, in *PRCAI 2008: Trends in Artificial Intelligence*, T.-B. Ho and Z.-H. Zhou, Editors. 2008, Springer: Hanoi, Vietnam. p. 473-484.
21. Bateman, J.A., *On the relationship between ontology construction and natural language: A socio-semiotic view.* International Journal of Human-Computer Studies, 1995. **43**(5-6): p. 929-944.
22. Hegarty, M., P.A. Carpenter, and M.A. Just, *Diagrams in the comprehension of scientific texts.*, in *Handbook of reading research*, R. Barr, et al., Editors. 1990. p. 641-668.