THE EFFECTS OF A PATENT APPLICATION'S TECHNOLOGY ON THE PATENT PROSECUTION PROCESS

by
Tommy L. Berry

A capstone submitted to Johns Hopkins University in conformity with the requirements for the degree of Master of Science in Data Analytics and Policy

Baltimore, Maryland
December 2020

1 ABSTRACT

Existing research on patent prosecution relies on limited data sets containing granted patents, which excludes a population of applications that end in terminal abandonment. Furthermore, previous research generally focuses on associating a patent's subject matter with the outcome of patent litigation rather than the focusing on the administrative process of adjudicating the patent before the United States Patent and Trademark Office. The research presented here takes novel efforts to classify patent applications into industries and technologies as determinants of the pendency before the office and the quantity, type, and sequence of transactions within the prosecution. The results offer support for the differentiation of the prosecution pathway based on the technology of the claimed invention. This knowledge enhances the private sector's ability to strategically plan and administer an intellectual property portfolio. Likewise, this research increases the public sector's ability to offer policy guidance, strategic staffing, and workload modeling to provide optimal service.

TABLE OF CONTENTS

2   INTRODUCTION

The Manual of Patent Examination Procedure lays out a standard process by which patent applications, regardless of the technology of the claimed invention, must proceed from initiation to adjudication. None the less, there are a variety of permutations that are specific to the sequencing of the actions in the patent prosecution pathway that have a determinant effect on the ultimate resolution in terms of the time an application is pending with the United States Patent and Trademark Office (USPTO) and the number of significant transactions that an application undergoes during its lifecycle.

To that end, this research paper proposes to evaluate the effect of the technology of the subject matter claimed in a patent application in terms of the sequence of the actions taken by the USPTO, the total number of transactions completed in the lifecycle of the application, and the number of days the application is pending adjudication by the office. Understanding how technology effects the patent application process can have an immediate and immense impact on both the operations of the USPTO and how the private sector plan and implement their intellectual property portfolios.

The USPTO constantly faces challenges related to staffing appropriately to match the backlog of patent application as well as strategically planning staffing needs to anticipate future changes in current technology and emerging (and dissolving) fields. Because a patent examiner specializes in a specific field (known as an art), hiring and placing appropriately is paramount to ensuring a proper throughput of applications. To effectively model the staffing needs, the office needs to understand how applications differ in terms of the amount of effort (transactions) and the amount of time (pendency). Both effort and time translate to a delta in on-hand firepower versus existing and expected patent application filings, but in

different ways. A set of applications that share a characteristic (such as technology of the claimed invention) might have a higher than usual effort due to intricacies in the rules or laws pertaining to that specific art. Alternatively, a set of applications that share a characteristic and have a higher than usual amount of time in adjudication might indicate an understaffed section of the office, requiring applications to age between actions.

The private sector also considers how an application might proceed during examination by the USPTO. In particular, the sequence of actions has a significant effect on the strategy the company takes in filing the application and in responding to actions from the USPTO. A company increases their trust in the intellectual property system supported by the USPTO when they have an understanding of how, when, and why their application takes a certain prosecution pathway or takes a certain amount of time.

To properly understand the extent and impact of this research, a reader must have a general knowledge of the patent process. The next two sections provide background and information necessary to appreciate the complexity and novelty of the patent system.

2.1 Classification

Classification is the process of coding a patent application with a set of numeric values that correspond to a technology field. This is done for a variety of reasons. One of which is to route patent applications to a patent examiner with the requisite knowledge and education to substantively assess the patent for procedural correctness and technological viability. It is imperative that a patent examiner have sufficient knowledge in the field which the applicant seeks to claim a patent as the examiner must be able to evaluate the claimed invention.

Until October 1, 2020, the United States Patent and Trademark Office (USPTO) employed the United States Patent Classification (USPC) system route patent applications to examiners. A key component of the USPC system is the application of unique alpha-numeric code to incoming patent applications. These codes are referred to as classification symbols and are hierarchical in nature with a major component called a class representing the technology and a minor component called a subclass that distinguishes processes and features within the assigned class. There are over 450 classes and 150,000 subclasses in the USPC scheme.[1] Upon receipt by the USPTO, a patent application receives an original classification (class/subclass) that represents the primary claimed invention.

After October 1, 2020, the USPTO began routing applications via the Cooperative Patent Classification (CPC) system. The CPC system is a joint effort between the USPTO and the European Patent Office. The international nature of property rights led both offices to develop and adopt a comprehensive system that would be compatible with the International Patent Classification (IPC) system standards developed and managed by the World Intellectual Property Organization (WIPO).[2] The highest level of the CPC classification hierarchy is comprised of nine sections. There are 160,000 symbols within the main truck of the CPC scheme, and is based off the IPC scheme with more subdivisions and subgroups added.

2.2 Patent Prosecution

The USPTO Chief Economist prepared a paper on USPTO Patent Prosecution and Examiner Performance Appraisal that serves as a detailed primer on conducting research

---

[1] U.S. Patent and Trademark Office 2012, "Overview of the U.S. Patent Classification System (USPC)."
[2] European Patent Office and U.S. Patent and Trademark Office n.d., "CPC Training."

with USPTO and patent data.[3] Detailed below is information pertinent to the research topic of this paper. For additional background or a more detailed explanation of the process, including many nuances abbreviated for conciseness here, refer to the Chief Economists paper.

Classification is assigned to applications prior to examination in a phase of the process known as pre-examination. In addition to the prescribing of classification symbols, this process includes many perfunctory checks to ensure requisite forms are completed and fees are paid. Applications are then routed, based on the USPC classification to one of the eight Technology Centers (TCs).[4] Each of the TCs handles a broad category of technology (i.e. computer architecture and software, biotechnology and organic chemistry, etc.). Listed in Table 1 are the TCs and their associated broad technological area. TCs are further broken down into Work Groups and subsequently Art Units, each level intended to represent a further subdivision of the broader TC technology area. Once an application is assigned to an Art Unit, it is placed on a patent examiner's docket for them to being the prosecution process.

---

[3] Marco, et al. 2017, "USPTO Patent Prosecution and Examiner Performance Appraisal."
[4] Prior to October 1, 2020, which includes the applications in the data set used for this research. After October 1, 2020, routing is conducted via CPC classification symbols.

Table 1. USPTO technology Centers and their associated technology areas.[5]

Technology Center	Technology Area
TC 1600	Biotechnology and Organic fields.
TC 1700	Chemical and Materials Engineering fields.
TC 2100	Computer Architecture Software and Information Security.
TC 2400	Computer Networks, Multiplex, Cable and Cryptography/Security.
TC 2600	Communications
TC 2800	Semiconductors, Electrical and Optical Systems and Components.
TC 3600	Transportation, Electronic Commerce, Construction, Agriculture, Licensing and Review.
TC 3700	Mechanical Engineering, Manufacturing and Products.

A patent examiner begins examination of a patent by evaluating the claims in the

patent application for compliance with the required statues, ensuring that the claimed

invention is eligible for a patent, that the written description give a sufficient description of

the claimed invention, and that the claim is clearly defined.[6]   If the examiner determines that

more than one invention is claimed in an application, she might issue a restriction, which

would then require the applicant to choose which claim to continue. The examiner then

conducts a search of the prior art to review existing literature and ensure the claimed

invention is original. This phase terminates with either an allowance of the claimed

invention, leading to the grant of the patent, or a non-final rejection, which is the first

significant office action and informs the applicant of the claim or claims that the examiner

find fault with. The applicant has three months to respond to the non-final office action.

The applicant will typically respond with an argument contrasting the examiners

---

[5] U.S. Patent and Trademark Office n.d., *Patent Technology Centers Management.*
[6] U.S. Patent and Trademark Office 2020, *Manual of Patent Examining Procedure (MPEP) Ninth Edition, Revision 10.2019*

determination in the non-final rejection, with additional evidence supporting their claim or claims, or with an edit to their claims meant to address the concerns of the examiner. The examiner determines whether the applicant's additional information overcomes the examiners initial rejection, and if so issues an allowance. If not, the examiner issues a final rejection. A final rejection gives the applicant a series of options: abandon the application, request continued examination (file an RCE), file additional information requesting an advisory action from the examiner, or file an appeal with the Patent Trial and Appeal Board.

3   LITERATURE REVIEW

There is no lack of existing research concerning classification of patent applications or the patent prosecution process, however, there is little of note in academia that discusses the link between the technology of the claimed invention and the patent prosecution pathway while under consideration at the United States Patent and Trademark Office. The research presented in this paper seeks to contribute to the existing knowledge by evaluating related to the period during which the patent in under the jurisdiction of USPTO, and the relevant effects of the categorical technology of the Patent. The literature reviewed herein describes the classification methodology and the ability of classification to represent accurately the technology field, in broad terms, of the invention being patented. Additionally, there is information presented on the patent prosecution process which serves as a primer for the investigation of the relationship between classification and the process a patent application follows from filing to final adjudication.

3.1 Existing Patent Related Research

Researcher who have analyzed classification as a predictor for patent outcomes have focused on patent litigation and the associated legal process by which intellectual property laws and rights are enforces by the court system after the awarding of a patent by the United

States Patent and Trademark Office (USPTO). Cowart, Lirely, and Avery discuss the application of logistic regression and classification trees to predict patent litigation outcomes using, among many factors related to the courts and the legal system, the technology area of the patent in dispute.[7] To conduct this research, they used a proprietary classification mapping of the International Patent Classification (IPC) into 5 broad technology areas: (1) drugs and health, (2) chemical, (3) electronic, (4) mechanical, or (5) other. Other researchers have used the United States Patent Classification (USPC) as an identifier to the technology field, as did Lanjouw and Schankerman when they aggregated the USPC classification into eight categories (drugs, biotechnology, health, chemicals, electronics, computers, mechanical and miscellaneous) to study the determinants of patent suits and settlements.[8] In both cases, the intention of the use of classification as technology was to represent the area of commerce related to the patent content, and to use that industry as a characteristic of the patent application for evaluation as a determinant of patent infringement suits, including the likelihood of an individual patent being challenged.

Other research has been conducted to evaluate the differences in patent prosecution based on patent examiner characteristics. An example is Mann's work in 2014 which compares examiner characteristics to the patent prosecution process to evaluate the importance of experience, tenure, and education.[9] Mann used a set of 310,000 patents examined by 231 examiners. The information on these patents was limited to the number of claims in the applications, the number of references, originality, and the mean age of the

---

[7] Cowart, Lirely and Jackson 2014, "Two Methodologies for Predicting Patent Litigation Outcomes: Logistic Regression Versus Classification Trees."

[8] Lanjouw and Schankerman 2004, "Protecting Intellectual Property Rights: Are Small Firms Handicapped?"

[9] Mann 2014, "The Idiosyncrasy of Patent Examiners: Effects of Experience and Attrition."

patents cited in the patent.[10] Mann finds examiners with more experience (have been at the USPTO longer) had a higher grant rate and more cited patents per application, and an increase in the amount of time an application was pending as an examiners education increased from less than a bachelors degree to having a Ph.D.[11]

Transaction data, such as that used in this research, has been used in previous academic research, but on a smaller scale and with different objectives. Lemley and Sampat observed 9,960 patent applications filed in January 2001, and using publicly available data provided by the USPTO, compared summary statistics of the transactions, or office actions, of that set of applications. A portion of their work bears specific discussion in context of the research conducted in this paper. Lemley and Sampat, using the TC and the technology area that TC is assigned to examine, produced statistics on the number and percentage of applications where efforts were made by the applicant to continue examination (via a Request for Continued Examination (RCE), or a continuation) by technology area, showing biotechnology and Chemical/material engineering are approximately twice as likely to attempt to continue examination after a final rejection than other technology areas.[12]

One notable example is a piece of research from John Allison and Mark Lemley, which samples 1000 granted patent applications from between 1996 and 1998, associates them with broad technologies through a manual process of review, the tests the set for a variety of relationships, amongst which is an investigation into the relationship between the

---

[10] The technological breadth of the references, calculated according to the methodology of Manuel Trajtenberg, Rebecca Henderson, and Adam Jaffe). The original citation from Mann's work is: *Manuel Trajtenberg, Rebecca Henderson & Adam Jaffe, University Versus Corporate Patents: A Window on the Basicness of Invention, 5 ECON. INNOVATION & NEW TECH. 19, 29-30 (1997).*
[11] Mann 2014, "The Idiosyncrasy of Patent Examiners"
[12] Sampat and Lemley 2009, "Examining Patent Examination."

patent prosecution and the technology of the patent.[13] This research discovers interesting findings pertaining to the variation in the time an application spent in examination and the number of application submitted before the granting of a patent, when paneling by technologies. Allison and Lemley offer insight and explanation for these differences in terms of the industrial and commercial environments. For example, commercial areas such as pharmaceuticals rely more heavily on patents, and have therefore been willing to extend the patent prosecution process obtain the broadest patent possible (interestingly, this is also supported by Lemly and Sampat's conclusion).[14] [15] Contemporary application of these findings is problematics since both the processes and policies of the USPTO and the technological and commercial environment has changed significantly is the past 20 years, including major legislative changes in the office process (e.g. The Leahy-Smith America Invents Act of 2011) and judicial rulings that changed significantly the interpretation of the patent rules (Alice Corp. v. CLS Bank Int'l).[16] [17] The research is also limited to those patents that received a grant, which represents only X% for the dataset used in this paper's research. Excluding those patents that terminated in an abandonment limits the analysis to patents that received a grant, which biases results to successful patents and, in terms of this paper's research objective, only tells a portion of the story of the relationship between technologies and patent prosecution.

3.2 Evaluating Administrative Actions in the Public Sector

There are numerous studies that have evaluated bureaucratic activity related to time and administrative activities. At its simplest, patent prosecution is the process of evaluating

---

[13] Lemley and Allison 2009, "Who's Patenting What? An Empirical Exploration of Patent Prosecution."
[14] Ibid.
[15] Sampat 2009, "Examining Patent Examination."
[16] Leahy-Smith America Invents Act, Public Law 112-29, U.S. Code 35 (2011).
[17] Alice Corp. v. CLS Bank Int'l, 573 U.S. 208 (2014).

a claim, little different than the Social Security Administration does for Disability Compensation or the General Service Administration does when reviewing contract proposals. There a facets of each of these that make them unique. In terms of the USPTO, it is the education and specialization of the examiner corps. One piece of research of particular interest is Rachel Potter's *Slow-Rolling, Fast-Tracking, and the Pace of Bureaucratic Decisions in Rulemaking.* What is specifically compelling is the use of event based history to evaluate the amount of time an agency takes to finalize a decision. [18] Ms. Potter, using this method, estimated the likelihood that an agency would complete a proposed rule in a given time, utilizing a set of variables of the rule that remained consistent. In terms of the research presented in this paper, this applies to the event based, transactional time-series data set that is used in the sequencing analysis, using the technology of the claimed patent as the non-time-variant characteristic.

Another major study that looked at time-dependent research in the public sector is Box-Steffensmeier and Jones's *Time is of the Essence: Event History Models in Political Science.* In their research, they cover the use of regression-based methods to evaluate event history. One major shortcoming that is identified is the inability of regression based models to properly distinguish between distinct populations that have external or unaccounted for influences that cause the algorithmic model to improperly classify the group. [19] This is an issue the researches run into in this paper as well, as differences are statistically recognizable, but there are numerous observations that exist in a space which causes the stratification of the technologies to blend together and obscure classification efforts.

---

[18] Potter 2017, "Slow-Rolling, Fast-Tracking, and the Pace of Bureaucratic Decisions in Rulemaking"
[19] Box-Steffensmeier and Jones 2000, "Time is of the Essence: Event History Models in Political Science"

4 DATA

    The research presented here seeks to analyze the relationship between a patent

application's prosecution pathway (i.e. the steps the office and applicant take during the

adjudication of the patent application) and the industry of the claimed patent (e.g.

Communications Equipment, Aerospace, Food and Beverage, etc…). To gather the

information on the prosecution pathway of patent applications, we draw upon the 2019

Patent Examination Research Dataset (PatEx) release, which is compiled by the Office of

the Chief Economist for the USPTO.[20] Specifically, the data set is derived by assembling

two distinct datasets available in the PatEx, the Application Data Tab Release and the

Transaction History Data Tab Release. The Applications Data Tab Release includes an

observation for each publicly viewable patent application through April, 2020. The variables

used for this paper's research are: *application_number*, a unique numerical identifier for a

patent application; *filing_date,* the recorded date of the filing of the patent application;

examiner_art_unit, the lowest level of the organizational hierarchy in which the patent

examiner of record was assigned; and classification information for the patent as *uspc_class*

and *uspc_subclass*. The Transaction History Data Tab Release includes an observation for

each pre-examination and examination event for a patent application. The variables used in

this paper's research include: *application_number*; *event_code,* an alpha-numeric identifier for the

event; and *recorded_date*, the date of the event transaction. The *event_code* variable is used in

conjunction with a standards table of event codes and descriptions of the event.

    We use the *uspc_class* and *uspc_subclass* variables from the Application Data Tab

Release along with a custom concordance mapping between the combined class/subclass

---

[20] Marco, Alan C. and Toole, Andrew A. and Miller, Richard and Frumkin, Jesse, USPTO Patent Prosecution
and Examiner Performance Appraisal (June 1, 2017). USPTO Economic Working Paper No. 2017-08.
Available at SSRN: https://ssrn.com/abstract=2995674

and North American Industry Classification System (NAICS) product field codes to categorize each application in the data set to 1 or more of 30 broad industries.[21] If the class/subclass of the application fits into more than one industry, the application's transaction information was used in each of the industry sets, therefore an application may show up in more than one industry. The 30 industry categories are displayed in Table 2.

The final research dataset is prepared by limiting applications to those filed on or after January 1, 2015 and a subset of their associated transactions. There are various occurrences such as changes in the law, court rulings, fee changes, or rule changes that affect the prosecution of an application, the last major one being the 2011 Leahy-Smith American Invents Act, whose major provisions went into effect in mid-2013. To best represent the functioning of the USPTO at the time of publication of this paper, applications were limited those filed in 2015 or later whose final transaction was either an abandonment or an allowance of the patent. There are various transaction that are irrelevant to the research question. As such, the data is limited to the transaction that are descriptive of the patent prosecution pathway. The transaction used in this analysis are in Table 3. For the purpose of this research, the patent prosecution begins once the application is placed on an examiner's docket. There are pre and post-examination activities that are relevant to the patent's prosecution, however, these are industry and patent-claim immaterial, and are therefore excluded in this dataset as there would be no implied or theoretical reasoning for differences based on the technology or industry. Likewise, the pendency of a patent application before the USPTO is measured from the docketing of the application to the final adjudication by either an abandonment or a patent grant. This is divergent to how the

---

[21] U.S. Patent and Trademark Office n.d., *North American Industry Classification System (2002) Product Fields.*

USPTO measures pendency of application, which is from filing to final adjudication. Since

the purpose of this research is to evaluate the effect of a patent's technology or industry on

the prosecution process, the time spent on pre and post-examination administrative activities

are excluded from the dataset. The final dataset includes 984,023 distinct patent applications

filed between 1 January, 2015 and 13 November, 2019. The set includes 8,826,946

transactions with an average of 6.63 transactions per application (median 6 transactions), a

maximum of 35 transactions, and a minimum of 2 transactions on a unique application. The

applications were pending on average 663 days (median 629 days) with a minimum pendency

of 1 day and a maximum pendency of 1,870 days.

Table 2. Applications by Industry

Index	Industry	Number of Applications	Index	Industry	Number of Applications
1	Food	2,994	16	Computer and Electronic Products	0
2	Beverage and Tobacco Products	1,823	17	Computer and Peripheral Equipment	172,539
3	Textiles, Apparel and Leather	12,910	18	Communications Equipment	145,861
4	Wood Products	6,711	19	Semiconductors and Other Electronic Components	139,909
5	Paper, Printing and support activities	6,362	20	Navigational, Measuring, Electro-medical, and Control Instruments	129,320
6	Chemicals	0	21	Other Computer and Electronic Products	32,811
7	Basic Chemicals	28,616	22	Electrical Equipment, Appliances, and Components	82,531
8	Resin, Synthetic Rubber, and Artificial and Synthetic Fibers and Filaments	6,032	23	Transportation Equipment	0
9	Pharmaceutical and Medicines	64,583	24	Motor Vehicles, Trailers and Parts	51,684
10	Other Chemical Product and Preparation	54,087	25	Aerospace Product and Parts	18,137
11	Plastics and Rubber Products	53,248	26	Other Transportation Equipment	8,676
12	Nonmetallic Mineral Products	21,285	27	Furniture and Related Products	5,752
13	Primary Metal	4,816	28	Miscellaneous Manufacturing	0
14	Fabricated Metal Products	65,708	29	Medical Equipment and Supplies	36,803
15	Machinery	130,491	30	Other Miscellaneous	45,719

Table 3. Transactions by Transaction Code

Code	Description	Count of Transactions	Code	Description	Count of Transactions
CTNF	Non-Final Rejection	1,524,968	ABN3	Express Abandonment (during Examination)	4,826
A...	Response after Non-Final Action	1,387,416	ABN10	Abdn. after Exam Answer or PTAB Decision	2,242
DOCK	Docketed to an Examiner	1,329,408	ABN7	Abdn. Failure to Correct Drawings/Oath	2,174
N/=.	Allowance Data Verification	1,087,767	AP/A	Amendment/Argument after Notice of Appeal	2,139

WPIR	Issue Notification Mailed	948,560	*APDA*	PTAB Decision - Examiner Affirmed	1,914
CTFR	Final Rejection	599,507	*APDR*	PTAB Decision - Examiner Reversed	1,420
XT/G	Extension of Time - Granted	492,198	*C105-D*	Req. under Rule 105 Included with Office Action	542
A.NE	Response after Final Action	367,465	*APDP*	PTAB Decision - Examiner Affirmed in Part	417
RCEX	Request for Continued Examination	343,401	*BD.A*	Amendment/Argument after PTAB Decision	206
ABN2	Abnd. Failure to Respond to O. A.	283,355	*ABN11*	Withdraw from Issue for Express Abandonment	111
CTRS	Restriction/Election Requirement	275,953	*ABNX*	Abandonment -- During Pre-exam Processing	103
A.NA	Amend. after Allowance (312)	101,984	*R105*	Response to Rule 105 Required for Info	82
N/AP	Notice of Appeal Filed	26,108	*C105-I*	Rule 105, Independent Communication	66
AP.B	Appeal Brief Filed	14,157	*ABN4*	Express Abandonment after Allowance	61
ABN6	Abdn. Failure to Pay Issue Fee	12,504	*APDS*	Appeal Dismissed	37
AP.C	Request for Pre-Appeal Conference	10,877	*APAR*	PTAB Administrator Remand to the Examiner	30
APEA	Examiner's Answer to Appeal Brief	4,941	*ABNF*	Abdn. -- Inc. App. under 53(b) - Filing Fee Paid	4
			ABN8	Abdn. -- Respond to 30-Day Property Rights	3

The paper offers two separate dependent variables in the analysis of how a patent application's technology or industry effects the patent prosecution pathway. The first is an indexed alpha-numeric representation of the sequence of significant transactions an application goes through, starting with docketing to an examiner and ending with a terminal transaction (ether an abandonment or a patent allowance). Using this approach, each application is assigned its own sequence of transaction codes, whereby both the characters in the sequence and the order of the sequence convey relevant information on the steps the USPTO and the applicant took during the processing of the application. Also considered is a count of the transactions an individual applications accrues during the patent prosecution lifecycle. The second independent variable is the pendency of the application during the examination activities, measured in days from docketing to an examiner to the terminal transaction. For purpose of this analysis, the technology or industry effect of patent prosecution, the dependent variable is the index, 1-30, from Table 2, representing the industry as defined by the NAICS, applied to each application individually based on the mapping between the USPC class/subclass and the NAICS field codes.

5 METHODOLOGY

The researcher prepared the collected and merged time-series cross sectional panel of observational data by utilizing the R programming language to assign a sequence number for each transaction based on an ascending order of the date of the transaction, beginning with the DOCK transaction, which is common to all applications in the data set. Additionally, each transaction was assigned a number of days the applications spent pending in that transaction, summing which produces the total days of pendency for each application. The data set was stratified based on the assigned industry group, and minimum, maximum, mean, median and standard deviation for pendency and total transactions within the industry group was calculated and displayed in Table 6 and Table 7. Within each stratified industry group, a percentage of applications in each relevant transaction was calculated for each phase of the patent prosecution. For example, 100% of applications are in the DOCK transaction during the first phase of patent prosecution. Various attempts at reference-based sequence classification was attempted, however no model produced significant results due to a insufficient differentiation between the percentage of transactions apparent in phase of the application lifecycle when comparing industry groups. Instead, a statistical visualization approach with analysis accompanies the results section of this research regarding the sequencing dissimilarities of patent prosecution.

Given the inability of sequence modeling to classify, the researchers turned to multinomial logistic regression to model the nominal outcomes of the variables.   Using this method the researcher was able to classify applications by generalizing logistic regression to 30 discrete outcomes based on the industry groupings. This allowed the researcher to describe the log odds of an application being in an industry group based on unit increases in transactions the application received and separately, unit increases total amount of days

pending. In order to interpret the results in a meaningful way, a multinomial logistic

regression model requires a baseline from which to compare the levels, in this case the

industry groups. To create this baseline application statistic, a median was created

comprised of the median number of transactions per application (6) and a median amount of

days pending per application (629). Median was chosen over mean to better handle outliers

of more than three standard deviations from the mean in both the pendency and

transactions variables. In each case, there are certain circumstances that are not germane this

analysis that could cause substantial changes in either. Table 4 and 5 show histograms of the

pendency and transactions variables, respectively, along with a density curve descriptive of

the data. Table 6 and 7 display the mean and standard deviation for each The choice of

using multinomial logistic regression on the dataset was made since it does not require the

independent variables to be statistically independent from each other, but rather they are

case-specific, in this case a single industry group. A model was built for each dependent

variable separately and is presented in the subsequent results section of this paper.

Table 4. Density Plot of Pendency   Table 5. Density Plot of Transactions
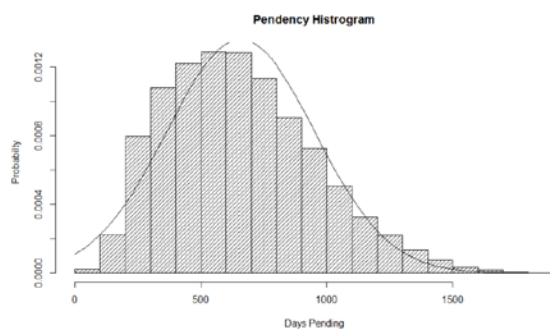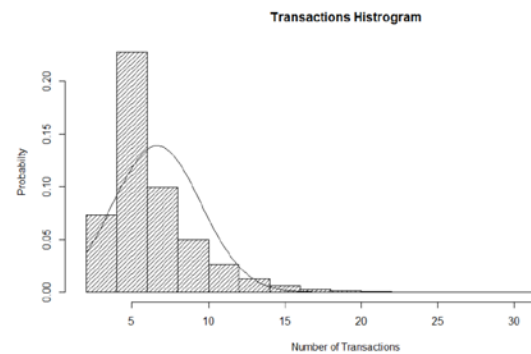
Table 6. Mean & Standard Deviation for Pendency Variable

Industry Group	Mean	Standard Deviation	Industry Group	Mean	Standard Deviation
Aerospace Product and Parts	720.4201	278.4719	Chemical Product and Preparation	616.1247	285.7527
Basic Chemicals	589.0823	275.8809	Computer and Electronic Products	564.988	255.2999
Beverage and Tobacco Products	761.8799	324.5314	Other Miscellaneous	629.5641	288.5996

16

Industry Group	Mean	Std	Industry Group	Mean	Std
Communications Equipment	629.2474	280.6342	Other Transportation Equipment	546.5594	239.8577
Computer and Peripheral Equipment	732.6994	315.872	Paper, Printing and support activities	700.8257	305.9315
Electrical Equipment, Appliances, and Components	659.1903	286.5468	Pharmaceutical and Medicines	631.9353	294.6906
Fabricated Metal Products	637.8205	287.5943	Plastics and Rubber Products	650.1237	293.6676
Food	767.9516	319.5754	Primary Metal	769.0762	303.7203
Furniture and Related Products	559.7467	267.6331	Resin, Synthetic Rubber, and Artificial and Synthetic Fibers and Filaments	599.4821	259.6042
Machinery	687.547	290.037	Semiconductors and Other Electronic Components	587.0808	264.9841
Medical Equipment and Supplies	751.5396	310.2957	Textiles, Apparel and Leather	704.142	304.1354
Motor Vehicles, Trailers and Parts	617.0936	250.1456	Wood Products	523.9666	259.2512
Navigational, Measuring, Electro-medical, and Control Instruments	710.3529	295.0571	**Total Data Set**	**657.4952**	**293.0049**
Nonmetallic Mineral Products	669.8563	299.8188			

Table 7. Mean and Standard Deviation for Transactions Variable

Industry Group	Mean	Standard Deviation	Industry Group	Mean	Standard Deviation
Aerospace Product And Parts	6.308044	2.591212	Chemical Product and Preparation	7.058387	3.23601
Basic Chemicals	6.755801	2.863287	Computer and Electronic Products	6.611045	2.766236
Beverage And Tobacco Products	6.964344	3.907175	Other Miscellaneous	6.372755	2.795811
Communications Equipment	6.762692	2.87786	Other Transportation Equipment	6.218188	2.441712
Computer And Peripheral Equipment	6.7259	2.938571	Paper, Printing and support activities	6.870324	3.158448
Electrical Equipment, Appliances, And Components	6.424968	2.662342	Pharmaceutical and Medicines	7.077776	3.225785
Fabricated Metal Products	6.49688	2.84023	Plastics and Rubber Products	6.672345	2.970303
Food	6.881764	3.824768	Primary Metal	6.754568	2.921894
Furniture And Related Products	6.11509	2.521195	Resin, Synthetic Rubber, and Artificial and Synthetic Fibers and Filaments	6.744529	2.805687
Machinery	6.433723	2.718921	Semiconductors and Other Electronic Components	6.69716	2.789448
Medical Equipment And Supplies	6.851289	3.055352	Textiles, Apparel and Leather	6.479086	3.016312
Motor Vehicles, Trailers And Parts	6.163087	2.402853	Wood Products	6.901505	3.048586
Navigational, Measuring, Electro-medical, And Control Instruments	6.590582	2.795426	**Total Data Set**	**6.639756**	**2.867361**

6 RESULTS

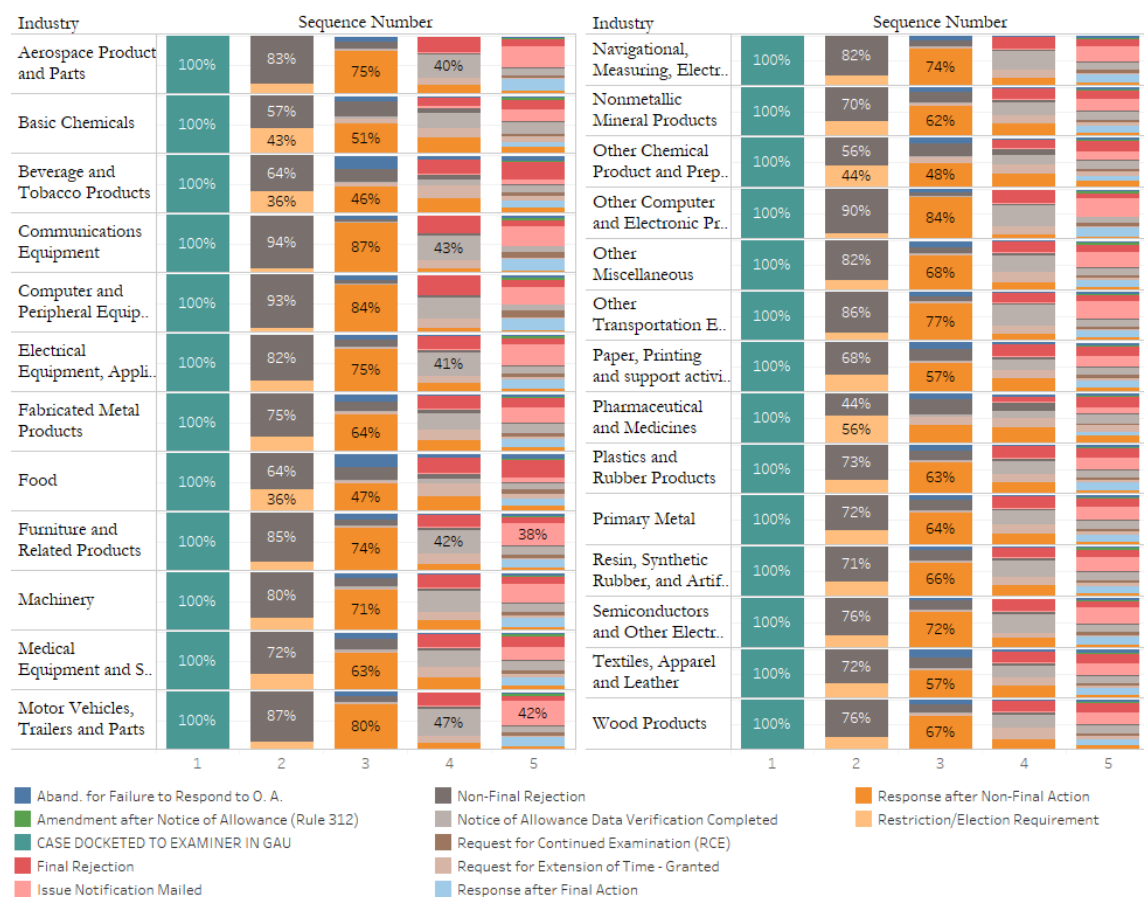## 6.1 Statistical Differentiation in Sequence of Activities

There are statistical differences between the prosecution by industry, and the dataset used in this paper is large enough to properly represent each of the industries, exposing some useful and usable knowledge in the statistical analysis. Presented below are summary statistics that explore and explain those along with accompanying conclusions.

The first action an application undergoes in patent prosecution is the docketing action to a qualified examiner - someone who is capable and knowledgeable in the art of the invention claimed. This dataset has been truncated such that each applications history begins with that action. Differentiation immediately begins to appear in the second action, which is generally the first work a patent examiner does on the application. For the most part, these fall into three broad categories, a non-final rejection (meaning there is some aspect of the applications that that the application must overcome in order to be granted a patent), a restriction action (meaning there are multiple claimed inventions that must be separated into individual claims), and a first action issuance. The first action issuance happens so infrequently that it does not appear in most of the statistical summaries of the applications presented in the paper. However, the first two appear at remarkably different rates based on the industry in which the application is categorized. For example, an applications that falls into the 'Communications' bucket receives a non-final rejection as the second action approximately 94% of the time whereas an application that falls into the 'Pharmaceuticals and Medicines' bucket only receives the same actions approximately 44% of the time. In fact, most of the chemical and biological sciences typically see higher levels of restrictions, presumably due to the interconnectedness of the technology and the highly complex nature of the science. There is also likely market factors that play into this, as it is of the applicants best interest to gain the broadest and most encompassing patent they can, and in areas such as chemicals and pharmaceuticals where there is a significant amount of competition with the chance of very large patent benefits, an applicant is incentivized to gain the initial rights to the inventions, even those that are restricted, though they must ultimately become their own patent applications. Interestingly, for industries with high restriction rates in the second action, the third action has a higher rate of being a request for an extension of

time from the applicant to respond to the office action. Following these same examples through the first five actions on an application, one can see other interesting results. For example, the percent of applications that resolve to a patent issuance by the fifth action is considerably higher in applications with electrical subject matter (i.e. semiconductors, computer peripherals) and mechanical subject matter (aerospace, motor vehicles) than in chemical subject matter (i.e. pharmaceuticals, food & beverage).

Table 8. Percent of Actions by Type and Sequence Number, First Five Actions

Industry	1	2	3	4	5
Aerospace Product and Parts	100%	83%	75%	40%	
Basic Chemicals	100%	57% / 43%	51%		
Beverage and Tobacco Products	100%	64% / 36%	46%		
Communications Equipment	100%	94%	87%	43%	
Computer and Peripheral Equip..	100%	93%	84%		
Electrical Equipment, Appli..	100%	82%	75%	41%	
Fabricated Metal Products	100%	75%	64%		
Food	100%	64% / 36%	47%		
Furniture and Related Products	100%	85%	74%	42%	38%
Machinery	100%	80%	71%		
Medical Equipment and S..	100%	72%	63%		
Motor Vehicles, Trailers and Parts	100%	87%	80%	47%	42%

Industry	1	2	3	4	5
Navigational, Measuring, Electr..	100%	82%	74%		
Nonmetallic Mineral Products	100%	70%	62%		
Other Chemical Product and Prep..	100%	56% / 44%	48%		
Other Computer and Electronic Pr..	100%	90%	84%		
Other Miscellaneous	100%	82%	68%		
Other Transportation E..	100%	86%	77%		
Paper, Printing and support activi..	100%	68%	57%		
Pharmaceutical and Medicines	100%	44% / 56%			
Plastics and Rubber Products	100%	73%	63%		
Primary Metal	100%	72%	64%		
Resin, Synthetic Rubber, and Artif..	100%	71%	66%		
Semiconductors and Other Electr..	100%	76%	72%		
Textiles, Apparel and Leather	100%	72%	57%		
Wood Products	100%	76%	67%		

Legend:
- Aband. for Failure to Respond to O. A.
- Amendment after Notice of Allowance (Rule 312)
- CASE DOCKETED TO EXAMINER IN GAU
- Final Rejection
- Issue Notification Mailed
- Non-Final Rejection
- Notice of Allowance Data Verification Completed
- Request for Continued Examination (RCE)
- Request for Extension of Time - Granted
- Response after Final Action
- Response after Non-Final Action
- Restriction/Election Requirement

6.2 Days Pending and Number of Transactions

Alternative analysis was performed to evaluate the characteristics of applications based on the assigned technology group. The researchers began with a statistical analysis of the variables of days pending and number of transactions in the lifecycle of the patent

application.   Review of the average number of transactions per application by technology group confirms the analysis above that applications with chemical related subject matter require more, on average, transactions during the lifecycle, as displayed in Table 9.

Table 9. Average Transactions by Technology Group
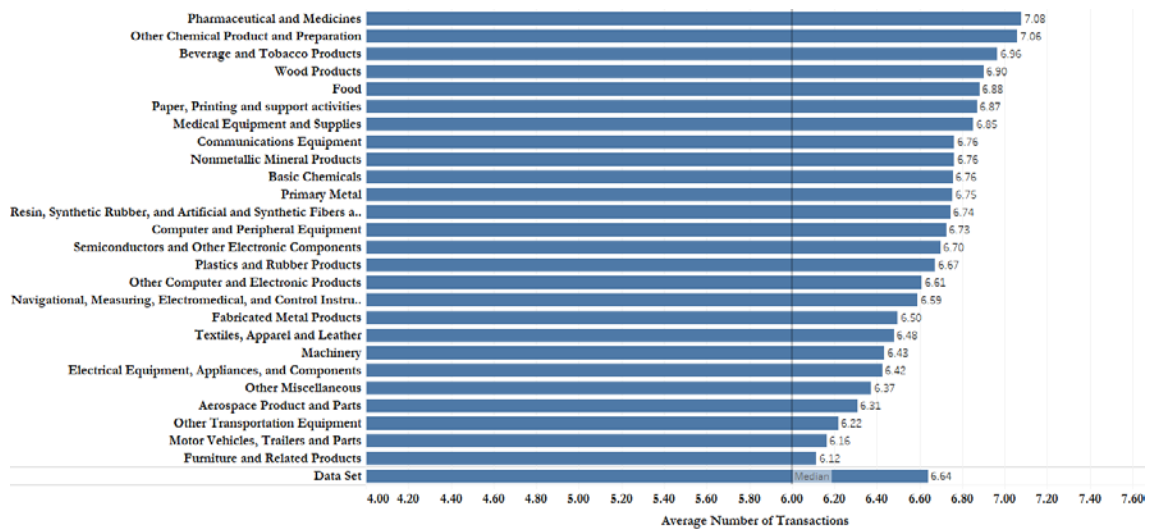
To evaluate the number of days pending the researchers bucketed the variable into five ordinal bins representing the quartile between the least and most days pending in the data set. These bins are labeled low (<20%), medium low (20% - 39%), medium (40% - 59%), medium-high (60% - 79%), and high (80% - 100%). A table showing the percentage of applications that fall into one of these pendency bins, by technology group, is displayed in Table 10. The results are colored to represent how that technology group compares to a compilation of the total data set. For example, 12.49% of the application with Aerospace subject matter fell into the low pendency bin (meaning they had the same pendency as the bottom 20% of the total data set). Since 12.49% is significantly lower than 20%, it is surmised that fewer Aerospace applications are completed in the earlier time frame. Conversely, only 9.24% of applications with Wood Product subject matter fall into the high pendency bin, meaning that few of them reach the upper end of the pendency spectrum.

Table 10. Percent of Applications by Pendency Bucket

	low	medium-low	medium	medium-high	high
Aerospace Product and Parts	12.49%	15.73%	21.61%	24.81%	25.35%
Basic Chemicals	26.61%	24.02%	20.05%	15.70%	13.63%
Beverage and Tobacco Products	13.27%	14.37%	18.98%	22.05%	31.32%
Communications Equipment	21.84%	21.33%	20.56%	19.98%	16.29%
Computer and Peripheral Equipment	15.85%	14.94%	17.86%	21.93%	29.42%
Electrical Equipment, Appliances, and Components	19.29%	19.82%	20.31%	20.74%	19.84%
Fabricated Metal Products	21.98%	20.35%	19.88%	19.46%	18.33%
Food	12.66%	14.30%	17.70%	22.98%	32.36%
Furniture and Related Products	29.33%	24.72%	19.84%	14.79%	11.32%
Machinery	16.75%	18.02%	20.17%	22.16%	22.91%
Medical Equipment and Supplies	13.78%	13.79%	17.99%	22.79%	31.64%
Motor Vehicles, Trailers and Parts	19.39%	22.44%	24.59%	20.84%	12.73%
Navigational, Measuring, Electromedical, and Control Instru..	15.20%	15.96%	20.34%	23.46%	25.04%
Nonmetallic Mineral Products	20.11%	18.83%	18.31%	20.44%	22.32%
Other Chemical Product and Preparation	23.00%	23.77%	20.76%	16.84%	15.64%
Other Computer and Electronic Products	27.08%	26.85%	21.08%	14.29%	10.69%
Other Miscellaneous	22.83%	20.79%	19.85%	19.24%	17.29%
Other Transportation Equipment	28.28%	26.46%	22.45%	14.57%	8.23%
Paper, Printing and support activities	16.94%	18.11%	18.04%	21.50%	25.40%
Pharmaceutical and Medicines	22.19%	22.56%	20.30%	17.37%	17.59%
Plastics and Rubber Products	21.16%	20.02%	19.54%	19.52%	19.76%
Primary Metal	12.52%	12.13%	18.09%	23.48%	33.78%
Resin, Synthetic Rubber, and Artificial and Synthetic Fibers a..	21.37%	25.81%	24.10%	16.48%	12.23%
Semiconductors and Other Electronic Components	25.57%	24.77%	20.83%	16.22%	12.60%
Textiles, Apparel and Leather	16.84%	16.13%	19.25%	22.26%	25.52%
Wood Products	35.97%	25.36%	16.63%	12.80%	9.24%
Grand Total	19.99%	19.84%	20.09%	20.01%	20.07%

Another interesting set of results is arrived at by looking at a comparison of the average number of transactions for a technology group, plotted against the average days pending for that technology group. This is of particular interest since common perception would generally follow that an application with more transactions requires a longer period of pendency. What the research finds is that, despite the obvious trend in relationship between the two variables, certain technology groups exhibit higher or lower than expected transactions or pendency, as displayed in Table 11. Continuing the analysis examples from previous portions of the paper, it is evident that applications with chemical related subject matter have a much higher average number of transactions per days pending than applications with mechanical related subject matter, which exhibit a much smaller proportion of transactions to days pending.

Table 11. Transactions and Days Pending by Technology Group
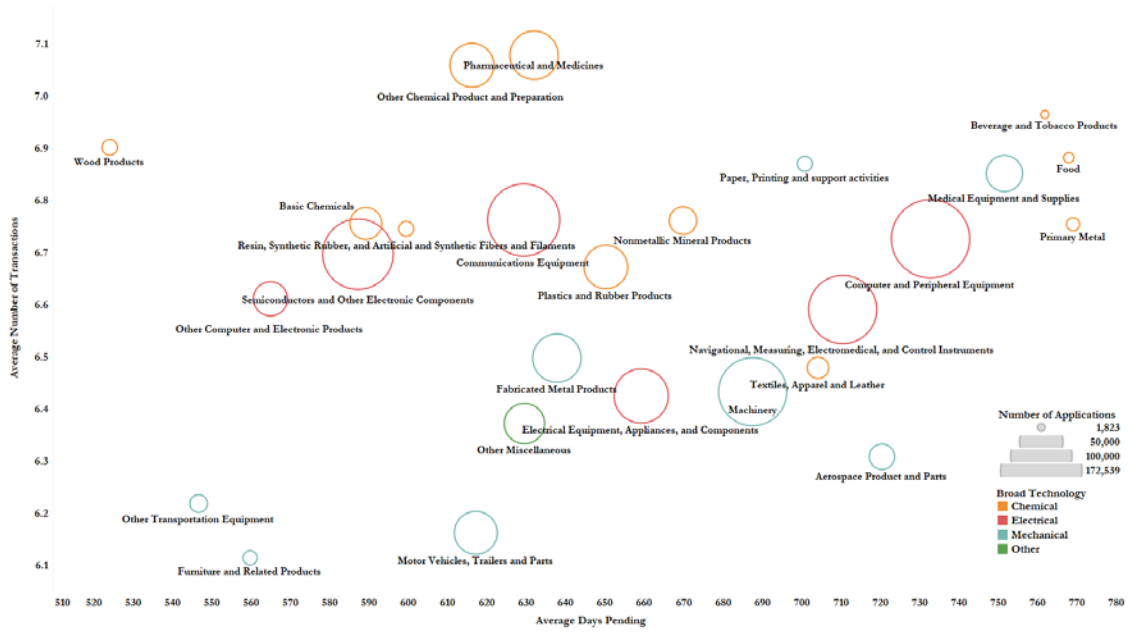
6.3 Classification based on Multinomial Logistic Regression

Finally, the researchers derive linear combinations of the pendency bins described above and the number of transactions an application goes through during its lifecycles as predictor variables to feed logistic regression models and determine log-odds of the outcomes of those variables. In this application, the researchers study the relationships of the technology's subject matter (in terms of the technology group to which the application is assigned) with the number of transactions the application went through and the pendency bin in which the application ultimately fell, based on the number of days the application was pending. The data set contains variables from 984,023 applications. The outcome is the technology group described in Table 2. The predictor variables are days-pending bin (a 5 level ordinal variable) and number of transactions (a continuous variable). Further descriptive statistics can be found in the data portion of this paper. In terms of the multinomial logistic regression, a derived median outcome record was created to represents

22

the dataset's median in terms of both pendency and number of transactions, which is leveled

to be used as the baseline for the model interpretation.

Table 12 is the model output summary that lists coefficients and standard errors for

each technology group as it relates to the continuous variable transactions and the

nominally-binned variable pendency. The coefficients represent how the technology group

compares to the derived median application of the dataset variables (transactions = 6,

pendency = 629).

Table 12. Multinomial Logistic Model Summary Output Results

Technology Groups		(Intercept)	Transactions	Pendency				
				low	medium-low	medium	medium-high	high
Aerospace Product and Parts	Coefficients	2.948	-0.150	0.566	0.312	0.898	0.822	0.389
	Standard Error	0.068	0.012	0.083	0.054	0.073	0.067	0.064
Basic Chemicals	Coefficients	1.619	0.178	1.470	0.389	0.320	0.641	-1.135
	Standard Error	0.067	0.012	0.082	0.053	0.073	0.066	0.064
Beverage and Tobacco Products	Coefficients	1.503	-0.231	2.191	-0.253	-2.379	0.555	1.394
	Standard Error	0.087	0.014	0.093	0.080	0.210	0.088	0.080
Communications Equipment	Coefficients	3.299	0.137	1.714	0.413	1.032	0.761	-0.377
	Standard Error	0.066	0.011	0.081	0.052	0.072	0.065	0.062
Computer and Peripheral Equipment	Coefficients	3.947	0.055	1.473	0.202	1.195	1.003	0.338
	Standard Error	0.066	0.011	0.081	0.052	0.071	0.065	0.062
Electrical Equipment, Appliances, and Components	Coefficients	3.515	0.010*	1.384	0.366	0.971	0.789	0.141
	Standard Error	0.066	0.011	0.081	0.053	0.072	0.066	0.062
Fabricated Metal Products	Coefficients	3.504	-0.011*	0.985	0.567	1.016	1.008	0.048*
	Standard Error	0.066	0.011	0.081	0.053	0.072	0.066	0.062
Food	Coefficients	1.501	-0.162	0.650	-0.138	0.817	-0.168	0.350
	Standard Error	0.081	0.015	0.091	0.065	0.081	0.084	0.074
Furniture and Related Products	Coefficients	1.975	-0.128	1.124	0.487	0.823	0.474	-0.916
	Standard Error	0.075	0.013	0.085	0.057	0.076	0.071	0.077
Machinery	Coefficients	4.006	-0.009*	1.414	0.156	1.236	1.019	0.396
	Standard Error	0.066	0.011	0.081	0.053	0.072	0.065	0.062
Medical Equipment and Supplies	Coefficients	3.164	-0.060	1.366	-0.511	0.989	0.600	0.788
	Standard Error	0.067	0.012	0.081	0.054	0.072	0.066	0.063
Motor Vehicles, Trailers and Parts	Coefficients	2.759	0.057	1.050	0.346	1.267	0.789	-0.597
	Standard Error	0.067	0.012	0.082	0.053	0.072	0.066	0.063
Navigational, Measuring, Electro-medical, and Control Instruments	Coefficients	4.069	-0.023	1.129	0.344	1.199	1.074	0.537
	Standard Error	0.066	0.011	0.081	0.053	0.072	0.065	0.062
Nonmetallic Mineral Products	Coefficients	2.165	0.031	0.956	0.120	0.441	0.714	-0.016*
	Standard Error	0.068	0.012	0.082	0.054	0.073	0.067	0.064
Other Chemical Product and Preparation	Coefficients	2.538	0.111	1.523	0.352	0.678	0.457	-0.362
	Standard Error	0.067	0.011	0.081	0.053	0.072	0.066	0.063
Other Computer and Electronic Products	Coefficients	1.370	0.242	1.737	0.380	0.865	-0.293	-1.251
	Standard Error	0.067	0.012	0.081	0.053	0.072	0.067	0.064
Other Miscellaneous	Coefficients	2.929	0.027	1.383	0.054	1.146	0.731	-0.297
	Standard Error	0.067	0.012	0.081	0.053	0.072	0.066	0.063
Other Transportation Equipment	Coefficients	1.840	-0.103	1.911	0.369	0.775	-0.352	-0.843
	Standard Error	0.076	0.013	0.083	0.057	0.076	0.077	0.076
Paper, Printing and support activities	Coefficients	1.262	0.018*	0.840	-0.352	0.348	0.367	0.078*
	Standard Error	0.072	0.012	0.086	0.060	0.077	0.071	0.068
Pharmaceutical and Medicines	Coefficients	2.341	0.175	1.419	0.585	1.189	0.424	-1.148
	Standard Error	0.066	0.011	0.081	0.053	0.072	0.066	0.063
Plastics and Rubber Products	Coefficients	3.137	0.019*	1.480	0.218	1.024	0.756	-0.238
	Standard Error	0.066	0.011	0.081	0.053	0.072	0.066	0.063

Primary Metal	Coefficients	0.950	0.007*	0.377	-1.124	0.170	0.681	0.859
	Standard Error	0.072	0.012	0.091	0.073	0.082	0.072	0.068
Resin, Synthetic Rubber, and	Coefficients	0.543	0.150	1.424	0.056*	0.508	0.021*	-1.448
Artificial and Synthetic Fibers	Standard Error	0.074	0.013	0.084	0.058	0.076	0.071	0.075
Semiconductors and Other Electronic	Coefficients	3.361	0.092	1.834	0.620	1.373	0.562	-0.803
Components	Standard Error	0.066	0.011	0.081	0.052	0.072	0.065	0.062
Textiles, Apparel and Leather	Coefficients	2.464	-0.088	1.105	-0.350	0.754	1.040	-0.054*
	Standard Error	0.069	0.012	0.083	0.056	0.074	0.067	0.066
Wood Products	Coefficients	-0.291	0.262	1.527	0.219	0.711	-0.951	-1.780
	Standard Error	0.075	0.012	0.085	0.058	0.076	0.078	0.076

*Not statistically significant at the 95% level

Below are some examples of interpreting this model:

- A one-unit increase in the variable *transactions* is associated with a decrease in the log-odds by 0.15 of an application with the subject matter of Aerospace Product of Parts having an equal amount of transactions as the median application (6).

- A one-unit increase in the variable *transactions* is associated with an increase in the log-odds by 0.178 of an application with the subject matter of Basic Chemicals having an equal amount of transactions as the median application (6).

- The log-odds of being in the Beverage and Tobacco technology group versus the median will increase by 1.394 if moving from the *low pendency* bin to the *high pendency* bin.

- The log-odds of being in the Communications Equipment technology group versus the median will decrease by 0.377 if moving from the *low pendency* bin to the *high pendency* bin.

The researchers next looked at the odds, per the regression parameters, of the probability of choosing one of the technology groups over the probability of choosing the median application. Table 13 shows the exponent of the right side linear-equation, which shows the risk ratios (otherwise referred to as odds).

Table 13. Relative Risk Ratios for a Unit of Change by Technology Group

Technology Groups	(Intercept)	Transactions	Pendency				
			low	medium-low	medium	medium-high	high
Aerospace Product and Parts	19.069	0.860	1.761	1.367	2.455	2.276	1.476
Basic Chemicals	5.046	1.195	4.348	1.476	1.377	1.899	0.321
Beverage and Tobacco Products	4.493	0.793	8.943	0.776	0.093	1.741	4.032
Communications Equipment	27.075	1.147	5.550	1.511	2.805	2.141	0.686
Computer and Peripheral Equipment	51.774	1.057	4.364	1.224	3.302	2.726	1.402
Electrical Equipment, Appliances, and Components	33.610	1.010	3.989	1.442	2.642	2.201	1.151
Fabricated Metal Products	33.241	0.989	2.677	1.763	2.762	2.740	1.050
Food	4.488	0.850	1.916	0.871	2.263	0.845	1.419
Furniture and Related Products	7.206	0.879	3.076	1.627	2.277	1.606	0.400
Machinery	54.940	0.991	4.113	1.169	3.442	2.769	1.485
Medical Equipment and Supplies	23.655	0.942	3.920	0.600	2.690	1.821	2.199
Motor Vehicles, Trailers and Parts	15.786	1.059	2.857	1.413	3.550	2.201	0.550
Navigational, Measuring, Electro-medical, and Control Instruments	58.522	0.977	3.091	1.411	3.316	2.927	1.711
Nonmetallic Mineral Products	8.715	1.032	2.602	1.128	1.554	2.042	0.985
Other Chemical Product and Preparation	12.650	1.117	4.588	1.422	1.970	1.580	0.696
Other Computer and Electronic Products	3.933	1.273	5.682	1.462	2.374	0.746	0.286
Other Miscellaneous	18.708	1.027	3.986	1.055	3.147	2.078	0.743
Other Transportation Equipment	6.298	0.902	6.763	1.447	2.170	0.704	0.430
Paper, Printing and support activities	3.534	1.018	2.317	0.703	1.416	1.443	1.081
Pharmaceutical and Medicines	10.392	1.191	4.133	1.795	3.282	1.528	0.317
Plastics and Rubber Products	23.034	1.019	4.393	1.244	2.784	2.131	0.788
Primary Metal	2.585	1.007	1.458	0.325	1.185	1.976	2.360
Resin, Synthetic Rubber, and Artificial and Synthetic Fibers and Filaments	1.722	1.162	4.153	1.057	1.663	1.021	0.235
Semiconductors and Other Electronic Components	28.831	1.096	6.261	1.859	3.948	1.754	0.448
Textiles, Apparel and Leather	11.757	0.916	3.019	0.705	2.125	2.830	0.948
Wood Products	0.748	1.300	4.603	1.245	2.036	0.386	0.169

These results can be interpreted as:

- The relative risk ratio for a one-unit increase in the variable *transactions* is 1.057 for being in the Computer and Peripheral Equipment technology group versus the median application.

- The relative risk ratio for moving from the *low pendency* bin to the *high pendency* bin is 1.419 for being in the Food technology group versus the median application.

7 CONCLUSION

From then numerous points of data, a few intriguing results stand out in relation to patent portfolio planning and staffing. Chief amongst these are she simple fact that a

patents claimed technology greatly impacts the sequence and number of transactions an application goes through, and can have a noticeable effect on the days an application spends spending before the USPTO.

- It is clear from the analysis that chemical and biological sciences have a uniquely imprinted patent prosecution pathway due in part to the nature of the technology dictating how patent examiners and applicants process the claims.

- Despite the above, some of the sub-categories of the chemical and biological sciences enjoy a large portion of their applications in the lowest pendency buckets, despite an increase in transactions.

- Outside of these, transactions and pendency generally track together, as would be expected, though there are outliers in areas that presumably are shrinking in market size. Wood products is a great example here, as there are less new inventions in the space and the USPTO has not caught up with the lower trends via staffing reduction, causing a significant decrease in pendency due to being over staffed, while increasing actions due to a more narrowly defined intellectual property space.

This research has some limitations. The use of USPC to map to the NAICS poses a number of potential problems. First, emerging technologies that might cross traditional grouping definitions might not be accurately categorized to represent the industry. USPC is in itself limiting as it assigns a primary field of subject matter which can be overly general. Likewise, the USPTO is currently transitioning from USPC classification to the more elaborate and flexible CPC classification, under which this analysis would take a significantly different form since the CPC system is a "classification picture" based system, meaning it is

a collection of unique symbols for each application. Also, NAICS systematically excludes

many service sector technologies (as are many of the patents related to business

methodology), leaving a gap in knowledge for staffing and portfolio planning.

In the end, the research and knowledge gained is beneficial to those in the patent

prosecution practice, the public patent policy sector, and intellectual property owners and

managers who desire additional insight on possible strategies to manage patent portfolios.

8   **REFERENCES**

Alice Corp. v. CLS Bank Int'l, 573 U.S. 208 (2014).

Box-Steffensmeier, Janet M., and Bradford S. Jones. "Time Is of the Essence: Event History Models in Political Science." American Journal of Political Science 41, no. 4 (1997): 1414-461. doi:10.2307/2960496.

Cowart, Tammy, Roger Lirely, and Sherry Jackson. 2014. "Two Methodologies for Predicting Patent Litigation Outcomes: Logistic Regression Versus Classification Trees." *American Business Law Journal* (51. 10.1111/ablj.12036).

European Patent Office and U.S. Patent and Trademark Office. n.d. "CPC Training." *Introduction to the Cooperative Patent Classification (CPC).* Accessed August 2020. https://www.cooperativepatentclassification.org/Training.

Lanjouw, Jean O., and Mark Schankerman. 2004. "Protecting Intellectual Property Rights: Are Small Firms Handicapped?" *The Journal of Law & Economics* 47 (no. 1): 45-74.

Leahy-Smith America Invents Act. Public Law 112-29, U.S. Code 35 (2011).

Lemley, Mark A., and John R. Allison. 2009. "Who's Patenting What? An Empirical Exploration of Patent Prosecution." *Vanderbilt Law Review* 53 (6).

Mann, Ronald J. 2014. "The Idiosyncrasy of Patent Examiners: Effects of Experience and Attrition." *Scholarship Archive* (Columbia Law School) (92 TEX. L. REV. 2149 ().

Marco, Alan C., Andrew A. Toole, Richard Miller, and Frumkin Jesse. 2017. "USPTO Patent Prosecution and Examiner Performance Appraisal." *USPTO Economic Working Paper No. 2017-08.*

Potter, Rachel Augustine, Slow-Rolling, Fast-Tracking, and the Pace of Bureaucratic Decisions in Rulemaking (April 4, 2016). Available at SSRN: https://ssrn.com/abstract=2759117 or http://dx.doi.org/10.2139/ssrn.2759117

Sampat, Bhaven N., and Mark A. Lemley. 2009. "Examining Patent Examination." *Stanford Technology Law Review* 2010 (Stanford Public Law Working Paper No. 1485011): 2.

U.S. Patent and Trademark Office. 2020. *Manual of Patent Examining Procedure (MPEP) Ninth Edition, Revision 10.2019.* Alexandria, VA: USPTO.

U.S. Patent and Trademark Office. n.d."Overview of the U.S. Patent Classification System (USPC)." *USPTO Resources.* December. Accessed August 2020. https://www.uspto.gov/sites/default/files/patents/resources/classification/overview.pdf.

U.S. Patent and Trademark Office. n.d. *Patent Technology Centers Management.* Accessed September 2020. https://www.uspto.gov/patent/contact-patents/patent-technology-centers-management.

9   CURRICULUM VITA

Tommy L. Berry
6904 Deer Run Dr.,
Alexandria,
VA 22306
(612) 481-1386
tberry4@jh.edu

Summary Statement

Tommy L. Berry was born outside Houston, TX. After graduating high school he spent a
year in South America before joining the US Army, where he served as a Human Intelligence
Collector for 8 years, deploying to Iraq, Afghanistan, and Korea. He moved to Minnesota
after leaving active service where he began his federal government career with the
Department of Veteran Affairs, working on policy and program implementation with the
Office of Strategic Planning. He joined the United States Patent and Trademark Office in
2016, where he works with the Chief Data Analytics Officer for Patent Operations,
preforming data analysis to support executive decision making.

Education

Master of Public Administration (MPA), March 2015
            Hamline University, St. Paul, MN

Bachelor of Business Administration, Business Analysis, May 2011
            American Military University, Charles Town, WV

Licenses/Certifications
- *Project Management Profession (PMP),* Project Management Institute
- *Federal Acquisition Certification for Program and Project Managers (FAC-P/PM)*, Federal
  Acquisition Institute
- *Lean Six Sigma*, VA Acquisitions Academy
- *Army Basic Instructor,* Fort McCoy NCO Academy