



Analyzing and Reporting Patent Quality Data: Examining the Master Review Form

**An Interactive Qualifying Project for the United States Patent and
Trademark Office**

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Abstract

Our team worked with the United States Patent and Trademark Office (USPTO) to improve the quality of patent examinations. We analyzed Master Review Form (MRF) responses to identify potential quality issues in order to recommend areas for further analysis. Based on interviews with managers regarding internal reporting, we also created a decision matrix to assist the Office of Patent Quality Assurance to implement an Ad Hoc analysis tool. Our recommendations will allow USPTO employees to utilize MRF data more effectively.

Acknowledgements

To complete our project, the team worked with many individuals who provided valuable resources and information to help structure our final outcome. We would like to give a huge thanks to our liaisons at the United States Patent and Trademark Office (USPTO), Martin Rater, David Fitzpatrick and Daniel Sullivan. Without the countless hours they provided to us through email and in person meetings, we wouldn't have been able to construct and format our project as we did. We would also like to thank all USPTO employees who were able to meet with us for a half-hour interview. Information collected from these interviews helped us to form recommendations for models to display data. We would also like to thank our project advisors, James Hanlan and Stephen McCauley. They have worked endlessly with our group the past two terms and have been there to help us with issues regarding our paper, learning how to construct an interview and providing feedback based on our team work.

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Executive Summary

The United States Patent and Trademark Office (USPTO) is essential to fostering the spirit of competitiveness and innovation across the country. On average, the USPTO examines 580,000 patent applications and processes 1.6 million office actions annually from various organizations and industries nationwide (USPTO, 2016c). Because of the number of organizations that depend on this system, it is important that patent examinations are conducted fairly and equally. In addition, when a patent application is rejected it can often lead to a lengthy and expensive appeal process. Therefore, it is vital that the patent examination process is as consistent and accurate as possible, rejecting applications only when necessary. Accordingly, the USPTO established the Office of Patent Quality Assurance (OPQA), an office within the USPTO which handles assessment, measurement and improvement of patent examination quality (USPTO, 2015a). Our project assisted the OPQA in improving the quality and consistency of patent reviews by identifying key trends underlying patent quality and mapping potential quality issues within the patent review process.

Background

In early 2015, the USPTO launched the Enhanced Patent Quality Initiative (EPQI) in order to improve the quality and consistency of the patent examination process (Camarota, 2016). As a part of this initiative, the OPQA created the Master Review Form (MRF), which measures the overall correctness and clarity of the work of patent examiners (Spyrou & Rater, 2016).

The MRF is broken down by what statute of patent law is being cited by the examiner as the reason for rejection. The most common statutes cited are 102 and 103. Statute 102 refers to prior art; if a claimed invention was patented or available to the public before the filing date, it will be rejected due to prior art (USPTO, 2015b). Statute 103 refers to non-obviousness; if a claimed invention is similar enough to previously patented work to be considered obvious “to a person having ordinary skill in the art to which the claimed invention pertains”, it will be rejected under statute 103 (USPTO, 2015c). Reviewers rate individual sections of the examination as either No Issues Found (OK), Needs Attention (AT), or Significantly Deficient (SD), for both the correctness and the clarity of the examiner’s work. In addition, each section

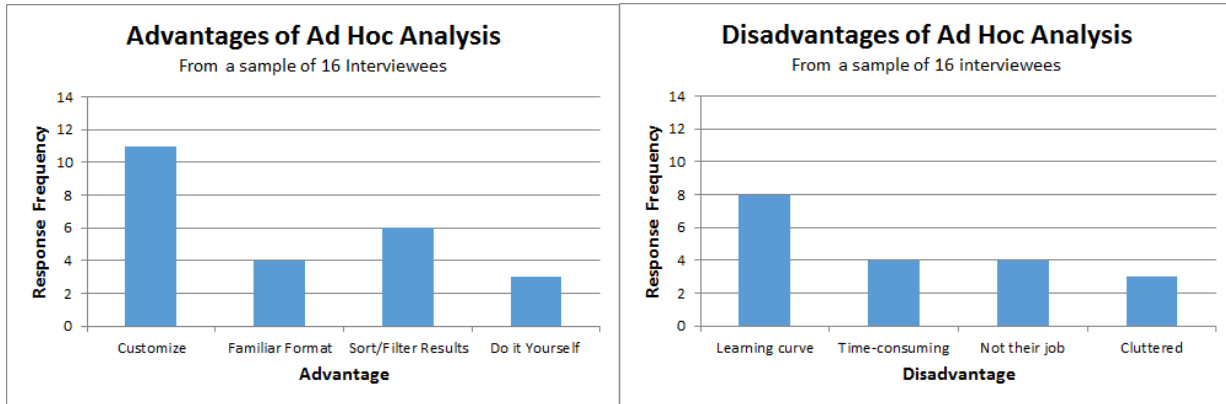
contains a number of sub-questions which help identify exactly which portions of the examiner's decision are not meeting the USPTO standards of quality (Spyrou & Rater, 2016).

Methods

To begin, we determined the needs of USPTO managers regarding the MRF data. In order to accomplish this, we conducted structured interviews with Quality Leads (QLs), Training Quality Assurance Specialists (TQASs) and Supervisory Patent Examiners (SPEs), utilizing a snowball sampling method to identify relevant interviewees in each category. We began interviews with QLs because they hold managerial positions and work closely with the MRF. Interviewees were questioned about what MRF data they would find most useful, and about various ways they would like to have the data presented to them. After each interview, responses taken from our written and audio notes and further analyzed to determine key patterns.

After determining employees' MRF data needs, we analyzed the MRF data to find patterns related to the consistency and accuracy of patent examinations. We started our comparisons by looking at the overall clarity and correctness scores for each statute, as well of the specific sub-questions for these statutes. In addition, we filtered data by examiner grouping based on subject matter, referred to as Technology Centers (TC), as well as the Work Groups and Art Units that make up these TCs. This allowed us to determine whether there are patterns in correctness and clarity among groups of examiners.

Finally, we used the data we gathered throughout the interviews to identify the most popular models for reporting MRF data. The three reporting models that were discussed are Canned Reports, Snapshots, and Ad Hoc analysis. A Canned Report is a detailed, widely distributed report which focuses on data and analysis deemed to be most important. A Snapshot is a brief display of key data points that allows users to quickly gauge important information. Ad Hoc analysis allows the user to interactively examine trends and information they determine is most important. We then identified the advantages and disadvantages of each model based on interviewee responses. We organized these features, based on importance, by coding interviewee responses. This information was used to create a decision matrix to help guide implementation of the selected reporting method in order to help the OPQA meet the data reporting needs of USPTO managers.



Summary Figure 2- Advantages and Disadvantages of Ad Hoc Analysis Based on Interview Responses

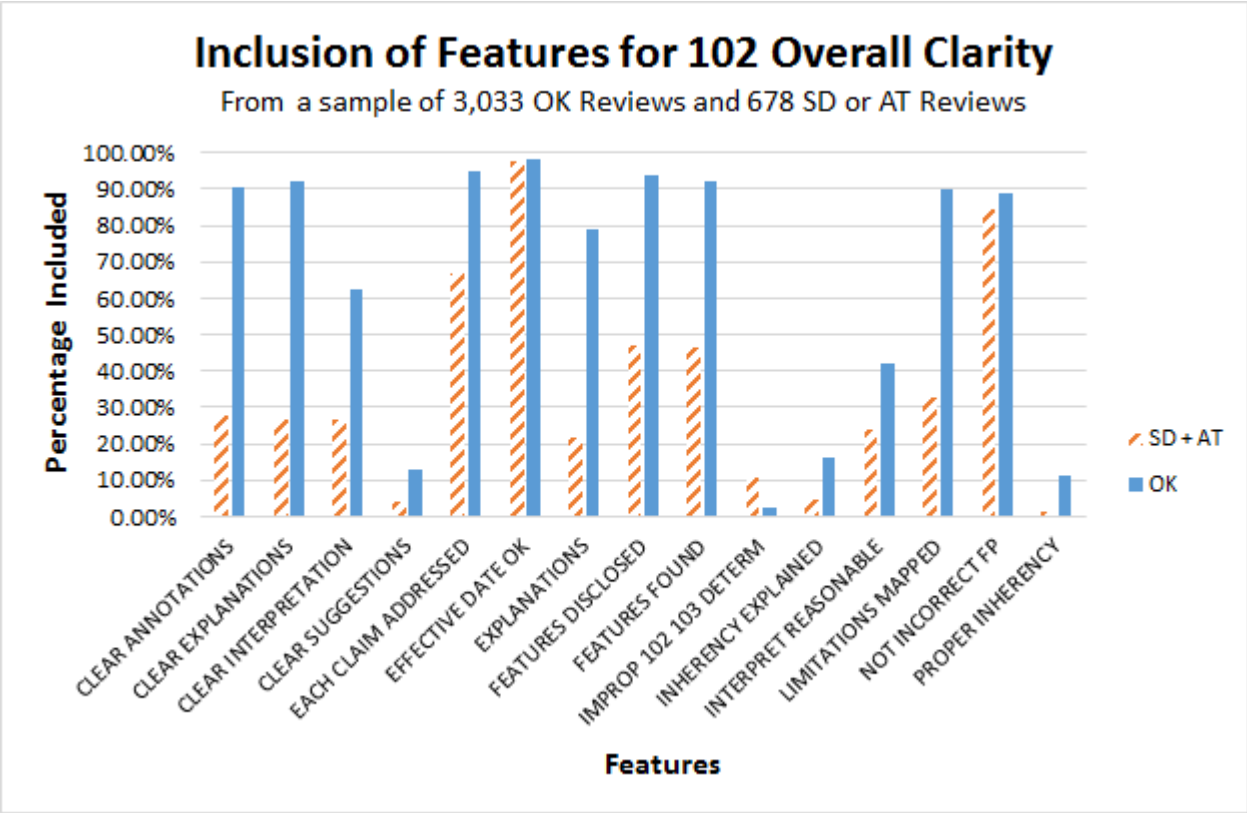
Our team organized the data collected by the MRF, then analyzed and drew conclusions from the information related to patent quality trends. While the MRF contains 395 questions concerning several different sections of patent law, we chose to focus on only the questions concerning statutes 102 (prior art) and 103 (obviousness) of the US Code, as the majority of reviews cited these statutes.

Our first analysis compared overall clarity to overall correctness. We looked at the percentage of total reviews that received the same rating in clarity and correctness, seen in Summary Table 1. Summing the percentages together, it can be seen that 85% of reviews received the same rating in both clarity and correctness, suggesting that there is a strong relationship between overall clarity and correctness.

102 Comparison of Overall Scores (From a sample of 3,711)	Correctness		
Clarity	OK	AT	SD
OK	2,790 (75% of total)	173	70
AT	259	280 (8%)	63
SD	1	4	71 (2%)

Summary Table 1- Comparison of 102 Overall Correctness and Overall Clarity

After comparing overall clarity and correctness scores, we examined whether the inclusion of specific features of an examination, such as clear explanations, affected that examination’s overall rating. We did this by graphing the percentage of examinations that received an OK rating in statute 102 (prior art) clarity that also included each of that statute’s features, compared to those that received an AT or SD rating in clarity that included that feature. This comparison can be seen in Sample Figure 3. By observing features that were included in most OK reviews but excluded from most SD and AT reviews, we can identify these features as driving the overall clarity for 102 (prior art). An example of this type of driver is clear annotations. Conversely, features that were included or excluded in the majority of all reviews, regardless of ranking, such as Effective Date OK, likely do not affect the overall clarity score or overall quality. This suggests that these questions could be removed from the MRF to save time and simplify the output, without affecting the overall results. These types of comparisons were also conducted for 102 correctness, as well as for 103 clarity and correctness as can be seen in Appendix C.

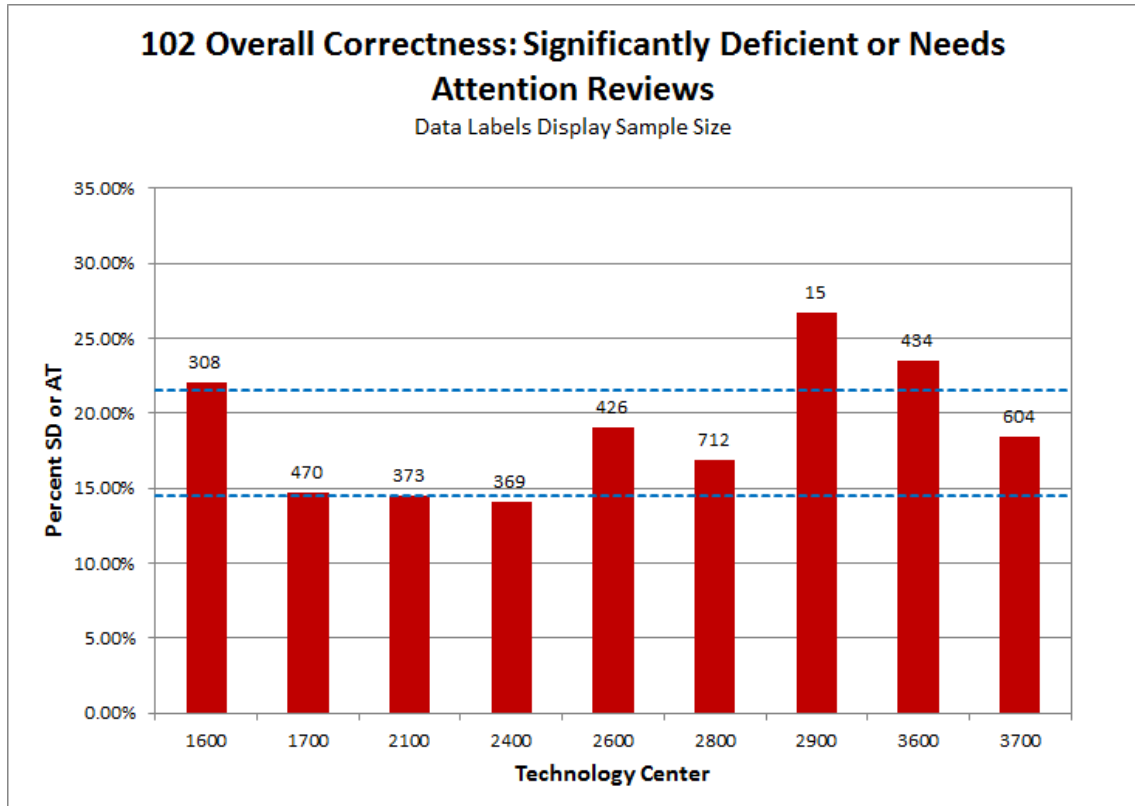


Summary Figure 3- Feature Inclusion Percentage for 102 Overall Clarity

In addition to understanding trends for the entire USPTO, it was important to examine how different groups of examiners were performing. Specifically, we examined the overall correctness and clarity of reviews for 102 and 103 rejections for each TC (TC). By seeing how many of these reviews were rated as OK or AT/SD for each TC, we can quickly view which TCs have the most room for improvement and in which areas. The example in Summary Figure 4 below looks at TC performance for the clarity of statute 102. Using the sample size estimation equation we find that meaningful conclusions can only be drawn from groupings with a sample of 300 or more reviews.

Conclusions can only be made about TCs with a percentage of AT and SD reviews that is above or below a 95% confidence interval, indicated by the blue dotted line. A 95% confidence interval means that, if the results were recreated 100 times, it would be expected that a result would fall within this confidence range 95% of the time (Lane, n.d). Results outside this interval are considered statistically significant. TCs above this interval have statistically significantly more AT and SD reviews than other TCs and therefore may be the target of future training to

improve quality concerning statute 102. In the future, further analysis can be done to analyze Work Groups and Art Units that make up any TC that could be having a problem with a given statute. Currently no conclusions can be made from looking at these groupings, because the sample sizes are too small to find statistically significant results.



Summary Figure 4- 102 Overall Correctness SD or AT

Proposed Modeling for Reporting Needs

To assist the OPQA with identifying data reporting models that will meet the needs of USPTO managers, we created a Decision Matrix for Ad Hoc Analysis implementation, as seen in Summary Figure 5. The OPQA can use this Matrix to determine exactly what implementation of the Ad Hoc model will best fit the needs of USPTO employees. The categories, features, and weights were all chosen based on three main areas: the interview responses we collected, our discussions with USPTO liaisons, and our own experience with Ad Hoc tools like Microsoft Excel or Microsoft Analysis. Implementations of Ad Hoc analysis can be rated for each feature on a scale of 1-10; these scores are then multiplied by that feature’s weight to find the weighted

score. Finally, the weighted scores are summed together to find the total score. The implementation which receives the highest total score is best suited to fit the needs of the USPTO.

Ad Hoc Analysis Decision Matrix		
Category	Feature	Weight
Flexibility	Tools for multiple forms of analysis/visuals	4
	Ability to Sort/Filter	10
Robustness	Updates with new reviews	5
	Re-use past "queries"	5
	Handles large number of fields	8
	Easy to update saved "queries"	3
Ease of Use	Ability to manipulate data quickly	5
	Simple Interface	8
	Good Help options	6
	External Learning Resources	4
Utility	Ability to print/export reports	7
	Compatibility with SQL	6
	Can create Graphs/Visuals	9
	Can test Statistical Significance	8

Summary Figure 5- Ad Hoc Decision Matrix

Recommendations and Conclusions

Our project focused on performing a preliminary analysis on MRF data with a focus on statues 102 (prior art) and 103 (obviousness). We believe that this will provide a valuable basis from which the OPQA can complete more detailed and specific analysis of this data involving all 12 statutes cited by the MRF. There are many areas of the MRF where analysis could allow employees to improve the quality of patent examination. However, in order to understand the results, employees need the proper tools to generate and communicate results.

We offer the following recommendations:

- Utilize the decision matrix to implement a form of Ad Hoc analysis and distribute this implementation, integrated with MRF data, to USPTO employees
- Consider other forms of data reporting for MRF data, such as canned reports or snapshots, using interview responses to guide the design of these models
- Use MRF data to identify areas of USPTO experiencing quality difficulties
- Improve validity of MRF conclusions by examining the methods used for form sample selection
- Examine MRF data based on reviewers who complete the form to find and eliminate any potential biases that could skew results
- Reevaluate relevance of questions asked by MRF based on main drivers of quality, by focusing on questions regarded as drivers of quality while considering eliminating questions that are not seen as drivers of quality

Our project will allow OPQA employees to better interpret and utilize results they receive from the MRF. This will allow them to better identify and eliminate quality issues involved with the patent examination process. Effectively eliminating issues regarding patent quality will not only increase the reliability of examination results produced by the USPTO, but also improve the trust between the USPTO and the community of inventors and innovators whom they serve.

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Acronyms

EPQI – Enhanced Patent Quality Initiative

IPR – In- Process Review

MRF – Master Review Form

AT – Needs Attention

OPQA – Office of Patent Quality Assurance

OK – No Issues Found

PATI – Patent Application Text Initiative

QAS – Quality Assurance Specialists

QIR – Quality Index Report

QL – Quality Leads

RQAS – Review Quality Assurance Specialists

SD – Significantly Deficient

SPE – Supervisory Patent Examiner

TC – Technology Center

TQAS – Training Quality Assurance Specialists

USPTO – United States Patent and Trademark Office

Chapter 1: Introduction

The United States Patent & Trademark Office (USPTO) is essential to fostering the spirit of competitiveness and innovation across the country. It is responsible for maintaining a high quality, productive and responsive network that supports a vast intellectual property system (USPTO, 2009). On average, the USPTO examines 580,000 patent applications and processes 1.6 million office actions annually (USPTO, 2016c); with such a large number of applications being processed each year, systemic issues can impact many organizations and industries nationwide (Camarota, 2016). Because of the number of organizations that depend on this system, it is vitally important that patent examinations are conducted fairly and equally. To achieve this, the USPTO established the Office of Patent Quality Assurance (OPQA), an office within the USPTO which handles assessment, measurement and improvement of patent examination quality (USPTO, 2015a).

A rigorous inspection is required to ensure that an application deserves a patent; this process can be extremely time consuming. Examiners must thoroughly consider all parts of each application in order to ensure that the proposed patent does not infringe on a previous patent, referred to as prior art. The application is also checked to make sure it is not considered obvious for its field, since an application must be considered "non-obvious" to be eligible for a patent, along with many other areas of patent law (Purvis, 2013). A massive backlog of pending patent reviews has built up due to the time-consuming review process the examiners have to follow. The backlog consists of over 540,000 applications and contains patent applications which have been filed up to two years ago (USPTO, 2016b). In addition, communication and motivation problems exist in the current examination process. The process discourages examiners from correcting mistakes because admitting to a mistake counts against them in the workplace (Weiler et. al, 2014). Along with the pressure that is put on from mistakes and appeals, the examiners are given a quota of applications that they must process each quarter; they must “maintain an average minimum production level ... to avoid disciplinary action by the USPTO” (Penny, 2014). New patent examiners tend to take longer on each application, taking more time to review all past information. Patent examiners with more experience tend to cite less prior art and are more likely to grant patents than less experienced examiners, which suggests that a patent’s chance of being approved can be greatly impacted by which examiner reviews it (Lemley & Sampat, 2012).

There have been a number of attempts by the USPTO to improve the quality of work produced by the examination process. In early 2015, the Enhanced Patent Quality Initiative (EPQI) was launched to improve the process the OPQA had used to ensure patent quality (Camarota, 2016). The EPQI introduced several changes to the metrics used by the USPTO and the OPQA to more accurately quantify the quality of the patent review process. With the EPQI, communications were started with patent applicants and other stakeholders through initiatives such as a webinar series and a patent summit hosted in 2015. The webinar series went in depth on a number of the changes introduced by the EPQI. The summit was designed to allow all stakeholders the opportunity to give feedback on the EPQI and on patent quality assessment as a whole (Lee, M, 2015).

As part of the EPQI, the Master Review Form (MRF) was introduced to improve the metrics used by the OPQA when evaluating patent examination quality. The MRF is a 250 point form that is completed by patent examiner supervisors and OPQA quality reviewers to check the quality of decisions made on patent applications. While the MRF collects vital data on patent applications and the review process, the data has not yet been analyzed. In order to increase overall efficiency and accuracy at the USPTO, this raw data should be compiled into reports that are available to supervisors (Lee, M, 2016).

Our project assists the OPQA in improving the quality and consistency of patent reviews by identifying key topics linked to patent quality and mapping potential quality issues within those topics. We accomplished this goal by first analyzing the MRF for potential improvements using software such as Microsoft Excel and Microsoft Access to examine data collected from the form. In addition, our project aims to improve the techniques used to report the form's data. This was accomplished by interviewing employees about opinions on internal reporting and then working with the OPQA to select a reporting style that reflects the gathered opinions. These features will allow the USPTO to collect and use data in the most efficient way possible. Efficient data usage allows issues in the OPQA's current process to be identified and remedied, thus improving patent quality throughout all of the USPTO.

Chapter 2: Background

This section discusses the information we have gathered about the United States Patent and Trademark Office (USPTO) and data analysis. This includes an overview of current patent examination techniques as well as a history of improvements and changes that the examination process has undergone. In addition, this section reviews challenges that the USPTO has encountered in analyzing the quality of patent examinations and what has been done to meet these challenges. In this section we will also explore the best practices for the methods used in analyzing and reporting of data.

2.1 Patent Application and Examination Process

The patent application process is important to ensuring that the approved patents are novel and non-obvious. This section will explore the various steps of this process, as well as both positive and negative effects the process can have on the applicants and the reviewers.

There are three different forms of patents in the United States (USPTO, 2014):

- Design patents such as those for ornamental characteristics
- Plant patents such as those for new asexual plants
- Utility patents such as those for processes, machines, and manufactured items

Utility and plant applications can be submitted in a provisional or nonprovisional format, while design patents can only be submitted as nonprovisional. Provisional applications do not undergo examination within the USPTO (Norek, 2015). Provisional patents are used to protect a product while testing feasibility of an idea and determining if the patent would be beneficial. During this period, it allows the innovator to begin working on the nonprovisional applications. Nonprovisional applications fully undergo examination.

Patent applicants commonly use a registered attorney or agent in order to legally support the invention. While attorneys can cost roughly \$2,000 - \$10,000 per application, they can be useful to fully protect both the invention and the applicant (Pressman, 2012). The application must be filed electronically through the Electronic Filing System. Upon filing the application, the applicant receives a customer number and a digital certificate. The customer number allows the applicant to organize all filings under a single mailing address, and a digital certificate allows them to be uniquely identified and provides secure access to vulnerable data (USPTO, 2014).

Once the application has been written, it can either be submitted normally or expedited using one of several different programs: Prioritized Examination, Accelerated Examination Program, First Action Interview, or Patent Prosecution Highway. Prioritized Examination can be used for utility and plant applications, and, if accepted, “the application will be accorded special status during prosecution before the patent examiner.” This program halves the application process to 12 months; however, only 10,000 applications total can be accepted per year on a first come first serve basis, with additional fees attached. A similar process exists for Design Patents, known as the Design Rocket Docket (Signore, 2010). The Accelerated Examination Program is similar to Prioritized Examination in that it will be completed within 12 months, but is specific to groundbreaking environmental, medical or counter-terrorism research. This program is meant to expedite inventions that have a major impact on the world, such as life saving medication. On a more personal level, First Action Interviews can be set up between the examiner and the applicant. Interviews speed up prosecution and provide a personal interaction between the applicant and the examiner, giving the applicant the chance to discuss, and possibly fix, issues with the application in front of the examiner. Finally, Patent Prosecution Highway is a program that speeds the process of an application once it has been transferred between offices. These four programs are an effective way for relevant and well written patent applications to speed up the normal two-year backup (USPTO, 2014).

After the full application has been sent in electronically, it is received and sorted into a class and subclass, and then assigned to a specific examiner by a Supervisory Patent Examiner (SPE) (Lemley & Sampat, 2012). The class and subclass allows the application to be assigned to a Technology Center (TC). The TC will review each application and distribute them out to examiners based on each examiner’s expertise. Once the application reaches the examiner, it will go through many checks, including prior art, non-obviousness, and usefulness to make sure the application meets the basic patent requirements. If an application fails any part of the examination initially, the applicant is given a chance to make corrections and resubmit. After this, if a final rejection is made, the applicant is given the option to request reconsideration or attempt to appeal the decision in court. If the application is allowed, the applicant must pay issue fees and publication fees to receive an official patent. The only upkeep after the patent has been granted are maintenance fees that are due 3.5, 7.5 and 11.5 years after the patent has been granted. Patents expire after 20 years, but can be reapplied for if proper maintenance fees are

paid. If the holder of the patent does not pay proper fees, the patent becomes abandoned. (USPTO, 2014).

2.2 History of Quality Assurance

The USPTO keeps a strict quality assurance program in order to ensure patent quality. The public has spoken through many surveys, sent out by the USPTO, requesting better quality in patent examinations. Prior to the recent Enhanced Patent Quality Initiative (EPQI), the USPTO improved their Quality Assurance Program in 2012 (USPTO, 2016a). This program improved connections between data collection and training development. Using various forms of data, such as that collected from the Master Review Form (MRF), training programs can be established to maximize instruction efficiency. To improve patent quality, USPTO has implemented the following review processes.

2.2.1 Evaluation by Quality Assurance Specialists

Quality Assurance Specialists (QAS) measure and review data from past examiner reports year round and make sure this data is available and current. Examiner reports are based on past applications and whether they were rejected or accepted. When reviews are completed, employees upload raw data from these reports to a shared database (USPTO, 2016a). Reviews and measurements are based on the following items:

- Was the rejection clearly wrong?
- Were claim limitations correctly matched to the prior art?
- Was the examiner's position properly supported?
- Were the differences from prior art stated?

2.2.2 In-Process Review

Based on applicant and attorney feedback, the USPTO established its current in-process review (IPR) of examiners' work. This review looks at the quality of an examiner's intermediate decisions as the application goes through the examination process. QASs from each TC are assigned to review a random sample of roughly 380 office actions each year. QASs in technology centers can perform focused IPR in addition to the random reviews. With focused

IPR, specific training needs of a single examiner can be developed (USPTO, 2016a). The data that is collected during in-process reviews can lead to:

- Training sessions on both an individual level and for an overall department
- Examiner certification or recertification
- Quality measurements

2.2.3 Supervisory Patent Examiner Internal Process Review

A SPE is expected to review four applications per year, one application per quarter year, from each one of their primary examiners. Every supervisory patent examiner is responsible for the overview of roughly 13-14 patent examiners. The purpose of the SPE reviewing their primary examiners is to keep them directly connected with the work produced within their area of specific art (USPTO, 2016a). It is likely that having past applications examined keeps the examiner's work quality from decreasing, which in turn increases patent quality.

2.3 Current Patent Quality Assessment

Patent examination quality is important in preventing uncertainty and unfairness in the patent application system. If businesses become uncertain of the validity and scope of patents, they will be less likely to file new patents, which could slow the process of innovation. Uncertainty in patents also leads to more patent litigation, which is expensive and time consuming. Poor quality often comes in the form of both inappropriate grants and inappropriate rejections (Wagner, 2009). This section will explore the efforts of the entire USPTO to solve quality concerns, as well as critiques of their methods and recent innovations made to the quality review process.

A number of different Office of Patent Quality Assurance (OPQA) employees are involved with both general quality review as well as the MRF. The QAS' main duties are the quality control of examiner work, as well as the conduct of various quality programs such as training. Training Quality Assurance Specialists (TQAS) work more closely with training programs and are stationed at individual technology centers. Review Quality Assurance Specialists (RQAS) work primarily with reviewing the work done by patent examiners. They are stationed in the OPQA office. All QASs are assigned work focused on a specific technology and

report to Quality Leads. Quality Leads are experienced patent examiners whose primary duty is to review the Patent Examiner and QAS work product (USPTO, 2013; Spyrou & Rater, 2016).

In February, 2015, the Acting Head of the USPTO, Michelle K. Lee, launched the EPQI. This initiative encourages collaboration between many offices of the USPTO, as well as members of the public involved with the patent application process, in order to help achieve excellence in three main categories: Work Products, Measuring Patent Quality, and Customer Service. “Excellence in Work Products” refers to the performance of patent examiners, as well as the quality of the processes and programs they follow and the training they have received. “Excellence in Measuring Patent Quality” involves the improvement of the metrics used by the USPTO to analyze patent quality. Lastly, “Excellence in Customer Service” relates to the relationship between the patent office and customers such as patent applicants and holders; this includes interviews between examiners and applicants (Camarota, 2016).

The USPTO has received many recommendations for improvement in the past; these recommendations may have prompted the launch of the EPQI (USPTO, 2016d). A past Worcester Polytechnic Institute Interactive Qualifying Project recommended that the quality of the patent examination process be improved by giving clearer deadlines to examiners, as well as improving collaboration between examiners and the patent applicants themselves. This study also suggested changes to the feedback system used to evaluate patent examiners, as the current system discouraged the correction of mistakes by viewing actions such as reopening cases as errors which count against the examiner (Weiler et. al., 2014).

Since launching the EPQI, the USPTO has made many changes to the patent quality metrics and data collection process used by the Office of Patent Quality Assurance. Before these changes, several metrics were combined to create a Quality Composite Score, which was used to assess patent quality.

The metrics were as follows (USPTO):

1. Final Disposition Compliance Rate;
2. In-Process Compliance Rate;
3. Complete First Action on the Merits Review;
4. Search Review;
5. Quality Index Report (QIR);
6. External Quality Survey;
7. Internal Quality Survey.

These metrics have now been sorted into three categories, Product Indicators, Process Indicators, and Perception Indicators. These three categories have replaced the Quality Composite (Spyrou & Rater, 2016).

The Product Indicators metric focuses on the correctness and clarity of the examiner's work. Clarity is especially important to patent filers and inventors who need to understand what rights their patent gives them or why the patent has been rejected. It is also important for those who plan on using past patents as part of their research. Correctness and clarity are measured through the MRF. This form is designed to be used by many of the USPTO organizations. The form adapts to individual circumstances as it is being completed, automatically filling out certain sections and directing the examiners to the relevant sections. The Process Indicators are used to help reduce how often examiners have to reopen and rework patent applications. The Perception Indicators are a combination of two metrics: The Internal and External Surveys. These are used to get opinions from both the public and from examiners on patent quality and help verify that the patent quality measurement methods are working (Caputa & Rater, 2015; USPTO, 2014).

2.3.1 US Code: Statutes 102 and 103

The two main forms of patent application rejections are prior art (102) and non-obviousness (103). While writing a patent, the patentee makes certain claims about their invention that they wish to own. The claims then define the limit that the patent will cover if approved. If a claim is already patented, the new patent application will be rejected due to prior art (USPTO, 2015b). A patent examiner has many resources he or she can use while determining

prior art. Online patent databases make searching old patents easy with advance searches. Non-obviousness deals with patent applications that have claims similar to previous patents and their similarities are considered obvious “to a person having ordinary skill in the art to which the claimed invention pertains” (USPTO, 2015c). For more patent related statutes referenced in the MRF see appendix D.

2.4 Analysis of Patent Quality Data

David Fitzpatrick, Office of Patent Planning and Data Analysis, works closely with data and numbers that deal with patent applications and patent quality. According to Fitzpatrick, the OPQA handles roughly 102 applications a day. In particular, the OPQA works directly with significant patent quality data to determine the quality and consistency of patent reviews (USPTO, 2015a). In this section, we will examine the best practices of analyzing and presenting large amounts of data, as well as how the USPTO analyzes their data.

2.4.1 USPTO Data Analysis

The USPTO utilizes several methods to handle analysis of their data. To determine the quality of work performed by the USPTO, the OPQA collects multiple types of data. The MRF primarily collects nominal data. This type of data is organized and labeled based on categories which have no quantitative value. The MRF rates the correctness and clarity of examiner decisions as No Issues Found (OK), Needs Attention (AT), or Significantly Deficient (SD), as seen in Table 1 below (Spyrou & Rater, 2016). This data will later need to be quantified in order to conduct analysis (Duignan, 2016).

Definition of Overall Rankings	
Rank	Explanation
No Issues Found (OK)	Everything was Correct and Clear
Needs Attention (AT)	Coaching and mentoring issues are present
Significant Deficiency (SD)	Corrections are needed AND prosecution is adversely affected

Table 1- Definition of Overall Rankings

Another form of categorical data that could be used for quality analysis is ordinal data. Unlike nominal data, ordinal data is organized by categories that do have quantitative values. These categories, such as least preferred and most preferred, are easier to order and rank. However, it is not as effective as nominal data for measuring the frequency of responses (Duignan, 2016).

Recently, steps have been taken by the USPTO to make it easier for patent examiners to quickly search through and analyze patent data. Patent applications are stored as TIFF image files, in a database that is at least 78 TB large (Hamer et. al, 2012). Because these applications are stored as images, they must be manually examined and sorted with no way to automatically search through text. The Patent Application Text Initiative (PATI) aims to transcribe three key documents in each application into text format, so that patent examiners can quickly search through these documents to find and analyze the relevant data.

Loet Leydesdorff and Lutz Bornmann (2012) developed an additional method to present patent data. By creating a Google Maps overlay using published USPTO data, they created a map which indicates the quantity and quality of patents at the city level, as shown in Figure 1.

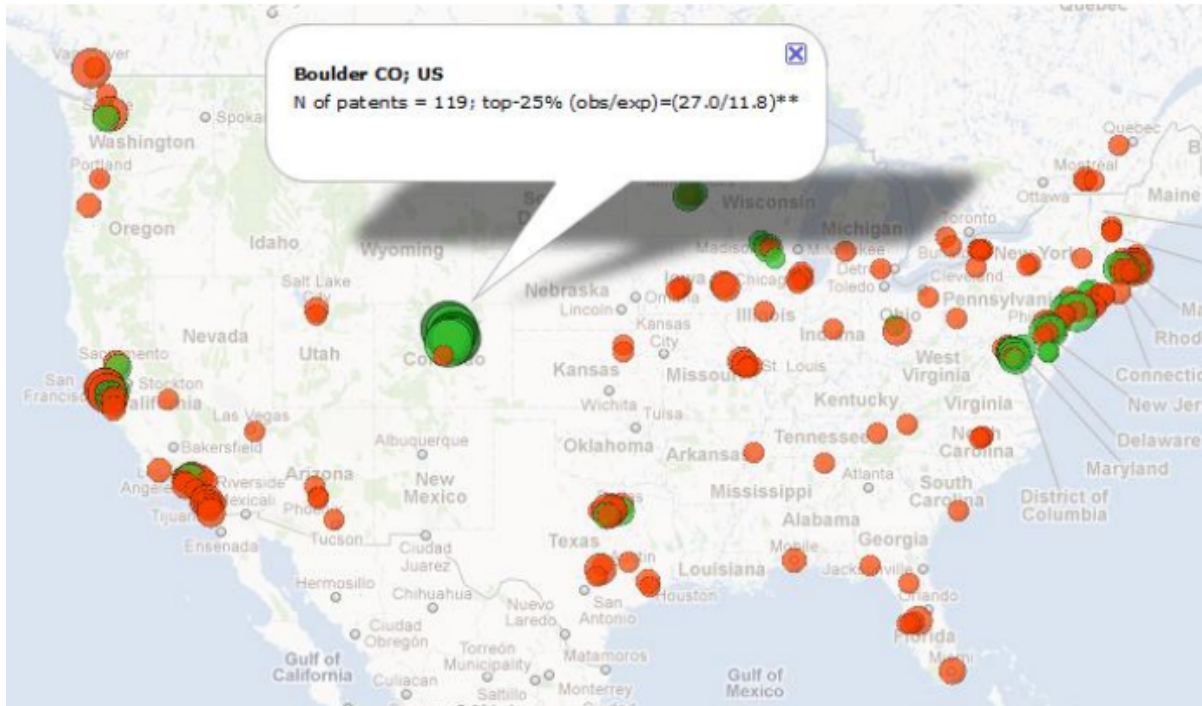


Figure 1- Example of the Patent Quality Map Created by Leydesdorff and Bornmann

Leydesdorff and Bornmann primarily use the number of times a patent is cited as a way to determine its quality; the more a patent is cited, the higher quality it is likely to be. This map assists the public by indicating where a high volume of high-quality patents are being filed, which would indicate to a new patent applicant where to go for assistance. This also makes technological analysis based on economic geography and innovational studies easier by centralizing all of the relevant data.

2.4.2 Relevant Statistical Data Analysis Techniques

Analyzing large sets of data presents a unique challenge. With a large amount of variables, comparing data sets to find valid relationships can be difficult (Reshef et. al, 2011). Therefore, it is vital to perform statistical analysis of the data in order to determine what points contain significant or valuable information. For our particular needs, we analyzed data mostly through the use of descriptive statistics. This type of analysis was used to better summarize data in order to locate patterns. An important tool for this type of analysis is percentiles. Percentiles are used to show where one data point is in relation to other relatable data points. Specifically,

the x^{th} percentile is defined as the smallest organized data point that is greater than or equal to $x\%$ of the data points (Lane, n.d).

Findings from any statistical analyses must be tested for statistical significance. Statistical significance means that the perceived findings actually correlate to a relationship in the data and are not caused by random chance. This is extremely vital for all statistical findings because, without statistical significance, conclusions are not necessarily valid. In order to test for statistical significance, a confidence interval can be constructed. A confidence interval is an interval estimate of a population parameter that differs from sample to sample based on sample size and characteristic. The characteristic of a sample is a measurable average usually calculated as a percent. In applied statistical practices, 95% confidence intervals are typically used. A 95% confidence interval means that, if the results were recreated 100 times, it would be expected that a result would fall within this confidence range 95% of the time (Lane, n.d). The confidence interval equation found in Appendix F is used to calculate these intervals for sets of data. If a data point is outside of the calculated confidence interval, then it is statistically significantly different than other data points at that level of confidence. After the confidence interval is created, an appropriate sample size can be estimated using the characteristic and the desired tolerance, or how wide the confidence interval is. This is useful for excluding groupings that are too small to be statistically significant. This equation can also be found in Appendix F.

In addition to analyzing the large scale data, it is important that the finding be presented correctly. Edward Tufte's "The Visual Display of Quantitative Information" describes several core philosophies for designing various methods for displaying such analysis. Most significantly, Tufte argues that graphical displays should reveal all of the data without distorting it at all; they should induce the viewer to think about the substance of the data, rather than the methodology or the presentation itself. Tufte defines the idea of "data-ink", which is the portion of graphical representations of data which display the data itself. He argues that designers should maximize data-ink while removing non-data-ink as much as possible, within reason. This prevents the graphic from becoming cluttered or distracting, and facilitates the presentation of data directly with as little distortion or confusion as possible. These guidelines guarantee that the data and analysis displayed is clear, concise, and informative.

Chapter 3: Methods

Our project assists the Office of Patent Quality Assurance (OPQA) in improving the quality and consistency of patent reviews. This is accomplished by identifying specific areas of analysis that may drive the overall quality of patent examiner work and mapping potential quality issues within these areas. In addition, we developed recommendations for a method of communicating both current and future Master Review Form (MRF) results to patent examiners, supervisors, and OPQA employees. To accomplish our goals, we identified three objectives:

- Determine the needs of United States Patent and Trademark Office (USPTO) managers and supervisors regarding analysis of the MRF data
- Analyze MRF data to find patterns related to the consistency and accuracy of patent examinations
- Develop recommendations regarding internal reports of MRF data based on USPTO employee preferences

3.1 Objective 1: Determine Needs of USPTO Employees Regarding MRF Data

Before we began analyzing the MRF data, it was important to understand how the USPTO employees would use our findings. To do this, we had to determine the reporting needs of these employees. We accomplished this by conducting interviews with employees at three different management levels: Quality Leads (QL), Training Quality Assurance Specialist (TQAS) and Supervisory Patent Examiners (SPE). With the data from the interviews, we were then able to determine employee needs from the overall MRF data, which allowed us to focus our attention in more detailed areas.

For our interviews, we initially considered a semi-structured interview format, aiming to learn stories of past employee experiences with internal reporting. However, after more consideration we decided that a more structured interview format would provide a better picture of employee internal reporting needs. This format better allowed us to ask the specific questions we had concerning both the types of data that need reporting, as well as the design choices that lead to an effective report. The more structured interview format also allowed results to easily be compared quantitatively. The questions for these interviews, along with our oral consent script can be found in Appendix B.

We began our interview process by conducting interviews with QLs. From there, we interviewed TQASs and finally SPEs who were recommended by previous interviewees through the snowball method of sample selection. The snowball selection method is performed by asking interviewees for other employees whom they believe could benefit our project through an interview. Choosing this method allowed us to interview employees we wouldn't have considered otherwise and helped make sure that our interviewees had relevant information for our project.

Interviewees were questioned about what data they wanted and would find most useful, and about various ways they would like to have the data presented to them. To limit biasing opinions within the interviews, interviewees were first asked to provide suggestions on what types of data they were looking for along with what presentation methods they found useful. We then went into more detail on what data and presentation methods we believe they would find useful from ideas that were provided to us by our liaison, Martin Rater, the Acting Director of the OPQA. In this way, the interviewee's ideas of how data should be presented would not be skewed to match one of the methods we were already considering. Qualitative responses were then coded by keywords and phrases and sorted based on frequency. In the first section of the interview we looked for mentions of fields from the MRF on which to focus our analysis, as well as for specific types of analysis that may need to be conducted. In the second section we looked for mentions of certain reporting types, as well as positive and negative characteristics of these reports. In addition to coding, ordinal data concerning the styles of reporting models was collected by having interviewees rank reports from 1 to 10, where 1 is not useful at all and 10 is most useful. This combination of data types allows us to get a comprehensive picture of USPTO employee needs.

3.2 Objective 2: Analyze Master Review Form Data

To accomplish our goal of discovering potential patent quality issues, our team analyzed data that had already been collected on the quality of patent examinations through the MRF. We looked for relationships between the overall clarity and correctness of patent reviews and individual examination components, such as explanations of rejections. In addition, we began a

preliminary exploration of trends seen in Technology Centers (TCs), Work Group and Art Units, as well as trends based on individual reviewers.

To begin, we looked at office action reviews collected by versions 1.0 to 2.01 of the MRF, provided to us by Martin Rater. We first separated the data into different categories based on which areas of patent law that a question concerns. Each section contains an overall correctness and overall clarity field, as well as additional sub-questions which help identify exactly which portions of the examiner's decisions are not meeting the USPTO standards of quality. We began our comparisons by looking at the overall clarity and correctness scores for each statute. This helped us see any relationships that may exist between the two fields. We then compared the results of the statute's sub-questions to the overall correctness and clarity fields. These comparisons were used to help identify which specific areas of the examination process seem to result in actions of insufficient quality. In addition, we filtered data by various examiner groupings, such as the TCs that examiners are a part of, or the Work Groups and Art Units within these TCs. This allowed us to see which groups of examiners have the most significant issues in terms of quality and clarity. We used two main tools to filter the data, Microsoft Excel's pivot tables and Microsoft Access. These allowed us to compare a large number of data fields relatively quickly to find results.

After the results were organized, statistical significance testing was performed on appropriate data sets in order to determine whether or not the differences in data warranted additional attention. General significance testing using the average sample size and characteristic was done in order to visualize statistically significant results (see Section 2.4.2). For future analysis, individual confidence intervals can be calculated for each grouping, allowing more accurate statistical significance. Significance testing was necessary for the TC, Work Group, and Art Unit breakdowns for statute overall correctness and clarity. This was done by calculating the average sample size of each grouping, along with the characteristic, or the average percent of Significant Deficiency (SD) or Needs Attention (AT) reviews found. Using the sample size and characteristic, a general 95% confidence interval was created for each finding. If a perceived difference is outside the confidence interval, it is considered a statistically significant difference. This then allowed us to use the characteristic and the allowed tolerance to calculate an estimation of the valid sample size needed for a difference to be significant under a 95% confidence interval.

3.3 Objective 3: Develop Data Reporting Model

Using the data, we gathered throughout our interviews found within objective 1, we were able to identify the most popular forms for reporting the collected data. We then identified the features that made this form of reporting most popular, as well as characteristics that employees feared may become potential problems. We also organized these features based on importance by coding interviewee responses. This information could then later be used to create a decision matrix to help guide the development of the selected reporting method.

3.3.1 Snapshot

One form of presenting data is the Snapshot. The goal of the Snapshot is to present data in a format that is easily readable and that can be understood quickly. Snapshots often use graphs, such as tables or charts, to display data in a format that can be read and interpreted quickly without the need for further analysis. In the context of MRF data, a Snapshot would likely consist of individual dashboards for TCs, Work Groups and Art Units reporting on the number of examinations that were rated No Issues Found (OK), AT or SD. This way only the most relevant data would be seen by the user, preventing unnecessary analysis.

3.3.2 Canned Report

The team also considered a Canned Report to present the collected data. The purpose of the report is to allow the user to read and understand data that has already been analyzed, with the use of graphs, tables and bar charts so no additional manipulation of data is required. In addition to graphs and figures, text explanations are provided to better explain the conclusions that were made by analysis. For MRF analysis, a single report would likely be used to communicate data to all employees in every TC including as much information as possible. Due to this, proper labeling and organization of reports are needed to ensure employees can easily find the data they need.

3.3.3 Ad Hoc Analysis

The last form of data reporting that we looked at was Ad Hoc analysis. This form of data presentation requires additional manipulation of data on the user end of the platform. Using an Ad Hoc tool allows employees to customize the data they are looking at by filtering it on an individual level. Because Ad Hoc analysis would involve introducing a new tool to employees, it would likely require training sessions to ensure that the users could fully take advantage of every feature. Using Ad Hoc at the USPTO would mean that employees would generate their own reports, ensuring that they get exactly what they need.

3.4 Project Timeline

During our time at the USPTO, our team followed a structured schedule to make sure all tasks were completed. To display our timeline, we created a Gantt chart. On the chart, each row represents a certain task where each column represents how long the certain task took to complete as shown in Figure 1.

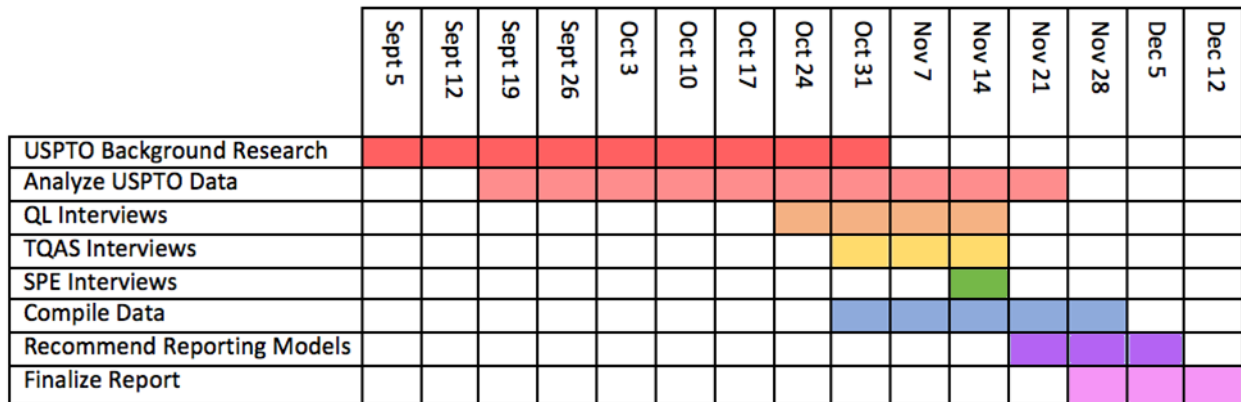


Figure 2- Gantt Chart, Project Timeline

During WPI’s first terms of classes in the 2016 academic year, starting August 25th and ending October 13th, our team worked on constructing the Introduction, Background and starting the Methods section of the report. We also began analyzing data sent by Martin Rater to begin familiarizing ourselves with the MRF. When we first arrived at the USPTO, our team reached out to QLs to set up interview dates and worked on analyzing data. At the start of the second

week we began interviews with QLs and sent emails to both SPEs and TQASs to set up dates for interviews. The specifics and details of all interviews are discussed in depth in the following chapter. After all data was gathered, we compiled the data and begin creating reports to provide to the USPTO.

Chapter 4: Findings and Results

This chapter contains the results of our objectives outlined in Chapter 3. We begin by presenting the results of the interviews conducted with United States Patent and Trademark Office (USPTO) employees. This is followed by analysis of Master Review Form (MRF) data and related findings.

4.1 Objective 1: Needs of USPTO Management Regarding Collected Data

After conducting interviews with eight Quality Leads (QLs), six Training Quality Assurance Specialists (TQASs) and two Supervisory Patent Examiners (SPEs), their responses were recorded, reviewed and summarized. Initially, responses were separated into two categories, data needs and reporting design needs. After the data was separated into these categories, the responses were coded and analyzed. Responses were organized into specific groups by keywords and the response rates were then added.

4.1.1 Master Review Form Data Reporting Needs

There were three questions classified as concerning data needs (for interview questions and interview script, see Appendix B). The first two questions, 1.1 and 1.2, were primarily icebreaker questions used to give context to the following discussion. Question 1.3 regarded the use of MRF Data by the employee's position and by the USPTO as a whole. These questions were used to determine what data collected by the MRF would be most useful to be reported back to the interviewee. These two questions were coded based on the frequency of responses. Figure 3 below shows a word cloud of interviewee responses to question 1. In the word cloud, responses that are displayed bolder and larger are responses that occurred more frequently within the interview.

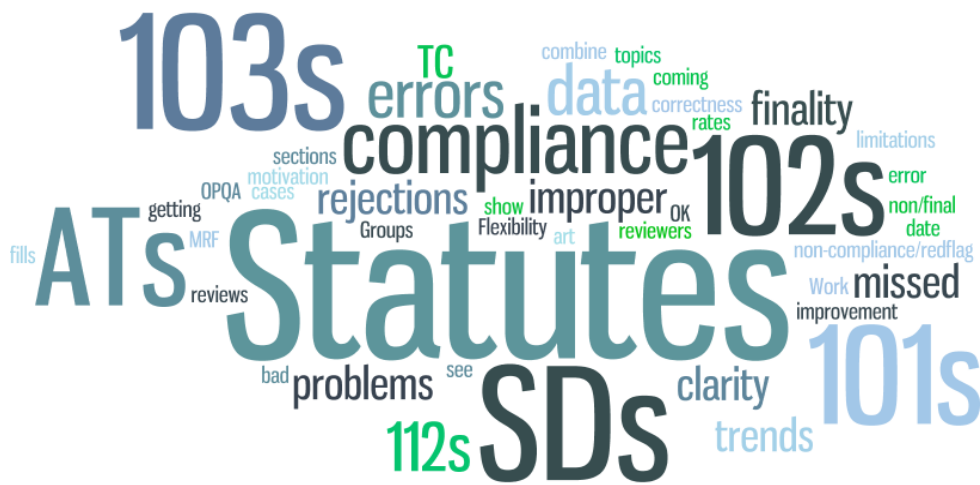


Figure 3- Word Cloud of Interviewee Responses to Question 1.3

From the word cloud it is clear that employees care most about which statutes the data relates to as well as whether or not the review was ranked Needs Attention (AT) or Significantly Deficient (SD). In particular, employees cared most about statutes 101 (usefulness), 102 (prior art) and 103 (obviousness). The interviewees also mentioned statute compliance, the terminology used in the most recent version of the MRF to describe review ratings. Compliant refers to No Issues Found (OK) reviews, partially compliant refers to AT reviews and non-compliant refers to SD reviews. This allows them to see exactly where the issue lied in the examination. These responses embody what employees are looking for in the MRF data and what they want to be reported to them.

4.1.2 Internal Report Design Needs

Thirteen interview questions were drafted concerning the design of reports. Of these questions, 2.1 and 2.5 a-c were the primary focus of our coding and analysis. Question 2.1 asked the interviewee for an example of a way that data had been reported to them in the past that was clear and effective. The most popular answer to this question was that employees preferred receiving data directly in an Excel spreadsheet, allowing them to perform their own analysis, as seen in figure 4 below.

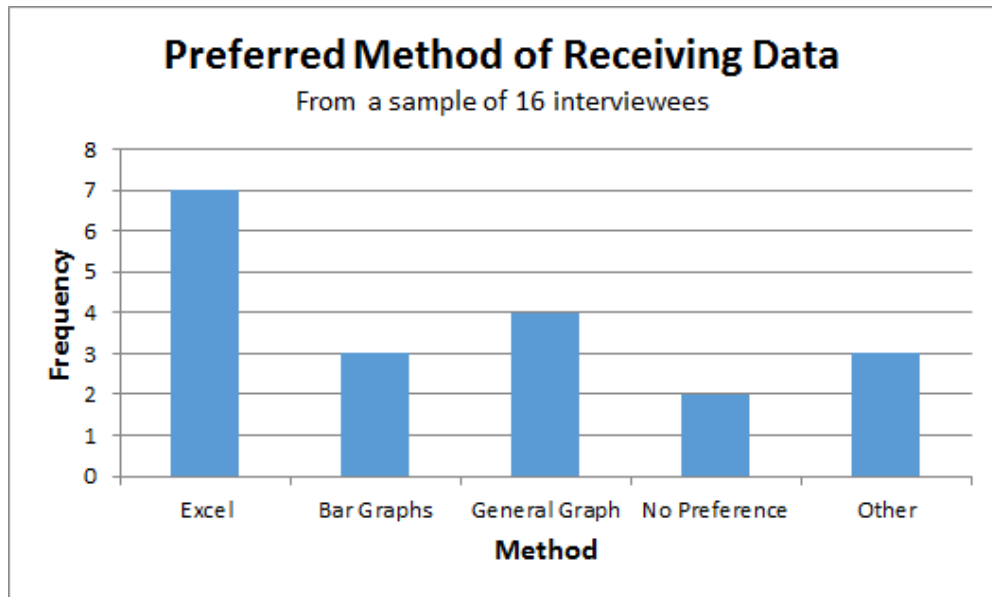


Figure 4- Preferred Method of Receiving Data Based on Interview Responses

While questions 2.2 through 2.4 asked them specific advantages and disadvantages of this example. Question 2.5 a-c asked for opinions about three types of reports that were being considered: Snapshots, Canned Reports and Ad Hoc analysis. Questions 2.8, 2.9 and 2.10 responses were recorded as ordinal data and therefore did not need to be coded before analysis. The remaining questions were used to provide context to the coded responses and were summarized to better understand and explain the results of the analysis of the coded responses.

Questions 2.8 through 2.10 discuss the three reporting methods by having interviewees score each report from 1 to 10 based on usefulness, as seen in figure 5 below. This graph indicates that most employees found the Ad Hoc Analysis style of reporting to be highly useful. Canned Reports were ranked lowest on average suggesting that they would be the least useful report. However, all three reporting models were ranked as having above average usefulness. This could mean that employees have a use for all three forms of reporting, or that all three methods are desirable in comparison to what they are currently receiving.

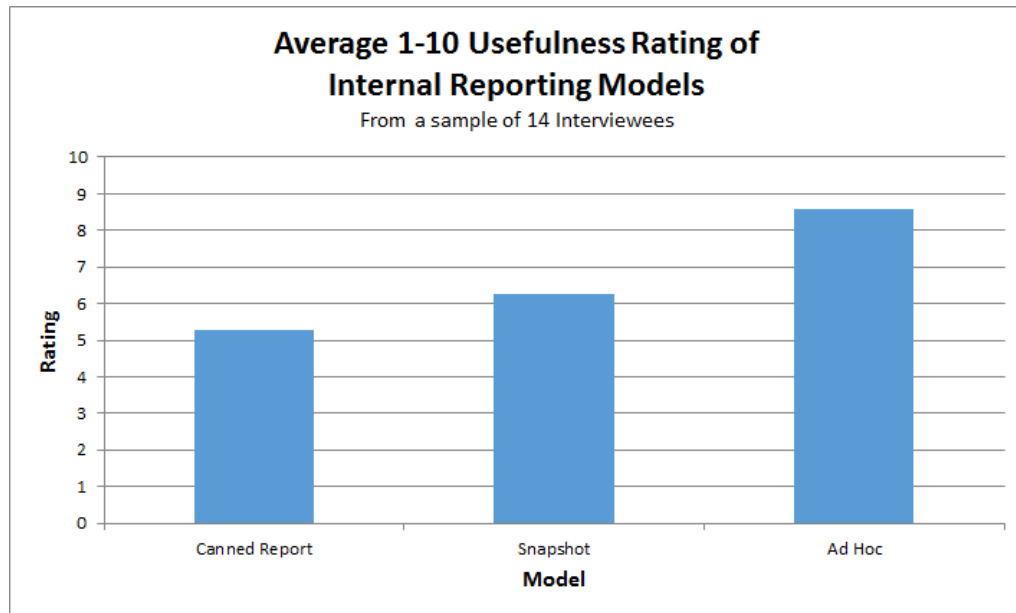


Figure 5- Average Rating of the Three Models Presented During Interviews

Because Ad-Hoc reporting received the highest rating, we prioritized analysis of question 2.5c response, which concerned the pros and cons of Ad-Hoc analysis. Figures 6 and 7 below show the results of 2.5c. From these figures we can see that employees identified customizability as the chief advantage of Ad Hoc analysis, while also identifying the ability to sort or filter results and the familiar format as benefits of using this model. Several employees also mentioned the usefulness of being able to perform the analysis themselves without relying on anyone else. However, there were also concerns about the learning curve of using this type of tool, as well about the process of training sessions being time consuming and results looking cluttered. Some employees also felt that Ad-Hoc software was not an appropriate form of reporting because using it was not a part of their job. Both the positive and negative attributes suggested were taken into consideration when developing a decision matrix for selection of an Ad-Hoc tool as discussed in section 5.

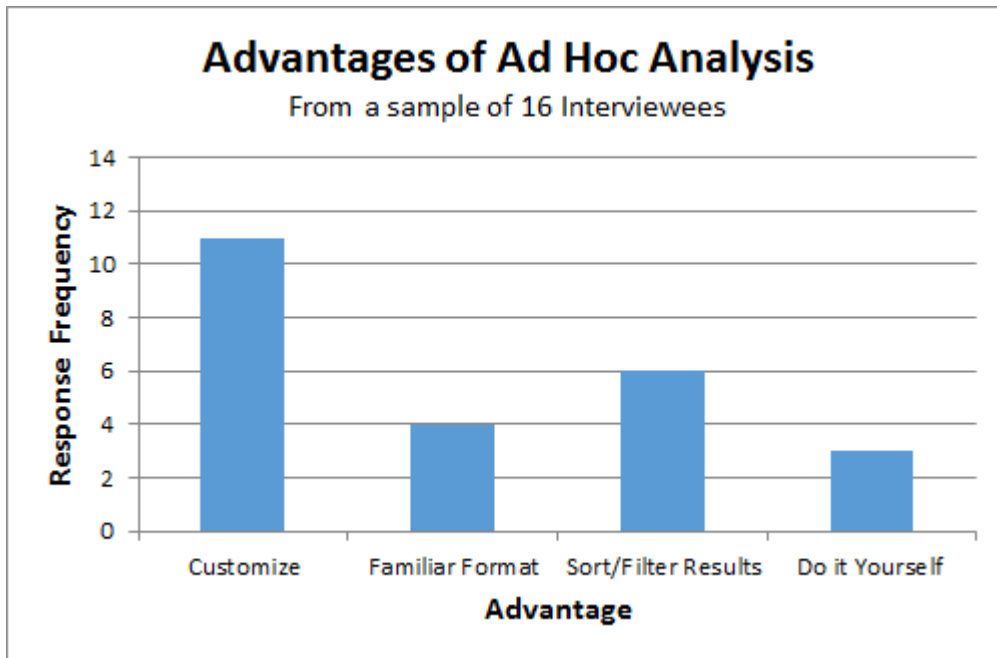


Figure 6- Advantages of Ad Hoc Analysis Based on Interview Responses

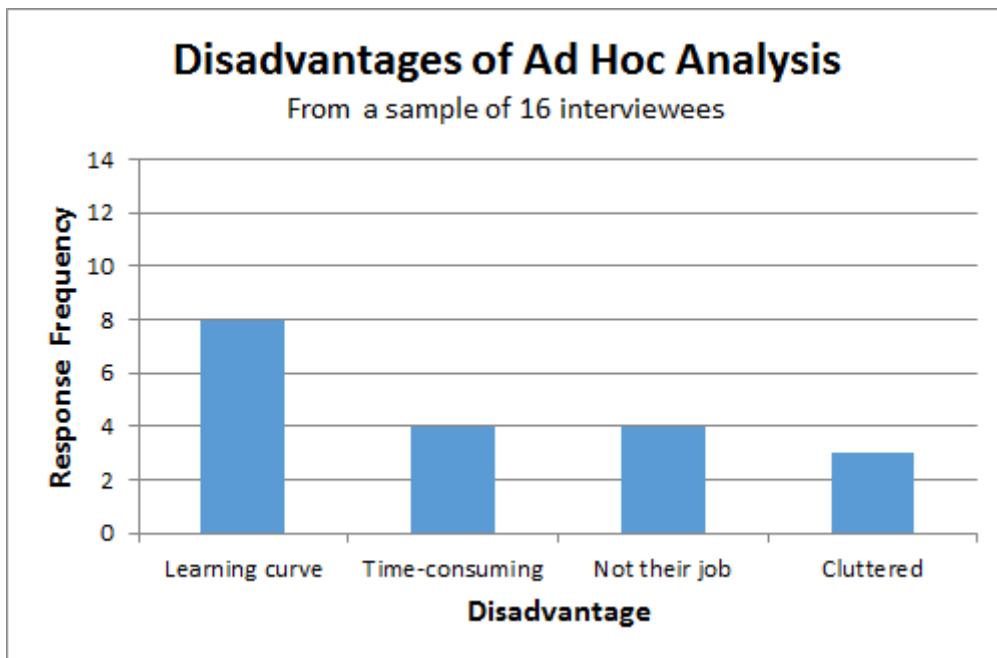


Figure 7- Disadvantages of Ad Hoc Analysis Based on Interview Responses

We also analyzed questions 2.5a and 2.5b in order to see if employees had similar compliments and complaints about Canned Reports and Snapshots. The purpose of analyzing these questions after deciding to go with Ad Hoc is for future reports. The results are shown in figures 8 and 9, respectively. The figures show that employees frequently mentioned the inclusion of necessary info and the usage of tables as advantages of a Canned Report model; however, they cite the lack of customizability, as well as the potential problem with including too much information, as disadvantages of the model.

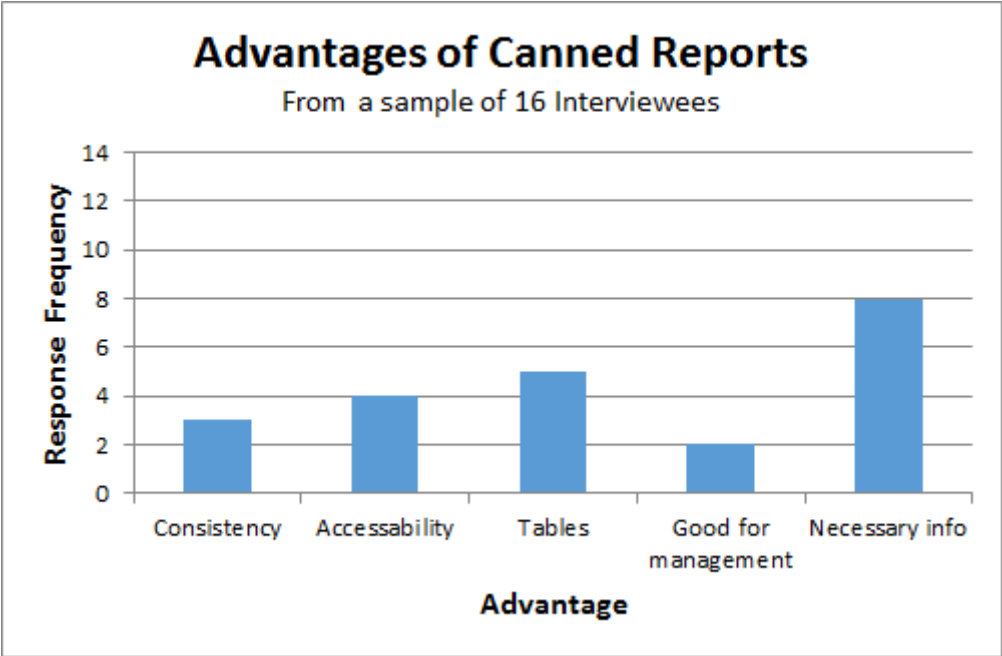


Figure 8- Advantages of Canned Reports Based on Interview Responses

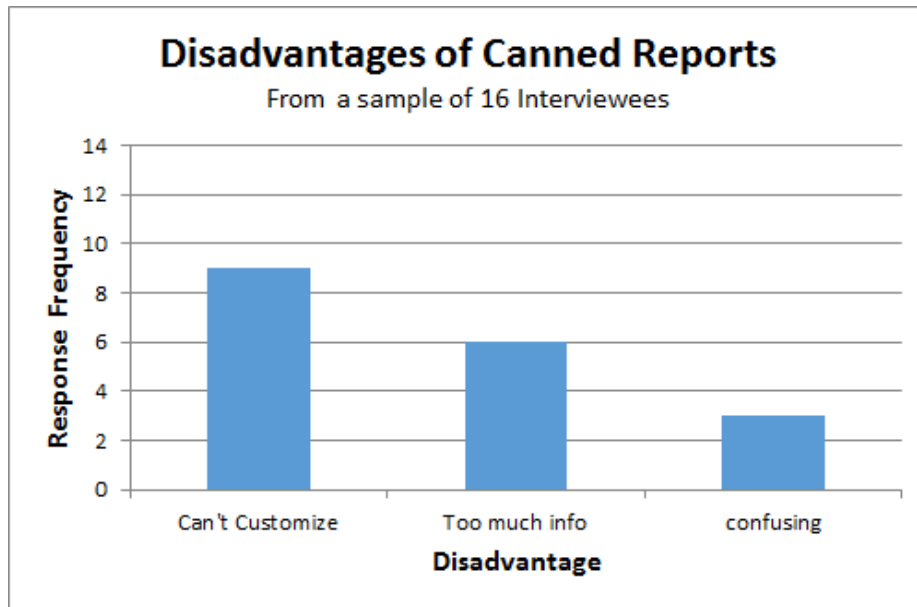


Figure 9- Disadvantages of Canned Reports Based on Interview Responses

Figures 10 and 11 indicate that the simplicity and flexibility of a Snapshot model, as well as the inclusion of key data points, are its chief advantages, while the lack of detailed information is the main disadvantage. There were also concerns that the Snapshot model could be oversimplified, even to the point of being misleading in some cases.

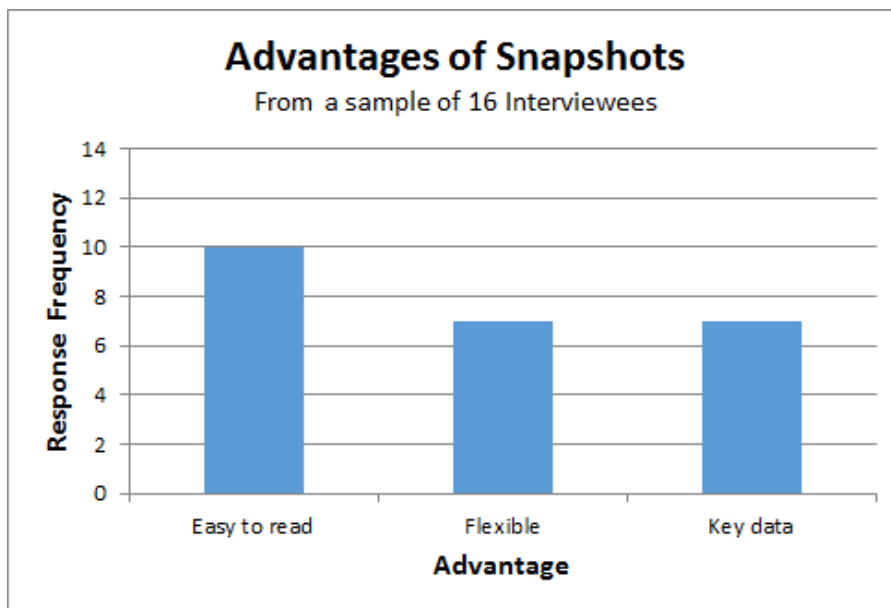


Figure 10- Advantages of Snapshots Based on Interview Responses

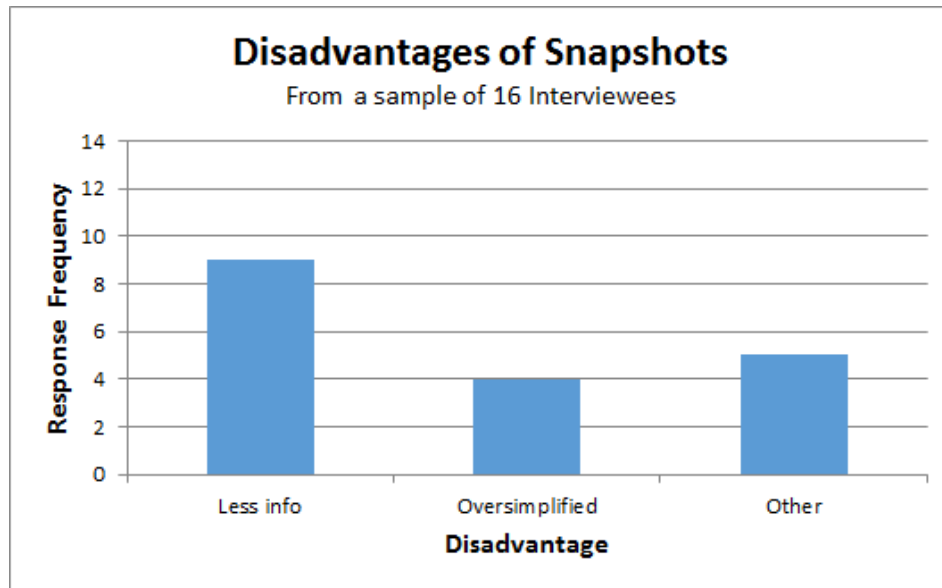


Figure 11- Disadvantages of Snapshots Based on Interview Responses

4.1.3 Limitations

There were several challenges associated with coding and analyzing interviewee responses. Although steps were taken to avoid introducing bias into the interview sample, we cannot be certain that no bias was introduced throughout the process. In particular, questions 2.8 through 2.10 were changed to be clearer after the first two interviews, which we believe resulted in the interviewees' rating of all three reporting methods to be higher than they would have been otherwise. The other major restriction of our interview process is the sample size. This is mainly due to time constraints. We were only able to interview 16 USPTO employees from only the QL, TQAS and SPE positions. It is important to consider that, while our data provides a window into the data reporting needs of the USPTO, it does not fully reflect the opinions of every position in the USPTO.

4.2 Objective 2: Analysis of Master Review Form Data

Our team worked to organize the data collected by the MRF, then analyze and draw conclusions from the information. Our team received 11,682 reviews that had been collected. While the MRF contains 395 questions concerning several different sections of patent law, we

chose to focus on only the questions concerning statutes 102 (prior art) and 103 (obviousness) of the US Code, as the majority of reviews concerned these subjects, as can be seen in Figure 12.

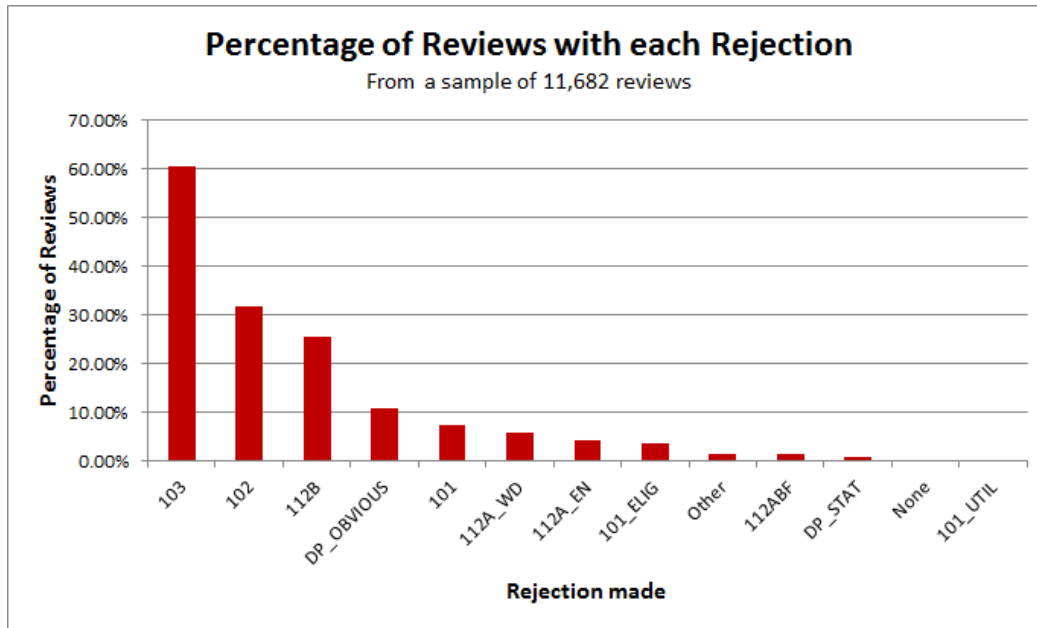


Figure 12- Percentage of Reviews Rejected by Statute

Each statute has a question concerning the overall clarity of examinations and another question concerning overall correctness. These questions describe the examinations as being OK, AT, and SD. Our first step was to compare just the overall clarity and correctness of each field. Secondly, we compared these two fields to the more specific questions of each statute. Lastly, we looked at the data by Technology Center (TC) and individual reviewer.

4.2.1 Comparison of Overall Correctness and Clarity for 102 and 103

To compare overall clarity and overall correctness, we counted the number of OK, AT and SD reviews for both the clarity and correctness fields. We then looked for patterns between which ranking an examination received for clarity and which ranking an examination received for correctness. Table 2, below, displays the number of examinations that received each possible combination of clarity and correctness ranking for statute 102. For example, the first row shows that 2790 examinations received a score of OK for both clarity and correctness, 173 received an OK clarity score and an AT correctness score, and 70 received on OK clarity score and an SD

correctness score. This shows that examinations with OK clarity scores tend to also receive OK correctness scores. Similarly, observing the first column shows that most examinations that received an OK correctness score also received an OK clarity score.

The AT clarity row, however, shows that a similar number of examinations with an AT in clarity received OK or AT ranking in correctness. A similar observation can be made from the AT correctness column. These observations suggest that conclusions about correctness cannot be made from AT clarity scores alone and clarity score conclusions cannot be made solely from AT correctness scores.

The SD clarity row shows that most examinations with an SD in clarity also received an SD in correctness. Looking at the SD correctness column shows that examinations with SD in correctness are spread close to evenly among the three clarity rankings; of the reviews rated SD for correctness, 70 were rated OK for clarity, 63 were rated AT for clarity and 71 were rated SD for clarity. Because these numbers are so close in value, we can conclude that there is no consistent relationship between SD correctness and SD clarity.

After analyzing each column individually, the table can be observed in a more general aspect, using percentages of the overall 102 total. While adding up the ‘perfect cases’, or cases that receive the same rating in both clarity and correctness, it can be seen that 85% (75% + 8% + 2%) of reviews received the same rating in both clarity and correctness. These perfect cases are indicated by the shaded boxes. This confirms that there is a strong relationship between overall clarity and correctness.

102 Comparison of Overall Scores (From a sample of 3,711)	Correctness		
Clarity	OK	AT	SD
OK	2,790 (75% of total)	173	70
AT	259	280 (8%)	63
SD	1	4	71 (2%)

Table 2- Comparison of 102 Overall Correctness and Overall Clarity

After analyzing table 3, it is apparent that clarity and correctness for statute 103 are distributed in similar patterns to statute 102. As seen in 102, after adding up the ‘perfect case’, 85% (74% + 9% + 2%) of reviews also received the same rating in both clarity and correctness. This result in both statute 102 and 103 comparisons suggests that clarity and correctness could have a strong relationship throughout all statutes.

103 Comparison of Overall Scores (From a sample of 7,073)	Correctness		
Clarity	OK	AT	SD
OK	5,269 (74% of total)	275	120
AT	521	651 (9%)	101
SD	2	7	127 (2%)

Table 3- Comparison of 103 Overall Correctness and Overall Clarity

Further analysis of 102 and 103 clarity allows additional observations to be made about the relationship between overall clarity and correctness. If a case is clear, it is 2.5 times more likely to be correct. This can be found by looking at 103 rejections (Table 3); if a case is unclear (AT or SD in clarity), there is a 37% chance $\left(\frac{521+2}{521+651+101+2+7+127}\right)$ of it also being correct. However, if a case is clear (OK in clarity), there is a 93% chance $\left(\frac{5269}{5269+275+120}\right)$ of it being correct. Calculations for the 102 statute are extremely similar, at 38% and 92% respectively. This suggests that an examiner who makes the correct decision on a patent application is more likely to be able to explain his or her decision clearly.

4.2.2 Analysis of Individual Questions Based on Clarity and Correctness

For our analysis, the overall correctness and clarity scores are being used to indicate the overall quality of a patent examination. However, this does not mean that they are the only important questions on the MRF. For each statute, there are a number of features, such as clear annotations, that may or may not be included in an examination. We took a closer look at the

inclusion of these features to see if this had an effect on the overall clarity and correctness scores and thus on the overall quality of an examination.

To more closely examine the inclusion of various features, we decided to look at their effect on clarity and correctness separately. For the clarity and correctness of each statute, we found the percentage of OK ranked examinations that included a given feature. We then looked at the percentage of SD and AT ranked examinations that included that feature. For an explanation of why the SD and AT ranking were combined for this analysis, see section 4.2.2.1. Figure 13 compares the percentage of OK examinations that included a given feature side by side with the percentage of SD and AT examinations that included that feature.

By observing features that were included in most OK reviews but excluded from most SD and AT reviews, we can identify these features as driving the overall clarity for 102. These drivers can then be considered as possible drivers of overall quality. An example of this type of driver is clear annotations. You can see from figure 12 that 90% of reviews rated OK for overall clarity included clear annotations, whereas only 28% of reviews rated SD or AT included this feature. This suggests that the inclusion of clear annotations is an indication of overall clarity for 102 reviews. Conversely, features that were included or excluded in the majority of all reviews, regardless of ranking, such as Effective Date OK, likely do not affect the overall clarity score or overall quality. This suggests that these questions could be removed from the MRF to save time and simplify the output, without affecting the overall results. These types of comparisons were also conducted for 102 correctness, as well as for 103 clarity and correctness as can be seen in Appendix C.

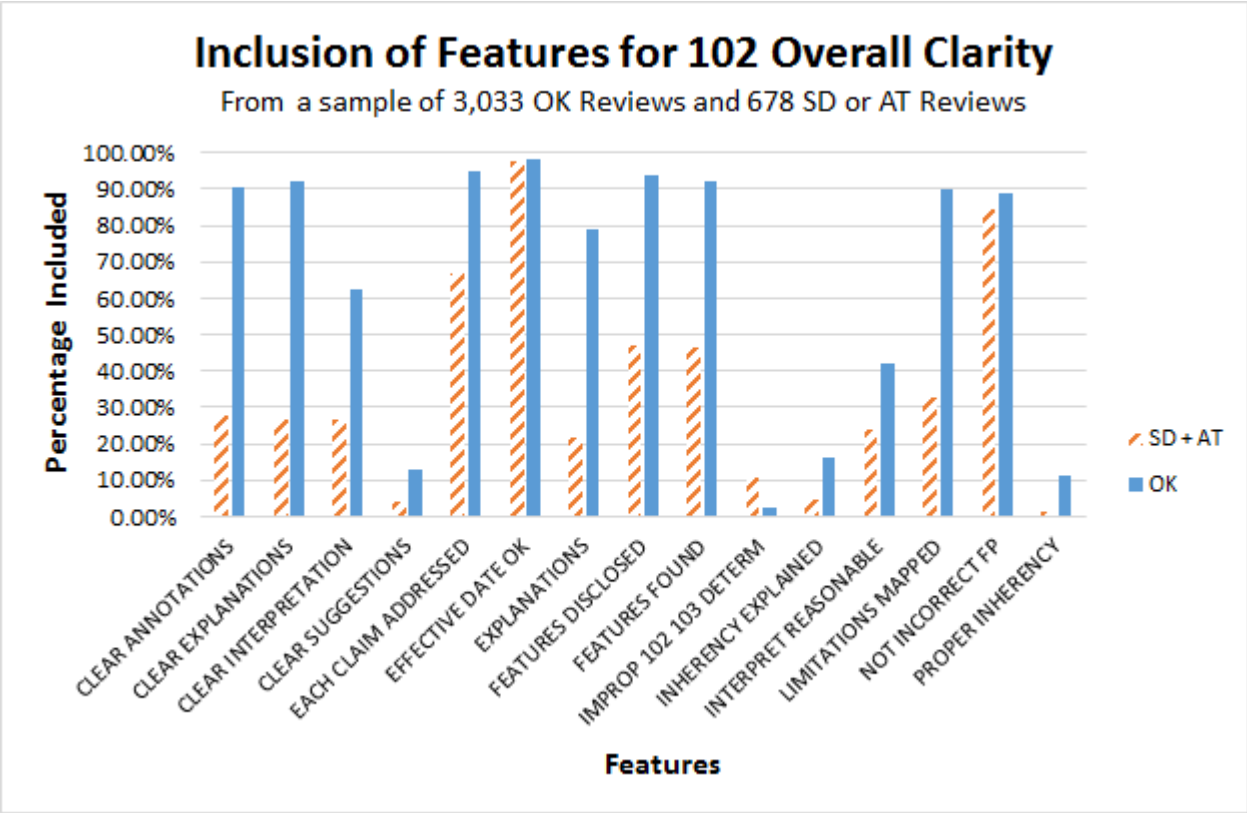


Figure 13- Feature Inclusion Percentage for 102 Overall Clarity Reviews

4.2.2.1 Combining the Needs Attention and Significantly Deficient Fields

In the graphs that we created, we combine SD and AT reviews together for comparison. Although SD and AT denote a different severity of issues, there is a potential overlap with the definitions of SD and AT, making it possible for one reviewer to give an SD, while another reviewer would have given the same examination an AT. This overlap should either be corrected, or SD and AT should be combined in order to eliminate reviewer bias. Being able to compare the reviews with problems to the reviews without problems directly allows meaningful comparisons with two fields. In addition, from interviews there was a sense that ATs and SDs were treated more similarly by employees. To definitively answer this question, we determined whether reviews rated as AT behaved most like OK or SD reviews. We first found the percentage of OK, AT and SD examinations that included specific features in 102 and 103 reviews. We then found the average difference in these values between AT and SD percentages and between AT and OK percentages for 102 and 103 overall clarity and correctness. By taking the average percent difference for all features combined, we could find whether AT reviews were most similar on

average to OK or SD reviews. We found that for 102 reviews, AT and OK reviews had an average difference of 16.31%, while AT and SD reviews had an average difference of 10.15%; for 103 reviews, AT and OK reviews had an average difference of 13.95% while AT and SD reviews had an average difference of 8.95%. Full results can be found in Appendix B. We could determine that AT reviews were, on average, most similar to SD reviews, because the average difference was smaller.

4.2.3 Context-Based Analysis

In addition to understanding trends for the entire USPTO, it was important to see how different groups of examiners were performing. Specifically, we examined the overall correctness and clarity of reviews for 102 and 103 rejections for each TC. By seeing how many of these reviews were rated as AT or SD for each TC, we can quickly view which TCs have the most room for improvement and in which areas. Paired with more specific analysis of individual questions as seen in section 4.2.2, this can guide training and improvement in the USPTO to the areas which need it most. Figures 14 through 17 show the breakdown of AT and SD reviews for each TC for 102 and 103 reviews in overall correctness and overall clarity. In these images, the value above the bar represents the sample size for that specific category. The two horizontal blue lines represent the confidence interval; the lower line represents the lower bound of the interval, and the upper line represents the upper bound of the interval.

While collecting data from any source, the sample size estimation equation suggests a minimum of 384 reviews in order to maintain statistical validity under a 95% confidence interval with a sampling error margin of 0.5%. Since the MRF is still in its first year of development, many groupings such as TCs, and more specifically Work Groups and Art Units, do not yet have 384 reviews. As the Master Review Form grows, more random reviews will be done and therefore more groupings will meet this recommended sample size. Preliminary conclusions can still be made about groupings with roughly over 300 reviews, such as TC 1600 in Figure 14 with 308 reviews, without greatly lowering the confidence level. However, valid conclusions cannot be made about a grouping such a TC 2900 in Figure 14 with only 15 reviews.

For 102 overall correctness (Figure 14), it can be seen that both TC 1600 and TC 3600 are above the confidence interval, and therefore have statistically significantly more

examinations marked AT and SD than other TCs. TC 2900 is also above the interval, but does not have a sufficiently large sample size and a valid conclusion cannot be drawn. Through these preliminary conclusions, more research can be done on these TCs, such as a breakdown by Work Group and Art Unit. Further research would tell if these TCs are actually having difficulty with examining correctness concerning statute 102, and if training is necessary to correct any issues the TC may be having.

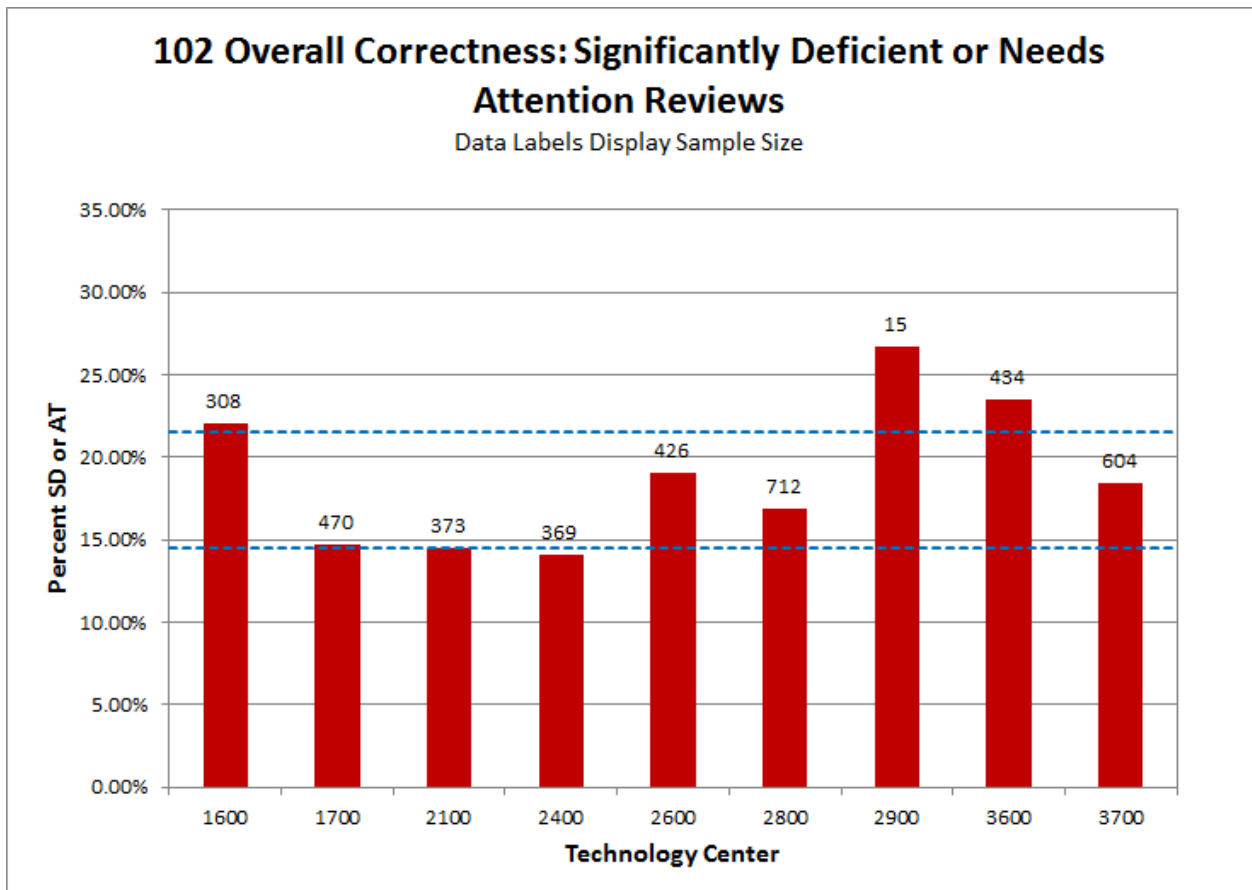


Figure 14- Percentage of 102 Overall Correctness Reviews Rated SD or AT in Each Technology Center

For 103 overall correctness (Figure 15), TC 2400, TC 3600, and TC 3700 are all above the confidence interval and therefore have statistically significantly more examinations marked SD and AT than other TCs. A noticeable trend can be found when comparing the percentage of SD and AT cases in both figures; TC 3600 has a statistically significantly higher percentage of SD and AT reviews for both 102 and 103 overall correctness than any other TC. On the other

end, TC 2100 is well under the confidence interval, therefore having statistically significantly less examinations marked SD and AT than other TCs.

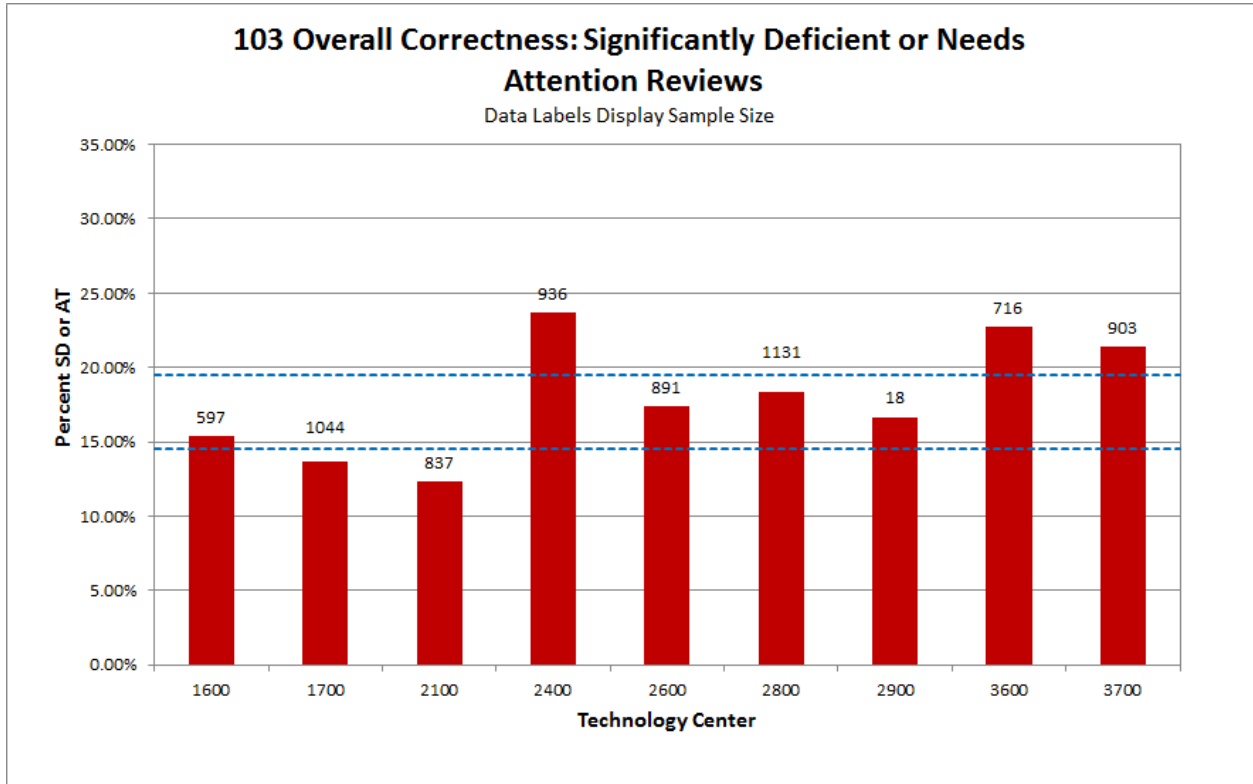


Figure 15- Percentage of 103 Overall Correctness SD or AT in Each Technology Center

For 102 overall clarity (Figure 16), TC 1600, TC 2600, and TC 3600 are all above the confidence interval. However, TC 2400 and TC 3700 is below the confidence interval.

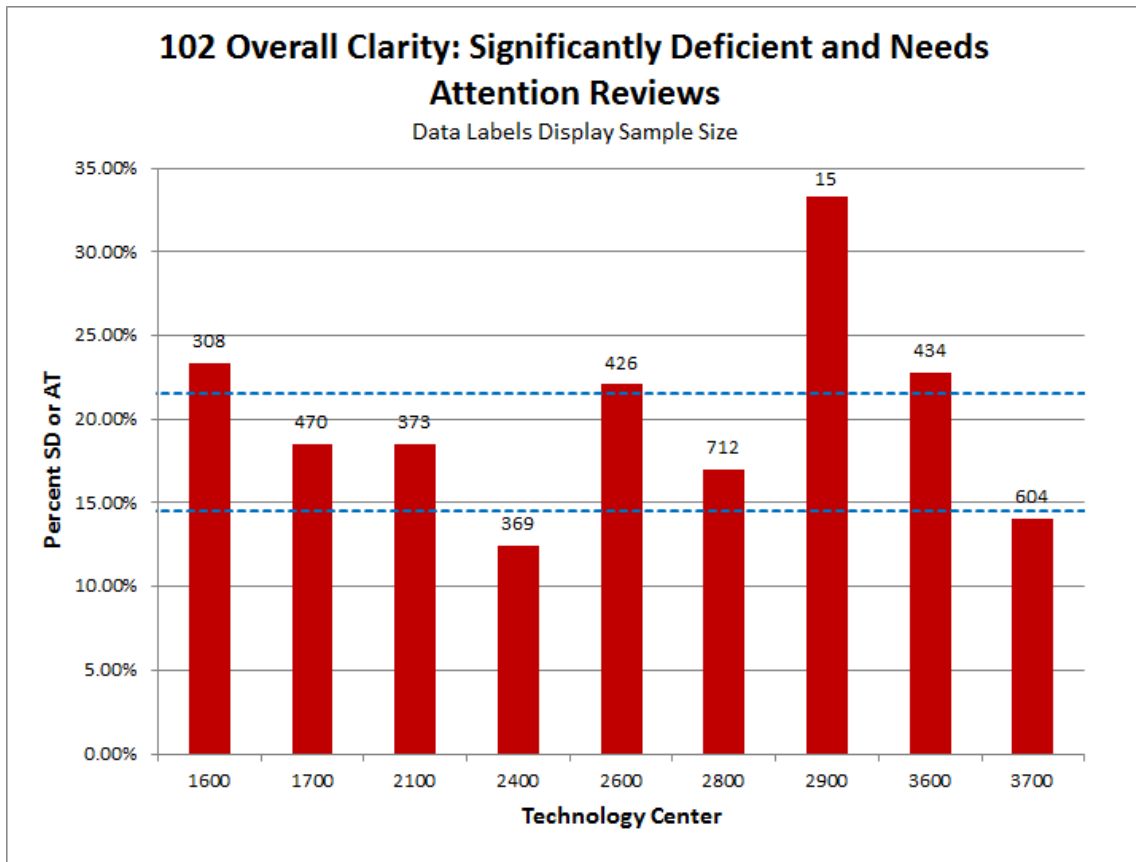


Figure 16- Percentage of 102 Overall Clarity Reviews rated SD or AT in Each Technology Center

For 103 overall clarity (Figure 17), TC 3600 stands out as the only TC above the confidence interval. On the other hand, TC 1600 is below the confidence interval.

TC 3600 has consistently been above the confidence interval for 102 and 103 overall clarity and correctness. This could be due to the subject difficulty TC 3600 has to examine, and could warrant further investigation in order to improve accuracy.

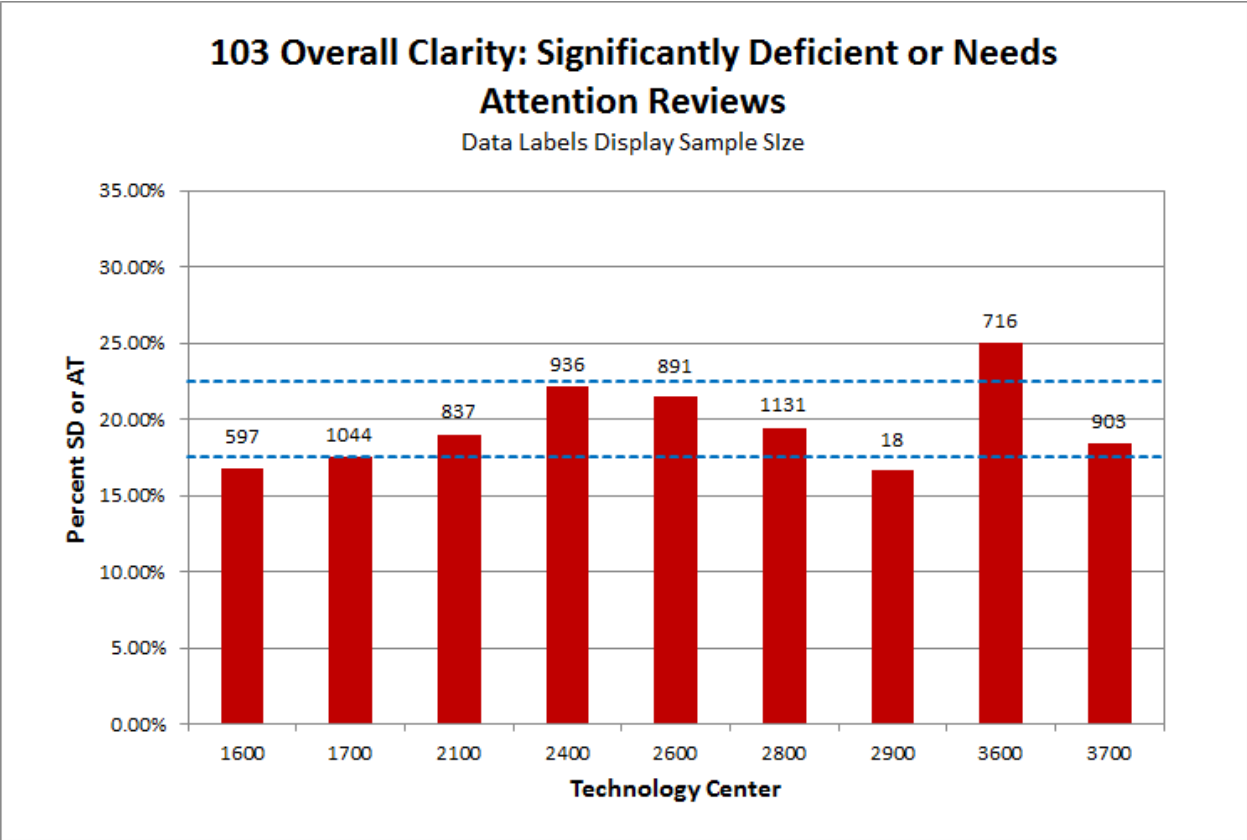


Figure 17- Percentage of 103 Overall Clarity SD or AT in Each Technology Center

This type of analysis can be extended to other groupings. For example, each TC contains numerous Work Groups, which contain around 100 examiners. Figure 18 shows the percentage of 103 reviews that were SD and AT in TC 2400, which covers patents related to networking, multiplexing, cable and security (USPTO, 2016e), broken down by each Work Group in that TC. After the data has been collected, smaller groupings require a smaller sample size. The sample size estimation equation suggests that a Work Group should have at least 80 reviews to be statistically valid. The downside of a smaller sample size is that the confidence interval tends to be much larger, meaning fewer results can be considered statistically significant. However, visual differences in the graph can still be used to monitor these Work Groups as the sample size grows.

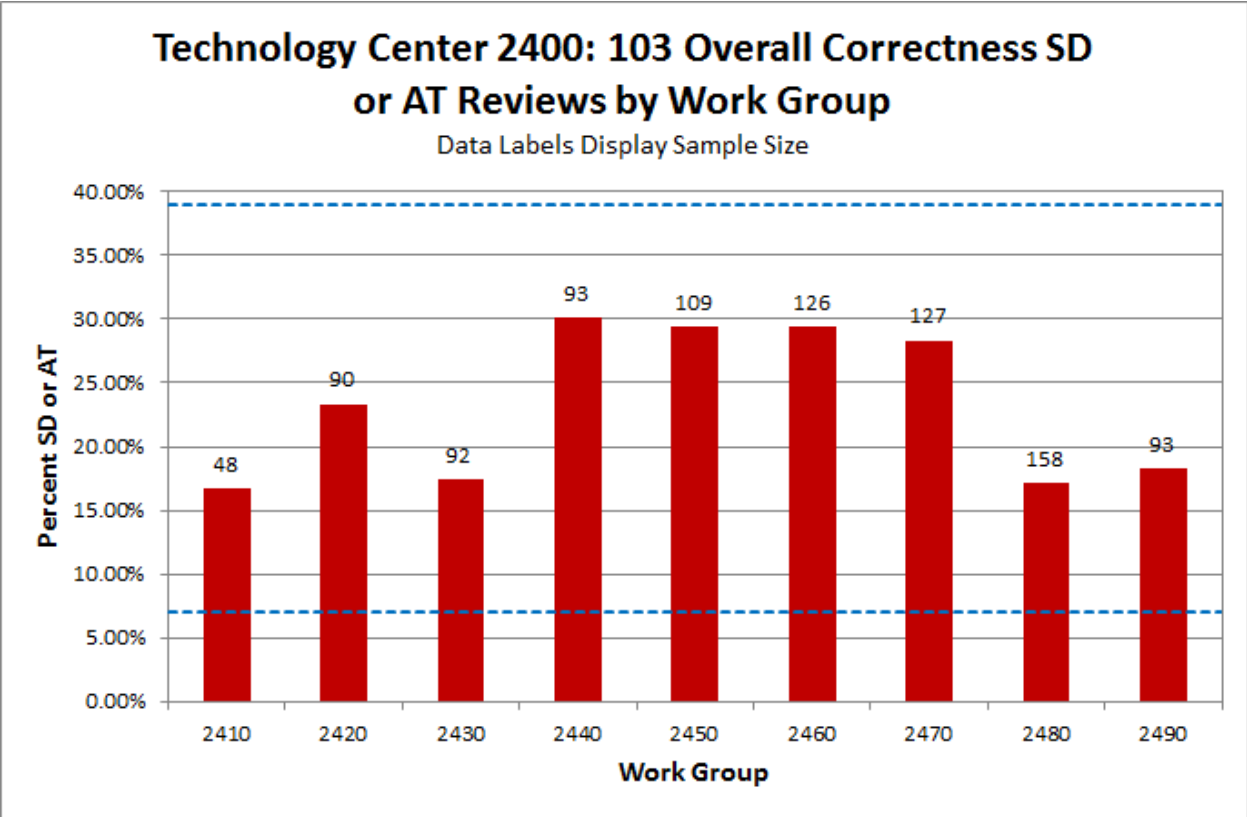


Figure 18- Percentage of 103 Overall Correctness SD or AT in Each Work Group

Each Work Group can be further broken down into Art Units, which generally contain around 10 Examiners each. We can examine the SD and AT percentages for the Art Units in Work Group 2440, as shown in figure 19. Since Art Units are even smaller, the sample size estimation equations suggest that an Art Unit should have at least 10 reviews to be statistically valid. Again, due to the small sample size, no results are statistically significant. However, as mentioned above, visual differences in the graph can still be used to monitor these Art Units as the sample size grows.

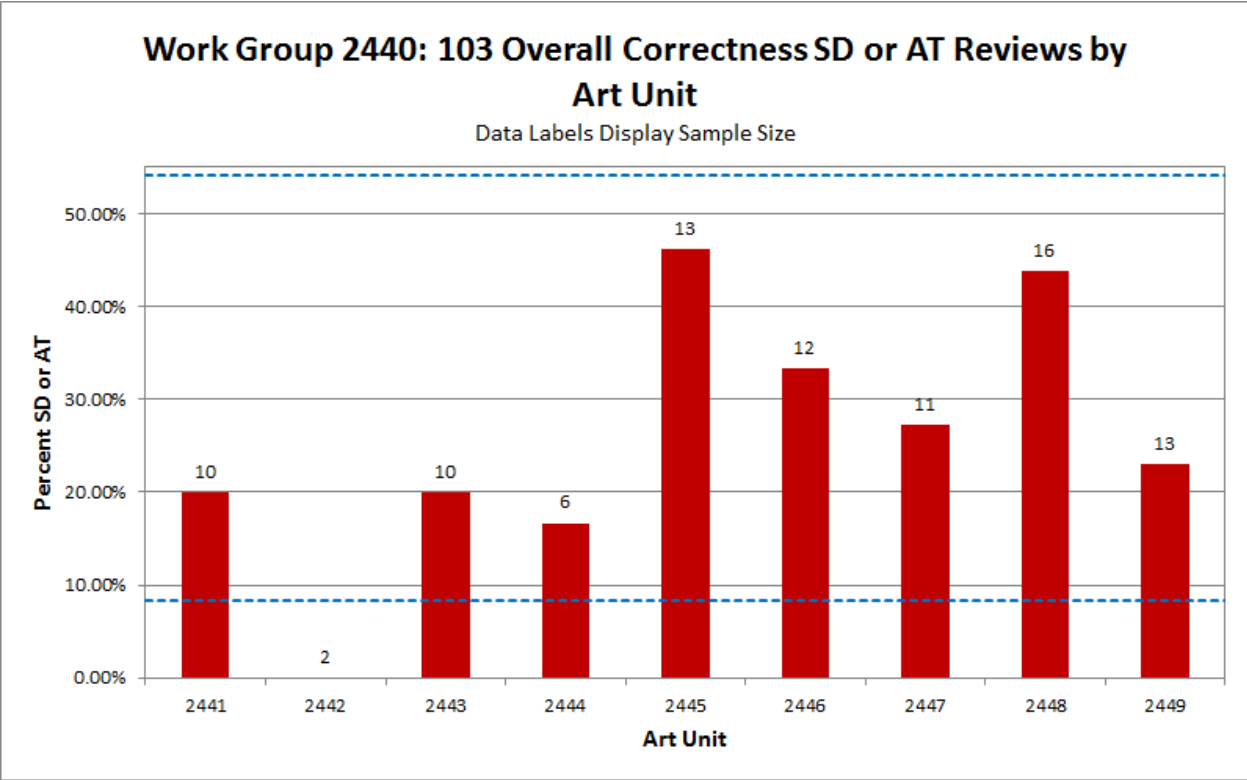


Figure 19- Percentage of 103 Overall Correctness SD or AT in Each Art Unit

Chapter 5: Proposed Modeling for Reporting Needs

A major goal of this project was identifying the best methods of internally reporting Master Review Form (MRF) data and recommending a method of implementing these reports. As seen from section 4.1.2, most employees felt that Ad Hoc analysis would be the most useful form of reporting data. From this, we developed a decision matrix to help guide the Office of Patent Quality Assurance (OPQA) when selecting a specific method of internal reporting.

Our team chose to create a decision matrix after consideration of developing our own Ad Hoc tool or recommending existing software. After discussing the options, both among ourselves and with liaisons, it was decided that developing a new tool would be outside the scope of the project. It was also suggested by our liaisons that the OPQA would prefer that a separate team be created to select an Ad Hoc tool. We then decided to use the decision matrix, as it allows the OPQA to select its own tool while still ensuring that they consider the wants and needs of employees discovered from our interviews.

Our decision matrix, seen in Figure 20, can be used to quantitatively evaluate Ad Hoc tools that may be used to report findings from the MRF. The matrix consists of weighted features separated into four categories: Flexibility, Robustness, Ease of Use, and Utility. Each feature is given a weight, ranging from one to ten, that reflects its overall importance. The decision matrix also provides an area where a tool can be rated on a scale of one through ten for each feature, based on how well this tool fulfills that specific feature. This score is then multiplied by the feature's weight, and the various feature scores are summed together into a total score. Tools that receive a higher total score are better equipped to handle United States Patent and Trademark Office's (USPTO) needs and should be considered first when selecting an Ad Hoc analysis tool. An example of this process can be seen in Figure 21.

Ad Hoc Analysis Decision Matrix		
Category	Feature	Weight
Flexibility	Tools for multiple forms of analysis/visuals	4
	Ability to Sort/Filter	10
Robustness	Updates with new reviews	5
	Re-use past "queries"	5
	Handles large number of fields	8
	Easy to update saved "queries"	3
Ease of Use	Ability to manipulate data quickly	5
	Simple Interface	8
	Good Help options	6
	External Learning Resources	4
Utility	Ability to print/export reports	7
	Compatibility with SQL	6
	Can create Graphs/Visuals	9
	Can test Statistical Significance	8

Figure 20- Ad Hoc Analysis Decision Matrix

Ad Hoc Analysis Decision Matrix			Example 1	
Category	Feature	Weight	Score	Weighted Score
Flexibility	Tools for multiple forms of analysis/visuals	4	5	20
	Ability to Sort/Filter	10	4	40
Robustness	Updates with new reviews	5	7	35
	Re-use past "queries"	5	5	25
	Handles large number of fields	8	9	72
	Easy to update saved "queries"	3	3	9
Ease of Use	Ability to manipulate data quickly	5	6	30
	Simple Interface	8	9	72
	Good Help options	6	8	48
	External Learning Resources	4	3	12
Utility	Ability to print/export reports	7	5	35
	Compatibility with SQL	6	2	12
	Can create Graphs/Visuals	9	8	72
	Can test Statistical Significance	8	6	48
			Total Score:	530

Figure 21- Ad Hoc Analysis Decision Matrix Featuring Example Implementation

Individual features were chosen using information from three sources. Our primary source was responses from interviews with USPTO employees. However, features were also selected based on conversations with our liaisons as well as from our own experiences with the MRF and with Ad Hoc tools such as Microsoft Excel or Microsoft Access. A detailed explanation of the feature selection can be found in the following sections.

5.1 Flexibility

Flexibility was one of the major benefits mentioned by employees when discussing Ad Hoc analysis. This category of the decision matrix was created to ensure that the selected tool truly provided that advantage.

The feature “Tools for multiple forms of analysis and visuals” refers to a tool's ability to provide options on which equations employees want to use to process data as well as options for how employees want this data to be displayed. This will allow different employees to use the tool for different purposes. This is one of the main features, based on interviews, we feel USPTO employees will expect from an ad hoc tool.

The feature of being able to filter and sort data was another recommendation taken from interview responses. Employees liked the idea of being able to limit the data being presented to only the information they needed to look at, as displayed in Figure located within Chapter 4. In addition, sorting data was a major part of our own analysis of the MRF data. Because of this we recommend that any Ad Hoc tool used by the USPTO have this functionality.

5.2 Robustness

Robustness refers to a tool's ability handle all needs of the user without error. This category was suggested because a tool must work reliably in order to provide the features that employees are expecting. The suggestion is also based on our own experiences with the limits of Microsoft Excel and Microsoft Access.

One feature discussed with our liaisons was the ability to save certain filters that an employee used to look at data. It was also suggested that employees should be able to save the format of the reports they generate. This was also requested by an interviewee when discussing the benefits of Ad Hoc analysis. This feature enables employees to filter data and create reports

more quickly the next time they want to look at MRF data. It also allows for sharing of filters and reports among employees, preventing multiple users from having to repeat the same processes.

As new reviews are completed, the MRF database must be updated to contain the results. The database must also be updated whenever a new version is released and the questions are revised, as the form is still a working document. Because of these constant changes, it is important that an Ad Hoc tool is able to update the database it is using as new reviews are added. It is also useful for the tool to update any saved filters or reports that employees have generated. This saves employees from having to spend time manually updating their reports or from having reports that use outdated information.

Based on our own experiences working with the MRF data, we also recommend that the Ad Hoc tool used by the USPTO be able to compare many different fields of data at the same time. When using Excel and Access, we experienced difficulty when trying to compare every field of a single statute in a single chart, ultimately requiring us to have a liaison sort the chart in a separate software and then reopening the chart in Excel. Not all USPTO employees will have the option of using multiple forms of software, so it is important that the tool they are given can handle the comparisons that they need.

5.3 Ease of Use

The ease of use category was created mainly based on concerns expressed during our interviews that Ad Hoc analysis would be difficult to learn or too complex to be useful. The category contains features that, based on interviewee and liaison discussions, we feel would make employees feel comfortable learning and using a new tool.

Although many employees liked the idea of being able to conduct their own analysis, there was concern that the process would be time consuming and involve a lot of extra work for the individual employees. The feature of being able to conduct analysis quickly addresses this concern, referring to the time it would take for an employee to use the available data filtration and report generation tools.

Another feature to help make Ad Hoc analysis easy to use is a simple interface. Many interviewees expressed concerns that an Ad Hoc tool would be overly complex. An interface that

clearly explained what each of its options did and how they were meant to be used without being overwhelming would help to ease these concerns.

Even with features to make an Ad Hoc tool easier to use, learning a new tool takes time and users will experience some initial difficulties. This is why we recommend that the chosen Ad Hoc tool come with thorough training and include an option for receiving help within the software itself. If the USPTO chooses to use existing software, it would also be useful if the program came with a tutorial or training program already developed. The majority of interviewees indicated that they would be willing to participate in a training session and this would help to smooth the learning curve of a new tool.

5.4 Utility

The last category included in the matrix, utility, concerns features that were seen as generally useful, but did not fit well into any other category. These features come from interviewee recommendations about what they would like to see in an internal report, as well as our own observations.

One concern expressed by an interviewee was the ability to print and export the reports that they create. It is helpful for employees to be able to save their reports in multiple file formats so that results can be shared and reports can be looked at in other programs if the need arises.

Many interviewees also mentioned the usefulness of graphs, charts or tables in their reports. Because of this we suggest that the Ad Hoc tool used by the USPTO include options for creating multiple varieties of graphs and charts.

From our own experiences in the USPTO, when working with databases most employees use the programming language SQL. Many employees are familiar with the language or know coworkers who are. Because of this, we suggest that the Ad Hoc tool selected includes the option to use SQL, as it will save some employees the time of having to learn a new language before using the database.

We also recommend that the chosen Ad Hoc tool contain a statistical significance testing feature. This would be a feature that allows employees to quickly tell whether or not the results they have generated are statistically significant. It may also automatically identify groupings that do not have large enough sizes to produce significant results, and discourage employees from

analyzing these groups until more samples are collected. This suggestion is based on recommendations from liaisons as well as personal experience with significance testing.

5.5 Weightings

The weights associated with each feature are currently selected using a combination of considerations based on the frequency of coded interview results as well as personal judgment. However, we acknowledge that our findings and knowledge are limited by the short time we spent at the USPTO and have left the option open for future teams to adjust the tool weightings based on their own experiences. We also provided the option to choose rankings based on overall categories should the individual features be too detailed for the type of research the OPQA is looking to conduct.

Chapter 6: Recommendations and Conclusions

While we have performed a great deal of preliminary analysis on Master Review Form (MRF) data and developed a decision matrix for the Office of Patent Quality (OPQA) to use in implementing an Ad Hoc Analysis model, there is further analysis that can be performed by the United States Patent and Trademark Office (USPTO) regarding MRF data, as well as other internal data and the way it is reported. In this section, we will make recommendations to the USPTO regarding the next steps that can be taken.

6.1 Internal Report Generation

The primary deliverable we created for our project was the Decision Matrix for Ad Hoc analysis implementation, as seen in Chapter 5. The OPQA can use this Matrix to determine exactly what implementation of the Ad Hoc model will best fit the needs of USPTO employees. However, there is further action that the Office can take regarding the reporting of MRF data.

6.1.1 Ad Hoc Analysis

After using the Decision Matrix to select an implementation of Ad Hoc analysis and distributing this implementation to USPTO employees, the OPQA should take several steps to ensure that users take full advantage of this tool. First, they must create and host training sessions for USPTO employees regarding the usage of the Ad Hoc software. As seen in Chapter 4.1.2, most interviewees identified the learning curve as a disadvantage of this model; giving users a powerful tool with complete access to all of the MRF data can be confusing and difficult to understand at first. Without proper training, employees will feel discouraged from using the tool at all and might not have the time or desire to learn how to use the software by themselves. In addition, only one of the 16 employees interviewed said that they would not be willing to attend a training session focused on teaching them how to use an Ad Hoc analysis tool. Therefore, we recommend that alongside the implementation and distribution of an Ad Hoc model, the OPQA should create a basic training program for all USPTO employees who might use this software that will instruct them on how to use the most important features and create their own basic analyses and reports. This will mitigate the steep learning curve associated with this kind of

model and allow the OPQA to focus employees' training on areas that are most relevant to MRF analysis.

In addition to training, we also recommend that the OPQA develop a medium for employees to share particularly useful filters or queries they have created, as well as any findings and reports they have developed. The idea of reusing techniques that employees create has been discussed numerous times both with employees through interviews and with our liaisons. By allowing employees to share these techniques, employees who may be experiencing more difficulty learning the tool can be assisted by others, using a feature that most employees already want to be included. In addition, this will save time for all employees by allowing them to quickly re-use common techniques or important queries without having to start from scratch.

6.1.2 Other Reporting Methods

While Ad Hoc analysis was the most popular reporting model among interviewees by a significant margin, the other two models, Canned Reports and Snapshots, cannot be dismissed outright. All reporting models received a higher than average score when ranked based on their usefulness, suggesting that these models may still serve a purpose. In addition, discussions with employees revealed that some employees were concerned that Ad Hoc analysis may require them to do work outside the scope of their job if they want to access MRF data and analysis, where other reports will not involve additional work.

Based on interviews, as well as liaison discussion, we recommend that, while initial reporting should use Ad Hoc analysis, the USPTO should consider developing Snapshots and Canned Reports from these results. By repackaging the results of Ad Hoc analysis, such as useful tables or charts, into simpler Snapshots and Canned Reports to be widely distributed, more employees can see results without running the same analysis. This will save employees time and allows them to focus on using the conclusions from the data rather than on drawing their own conclusions.

6.2 Data Analysis

Our project focused on performing a preliminary analysis on MRF data with a focus on statutes 102 and 103 (see Chapter 4.2). We believe that this will provide a valuable basis from

which the OPQA can complete more detailed and specific analysis of this data. In addition, similar analysis can be performed on other non-MRF data, which will give important insight into other key areas beyond just what is contained in the MRF.

6.2.1 Master Review Form Data

There are several areas in the MRF data where the OPQA can expand our analysis to find more detailed information. First, the analysis that we completed on 102 (prior art) and 103 (obviousness) reviews can be expanded to other statutes; in particular, we recommend beginning by expanding analysis to 112b reviews, which have the next highest count of reviews (see Chapter 4.2, Figure 11).

Next, the OPQA can expand the Context-Based Analysis seen in Chapter 4.2.3. In that chapter, we show an example about how a specific overall question, such as 103 overall Correctness, can be broken down to see where problems exist at the Technology Center (TC), Work Group, and Art Unit level. This kind of analysis can be expanded for different Statutes for both overall correctness and clarity, and can be performed more extensively at each level. This will allow TCs, Work Groups and Art Units to be compared quickly in order to see which groupings are having the most trouble with each Statute, which can be used to direct training and other programs to improve patent quality across the entire USPTO.

In addition, we recommend the OPQA conduct analysis based on individual reviewers. Differences in interpretation of what makes an examination considered No Issues Found (OK), Needs Attention (AT) or Significantly Deficient (SD) could lead to differences in how examinations are ranked, which could create biased results. By studying the frequency with which reviewers give the various rankings, the office can identify areas of examination where there may be misunderstanding, as well as boost confidence in conclusions made from other analyses.

It is recommended that more in-depth exploration into the various aspects of the MRF, as mentioned above, use both analysis methods similar to that conducted in this paper's methodology as well as additional processes. This may give other research teams insight into the data that were not discovered throughout this project. Examples of additional data analysis procedures can be seen in appendix E.

Finally, it is important to ensure that findings are statistically significant whenever possible. Currently, the sample sizes used in analysis of Work Groups and Art Units are often too small to draw any significant conclusions with high confidence (see Figures 12 and 13 in Chapter 4.2.3). By completing more reviews, the sample size for each breakdown will grow, which means that more conclusions can satisfy an appropriate confidence level. Therefore, we are recommending that the OPQA complete as many MRF reviews as possible to ensure that significant results can be drawn at every level. We also suggest that the OPQA research alternative, nonrandom methods of sample selection. This could allow the office to collect the desired sample sizes more efficiently and accurately.

In addition, the OPQA can examine groupings where there are already statistically significant findings in order to identify potential problem areas and develop training programs to fix these issues. For example, Figure 9 in chapter 4.2.2 shows that TC 2400 has a significantly higher percentage of SD and AT reviews for 103 overall correctness. Therefore, training examiners in TC 2400 on 103 reviews could be a valuable priority for the OPQA. We suggest that the OPQA uses statistically significant findings from these analyses to direct training related to patent quality, to ensure that they focus on the most important areas in as much detail as possible.

6.2.2 Other Data Analysis

The type of analysis that we have performed on the MRF data can be expanded to other USPTO data as well. For example, the office uses a service called WebTA to track time sheet data. Examining this data in a similar fashion to how the MRF data was analyzed, particularly on a TC, Work Group and Art Unit basis, would allow the OPQA to direct training related to efficiency in the patent examination process. In addition, this data could be used in tandem with MRF data to find potential correlation between details like the time spent on reviews and the overall correctness or clarity rank given to that review. Expanding analysis to information like WebTA data will vastly expand the scope of the findings that can be drawn.

6.3 Changes to the Master Review Form

There are several areas of the MRF that could be changed to make data collection and analysis more efficient. Currently in the MRF data, only the Art Unit of the examiner is listed; this number can be used to determine the TC and Work Group as well, but it can be time-consuming or repetitive. For example, if the Art Unit is listed as 1623, that Examiner is a part of TC 1600 and Work Group 1620. Separating these values into distinct fields will save time when sorting or analyzing data by each of these specific groupings.

The OPQA should also consider revising the specific sub-questions listed on the MRF to focus mostly on details that could be considered drivers of overall quality. Analysis as in Figure 7 in Chapter 4.2.2 would allow the OPQA to identify which questions are significantly correlated with overall correctness and clarity; questions which seem to have no correlation could potentially be removed, while questions with strong correlations could become the focus of further research and training. Therefore, we are recommending that the OPQA examine this data closely and consider changing the questions asked accordingly.

6.4 Conclusion

During this project we have gained insight into the best practices of data analysis and data communication through discussions with USPTO employees as well as our own experiences working with the MRF results. There are many areas of the MRF where analysis could allow employees to improve the quality of patent examination. However, in order to understand the results, employees need the proper tools to generate and communicate results. We offer the following recommendations to the USPTO:

- Utilize the decision matrix to implement a form of Ad Hoc analysis and distribute this implementation, integrated with MRF data, to USPTO employees
- Consider other forms of data reporting for MRF data, such as Canned Reports or Snapshots, using interview responses to guide the design of these models
- Use MRF data to identify areas of USPTO experiencing quality difficulties
- Improve validity of MRF conclusions by examining the methods used for form sample selection

- Examine MRF data based on reviewers who complete the form to find and eliminate any potential biases that could skew results
- Reevaluate relevance of questions asked by MRF based on main drivers of quality, by focusing on questions regarded as drivers of quality while considering eliminating questions that are not seen as drivers of quality

Our project will allow OPQA employees to better interpret and utilize results they receive from the MRF. This will allow them to better identify and eliminate quality issues involved with the patent examination process. Effectively eliminating issues regarding patent quality will not only increase the reliability of examination results produced by the USPTO, but also improve the trust between the USPTO and the community of inventors and innovators whom they serve.

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Appendix A: Survey Questions

Part 1: Oral Consent Form

Hello, my name is Alex Witkin (And I'm Brian McCarthy, I'll be taking notes during the interview). We are part of the Extern group from Worcester Polytechnic Institute working with Martin Rater. We are working with the OPQA to analyze Master Review Form data and develop methods to report our findings. Do you have any questions about the project?

Questions about Recording/note-taking

Before we start, we want to let you know that this interview is completely voluntary. If you don't want to answer any of the questions, that's totally fine, and you can end this interview at any time. Does that sound good?

We were planning on taking notes of your responses during this interview. Is that okay?

If yes:

Great, thank you. We also would like to record the audio of this interview so we can be sure that we have your responses recorded completely and correctly. Is that okay with you?

If no:

Okay, that's fine.

We will plan on using the information collected in this interview, along with the other interviews conducted, in our final report. If you would like, the interview and your responses can be completely anonymous. However we would like to ask your permission to quote you and your department in our report.

Okay, thank you. This interview shouldn't take any longer than 30 minutes to complete. Thank you for your patience. Let's get started.

Part 2: Interview Questions

Topic #1: What information should be reported

Question 1: We're interested in what kind of work you do on a day-to-day basis. Could you tell us about that?

We want to start by talking about which patent quality data should be reported to Quality Leads, and USPTO employees in general.

Question 2: In what ways have you worked with the Master Review Form?

Question 3: What kind of data collected by the Master Review Form do you think would be most useful for yourself, and other Quality Leads?

Question 4: What kind of data collected by the Master Review Form do you think would be most useful for USPTO employees in general?

Question 5 (OPT): What other kind of information, data, or analysis related to Patent Quality would you like to see reported to USPTO employees?

Topic #2: Reporting the data

Next, let's talk about how the patent quality data should be presented.

Question 1: In our email, we asked if you could think of a way that data has been reported to you in the past that was clear and effective. Did you get a chance to think of any examples?

If they don't have an example: In general, how do you think patent quality data should be reported? Do any examples come to mind?

Question 2: What are the strengths of this model? Why is it appropriate for Quality Leads or their employees?

Question 3: What do you think are the potential weaknesses of this model, if any?

Question 4 (OPT): Where have you seen this model implemented elsewhere, if anywhere?

Introduce the 3 models broadly: Snapshots, Canned Reports, and Ad Hoc Manipulation

NOTE: If they get really in detail: We want to keep these descriptions broad and non-specific for now to avoid any bias in our results.

Next we want to get your opinion on 3 different potential models that Marty and the OPQA are considering using to report patent quality data in the future. We're going to take a minute to briefly describe them.

First, there is a "Canned Report", which is a detailed, widely distributed report which focuses in-depth on specific data and analysis deemed to be most important. It's a prebuilt report that presents "batched" data of key metrics. They often includes graphics, tables, and text explanation of key points. They're often 10 pages or longer, to be completely comprehensive.

Question 5a: What's most useful about this model? How will you use it? *If necessary* What do you like/dislike about it?

Question 6a: Why is this model appropriate for Quality Leads or their employees?

Next we have the "Snapshot", which is a brief display of only a few key data points for individuals or groups to quickly gauge important information. Snapshots often allow the user to see more information about specific data points if they want more detail.

Question 5b: What's most useful about this model? How will you use it? What do you dislike about it?

Question 6b (OPT): Why is this model appropriate for Quality leads or their employees?

Finally, "Ad Hoc analysis", which allows the user to manually delve into the data to interactively examine trends and information that they determine is most important. An Ad Hoc analysis interface allows the user to interactively filter through all of the data to see specifically what information they need. It allows the user to perform their own analysis and compare information.

Question 5c: What's most useful about this model? How will you use it? What do you like/dislike about it?

Question 6c: (OPT) *If necessary:* Why is this model appropriate for Quality leads or their employees?

Next, we are going to be asking a couple questions about the usefulness of these methods on a scale of 1 to 10, where 1 is not useful at all, and 10 is extremely useful. We will be asking you about the usefulness for both you and QASes.

Question 7: On a scale of 1 to 10, how much do you like the Canned Report design?

Question 8: On a scale of 1 to 10, how much do you like the Snapshot design?

Question 9: On a scale of 1 to 10, how much do you like the Ad Hoc design?

Here's an example of the "Snapshot" kind of reporting. [Describe the example briefly]

(e.g. This is the Patent Dashboard from the USPTO Data Visualization Center. Have you seen this before? *If no*: The series of dials are used to indicate how successful the office is in each of the different categories. There are also buttons included, which each link to more information and data about the labeled topic.)

Question 10a: What specifically did you like about this example? What was most useful?

Question 11a: What didn't you like about this example?

Question 12a (OPT): How accurately does this example fit your idea of what a Snapshot should entail?

If the interviewee liked the "Canned Report" model:

Show them the Canned Report example

Here's an example of a Canned Report. [Brief description of the example]

(e.g. An example of Canned Reports, is the yearly Performance and Accountability Report issued by the USPTO. Here's one page from the report, which shows an example of what a Canned Report might contain. You can see that this example includes tables, color-coded graphics, and written explanations of the data and metrics. *Go into detail on what data is in the example, as necessary.*)

Question 10b: What specifically did you like about this example? What was most useful?

Question 11b: What didn't you like about this example?

Question 12b (OPT): How accurately does this example fit your idea of what a Canned Report should entail for your purposes?

Show them the Ad Hoc analysis example

Here's an example of the Ad Hoc analysis model.

(e.g. Oracle Smart View is an interface which is integrated into Microsoft Excel to allow simplified hands-on manipulation of the data. Shown here is the Oracle Smart View Excel interface. You can see in these images [Refer to Oracle SmartView notes] Here is an example of reports you can create with Oracle Smartview. Don't worry about the specific data, but notice how you can perform your own analysis on the information, as shown by the table and graphics in this image. *Show images and point out key features, e.g. Member Selection, Zooming In/Out on data, POV Menu, etc.*)

Question 10c: What specifically did you like about this example? What was most useful?

Question 11c: What didn't you like about this example?

Question 12c (OPT): How accurately does this example fit your idea of what an Ad Hoc analysis model should entail for your purposes?

Question 13: *Snowballing*: Who else do you think would have valuable information on this topic? This could include other Quality Leads, TQASes, or any other employees.

Thank you very much for your time. Do you have any other questions for us?

Is it okay if we contact you again if we have any follow-up questions later on?

BRIEF DESCRIPTIONS/NOTES

Canned Report: A prebuilt report that is widely distributed, presenting "batched" data of key metrics. They often includes graphics, tables, and text explanation of key points.

Snapshot: A brief view of a few key data points, often allowing the user to access more information if they so choose.

Ad Hoc: An interface which allows the user to interactively filter through all of the data to see specifically what information they need. It allows the user to perform their own analysis and compare information.

Oracle SmartView Examples:

- MemberSelection:
 - This shows the user selecting which information to display on the screen. It is organized in a hierarchy of broad and specific information.
- POVmenu:
 - This shows the “POV” tool which allows the user to customize what information is being compared, with specific parameters.
- ZoomMenu:
 - This shows the Zoom tool, which allows the user to get more specific information based on certain data points. For example, here the user is getting more information on the “Fiscal Calendar” data.

Appendix B: Yes Response Percentage for 102 Overall Correctness, 103 Overall Clarity and 103 Overall Correctness

Figure 1- Below is the percentage of OK responses that included the given features compared to the percentage of SD and AT responses that included these features, for 102 overall correctness reviews

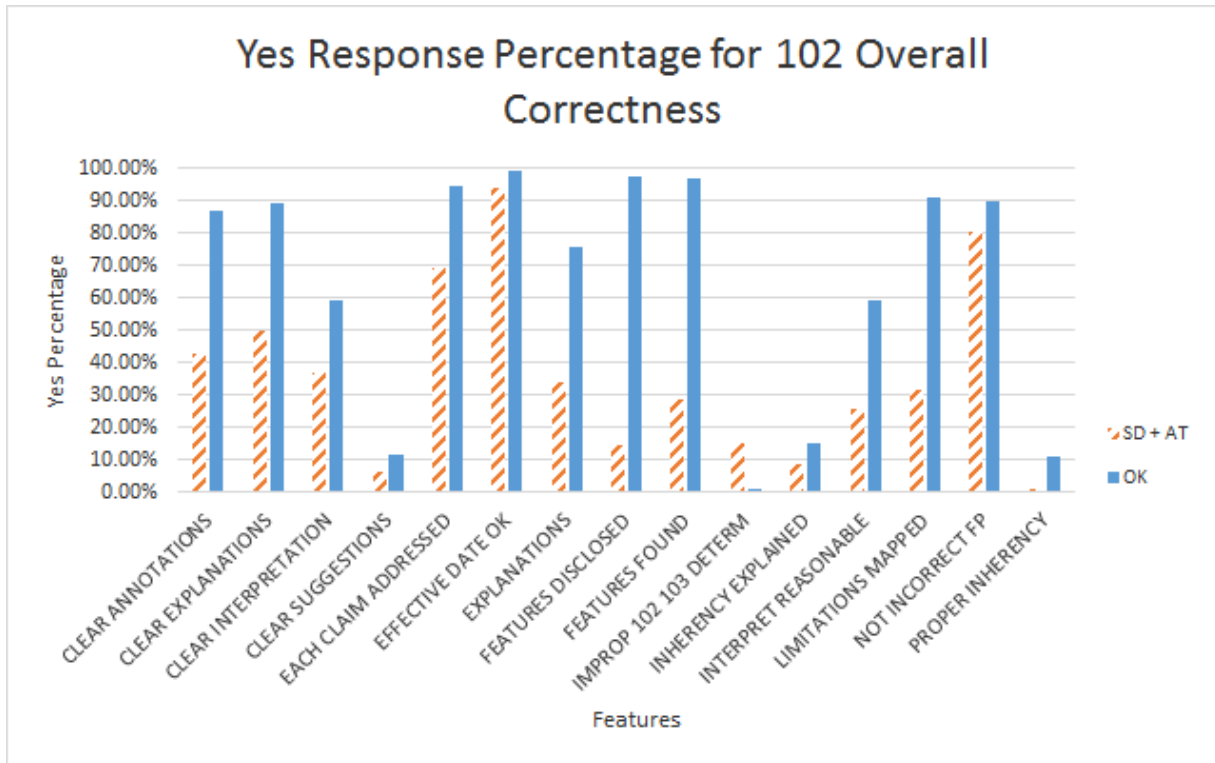


Figure 2- Below is the percentage of OK responses that included the given features compared to the percentage of SD and AT responses that included these features, for 103 overall clarity reviews

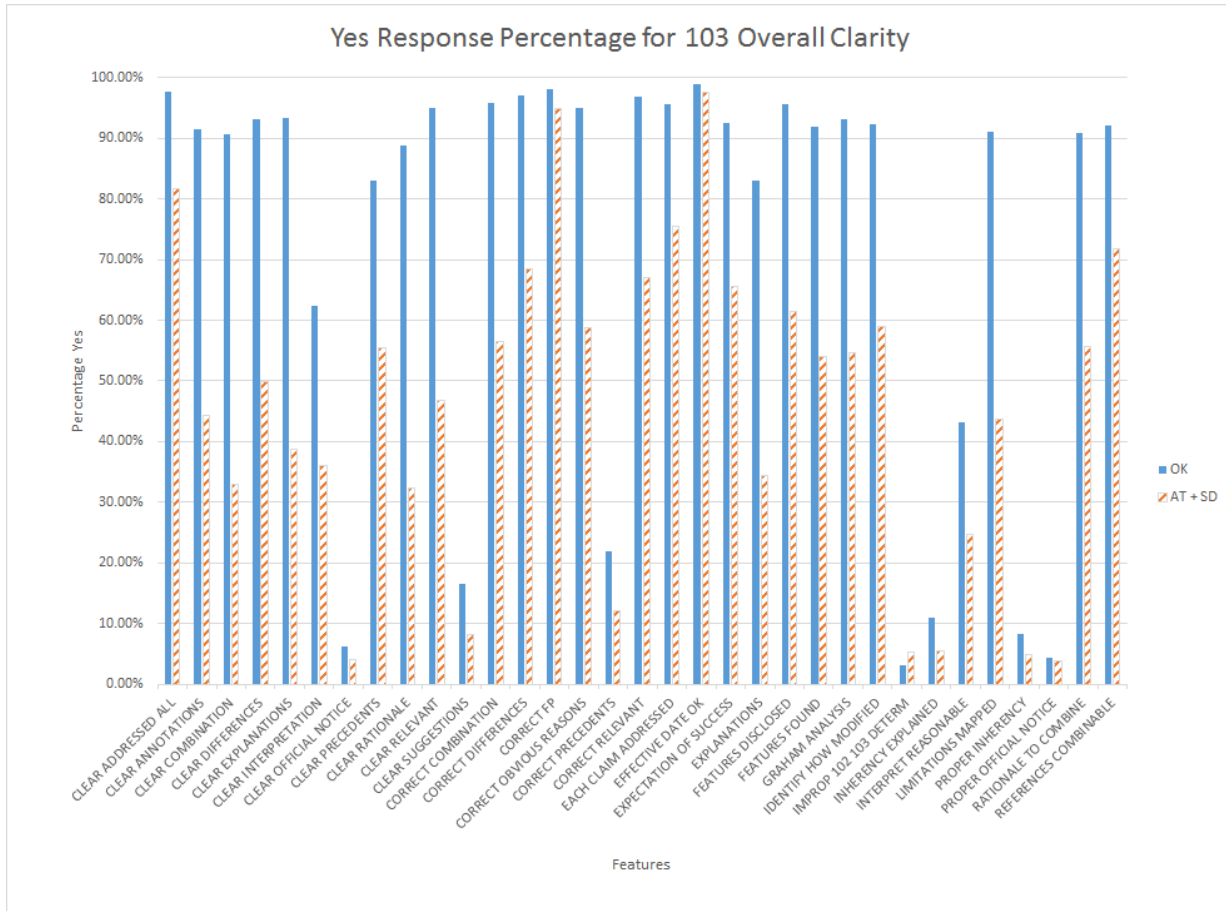
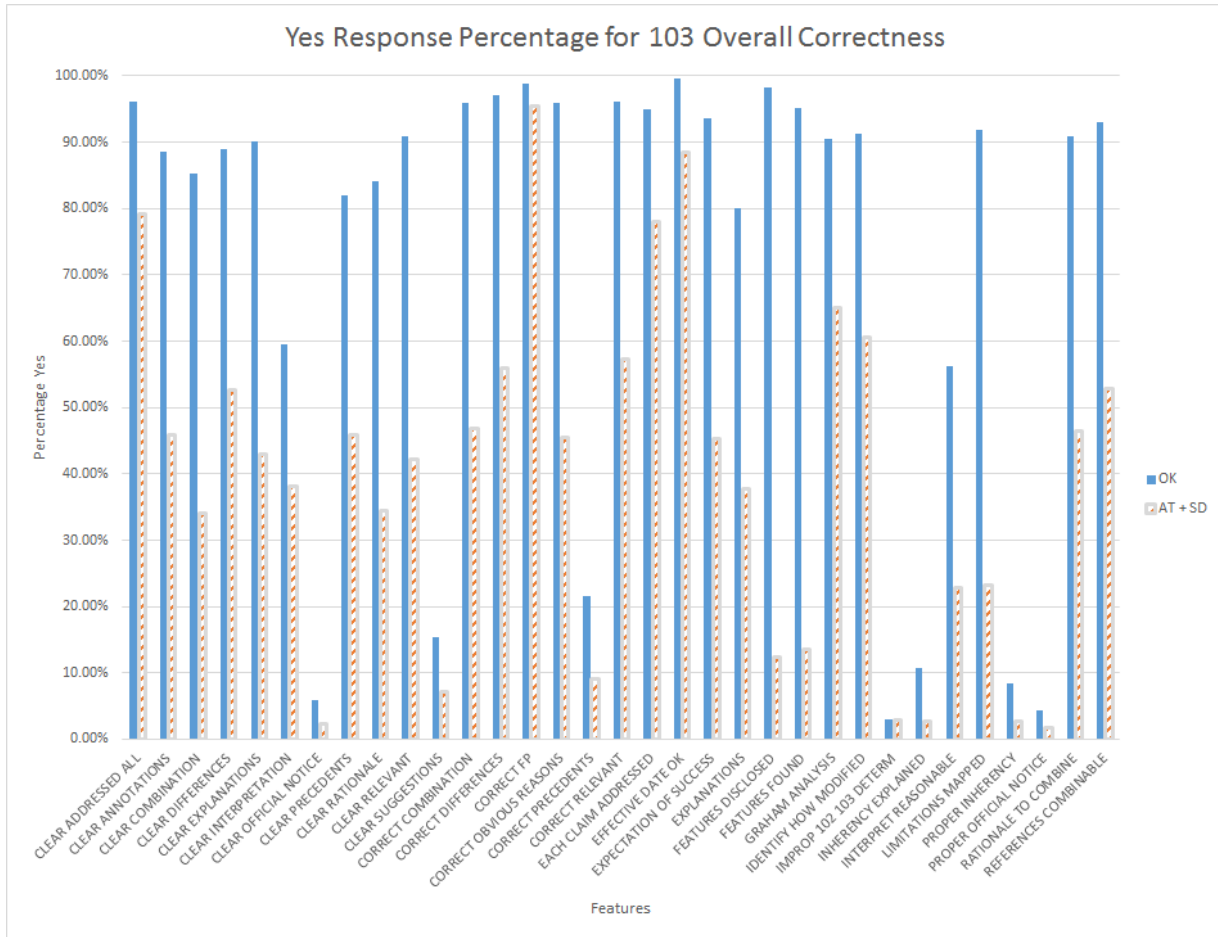


Figure 3- Below is the percentage of OK responses that included the given features compared to the percentage of SD and AT responses that included these features, for 103 overall Correctness



Appendix C: Differences between OK and AT responses and SD and AT responses

	102 Overall Clarity	102 Overall Correctness	103 Overall Clarity	103 Overall Correctness
Avg. Difference between OK and AT	15.98%	16.63%	13.90%	14.00%
Avg Difference between SD and AT	11.45%	16.31%	11.66%	6.25%
Δ	4.53%	0.32%	2.24%	7.75%

Average Δ: 3.71%

Appendix D: Definition of Statutes

Statute	Definition
101	The claimed invention must be considered new or useful, or must be a new or useful improvement of existing work.
102	Claimed invention was patented or available to the public before the filing date, also known as prior art. Prior art is any evidence that the invention is already known. Prior art does not need to be sold or be commercially available.
103	The claimed invention is similar enough to prior art that it would have been obvious to someone with ordinary skill in the field to make such modifications.
112a	Application must contain a written description of the invention so that anyone in the field could make and use it
112b	Application must conclude with one or more claims pointing out the subject matter. The claims must point out and define the bounds of the subject matter of the invention to be protected by the patent. The claim must be clear to a person possessing the ordinary skill level within the pertinent art.

Appendix E: Additional Statistical Analysis Methods

One method of data analysis is known as correlation analysis. In this analysis, two variables are compared side by side in order to identify the strength of their relationship. After the strength of the relationship has been identified, the variables can have either a positive or a negative correlation. A positive correlation is where one variable increases simultaneously with the other, while a negative correlation is where one value decreases as the other increases (Lane, n.d).

Regression analysis is also often used while looking for trends in data. Regression is a process used to estimate the relationship between variables, usually with the aid of charts and graphs. A simple example is linear regression, which uses the data points from two variables to estimate a linear relationship between the variables, which can then be graphed (Lane, n.d).

Another key process in data analysis is outlier analysis. Outliers are observation points which occur infrequently and deviate greatly from the majority of other points. While outliers are frequently due to experimental error and variability, it is still important to consider them while examining data in order to reach accurate conclusions. Charts and plots are often used to identify outliers in a set of data. A common example is the box and whisker plot, which represents data by creating boxes which outline the 25th, 50th, and 75th percentile. Whiskers extend from these boxes in either horizontal direction and end at the value furthest away from the median point without being considered an outlier. Lastly, outliers are plotted outside of the whiskers as points (Lane, n.d).

One method for testing statistical significance is a test statistic such as the t-statistic. While using the t-statistic, an error rate is chosen that is acceptable for the given study, referred to as α . After the research is completed, the test statistic is calculated and compared to a value, referred to as p, obtained from the t-test table. If p is less than α , then the finding is significant, while if p is greater than α , the finding is not significant (StatPac, 2014).

Appendix F: Statistical Equations

Confidence Interval Equation:

$$CI = Z_{\alpha/2} * \sqrt{\frac{P^*(1-P)}{n}}$$

Sample Size Determination for Estimation of Population Proportion:

$$n = \frac{Z^2 \Pi(1-\Pi)}{E^2}$$