The Patent Quality Cookbook: Identifying Perception Gaps at the USPTO

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Authors:

Richard Hayes	*rhhayes@wpi.edu*	_____
Brittany Kyer	*bmkyer@wpi.edu*	_____
Emily Weber	*ecweber@wpi.edu*	_____

In Cooperation with

Daniel Sullivan, Director
Organic Chemistry Patent Technology Center
Daniel.Sullivan@USPTO.gov

Martin Rater, Chief Statistician
Office of Patent Quality Assurance
Martin.Rater@USPTO.gov

Proposal Submitted to:

Prof. Fred J. Looft, *fjlooft@wpi.edu*

Prof. Brigitte Servatius, *bservat@wpi.edu*

Washington D.C. Project Center

Table of Contents

Table of Figures

Chapter 1: Introduction

Intellectual Property (IP) laws provide the backbone for the contemporary U.S. economy. Inventions drive our economy, and innovators need to secure their properties against theft and misuse. IP laws offer this protection, but the quality of the protection is dependent on the practices employed by the United States Patent and Trademark Office (USPTO). The USPTO is responsible for granting U.S. patents and registering trademarks, and works hard to meet an increasing quality standard to provide powerful protection for IP and develop a world class patent quality system (USPTO, 2015b).

In 2011, the Leahy-Smith America Invents Act (AIA) was signed into law, the most significant change to the U.S. patent system since 1952, shifting the patent system from a "first to invent" to a "first inventor to file" system. In response to this change, the United States Government Accountability Office (GAO) conducted a study on patent litigation (Marco et al., 2015, p. 4). Specifically, the GAO examined actions taken by the USPTO that could affect future patent litigation, and concluded that trends in patent infringement litigation need to be closely monitored and linked to internal assessments on the patent examination process (Marco et al., 2015, p. 4). In support of this conclusion, the USPTO is now considering how to link trends in patent litigation to its own patent examination data, and how to use the results of this examination to further improve patent prosecution and the quality of the patents it produces. *Patent prosecution* is the entire process from drafting a patent application to the final decision made by patent examiners. Based on this investigation, the USPTO has made multiple changes in the last few years to address problems or areas of concern that were identified in an ongoing process with the goal to strengthen the quality of service that the agency offers (Marco et al., 2015, p. 4).

In January 2015, the Office of the Chief Economist within the USPTO came out with a report based upon the recommendations set forth by the GAO for the USPTO. In the report, the USPTO used specific patent cases to research the link between certain qualities of patent prosecution to the likeliness of patent infringement litigation. This was a start to the USPTO using case studies as a research method (Sullivan & Rater, 2015).

In addition to this particular examination of patent prosecution, the Office of Patent Quality Assurance (OPQA) regularly develops internal and external quality assessments surveys. Internally, these surveys are given to the patent examiners to gauge their perception of the provided examining tools, training that they receive, and any other suggestions they may have for patent prosecution. The external quality surveys are used for law firms, corporations, and individual patent applicants that gauge how the

respondents felt about the level of fairness, speed, and overall quality of the patent office and its examiners (USPTO, 2015a). These surveys offer insight into the perceived quality of the USPTO (See Appendix A for the surveys).

In order to investigate perceptions of patent prosecution further, a research team explored the internal concerns of the USPTO regarding patent prosecution in 2014. In particular, the team studied problems that the examiners faced, with a focus on the quality of the patent reviewing system and the speed at which evaluations were performed (Weiler et al., 2014). The team proposed key areas for potential improvement of patent quality monitoring, and provided recommendations for the development of new metrics based on previously identified internal problem areas within the USPTO. This project provided a foundation for identifying and exploring problems with patent prosecution as perceived by individuals directly involved in patent processing. However, the USPTO has not examined external perceptions of patent prosecution or compared the internal and external perceptions to see if there are gaps in perceptions of the process.

The purpose of our project was to assist the USPTO in continuing their efforts to develop a world-class patent quality system through the improvement of patent prosecution. The USPTO has taken strides towards having world-class quality by starting the Enhanced Quality Initiative. Our team helped the office further its efforts by contributing to one of the 12 quality initiatives, “Topic Submission for Case Studies”. To do this we identified gaps in internal and external perceptions of patent prosecution and developed a framework for conducting and identifying case studies. With the identified gaps, we created a perception gap matrix (Appendix G) and a chart (Figure 22: Importance versus Gaps Priority Chart) that compare these gaps to the importance of each topic researched. Additionally, we created a “cookbook” (Appendix H) on how to conduct case studies. This “cookbook” is an instruction manual that contains different types of case studies that we researched and that have been approved by the GAO as a research method. Our final products will help the OPQA understand what parts of prosecution could be improved and what methods could be used to improve it.

Chapter 2: Background

2.1 The United States Patent and Trademark Office: Role and Mission

The United States Patent and Trademark Office (USPTO) is a federal agency responsible for granting patents and registering trademarks in the U.S. The agency has helped American industries flourish by offering an avenue for the innovation of new products and a means to find new uses for old products. The agency offers powerful protection for intellectual property, defending innovators from theft and infringement of their discoveries, designs, and inventions. The quality of the patent system, and the inventions it protects, form the foundation of the U.S. economy (USPTO, 2015b).

On April 10, 1790, President George Washington signed the Patent Act of 1790, which provided the foundation for the modern patent system in the U.S. This act defined what was allowed to be patented. In addition, the act established the formal process of patent approval, which included no appeal process, and granted full authority to patent board members (Hernandez, 2002).

The current mission of the USPTO is to, "foster innovation, competitiveness, and economic growth by delivering high quality and timely examination of patent and trademark applications, guiding domestic and international intellectual property policy, and delivering IP information and education worldwide." To accomplish this mission, the USPTO has 12,450 employees, including 9,302 patent examiners, 429 trademark attorneys, and 2,719 support staff (USPTO, 2014). The USPTO is under a branch of the Department of Commerce. This agency is under the direction of the Secretary of Commerce for Intellectual Property and the Director of the USPTO. The agency collaborates with the Patent Public Advisory Committee (PPAC) and the Trademark Public Advisory Committee. Within the USPTO is the Office of Patent Quality (OPQ) under the direction of the Deputy Commissioner of Patent Quality. The OPQ includes the Office of Quality Management, which houses the Office of Patent Quality Assurance (USPTO, 2015b). More information about the USPTO structure can be found in Appendix E.

The OPQA is responsible for reviewing the quality of patents, ensuring ISO compliance standards, and defining standards and metrics for the quality of patents. In order to accomplish these tasks, the OPQA has 53 Review Quality Assurance Specialists (RQAS), six supervisory RQASs, statisticians, and program analysts (Caputa & Rater, 2015, p. 10). The OPQA is focused on improving the patent quality system so that the USPTO can achieve a world-class quality system (Sullivan & Rater, 2015).

Since the inception of the OPQA, the number of patents being filed per year has steadily increased, along with demand for improved patent quality. Polk Wagner (2009), a University of Pennsylvania Law School professor, lists five major administrative adjustments that the USPTO has made in order to address this issue.

1. The office has increased the number of patent examiners. However, by 2007, this increase in examiners resulted in securing the same ratio of patent examiners per one thousand applications as was present in the office in the mid-1990s (See Figure 1: Patent Examiners per 1000 Applications Filed (U.S. & Japan), 1996–2007).
2. The office has improved the search tools available to patent examiners, including the addition of electronic databases.
3. Work has been done to institutionalize patent quality, a long-term goal of the OPQA.
4. Efforts have been made to broaden the public's access to patent prosecution.
5. The office has implemented the post grant review, which allows applicants and their representatives to extend the patent prosecution of a granted patent to determine if the patent needs further review or will be a useful resource (Wagner, 2009, pp. 2158-2161).

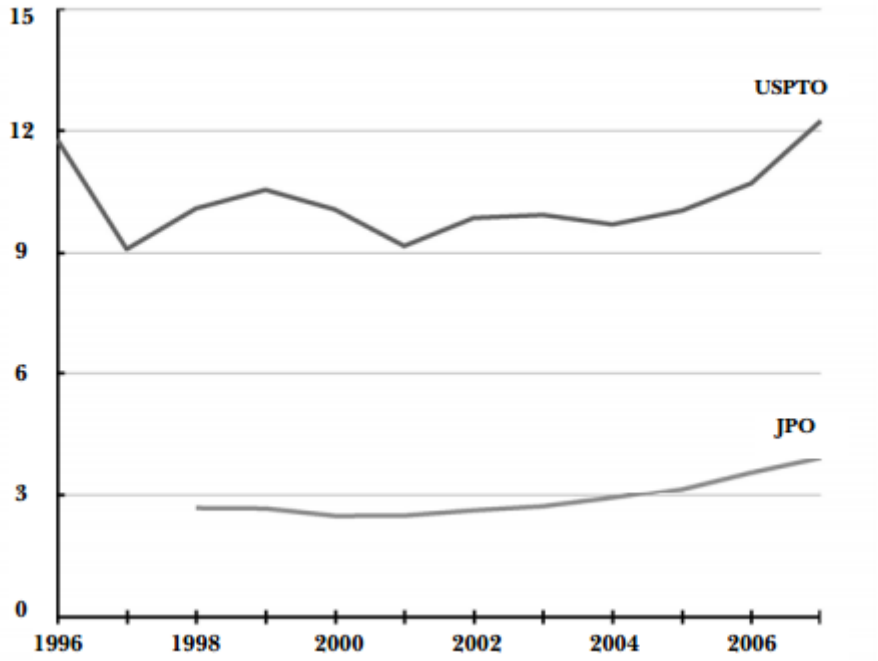

Figure 1: Patent Examiners per 1000 Applications Filed (U.S. & Japan), 1996–2007

(Wagner, 2009, pp. 2159)

In 2012, the USPTO implemented the Pre-Issuance Submission Program. Described by Kirby Drake, an experienced IP attorney, this program provided "a means for a third party to submit potentially relevant prior art or other documents ... to be considered during the prosecution of a pending patent application" (Drake, 2013)**.** The Pre-Issuance Submission Program essentially allows experts in technology fields to aid patent examiners to determine patent quality by submitting materials that are relevant to applications being prosecuted (Drake, 2013).

2.2 Patent Prosecution

Patent Prosecution is the entire process of drafting a patent application to the approval of the application. There are many people involved in this prosecution. Patent applicants are the people who have an idea for a patent, and patent examiners are the people who review patent applications and decide whether to reject or approve the patent (USPTO, 2015b).

In order to file a patent application, an applicant must determine what kind of patent to apply for. There are three types of patents: utility, design, and plant[1]. Each kind of patent is used for a different purpose. After the applicant chooses the type of patent, the applicant needs to submit the application and work with the examiner assigned to him. The examiner will review the contents in the application. To review the contents, the examiner will first search the database of approved patents to make sure the idea is not already patented. The examiner will then make sure the application fits the requirements of 35 U.S.C. 111(a). The requirements of 35 U.S.C. 111(a) state that the application must be made by or authorized by the inventor, the contents of the application need to meet the requirements and the applicant must submit the application with a fee required by law. The contents must include specification about the invention, a diagram of the invention when applicable, and an oath stating that the inventor believes that he is the first one to have the idea (USPTO, 2015b).

The reviewing process takes, on average, two years to complete. The applicant will receive an approval or a rejection, and if the patent is rejected, the applicant can resubmit the application to be reviewed. If it is rejected twice, the applicant can then appeal to the Patent Trial and Appeal Board for further investigation. If the application is approved, the applicant will receive a notice and will have to pay a fee so that the patent may be issued. The two-year patent reviewing process can be delayed by

[1] If you want to learn more about types of patents, follow this link: http://www.uspto.gov/patents-getting-started/patent-basics/types-patent-applicationsproceedings

miscommunication and misunderstanding between the parties involved, which is why the USPTO must keep track of the quality of this process (USPTO, 2015b).

2.3 Assuring Patent Quality

Patent quality has been a major focus for the OPQA since it was first established. John Thomas, an associate professor of law at George Washington University Law School, defines a quality patent as one that will "fortify private rights by making their proprietary uses, and therefore their value, more predictable," as well as "clarify the extent to which others may approach the protected invention without infringing" (Thomas, 2002, pp. 730-731). Other scholars have suggested different definitions. Li and colleagues, professors in the Department of Mechanical Engineering at Texas Tech University, believe that patent quality should be estimated using Level of Invention (LOI), a "[characterization of] the creativity of a design concept based on the resolution of a design conflict and the disciplines used in resolving the conflict" (Li, Tate, Lane, & Adams, 2012)**.** While the first definition focuses on the protection that the patent offers, the second focuses on the quality of the patent and how useful it will be to inventors. The challenges that the OPQA faces are to examine the various sources of dissatisfaction with the patent quality system and to determine the changes to improve the experience and the products that result from patent prosecution.

The OPQA operates under an ISO 9001-certified quality management system, and continues to be dedicated to the improvement of that system through the generation of new quality metrics, various forms of data collection and feedback analysis. Some of the forms of data collection that the OPQA regularly performs are work product reviews and quality surveys that are completed by patent examiners and patent applicants semi-annually after the patent process is complete. Work product reviews, as described by Anthony Caputa, director of the OPQA, and Martin Rater, chief statistician at the OPQA, are "randomly selected Office Actions to ensure that any metric [the OPQA] generate[s] represents a true picture of all patent corps work product" (Caputa & Rater, 2015, p. 13). An Office Action is a document written by a patent examiner and sent to a patent applicant during prosecution, explaining what needs to be changed in the application to advance prosecution. Quality surveys are brief surveys used to collect feedback from either patent applicants about their experience working with the USPTO or from patent examiners about their satisfaction with the patent examination process.

The OPQA continues its efforts to improve the quality of the patent examination process and the quality of the patents issued by examiners through developing metrics and improving training. The

office has developed useful metrics for determining patent quality, examined trends in the feedback, trained its patent examiners to use these metrics and feedback to improve their work, and regularly analyzed new programs to further improve its processes.

The results of these practices show a higher quality standard within the USPTO and a strong internal assessment of the quality of the patent system from beginning to end. However, patent quality and customer satisfaction continue to be topics of concern for the agency (USPTO, 2015b). Public dissatisfaction in the patent process can be collected through a variety of different sources, ranging from blogs online to large law firms and companies with vested interest in intellectual property. For the USPTO, this means that there is a shift of interest from concerns about internal processing standards towards exploring the external view of patent quality. The goal is to identify public concerns and points of dissatisfaction in order to improve the system more to meet public demands (Sullivan & Rater, 2015).

2.4 The Enhanced Quality Initiative

The USPTO launched the Enhanced Quality Initiative on February 5, 2015 with the goals of providing the best possible work products, improving the experience of the agency's clients, and refining the metrics for determining quality that are already in use. Recognizing the importance of the public's role in determining quality, the USPTO is making efforts to involve the public more directly with this initiative in order to help identify some of the best practices that could be put into play and some of the steps that need to be taken in the development of a new paradigm of patent quality (Request for Comments, 2015).

The USPTO was able to launch this initiative because it now has access to financial resources that it has never had before. The fee setting provisions provided by the America Invents Act allows the agency to use a sustainable funding model where costs are covered by the money received from the fees that applicants pay during filing, searching, examining, appealing, and maintaining existing patents (USPTO, 2015b). Under this model, the agency is no longer required to forfeit its earnings to the government, as would be required by an agency driven by taxpayer money. This presents a new opportunity for the USPTO to focus resources on more long-term improvements to patent quality that were previously too expensive to consider (Request for Comments, 2015).

The USPTO intends to collaborate with the public on a regular basis during the ongoing process of enhancing patent quality. The agency hopes that this collaboration will inspire the public to consider the topic of patent quality as a whole, as well as provide an opportunity for external opinions and

guidance about what specific topics should be prioritized and what areas of prosecution need the most focus (Request for Comments, 2015).

The enhanced quality initiative is built upon three patent quality pillars. These pillars play an important role in the goal of the USPTO to become a world-class patent office and to improve its customer and quality service (Request for Comments, 2015). The first pillar, "excellence in work products," focuses on the quality of the work that is performed during patent prosecution and the quality of the end result. This is important to the USPTO because it wants to have a superior work product as the end result of patent prosecution, and to do that it needs to study and find where in the process quality can be improved. The second pillar, "excellence in measuring patent quality," focuses on reviewing the metrics that are used to measure patent quality and determining how they can be improved. The third pillar, "excellence in customer service," focuses on customer satisfaction with the USPTO, the customer's experience with patent prosecution, and how to maximize the efficiency of examiner-practitioner interaction (USPTO, 2015b). All of these pillars work together to improve the overall quality of patent prosecution and the USPTO.

Figure 2: USPTO Patent Quality Pillars and Descriptions (USPTO, 2015b)

From the three patent quality pillars, the USPTO has created its 12 Quality Initiatives (USPTO, 2015b). These initiatives are projects that the USPTO is planning to undertake in the 2016 fiscal year. These 12, sorted by which pillar they fall under, are:

Pillar 1

1. Topic submission for case studies
2. Pilot automated pre-examination search
3. Scientific and Technology Information Center (STIC) awareness campaign
4. Examiner clarity of the record training
5. Post grant outcomes
6. Clarity of the record pilot

Pillar 2

7. Clarity and correctness data capture
8. Quality metrics

Pillar 3

9. Interview specialist
10. After Final Consideration Program (AFCP)/Pre-appeal
11. Quick Point Information Disclosure statement (QPIDs)
12. Design patent publication quality

Our project focuses on the "Topic submission for case studies" initiative. The case study initiative began with the USPTO proposing that the public submit completed patent applications for review by the OPQA to see where quality could be improved. This plan then evolved into a more anonymous approach where the public submits topics that the USPTO could turn into case studies and find where patent prosecution quality can be improved (Topics for Submission, 2015). As an example, the public could submit a topic about a perceived problem with training received by examiners. The OPQA could use this submission to plan and conduct a case study to review the training program examiners go through and, from the results, the OPQA could decide how to improve the quality of training. This initiative is a good way for the USPTO to improve quality of work products and get the public's opinion on the overall quality of patent prosecution (Topics for Submission, 2015).

Chapter 3: Methodology

An important aspect of this project was the perception gap analysis. This analysis involved the identification of internal and external perceptions of patent prosecution. A perception gap is when a company's employees view something differently from the public. A gap analysis is used to determine the difference between a current state and a desired state, and the path to get to the desired state. As such, a perception gap analysis is used to determine if the internal and external perceptions of a program or process are the same and what steps need to be taken to make sure internal perceptions match external perceptions. This perception gap analysis will help the USPTO reflect on these perceptions and take the necessary measures to make sure these discrepancies are resolved ("Gap Analysis," 2015).

One way to understand and offer solutions to the identified gaps is to employ case studies. Case studies offer a deeper look into a particular situation through the use of specific examples. Case studies can be used to find out how a project faired as it went through a pre-defined process, such as a patient being diagnosed and treated. There are six main types of case studies: illustrative, exploratory, cumulative, critical instance, program implementation, and program effects (GAO, 1990)**.** Illustrative case studies are mainly descriptive and serve as an introduction to a situation by using one or two examples to show what the situation is like. Exploratory, or pilot case studies, are generally used as a pre-emptive study before a full-blown investigation starts. Cumulative case studies collect data from several different areas to try to get a greater generalization on a subject. Critical Instance case studies gather data from one or more sites with the purpose of challenging general statements or answering cause-effect questions. Program Implementation case studies focus on why the implementation of a program is having difficulties, determining if a program has basic structural problems or if more time is simply required for people to adapt to it. Finally, Program Effects case studies are used to determine the reasons for a program's successes and/or failures, and to determine the effects that the program has on the people and systems involved. To find more information about types of case studies, see "The Cookbook" (Appendix H).

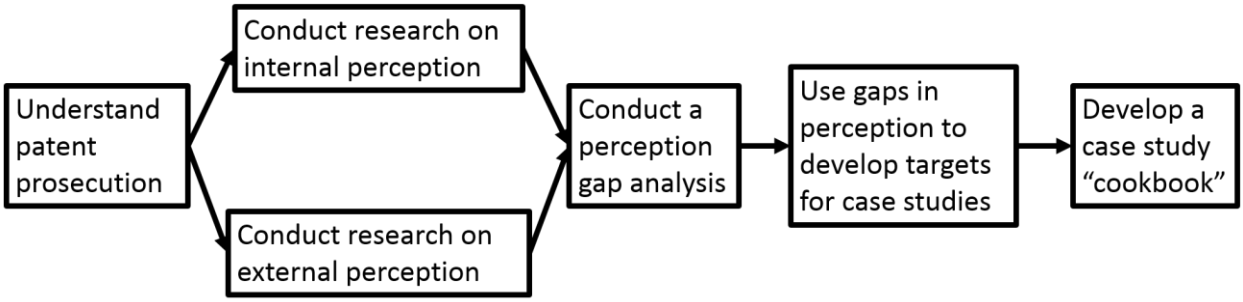

Figure 3: Methodology Graphic of Steps Taken to Complete Objectives

3.1 Objective 1: Assess internal and external perceptions of patent prosecution.

Before we began to address any concerns that existed in regard to patent prosecution, we first had to identify and understand the major points of satisfaction and dissatisfaction with the process. These points may differ from each other based on perspective; a patent examiner may be entirely satisfied with a certain part of patent prosecution which could generate dissatisfaction for a patent applicant. It was important to represent both perspectives in a situation like this in order to identify not only what concerns existed, but to which perspectives those concerns belonged. To accomplish this, we analyzed different sources to assess the perceptions of patent quality from two perspectives: internal, or the views of those who work within the USPTO, and external, or the views of those who do business with the USPTO. After the data was collected from these sources, it was analyzed and placed into a perception gap analysis matrix. The USPTO can use the results of the matrix to better resolve the issues the public and the employees of the USPTO feel are important.

3.1.1 Internal Perception

The USPTO gave us access to multiple sources of primary data, collected by the OPQA, which we used to help determine the internal perception of patent prosecution. We used data collected from the internal quality surveys, the RQAS interviews, and the 2014 Focus Group Sessions in our final matrix (See Appendix G).

3.1.1.1 Internal Quality Surveys

According to Anthony Caputa, the Director of the OPQA, and Martin Rater, the Chief Statistician at the OPQA, the Internal Quality Surveys are given to patent examiners semi-annually to gauge their satisfaction with the tools, training and other office resources they have available to them during patent prosecution, as well as their experience working with patent applicants and the applications they submit

(Caputa & Rater, 2015, p. 17). A blank version of this survey can be found in Appendix A. The data and reports on the data are not available to the public, so we requested access to the OPQA databases and records. We used the data collected in 2015 from the surveys conducted in quarter one and quarter three. In order to find perceptions from the surveys we had to make categories that fit what the questions were asking the examiner. We were then able to review the summary of data from the reports and add the data to the perception gap matrix (See Appendix G).

3.1.1.2 RQAS Interviews

While on the USPTO campus, we also conducted interviews with 15 Review Quality Assurance Specialists (RQAS) to reach a more thorough understanding of their perceptions of patent prosecution. An RQAS is a most senior examiner who has been promoted to review work products for the OPQA. During these interviews, we asked a series of questions (see Appendix C) to gauge an RQAS's impression of the quality of the process as a whole and identify any aspects that they believe could be changed or improved to enhance the experience of examiners and of the patent applicants. During the interviews we took notes and then used these notes to create categories. We created the categories in an Excel document by using what was said in the interview as comments for what needed to be done to enhance quality. We read over all the notes we took and once we encountered a comment that raised the same concern as another comment that we had already categorized, we incremented the category by one. We analyzed the responses from the interviews in order to locate common perceptions among the RQASs. This data later contributed to the perception gap matrix (See Appendix G).

3.1.1.3 2014 Focus Group Data

This data was collected by a team in 2014 that focused on the internal perspective of quality. The team interviewed 163 randomly selected USPTO employees, this included examiners, RQASs, and Supervisory Patent Examiners (SPE), in an effort to gain an encompassing view on the perception of quality within the USPTO. This group attended six sessions held by the OPQA which had, on average, 27 participants per session. The sessions had groups of 5-8 participants sit at tables and discuss ideas for questions presented to them. Every idea was then written on boards and every participant in the group got to vote on the ideas that they thought the USPTO should consider doing (Weiler et al., 2014). We took the data collected by this team and categorized all the ideas for the team's third question, "What are the most important aspects that contribute to a quality examination, what are some ideas to improve those aspects, and are there ways to make those aspects more transparent to applicants?" The

ideas were categorized in a similar fashion to the internal interviews, where we would make categories and tally every time that category was mentioned. Each of the ideas had a vote tally from the focus groups. We had each idea start with five votes so that if the idea had zero votes from the focus group, it still had some weight because it was considered in the smaller table discussions. From there, we added the vote tally to the starting five to get the number of mentions for the category. This data was then reviewed and added to the perception gap matrix (See Appendix G).

3.1.2 External Perception

An external perception is a view of patent prosecution made by a person or company not affiliated with the USPTO. To establish this perception, we analyzed data already collected by the OPQA. The data we analyzed for the matrix (See Appendix G) was the external quality surveys, the external quality survey comments, and comments from the USPTO ombudsman.

3.1.2.1 External Quality Surveys

External Quality Surveys are given to frequent patent filers every three months gauging their satisfaction with the process. A blank version of the External Quality Survey can be found in Appendix A. The data and reports on the data are not available to the public, so we requested access to the OPQA databases and records. We used the data collected in 2015 from the surveys conducted in quarter one and quarter three. In order to find perceptions from the surveys we had to make categories that fit what the questions were asking the examiner. We were then able to review the summary of data of the multiple choice questions from the reports and add the data to the perception gap matrix (See Appendix G).

3.1.2.2 External Quality Surveys Comments

The External Quality Surveys have an open ended question at the end of each survey. The question was the same for the past three surveys: “The USPTO is currently evaluating and refining its patent examination quality measures. What measures/metrics would you like to see the USPTO provide to gauge the quality of work performed by its patent examiners?” The answers we analyzed were from Fiscal Year 2014 quarter 3, Fiscal Year 2015 quarter 1, and Fiscal Year 2015 quarter 3 and were in the form of comments presented in a document of 60-80 pages of comments per survey. These three surveys were the most recently conducted and the question asked was specifically about quality, so this was the best fit for our data collection.

To collect a sample of this data, we used a random number generator to select a page to read. We wanted to read random pages because the comments were separated by mechanical, chemical, and electrical technology centers and we did not want the data to be biased to one technology center's concerns. Each survey had around 10 answers per page, so this equated to approximately 700 comments per document. We decided to read 30% of each document as our sample size in order to make the amount of comments we had to read a reasonable amount of work. To determine this percentage, we used the saturation method to decide how much to work with while still having a sample size that represented the data. After some discussion with Martin Rater, we hypothesized that if we categorized the comments while reading through the documents, we would find trends where certain complaints or suggestions would start showing up frequently.

While reading through the responses, we created a new category in an Excel document for each comment until we encountered a comment that raised the same concern as another that we had already categorized. When we encountered such a comment, we would increment the number of comments made in that category by one. Occasionally, a comment would reference several different parts of patent prosecution so we would increment each referenced category by one. We then analyzed the categories after reading more than 600 comments and used these categories in the perception gap matrix (See Appendix G).

3.1.2.3 Ombudsman Comments

Ombudsman is a system that the USPTO uses to assist applicants with issues that appear during the patent prosecution (USPTO, 2015b). For the ombudsman data, we looked at the past four months of comments. We chose four months because for Fiscal Year 2015 the amount of comments that had been summited was 641, and because of time constraints, we could not read all the comments so we chose to do approximately 30%. We then categorized the comments in a similar fashion to the surveys to show trends in what the applicants felt went wrong during patent prosecution. We then analyzed the categories for trends to give us the topics needed for the perception gap matrix (See Appendix G).

3.1.2.4 External Interview

We were planning on holding interviews with patent attorneys and had planned to conduct as many as we could in our limited timeframe. However, the law firms around the patent office were found to be difficult to get in contact with and we were not able to secure any interviews with people from the

external side. We recognize that this could lead to bias against the external side, but our time limitation prevented us from getting the data we needed. The questions we wanted to ask are in Appendix C.

3.1.2.5 Blogs

We were going to analyze patent blogs as another source of external data, but after looking and reading these blogs, we determined that the information would not be useful for the purpose of our project. We determined this because the articles available tended to focus only on very specific topics other than the quality of patent prosecution.

3.2 Objective 2: Develop a Framework for Case Study Analysis of Patent Prosecution

The OPQA wants to use case studies to investigate the gaps in perception that are presented in the matrix and the topics submitted by the public as part of the Enhanced Quality Initiative. However, the office is unfamiliar with the case study method and requires a tool to introduce them to the different types of case studies and provide guidance for selecting and designing such studies. To address this, we created an instruction manual, or "cookbook", to help the OPQA understand and implement case studies. This manual has instructions on how to design and conduct different types of case studies to accomplish different kinds of research goals and address different areas of concern in the USPTO. To fulfill this objective, we performed research on a number of different sources including books, guides and websites, and collected information on what a case study is and what types of case studies exist. The full list of resources we used during this process can be found in the Bibliography section of the cookbook (Appendix H).

Chapter 4: Results and Analysis

4.1 Data Analysis

Our analysis began by investigating the quality of patent prosecution. The OPQA provided us a summary of data from the external quality surveys that asked the question "How would you rate overall examination quality?" The answers to this question were already organized by technology center (mechanical, electrical or chemical) and by affiliation (law firm or corporation), and gave us a good impression of how people outside the USPTO felt about prosecution quality. In order to gather some data on the internal opinions of prosecution quality, we included a question in our interviews with RQASs that asked "What level of quality do you believe patent prosecution is operating at?" The data from these two sources showed us that all the affiliations had the highest percentage of response in the "good/excellent" rating with the second highest percentage being in the "fair" rating. However, it was evident that there was still room for improvement because four out of the six affiliations showed more than 10% of responses reported that quality was poor. Figure 4: Comparison of Quality Rating by Affiliation shows a side-by-side comparison of the reports on quality from the six different affiliations.

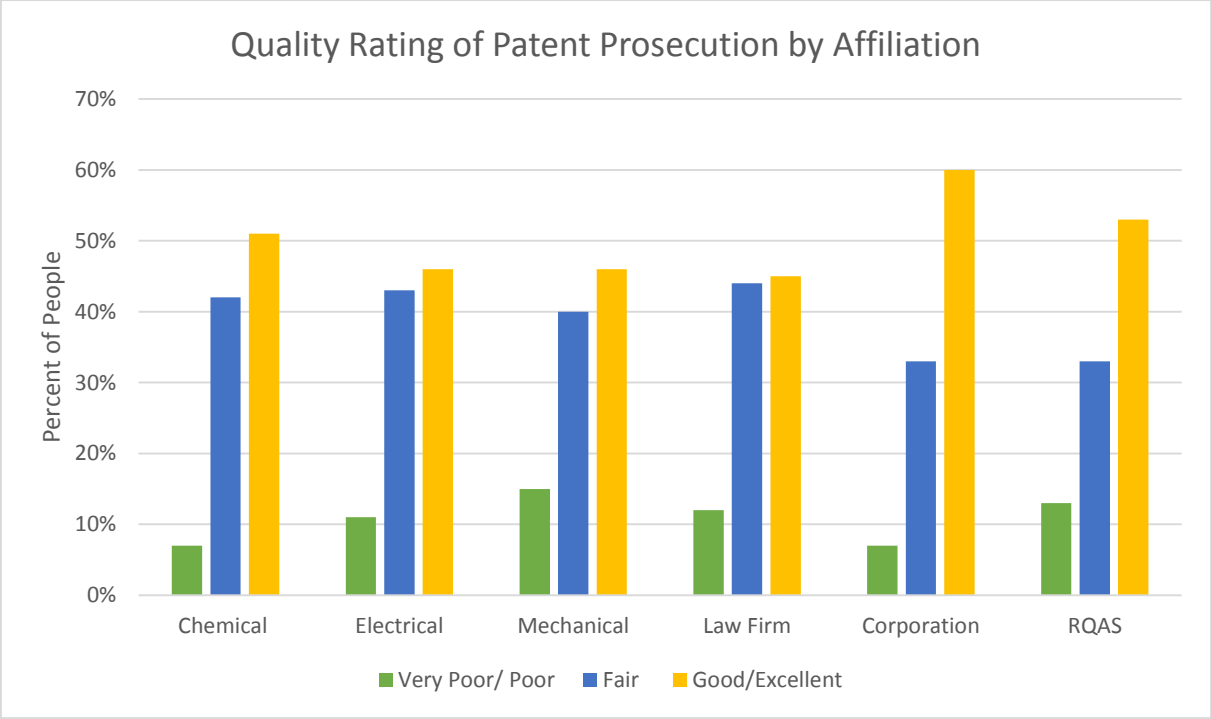

Figure 4: Comparison of Quality Rating by Affiliation

4.2 Internal Perception

4.2.1 Internal Data Results

4.2.1.1 RQAS Interviews

While analyzing the data collected from the 15 RQAS interviews, described in the Methodology Section 3.1.1.2 RQAS Interviews, 12 categories emerged. Figure 5: Table of RQAS Interview Categories shows the 12 categories, the number of mentions each category received, and the percent of instances for each category. “Number of mentions” was the number of times interviewees said there needed to be improvement regarding one of the categories. These numbers were used to find the percent of instances which was calculated by dividing the number of mentions for a category by the total number of mentions: 88.

Categories	**Number of Mentions**	**Percent of Instances**
Training	20	22.7%
Clarity	16	18.2%
Consistency	13	14.8%
Completeness	9	10.2%
Communication	6	6.8%
Time Restrictions	6	6.8%
Examiner Attitude	5	5.7%
Low Quality Applications	4	4.5%
Interviews	3	3.4%
Change Performance Review	3	3.4%
More Supervisor Interaction	2	2.3%
Union	1	1.1%
Total	88	100%

Figure 5: Table of RQAS Interview Categories

In order for a category to be used in the perception gap matrix, the percent of instances had to be greater than five percent in at least one of the sources used in our analysis. Because of this, we chose to

graph the categories that were greater than five percent and called them the "top categories for RQAS interviews" shown in Figure 6: Top Categories for Improvement from RQAS Interviews. Figure 6: Top Categories for Improvement from RQAS Interviews shows these top categories and the frequency of mentions. As seen in Figure 6: Top Categories for Improvement from RQAS Interviews, "training" had the highest percentage for needing improvement at 23%. This means that the RQASs felt that better training overall is needed, as well as more training for new examiners and refresher training for more senior examiners. Detailed category descriptions can be found in Appendix F.

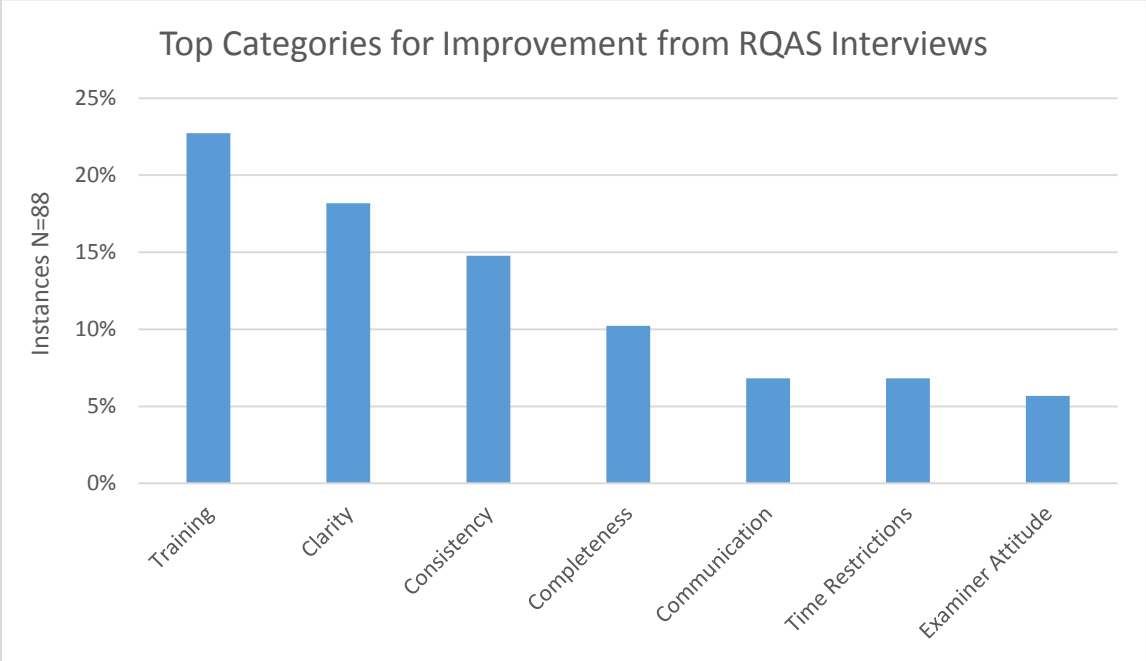

Figure 6: Top Categories for Improvement from RQAS Interviews

4.2.1.2 2014 Focus Group Data

In 2014, a team attended focus groups of USPTO employees organized by the OPQA to collect data on determining what internal people thought could be done to improve quality. After analyzing the data collected, using the methods discussed in Methodology Section 3.1.1.3 2014 Focus Group Data, 18 categories emerged from the responses. Figure 7: Table of Focus Group Categories shows the 18 categories, as well as the number of mentions each category received and the percent of instances for each category. "Number of mentions" was the number of times suggestions from the focus groups discussed one of the categories. "Percent of instances" was found by dividing the number of mentions by the total number of mentions: 833.

Categories	Number of Mentions	Percent of Instances
Training	132	15.8%
Change Performance Review	99	11.9%
Communication	78	9.4%
Completeness	73	8.8%
Clarity	60	7.2%
Technology Improvements	60	7.2%
Multiple Reviews	45	5.4%
Subject Matter Expert	45	5.4%
Search Record Keeping	41	4.9%
Low Quality Applications	33	4.0%
Consistency	31	3.7%
Time Restrictions	29	3.5%
Transparency	27	3.2%
Quality Enhancement	22	2.6%
More Supervisor Interaction	19	2.3%
Timeliness	16	1.9%
Interviews	13	1.6%
Examiner Attitude	10	1.2%
Total	833	100%

Figure 7: Table of Focus Group Categories

Eight of the original 18 categories had a percent of instance greater than five percent, making those categories eligible for use in the perception gap matrix. These eight categories were considered the top categories for the focus group data and are shown in Figure 8:. The category with the highest percent of instance was “training” at 16%. This means that the focus groups felt that examiners needed more training as a whole. So examiners need more training when they first become examiners, more

training when a law changes, and refresher training for older examiners. Detailed descriptions of the categories can be found in Appendix F.

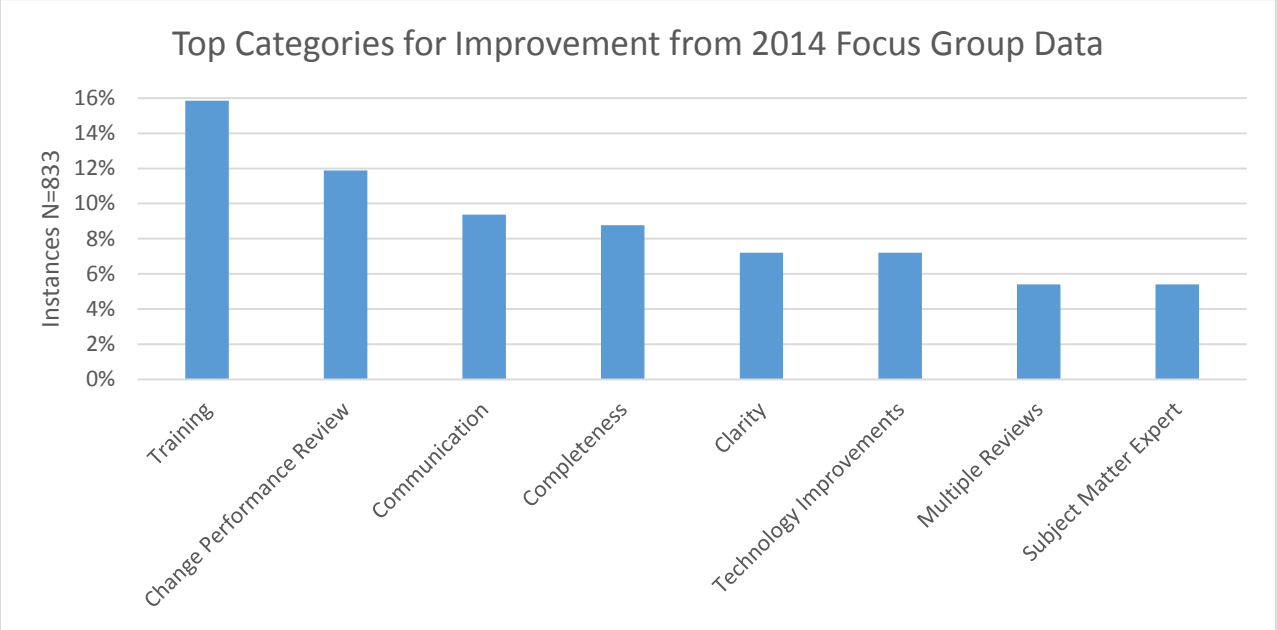

Figure 8: Top Categories for Improvement from 2014 Focus Group Data

4.2.1.3 Internal Quality Surveys

The internal quality surveys have two sections of questions, internal factors affecting quality and external factors affecting quality. The two sections of the survey were analyzed using the methods described in Methodology Section 3.1.1.1 Internal Quality Surveys. The data was given to us by the OPQA as a summary for quarters one and three of the Fiscal Year 2015. We used a combined average of the data to have one number for 2015. Figure 9: Internal Factors Affecting Examiner Quality and Figure 10: External Factors Impacting High Examiner Quality show the categories in a side by side comparison. Figure 9: Internal Factors Affecting Examiner Quality shows that all three categories as “favorable” being the most selected, “neutral” in the middle and “unfavorable” the least selected. All three categories show that “unfavorable” was chosen by 10% of the 750 examiners surveyed. This means that the internal factors for examiners need improvement so the examiners can have better quality work.

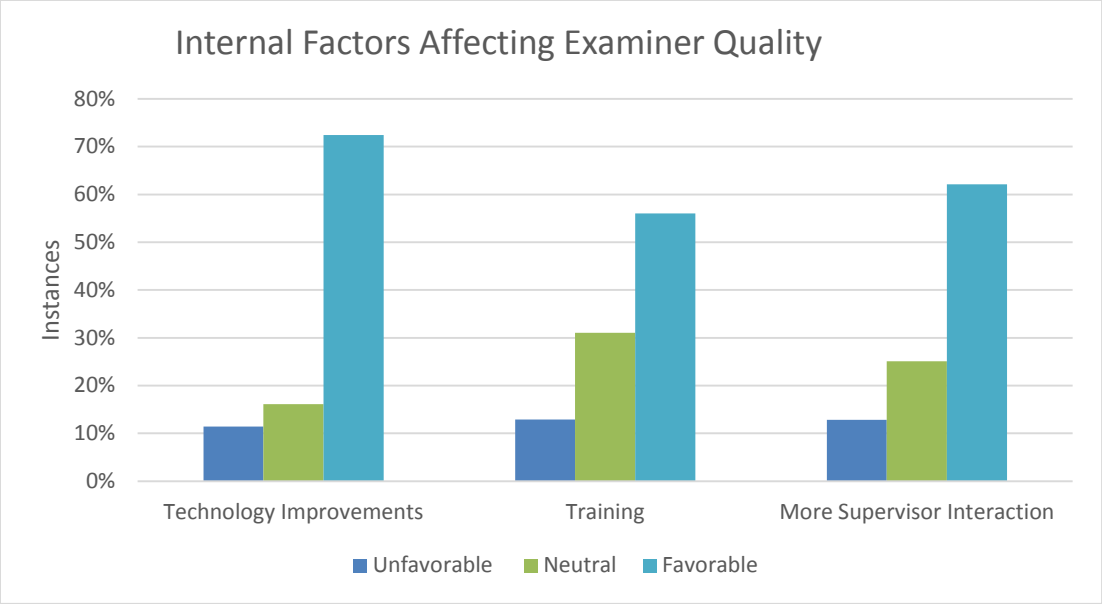

Figure 9: Internal Factors Affecting Examiner Quality

Figure 10: External Factors Impacting High Examiner Quality shows that each of the categories vary on whether applicants are able to help examiners have good quality work. For example, “clarity” is shown to have the highest percentage chosen for “moderate extent” at 53%, it then has the middle as “large extent” at 32% and the lowest is “not at all/small extent” at 15%. However, “low quality applications” has the highest percentage chosen for “moderate extent” at 48%, the middle percentage is “not at all/small extent” at 35% and the lowest is “large extent” at 17%. Despite this variation, all four categories show that “not at all/small extent” was chosen by more than 10% of the 750 examiners surveyed. This means that the external factors that examiners come in contact with need improvement so that the examiners can do better quality work.

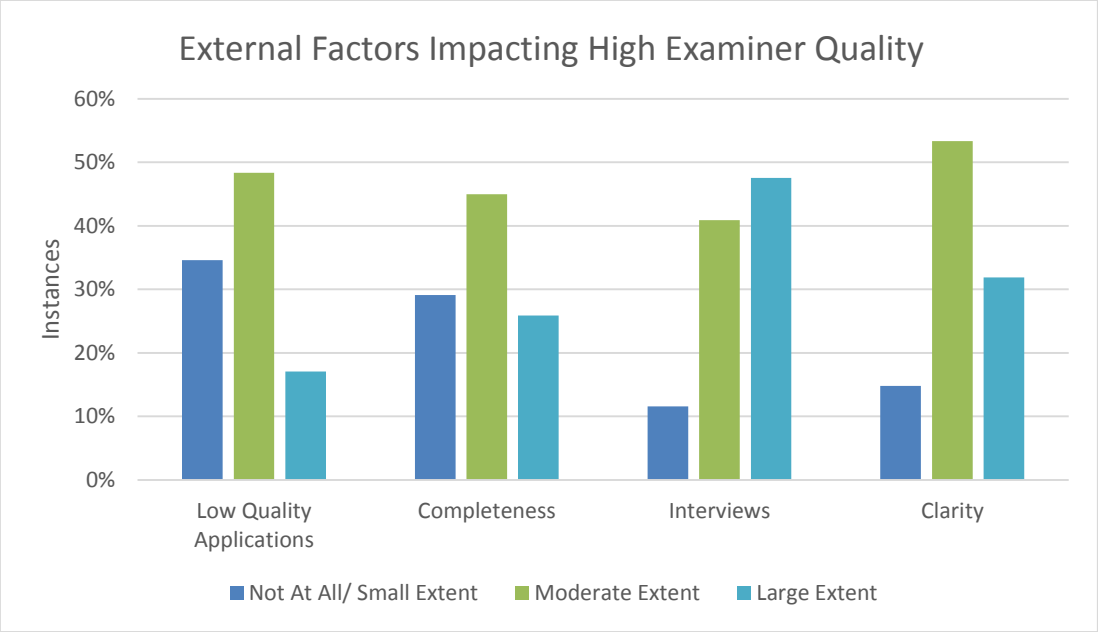

Figure 10: External Factors Impacting High Examiner Quality

We then continued to analyze the data collected by the OPQA. Figure 11: Table of Internal Quality Survey Categories shows the seven categories that emerged using the methods described in Methodology Section 3.1.1.1 Internal Quality Surveys as well as “number of mentions” and “percent of instances”. Since the data was given to us as a summary, the raw data was needed for the number of mentions. The raw data was found by multiplying the percent of people who answered “not at all/small extent” or “unfavorable” in the survey by the number of people sampled in the survey: 750 examiners. “Number of mentions” was then found by adding the raw data each category received together. To find the percent of instances, we then divided the number of mentions by the total number of mentions: 4203.

Categories	Number of Mentions	Percent of Instances
Low Quality Applications	2075	49%
Training	968	23%
Completeness	437	10%
Technology Improvements	342	8%
Interviews	174	4%
Clarity	111	3%
More Supervisor Interaction	96	2%
Total	4203	100%

Figure 11: Table of Internal Quality Survey Categories

Four of the seven categories were selected to be added to the matrix since they were greater than five percent. These four categories are considered the top categories for the internal quality surveys, shown in Figure 12:. The category with the highest percentage in this figure was "low quality applications" at 49%. The examiners feel that they were given low quality applications to review and that hinders the quality of prosecution. Detailed descriptions of the categories can be found in Appendix F.

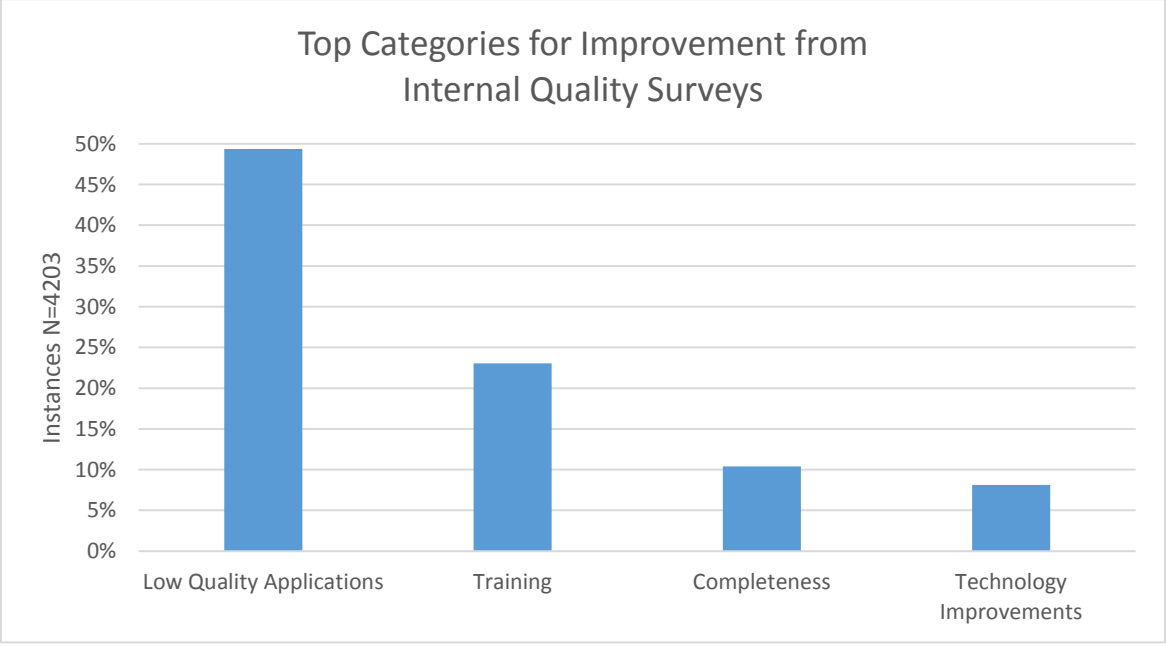

Figure 12: Top categories for Improvement from Internal Quality Surveys

4.3 External Perception

4.3.1 External Data Results

4.3.1.1 Ombudsman Comments

The ombudsman program records the comments they receive from applicants. We received and analyzed the recorded data, as described in Methodology Section 3.1.2.3 Ombudsman Comments. As we analyzed the data, 12 categories emerged. These 12 categories are shown in Figure 13: Table of Ombudsman Categories, along with the number of mentions each category received and the percent of instances. “Number of mentions” was the amount of times comments from the ombudsman program discussed one of the categories. The percent of instances was found by dividing the number of mentions each category received by the total number of mentions received: 138.

Categories	**Number of Mentions**	**Percent of Instances**
Clarity	24	17.4%
Improper Examination	21	15.2%
Communication	20	14.5%
Timeliness	14	10.1%
Examiner Attitude	11	8.0%
More Supervisor Interaction	11	8.0%
Abandonment Problems	9	6.5%
Interviews	9	6.5%
Training	7	5.1%
Technology Improvements	5	3.6%
Inconsistency	5	3.6%
Restriction Practice	2	1.4%
Total	138	100%

Figure 13: Table of Ombudsman Categories

Nine of the original 12 categories were selected to be added to the matrix because the categories met the inclusion criterion. These nine categories were considered the top categories among

the ombudsman data, shown in Figure 14. The category with the highest percent of instances in this figure was “clarity” at 17%, which means that the applicants who submitted comments to the ombudsman program feel that examiners are not clear in office actions or rejections. Detailed descriptions of the categories can be found in Appendix F.

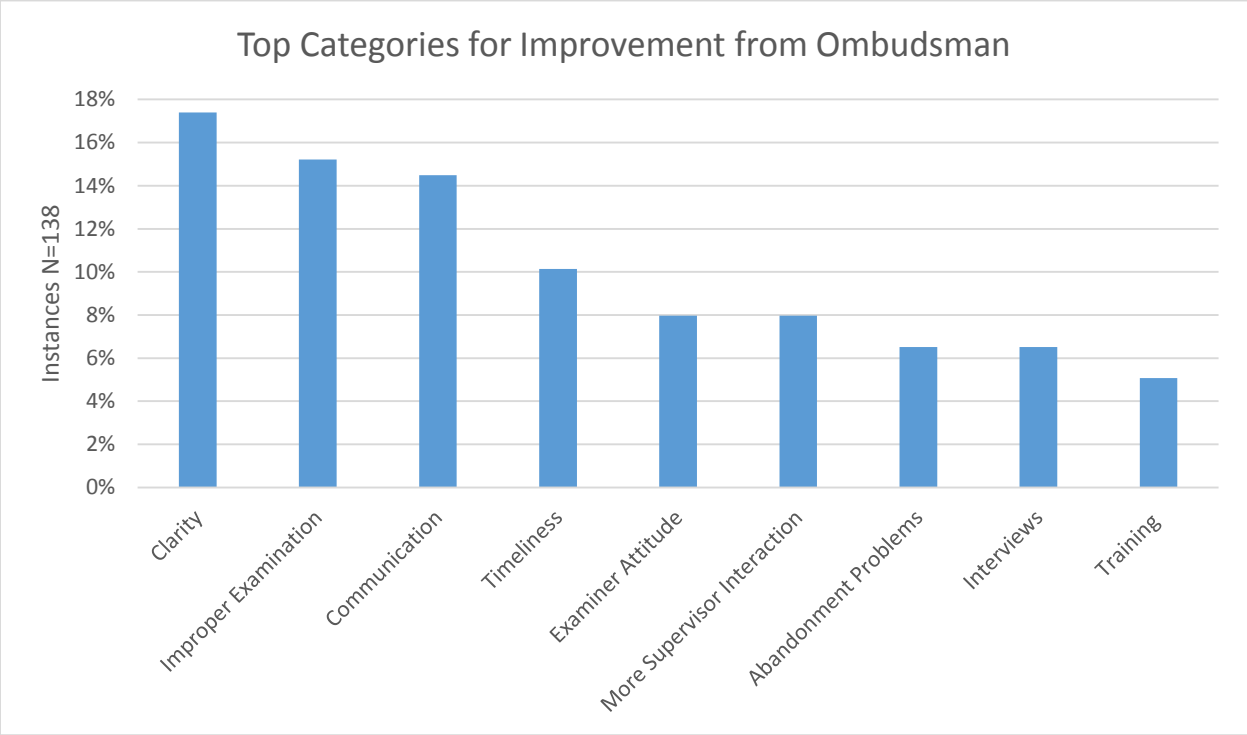

Figure 14: Top Categories for Improvement from Ombudsman

4.3.1.2 External Quality Surveys

The external surveys asked applicants multiple choice questions about the quality of service received from patent examiners. The multiple choice questions were analyzed using the methods described in Methodology Section 3.1.2.1 External Quality Surveys. The data was given to us by the OPQA as a summary for quarters one and three of the Fiscal Year 2015, and we used a combined average to have one number for 2015. Figure 15: Applicants Opinion on Examiner Quality with respect to Categories Shown shows a side-by-side comparison of all the categories the external quality surveys targeted. The figure varies on the quality of work an examiner performed during prosecution. For example, “clarity” shows that the applicants chose “large extent” the most at 47%, “moderate extent” in the middle at 39% and “not at all/small extent” the least at 15%, while “restriction practice” shows that the applicants chose “moderate extent” the most at 40% and chose “large extent” and “not at all/small

extent" approximately the same amount of times at 30%. Despite this variation, all five categories had "not at all/small extent" chosen by at least 10% of the applicants surveyed, meaning that all the areas could be improved.

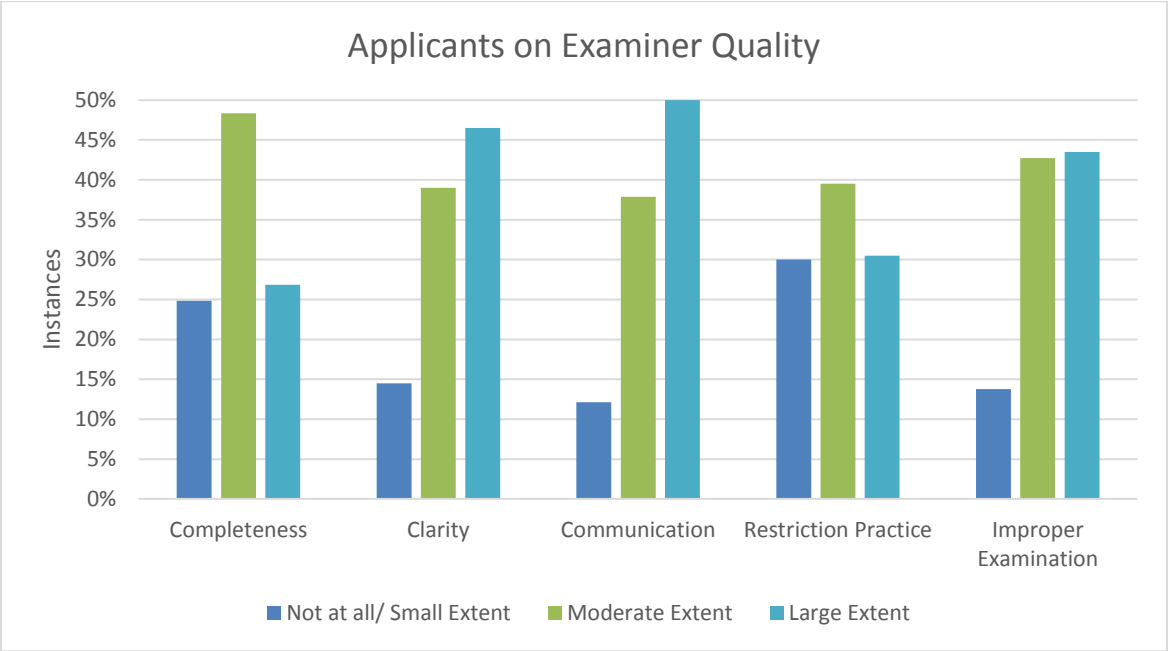

Figure 15: Applicants Opinion on Examiner Quality with respect to Categories Shown

Using the methods described in Methodology Section 3.1.2.1 External Quality Surveys we analyzed the data in the "not at all/small extent" responses to find areas of improvement. During the analysis, five categories emerged as shown in Figure 16: Table of Categories for External Quality Surveys along with the number of mentions and the percent of instances. We analyzed the "not at all" level of quality to see what categories needed to be most improved. Since the data was given to us as a summary, the raw data was needed for the number of mentions. The raw data was found by multiplying the percent of people who answered "not at all/small extent" in the survey by the number of people sampled in the survey: over 3000 frequent filers. "Number of mentions" was then found by adding the raw data each category received together. To find the percent of instances, we then divided the number of mentions by the total number of mentions: 7760.

Categories	Number of Mentions	Percent of Instances
Completeness	2285	29.4%
Clarity	2224	28.7%
Communication	1487	19.2%
Restriction Practice	920	11.9%
Improper Examination	844	10.9%
Total	7760	100%

Figure 16: Table of Categories for External Quality Surveys

All five of the categories that emerged during our analysis met the inclusion criterion of having a percent of instance greater than five percent and were placed into the matrix. The categories are considered to be the top categories, shown in Figure 17:, to be consistent with the rest of the data we analyzed in other sources. The figure shows that the category with the highest percent of instance was "completeness" at 29%, which means that applicants feel that examiners are not complete enough with their art searches or their office actions. Detailed descriptions of the categories can be found in Appendix F.

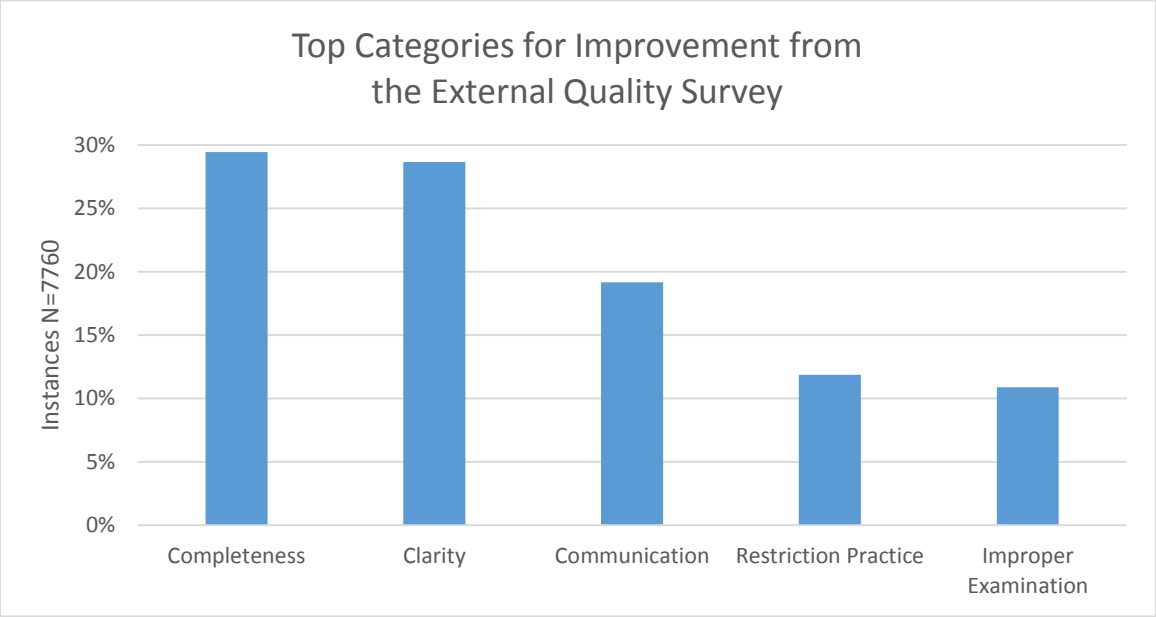

Figure 17: Top Categories for Improvement from the External Quality Survey

4.3.1.3 External Quality Survey Comments

Using the methods described in Methodology Section 3.1.2.2 External Quality Surveys Comments, we analyzed the responses to the opened-ended question in the survey and 14 categories emerged. Figure 18: Table of Categories for External Quality Survey Comments shows these categories as well as the number of mentions and the percent of instances. "Number of mentions" was the number of times the comments discussed one of the categories. "Percent of instances" was found by dividing the number of mentions each category received by the total number of mentions: 757.

Categories	**Number of Mentions**	**Percentage of Instances**
Clarity	227	30.0%
Transparency	145	19.2%
Interviews	66	8.7%
Training	54	7.1%
Change Performance Review	49	6.5%
Consistency	35	4.6%
More Supervisor Interaction	34	4.5%
Multiple Reviews	32	4.2%
Timeliness	31	4.1%
Restriction Practice	30	4.0%
Technology Improvements	22	2.9%
Time Restriction	12	1.6%
Completeness	11	1.5%
Quality Enhancement	9	1.2%
Total	757	100%

Figure 18: Table of Categories for External Quality Survey Comments

Five of the 14 categories that emerged during our analysis met the inclusion criterion of having a percent of instances greater than five percent and were placed in the matrix. These five categories are shown in Figure 19: Top Categories for Improvement from External Survey Comments and are

considered the top categories for the external survey comments. The category with the highest percent of instances was “clarity” at 30%. This means that applicants feel that examiners need to be clearer in their office actions and rejections. Detailed category descriptions can be found in Appendix F.

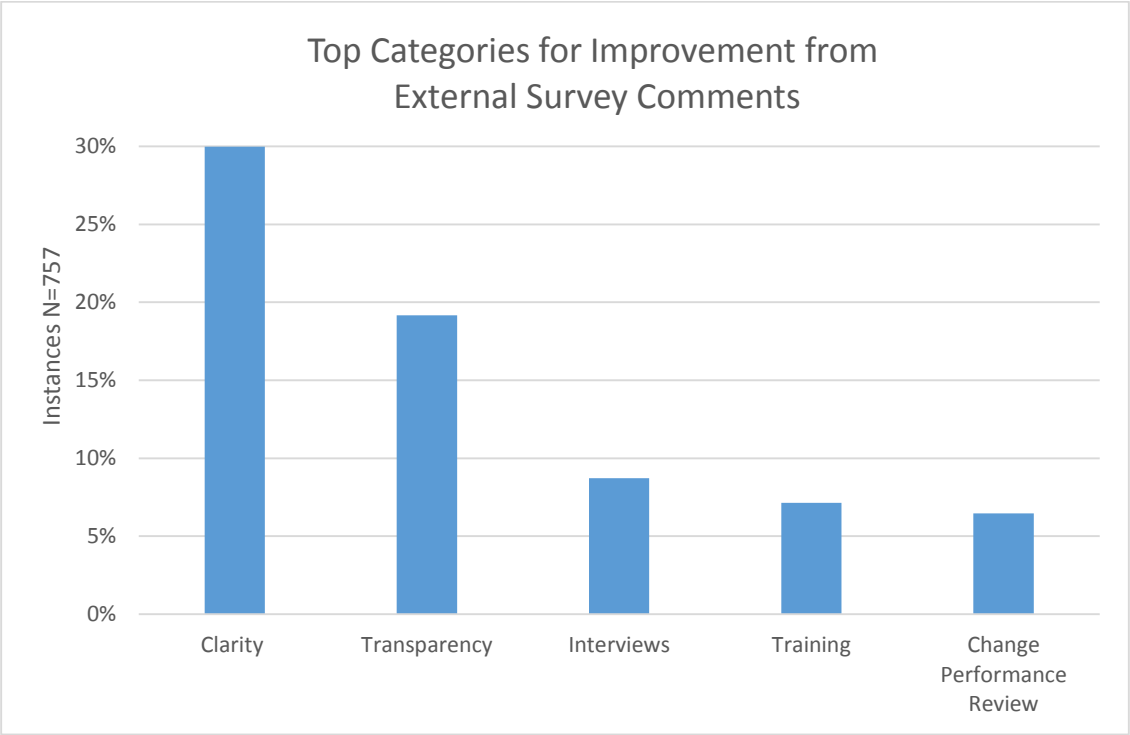

Figure 19: Top Categories for Improvement from External Survey Comments

4.4 Perception Graphs

All the data sources described above culminate into Figure 20: Topics for Gap Matrix made with four sources and Figure 21: Topics for Gap Matrix made with six sources. These show the categories that met the inclusion criterion and their side-by-side comparison of the internal and external perception. These categories were used to make the perception gap matrix found in Appendix G. The internal perceptions included the RQAS interviews, internal quality surveys and the 2014 focus group data. The external perceptions included the external quality survey questions and comments and the ombudsman data. The percent of instances for the internal and external percentages were determined by adding each of the source’s number of mentions together and dividing it by the total number of mentions. We chose to graph the categories into two graphs because the quality survey data had questions that were

targeted toward certain areas such as “clarity” and “completeness”. Because of these targets, the data was skewed against the other categories that were not found in the quality surveys, such as “change performance review” and “transparency”.

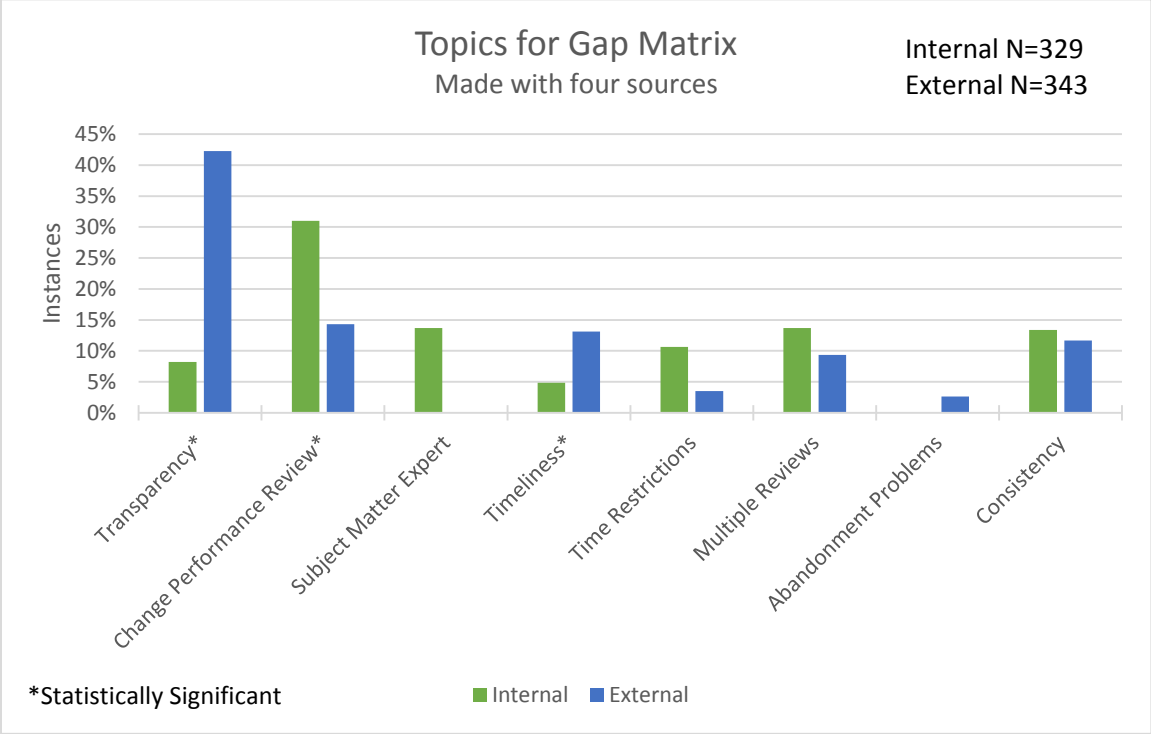

Figure 20: Topics for Gap Matrix made with four sources

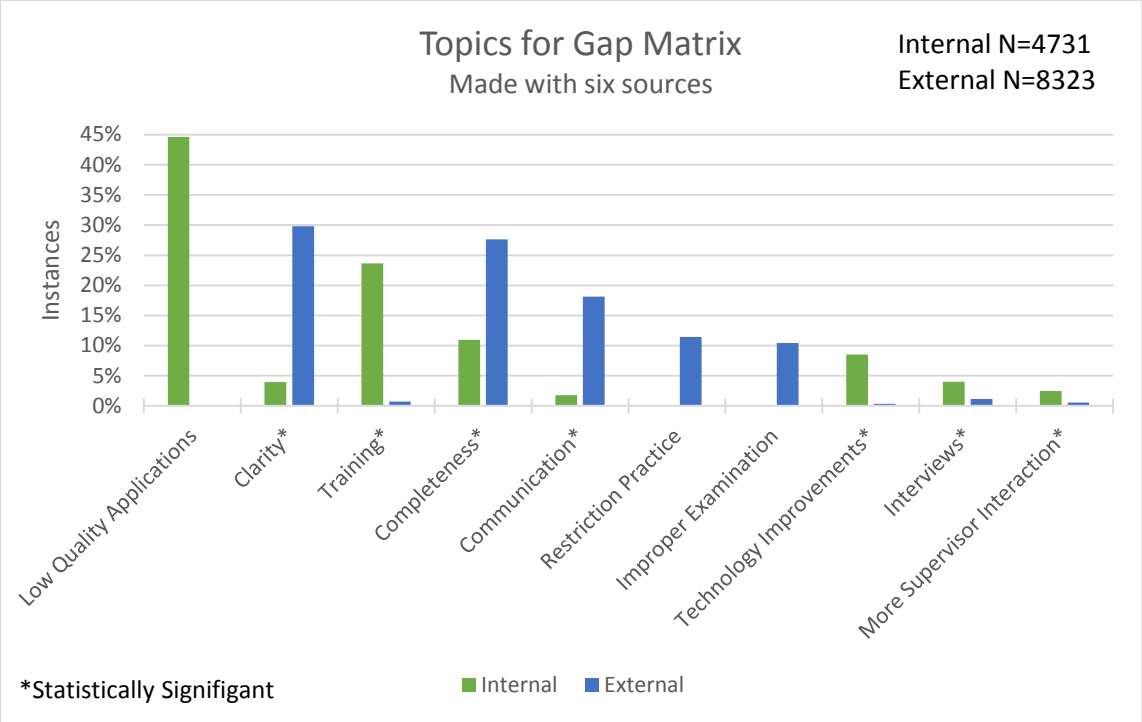

Figure 21: Topics for Gap Matrix made with six sources

4.4.1 Statistically Significant Gaps

We had to determine if the gaps found in Figure 20: Topics for Gap Matrix made with four sources and Figure 21: Topics for Gap Matrix made with six sources were statistically significant. To determine this we used the z-test for proportions. The z-test for proportions is a statistical test that compares two sample proportions and finds the probability of the population proportions being equal. If the probability is less than .05 then the proportions are significantly different. There were three types of statistical significance: statistically significant, not statistically significant, unknown significance. There were 10 categories that were determined to be statistically significant. These are shown Figure 20: Topics for Gap Matrix made with four sources and Figure 21: Topics for Gap Matrix made with six sources as well as in the perception gap matrix found in Appendix G. There were four categories that were determined to not be statistically significant. These categories were “time restrictions”, “examiner attitude”, “consistency”, and “multiple reviews”. There were five categories in which it is unknown if they are statistically significant. The significance was unable to be determined because one of the perceptions had a percent of instances that was zero percent. Because of this the assumptions for the z-test could not be met and therefore the test could not be conducted. However, since we did not survey

the entire population of internal and external perceptions, we cannot say that these categories are insignificant because there is the possibility that someone in the population would have mentioned these categories. These categories with unknown significance were “low quality applications”, “subject matter expert”, “restriction practice”, “improper examination”, and “abandonment problems”. All the categories can be found in the perception gap matrix in Appendix G.

4.5 Case Study Cookbook

4.5.1 Definition of Case Study

With the goal of creating an encompassing definition of a case study, we researched and collected information from the multiple sources discussed in the section “What is a Case Study?” of our “cookbook” (See Appendix H). From this research, we learned that there was no single accepted definition of a case study, and that even two researchers within the same discipline may disagree on how to use a case study and what can be achieved with a case study. In order to meet our goal of presenting an encompassing definition, we took the broadest aspects of the definitions in each source and combined those aspects to cover the many uses for case studies that were discussed. The result was the following definition, also offered in our “cookbook”:

> A case study is a form of observational study that focuses on the collection of data from a single case or multiple cases of a phenomenon. Case studies are used to gather data from one or more sites and can take place at a single point in time or over a period of time lasting up to several years. The goal of such a study is to increase understanding of the studied phenomenon, either in the context of a specific instance or generalized over a population.

4.5.2 Types of Case Studies

During our research, we discovered that there were two types of studies we wanted to cover: case studies and cross-case studies. These two types are compared and contrasted in the section “When to Use a Cross-Case Study Instead of a Case Study?” in our “cookbook” (Appendix H). These two types of study can take multiple forms, depending on the research goals and design that a researcher develops. From our research, we found six types of case study that can be conducted as case studies or as cross-case studies: Illustrative, Exploratory, Critical Instance, Program Implementation, Program Effects, and

Cumulative case studies. These six types of case studies are described in the section titled “Types of Case Studies” in “The Cookbook”. The full cookbook can be found in Appendix H.

Chapter 5: Conclusions and Recommendations

After completing the data analysis and the cookbook, we discovered that our analysis was essentially a cumulative case study. The analysis could be considered a cumulative case study because we took the individual sources previously conducted and aggregated them into a single study to determine the perception gap matrix (See Appendix G). Our case study was able to conclude that there are major gaps in perception that need to be prioritized and analyzed.

To prioritize the gaps found in the matrix, we created a chart that shows the importance of a category versus the perception gap. To find the importance of the categories, we reviewed how many sources each category emerged in and then placed them in order of a weighted average. Figure 22: Importance versus Gaps Priority Chart shows the importance chart and what recommendations the USPTO should consider for each section. The categories with a high importance and large gap are considered to be the categories with top priority for improvement. The categories with a low importance and large gap are considered to be the categories that need to be monitored to make sure their level of importance does not change. Categories with a high importance and small gap are considered to be the categories that need to be maintained so that the gap does not get any larger. Finally, categories with a low importance and small gap are considered to be the USPTO's strengths.

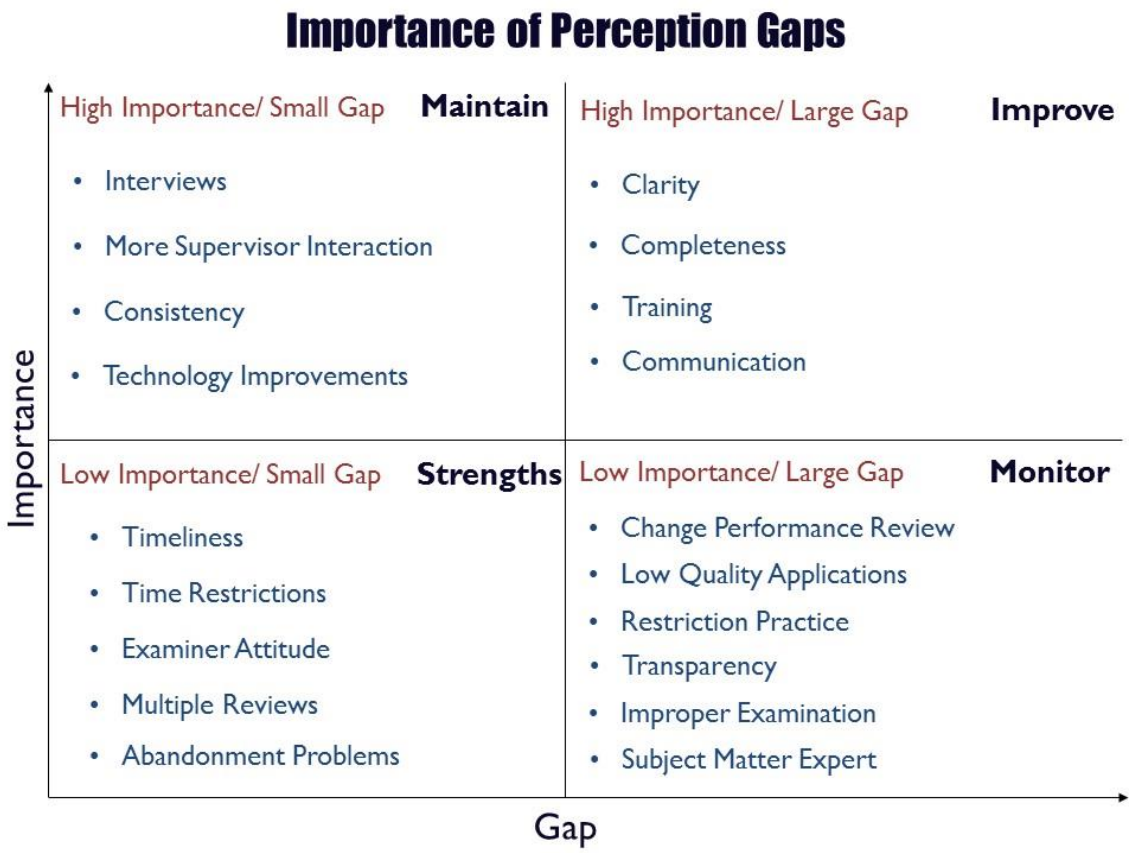

Figure 22: Importance versus Gaps Priority Chart

We recommend using Figure 22: Importance versus Gaps Priority Chart to prioritize the topics that come in from the "Topic Submission for Case Studies" quality initiative. From the topics that come in, the case studies that are performed first should be related to the categories in the "Improve" section of the chart. After a topic for a case study is decided and prioritized, the USPTO can then use the maturity chart for case studies in Figure 23: Value of Different Case Studies by the Maturity of the Investigation to determine what type of case study to conduct based on the maturity of the program they are studying. The descriptions of the maturity chart can be found in Appendix H. Finally, once a case study is chosen, the office can then use the cookbook as a reference for how to perform that particular case study.

Type of Study	Young	Middle	Old
Cross Case	Low	High	High
Critical Instance	Mid	High	Mid
Cumulative Prospective	Low	Mid	Low
Cumulative Retrospective	Very Low	Mid	High
Exploratory	High	Mid	Low
Illustrative	High	Mid	Low
Program Effects	Mid	High	Low
Program Implementation	Low	High	Low

Figure 23: Value of Different Case Studies by the Maturity of the Investigation

If you are interested in more information about the data, slides or report contact Martin Rater at martin.rater@uspto.gov or contact our advisors, Fred Looft or Brigitte Servatius.

Reflections

Richard Hayes's Reflection

This project had value to me both as an interactive media and game designer and as a professional writer. One of the most important aspects of being a game designer is having a broad range of knowledge on a vast number of topics. Even if that knowledge is not very deep, every extra little bit of trivia I know about the world, observations I make, and experiences I have will positively impact my creative process when designing and working on games. Also, as a game designer, intellectual property is very important to me. Working with the USPTO taught me a lot about the patenting process and about intellectual property laws in general. As a professional writer, this was an excellent way for me to practice the skills I learned during my time at school. I'm very thankful to have had this experience.

Brittany Kyer's Reflection

While working at the USPTO, I got to meet a bunch of awesome people who all had different stories of how they got to where they were at the patent office. All of these people influenced our project one way or another, through interviews or just through a passing conversation about our project and its goals. While performing this project, I definitely gain experience in statistical analysis, researching non-technical documents, and the case study method. I really enjoyed my time working here, and it had to do heavily with the people who we interacted with.

Emily Weber's Reflection

While working at the USPTO, I was able to refine and build skills that I have learned over the years. I used statistics skills that I learned at WPI to complete our project and even got to teach people how to do these skills. I also was able to build my writing and speaking skills by having to write many emails during our project and speaking to people at the patent office. I gained skills in learning the case study method and learning about patents and their importance. I really enjoyed working at the patent office and hope I can use my experience there for later in life.

Glossary

AFCP: After Final Consideration Program

AIA: Leahy-Smith America Invents Act

GAO: Government Accountability Office

IP: Intellectual Property

OPQ: Office of Patent Quality

OPQA: Office of Patent Quality Assurance

POPA: Patent Office Professional Association

PPAC: Patent Public Advisory Committee

RQAS: Review Quality Assurance Specialist

SPE: Supervisory Patent Examiner

USPTO: United States Patent and Trademark Office

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Appendix A

Internal Quality Survey

OPQA INTERNAL QUALITY SURVEY QUESTIONS

Demographic Section

1. Please indicate your current discipline.

Internal Quality Factors

2. During the past quarter, please indicate your level of satisfaction with the following tools that are needed to perform your work. Consider content and reliability.

a. Search tools
b. Office Action tools
c. EDan
d. Other electronic resources

3. Please indicate your level of satisfaction over the past quarter with the training opportunities that have been provided to maintain/improve the quality of your work. Consider the number and diversity of trainings offered.

a. Technical training
b. Legal training
c. Practice and procedure
d. Automation training
e. Professional development

4. During the past quarter, please indicate your level of satisfaction with the effectiveness of training you have received to maintain or improve the quality of your work.

a. Technical training
b. Legal training

c. Automation training

d. Professional development

5. During the past quarter, please indicate your level of satisfaction with the effectiveness of coaching and mentoring received to maintain/improve the quality of your work.

a. Technical, including search

b. Practice and procedure

6. During the past quarter, overall, how would you rate the internal USPTO factors (training, tools, coaching, etc.) that impact your ability to provide high-quality patent examination?

External Quality Factors

7. During the past quarter, consider your examination experiences relating to incoming patent applications. To what extent did the applicants and their agents/attorneys facilitate high-quality patent prosecution with respect to:

a. Clarity and completeness of specifications

b. Clarity of claims

c. Manageable number of claims

d. Claims drafted to capture concept of invention

e. Claims vary reasonably in scope from broad to narrow to facilitate examination

f. Art cited in IDS is material to patentability

g. Clarity of translations of foreign applications

h. Clarity and completeness of drawings

8. During the past quarter, consider your examination experiences relating to your written and personal interactions with applicants and their agents/attorneys. To what extent did the applicants and/or their agents/attorneys facilitate high-quality patent prosecution with respect to:

a. Clarity of responses to Office Actions

b. Thoroughness of response to Office actions in addressing the specific issues set forth in the Office action

c. Citation to the specification and/or drawings that provide support for newly added claim limitations

d. Preparedness to efficiently and effectively conduct an interview

e. Professional demeanor displayed in an interview to advance prosecution

9. During the past quarter, overall, how would you rate the various external factors (patent applicants/agents/attorneys and their interactions) that impact your ability to provide high-quality patent examination?

External Quality Survey

OPQA EXTERNAL QUALITY SURVEY QUESTIONS

Demographic Section

1. What is your affiliation?

2. Which technology field best describes the majority of patent applications you have files over the past 3 months?

3. Approximately how many Office Actions have you received during the past 3 months?

4. How often have you communicated over the telephone or in person with USPTO patent examiners in the past 3 months?

Interactions with Patent Examiners

5. To what extent were the non-supervisory Patent Examiners:

a. Available to resolve your issues?
b. Attentive to your concerns?
c. Responsive to your inquiries?
d. Properly prepared to discuss the issues at hand?
e. Able to facilitate a positive resolution?

Patent Examiners' Decisions

6. Consider your experiences over the past 3 months. Please think about the rules and procedures Patent Examiners must adhere to in their decisions. To what extent did the Patent Examiners you worked with adhere to the following rules and procedures with respect to:

a. Citing appropriate prior art?
b. Treating all claims?
c. Providing enough information to advance prosecution?
d. Substantively addressing your responses to Office Actions?
e. Following appropriate restriction practice?

Rejections Practice

7. Consider all rejections you have received over the past 3 months. How often do you think the rejections made under the following statutes were reasonable in terms of being technically, legally, and logically sound with respect to:

a. 35 U.S.C. 101 Rejections

b. 35 U.S.C. 102 Rejections

c. 35 U.S.C. 103 Rejections

d. 35 U.S.C. 112 Rejections, Paragraph 1

e. 35 U.S.C. 101 Rejections, Paragraph 2

Overall Examination Quality

8. In the past 3 months, how would you rate overall examination quality?

9. In the past 3 months, has overall examination quality declines, stayed the same, or improved?

10. In the past 3 months, have you experienced problems with the consistency of examination quality from one examiner to another?

Appendix B

Written Consent

Informed Consent Agreement for Participation in a Research Study

Investigators: Richard Hayes, Brittany Kyer, Emily Weber

Contact Information: dc15-uspto@wpi.edu

Sponsor: United States Patent and Trademark Office (USPTO)

You are being asked to participate in an interview for a research study. The interview will take around 10 to 15 minutes to complete, depending on the length of your responses and any follow-up questions we may have. Before you agree to participate, you must be fully informed about the purpose of this study, how the information we collect is being used, and about any risks or benefits involved with participation in this study. This page contains the information you need in order to make a fully informed decision to participate. If at any time you have a question about the following information, please feel free to pause from reading and ask.

The purpose of this research is to assist the Office of Patent Quality Assurance with improving the quality of patent prosecution by identify key areas of focus for case study research. This will be achieved in part by determining the perspectives of multiple parties involved with the USPTO in regards to the quality of patent prosecution. If you choose to participate, we will be asking you a series of questions to determine your personal opinion on patent prosecution quality. Your answers will be collected for further use in the study.

The information and the answers you provide during this interview will remain anonymous. Any answers that you give will be paraphrased and categorized together with information that we will collect from other participants. You will not be identifiable through the answers you provide. The signature you provide on this page will be the only documentation of your participation in this interview. The anonymous information gathered from this interview will be published with the project research, but any record of your participation in this interview will be held confidential so far as permitted by law.

This interview is entirely voluntary. There are no benefits or compensation involved with participation in this interview. Providing an answer to any question during this interview is not mandatory.

Refusal to participate in this interview or to answer any of the individual questions will not result in penalty or any loss of benefits. You have the right to cancel or postpone this interview at any time. The project investigators retain this right as well. You are entitled to receive contact information for the project team and the project advisors if you desire that information.

Before you make your decision about participating in this interview, do you have any questions or anything you would like clarified?

For more information about this research or about the rights of research participants, or in case of research-related injury, contact Investigators:

Richard Hayes, Brittany Kyer, Emily Weber dc15-uspto@wpi.edu

You may also contact the chair of the WPI Institutional Review Board (Prof. Kent Rissmiller, Tel. 508-831-5019, Email: kjr@wpi.edu) or WPI's University Compliance Officer (Jon Bartelson, Tel. 508-831-5725, Email: jonb@wpi.edu).

If you agree to participate in this interview for our research study, please sign below and provide the date:

Signature: _____ Date: _____

The investigator conducting this interview will provide their signature and the date below:

Signature: _____ Date: _____

Appendix C

Interview Questions

Unstructured Interview with USPTO RQASs

- How long have you been an RQAS?
- Tell us about your past jobs at the USPTO
- What level of quality do you believe patent prosecution is operating at?
- Where during prosecution do you think quality could be improved?
- Can you tell us about common difficulties you encounter with the current system, if any?
- What measures/metrics do you think could gauge the quality of work performed by examiners?
- How do you think applicants look at patent prosecution?
- Open up to extra comments

Unstructured Interview with Patent Attorneys

- How long have you been a patent attorney?
- Where do you fit into patent prosecution?
- What level of quality do you believe patent prosecution is operating at?
- Where during prosecution do you think quality could be improved?
- Can you tell us about common difficulties you encounter with the current system, if any?
- What measures/metrics do you think could gauge the quality of work performed by examiners?
- How do you think examiners see the quality of patent prosecution?
- Open up to extra comments

Appendix D

Acknowledgements

People who we wish to thank for their help with our project:

Marty Rater, Chief Statistician, Office of Patent Quality Assurance

Martin.Rater@USPTO.gov

Dan Sullivan, Director,Organic Chemistry Patent Technology Center

Daniel.Sullivan@USPTO.gov

Anthony Caputa, Director, Office of Patent Quality Assurance

Anthony.Caputa@USPTO.gov

Steve Ricks, Strategic Planning Project Manager, Office of the Asst. Dep. Commissioner for Patent Operations

Steven.Ricks@USPTO.gov

Brian Hanlon, Director, Office of Patent Legal Administration

Brian.Hanlon@USPTO.gov

Paul Rodriguez, Senior Review Quality Assurance Specialist, Office Patent Quality Assurance

Paul.Rodriguez@USPTO.gov

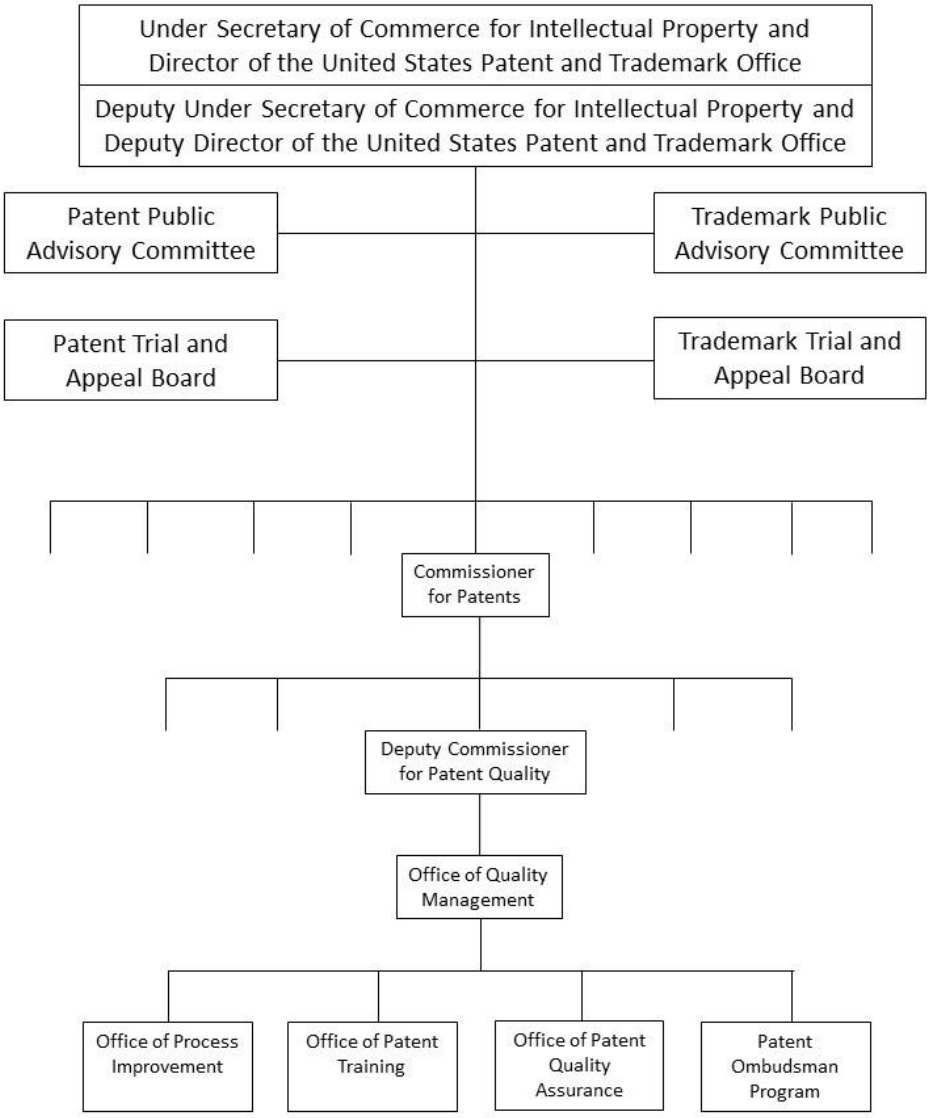
Dale Shaw, Director, Office of Ombudsman Program

Dale.Shaw@USPTO.gov

Appendix E

USPTO Employee Structure

The main USPTO campus is located in Alexandria, VA, the agency has also opened other offices around the country. The Alexandria campus has five buildings that house all the offices in the USPTO. The following organizational chart shows a portion of the USPTO structure. It shows the hierarchy of the OPQA and where it fits into the USPTO.



At the USPTO, employees include patent examiners, trademark attorneys and other support staff. Support staff include executives and managers in the various offices of the USPTO. Examiners and other patent professionals are a part of an independent union called the Patent Office Professional Association (POPA). POPA represents the views of patent professionals in regards to working conditions, personal policies and the atmosphere of professionalism at the USPTO (POPA 2015). Because of this union, change can be difficult to accomplish at the USPTO because the office has to get approval from POPA before it can move forward.

Appendix F

Category Descriptions

Abandonment Problems: This category refers to the problems that occur when an application is abandoned. It includes when an applicant felt that the rules for abandonment were unclear or their application was wrongfully abandoned when it should not have been.

Change Performance Review: This category refers to changing how examiners are reviewed when it comes to their performance. This includes incentives for doing a good job, punishments for doing a bad job, and changing the Examiner Performance Appraisal Plan[2] to focus on quality of work instead of quantity.

Clarity: This category refers to an examiner's clarity during patent prosecution. This includes the logic and reasoning behind rejections, Office Actions and use of prior art, as well as an Examiner's English speaking ability and their ability to write clearly.

Communication: This category refers to the communication from examiners to other examiners, applicants and other people at the USPTO. This includes communicating to other examiners, communicating to supervisors, and communicating to applicants to create a joint effort to advance prosecution.

Completeness: This category refers to how complete an examiner is during patent prosecution. This includes doing a complete art search before the first office action and completely addressing an applicant's arguments and claims when sending out the first office action.

Consistency: This category refers to the consistency of prosecution between examiners. This includes consistency in writing, quality, and claim interpretation.

Examiner Attitude: This category refers to an examiner's attitude with respect to quality and how they interact with customers.

[2] The way in which an examiner's performance is reviewed by their supervisor

Improper Examination: This category refers to when an examiner does not follow the rules when it comes to rejections or prior art.

Interviews: This category refers to anything that had to do with problems with the interview process. This includes having more interviews, having the examiner initiate the interview, and having them earlier and often throughout the process.

Low Quality Applications: This category refers to the low quality applications coming through the door and how it hinders the quality of prosecution, because of that the quality of prosecution is lower.

More Supervisor Interaction: This category refers to the lack of interaction and communication between the Supervisory Patent Examiners and the lower level examiners.

Multiple Reviews: This category refers to the need for multiple reviews of an application throughout prosecution by different examiners as well as comparing cases that are similar to check the quality of prosecution.

Quality Enhancement: This category refers to the need for the improvement of quality through a new quality control department or quality problems in general.

Restriction Practice: This category refers to how examiners choose to do restriction practice for applications.

Search Record Keeping: This category refers to the examiner's desire to have their search histories recorded for a patent application and to be able to view similar searches from both the USPTO and foreign patent offices.

Subject Matter Expert: This category refers to how employees at the USPTO think there should be a person who is well versed in a subject in the art units to help examiners understand inventions and claims.

Technology Improvements: This category refers to improvements in technology that the examiners and applicants need to use during prosecution. This includes improving the tools examiners use for search as well as making sure the computer systems are working correctly for applicants to see where their application is in prosecution.

Time Restrictions: This category refers to the amount of patents an examiner has to review and how much time they have to do it.

Timeliness: This category refers to the time it takes a patent to go through prosecution. This includes the time it takes an examiner to send office actions to applicants after a correction has been made.

Training: This category refers to the amount of training an examiner receives. It includes how much training a new examiner should get, more training after law changes and refreshers for the more senior examiners.

Transparency: This category refers to how transparent patent prosecution is to the public. This includes showing the public each step of prosecution as well as showing an examiner's statistics to see how they compare to other examiners.

Union: This category refers to the RQAS's opinions regarding the union at the USPTO and how it may impede progress with training and quality for the examiners.

Appendix G

Perception Gap Matrix

Category	Internal	External	Difference	Significant?
Transparency	8.2%	42.3%	34.1%	Yes
Clarity**	4.0%	29.8%	25.9%	Yes
Training**	23.7%	0.7%	22.9%	Yes
Change Performance Review	31.0%	14.3%	16.7%	Yes
Completeness**	11.0%	27.7%	16.7%	Yes
Communication**	1.8%	18.2%	16.4%	Yes
Timeliness	4.9%	13.1%	8.3%	Yes
Technology Improvements**	8.5%	0.3%	8.2%	Yes
Interviews**	4.0%	1.1%	2.9%	Yes
More Supervisor Interaction**	2.5%	0.5%	1.9%	Yes
Time Restrictions	10.6%	3.5%	7.1%	No
Multiple Reviews	13.7%	9.3%	4.4%	No
Consistency	13.4%	11.7%	1.7%	No
Examiner Attitude	4.6%	3.2%	1.4%	No
Low Quality Applications**	44.6%	0.0%	44.6%	--
Subject Matter Expert	13.7%	0.0%	13.7%	--
Restriction Practice**	0.0%	11.5%	11.5%	--
Improper Examination**	0.0%	10.4%	10.4%	--
Abandonment Problems	0.0%	2.6%	2.6%	--

**These percentages were made using 3 sources for internal and 3 sources for external instead of 2 for each.

Appendix H

The Case Study Cookbook

By

Richard Hayes

Brittany Kyer

Emily Weber

What Defines a Case Study?

The definition of a case study is a topic of disagreement between disciplines, or even between researchers in the same discipline. In this section, we will describe some of the aspects associated with common case study practices, and present a definition for case studies that incorporates elements from multiple sources in order to provide a deeper understanding of the subject.

What is a Case?

John Gerring, a professor of political science at Boston University, defines a case as "a spatially delimited phenomenon (a unit) observed at a single point in time or over some period of time". Gerring also states that a case must have identifiable boundaries and must comprise the primary object of an inference (Gerring, 2006). For example, if a researcher was studying how employees were spending their work hours at a particular location, the unit or "case" would be an individual employee. If a researcher was studying how a certain type of rejection was being applied during the patent examination process, the case would be an individual office action that featured that type of rejection. A case study can focus on a few or many cases. It is not uncommon for a case study to focus on a single case. In "Preparing a Case Study: A Guide for Designing and Conducting a Case Study for Evaluation Input", Palena Neale, et al. state that a case can be an individual, an organization, a process, a program, a neighborhood, an institution, and even an event (Neale et al., 2006, p. 3).

What is a Phenomenon?

The topic of study for a case study is entirely dependent on the researcher goals of an investigation. The topic might be a natural disaster, a program, a person or group of people, a law, an allegation, or anything else that could possibly be studied within the boundaries required by an investigation. Throughout this document we will use the word "phenomenon" to refer to the topic the researcher is studying.

What is a Sample?

A sample, as described by Gerring, is made up of cases that have been selected for analysis. N is commonly used to refer to the sample size, where a study with a single case would be N = 1. N can also

refer to the number of observations made on a particular case. This is usually made clear by the context (Gerring, 2006). In this document, we will not often use N when referring to measurements, but it is important to recognize the use of N as a common practice when conducting case studies.

What is an Observational Study?

Case studies are a type of Observational Study. In the 81st issue of *At Work*, a quarterly publication of the Institute for Work & Health, Observational Study is described as a type of study where a researcher will observe and record information about the subjects but is not allowed to manipulate the study environment in any way (*At Work*, 2015). The same article defines two types of Observational Studies that are common for case studies:

- **Cross-Sectional Study** - This is a form of Observational Study where a "snapshot" is taken to compare different population groups at a single point in time. This allows researchers to compare many different variables at the same time. Because these studies only look at a single point in time, they cannot provide definite information about cause-and-effect relationships (*At Work*, 2015).
- **Longitudinal Study** - This is a form of Observational Study where researchers conduct several observations of the same subjects over a period of time, sometimes lasting years. This form of study allows researchers to detect developments or changes at both the group and individual level. Longitudinal studies can help establish a sequence of events over time (*At Work*, 2015).

What is a Case Study?

The definitions offered above are related to case studies and are, for the most part, not subject to debate about their meaning. The definition of a case study itself is not so clear. On Harvard's Graduate School website, it is explained that case studies should focus "on gaining an in-depth understanding of a particular entity or event at a specific time" (Harvard). A guide on case studies from Colorado State University states that the focus should be on collecting and presenting detailed information (Becker et al., 2012). John Gerring takes another stance, believing that the purpose of such a study, at least in part, is to use the collected data to generalize the results over a population. These claims and more exist as parts of separate definitions for case studies in scholarly research. It is evident that some differences in definition exist to serve the purpose of the discipline the study is being used for, but this makes it difficult to fully understand what encompasses a case study as a broad idea.

There are common themes among definitions for case studies. If we look at the three perspectives we just discussed, we can see that there is focus on gathering data and using it for some purpose, whether that is to present it to others in detail, use it to gain a deep understanding of a topic, or use it to generalize something over a population. There is some debate as to how many cases are appropriate for a single case study, but valid studies with larger case samples do not invalidate studies with smaller case samples. In an effort to cover a broad definition for case studies, we will assume there is a valid use for studies with both large and small case sample sizes.

Taking into account everything that we have discussed so far, we will now offer a definition of a case study comprised of elements from the definitions provided by Harvard, Colorado State University, Neale et al., and John Gerring that encompasses a wide range of uses:

> A case study is a form of observational study that focuses on the collection of data from a single case or multiple cases of a phenomenon. Case studies are used to gather data from one or more sites and can take place at a single point in time or over a period of time lasting up to several years. The goal of such a study is to increase understanding of the studied phenomenon, either in the context of a specific instance or generalized over a population.

When to Use a Cross-Case Study Instead of a Case Study?

Basic distinctions between a case study and a cross-case study:

The main difference between case studies and cross-case studies is that case studies are based on one or a few cases that are each closely studied, while cross-case studies are based on multiple cases that are examined together instead of individually (Gerring, 2006, p. 20). Both kinds of studies can be classified as methods that study a "case" that has "identifiable boundaries and comprises the primary objective of an inference" (Gerring, 2006, p. 18). This means that the study is focused on the primary goal of finding the reason *why* something happens within a case.

Deciding which type to use:

	Case Study	**Cross-Case Study**
Research Goals		
1. Hypothesis	Generating	Testing
2. Validity	Internal	External
3. Causal Insight	Mechanisms	Effects
4. Scope of Proposition	Deep	Broad
Empirical Factors		
5. Population of Cases	Heterogeneous	Homogenous
6. Causal Strength	Strong	Weak

7. Useful Variation	Rare	Common
8. Data Availability	Concentrated	Dispersed
Additional Factors		
9. Causal Complexity	Indeterminate	
10. State of the Field	Indeterminate	

Figure 1: Case Study and Cross-Case Study Designs

(Gerring, 2006, p. 38)

When deciding whether to perform a case study or a cross-case study, "The key questions are (a) how many cases are studied and (b) how intensively are they studied—with the understanding that a "case" embodies the unit concern in the central inference" (Gerring, 2006, p. 23). That is, the researcher must consider the needs of the research to see how many cases should be looked at, and how closely each case must be studied. Overall, the more closely a subject needs to be studied, the more likely that the researcher will need to perform a kind of case study (see "Types of Case Studies"). The close examination offered by a case study gives it an advantage over other studies when it comes to dealing with a new subject or approaching a previously studied subject from a different angle.

The chart in Figure 1 displays the differences between a case study and a cross-case study by listing what each study accomplishes in terms of research goals and by showing the trade-offs that come with choosing one method over the other. This chart is not steadfast, however, as the way a researcher goes about achieving the research goals could potentially change what a case study or a cross-case study can achieve.

Hypothesis:

Case studies are better at generating a hypothesis than testing one. This is due to the "exploratory nature" of case studies and how they involve a deeper investigation of a phenomenon than a cross-case study does. A case study, however, is not as useful for testing a hypothesis because of the same nature that makes it successful at generating a hypothesis; it impedes work that attempts to confirm or deny an assumption (Gerring, 2006, p. 40). A cross-case study encompasses many cases and can test a few hypotheses with a greater degree of confidence (Gerring, 2006, p. 40).

Validity:

When the chart refers to "internal" and "external," internal means within the population of the study, and external means outside of the population of the study. Because of the large number of cases that comprise cross-case studies, they will always be more externally representative of a population than standard case studies as long as the samples statistically represent the population of the study (via

random sampling or normalization). Case studies have an advantage over cross-case studies when looking at causal relationships internally because of the depth of studying each case receives.

Causal Insight:

The chart refers to causal mechanisms and causal effects. Causal mechanism refers to the way something happens from input to output, and causal effects refer to how the output of something was affected by changes in the input. Case studies are more focused in causal mechanisms because it is easier for one to see the pathway from the input to output, but causal effects are better studied with cross-case study research because the larger number of cases allows the researcher to see changes to the input and how it can possibly affect the output.

Scope of Proposition:

Case studies let the researcher look at a population deeply because of the small amount of cases the study possesses. Cross-case studies allow the researcher to look at a population broadly because the amount of cases is large.

Population of Cases:

Case study research can have heterogeneous cases because the small amount of cases being studied means the researcher can look at them closely with the cases' differences being lost in the study. Cross-case study research requires the cases to be homogeneous, in order to avoid a loss of data in the differences that were present in the population.

Causal Strength:

When the input has a strong and consistent effect on the output, it makes the case overall easier to study and more conclusive. Causal strength is weak for cross-case studies because the scope of the population is large and the input could be inconsistent.

Useful Variation:

Useful variation is a temporal or spatial variation on "relevant parameters that might yield clues about a causal relationship" (Gerring p. 45). When a researcher expects there to be a distribution of evidence across the population being studied, the researcher should use a cross case study because there is a higher likelihood that the researcher could find useful variation within the path from input to output. On the other hand, useful variation is rare in case studies because the small amount of cases involved makes any type of variation less likely to appear during the study.

Data Availability:

In the chart, "concentrated" means that all the data is within a small population, and "dispersed" is spread out over a large population. Case studies can be concentrated or dispersed, but dispersed data is not evenly dispersed. The small amount of cases allows a case study to deeply examine data and explore uneven data, because the study will not be attempting to represent outside of the population studied. Cross-case studies, with the large amount of cases they can include, need the data to be evenly dispersed over the population.

Causal Complexity:

This field is indeterminate because the term “complexity” has a different interpretation depending on the researcher and the population being researched. Case study researchers claim that case studies have a better grasp of complex causes but other researches claim that the more complex a study is, the more it leans toward needing to be a cross-case study.

State of the Field:

This field is referring to the state of maturity of the research in a given field. The chart lists this field as indeterminate because this section is referring to how far a population or problem has already been explored. Both a case study and a cross-case study can have a lot of value at any given state of maturity; it all depends on the scope of research that has already been performed in that particular field. See Figure 2 on page 18 for the Case Study Maturity Chart.

Types of Case Studies

In this section, we cover six different types of case studies that are used by the Government Accountability Office (GAO): Illustrative, Exploratory, Critical Instance, Program Implementation, Program Effects, and Cumulative Case Studies. Each case study will be defined and provide an explanation of the study's purpose, its design, and any pitfalls associated with the method. Each type of case study is defined in general terms, but it is important to keep in mind that many aspects of a case study such as site samples, case samples, data collection rules, research questions, research goals, number of researchers, length of the study, etc. are dependent on the needs of the researchers and the inquiry the study is looking to address. This section should be considered as a set of guidelines for conducting different types of case studies.

Illustrative Case Study

- Description
    - Illustrative Case Studies are used to describe a situation or a phenomenon, what is happening with it, and why it is happening. This is often helpful when the study is addressing a target audience that is greatly uninformed about the topic. These studies should describe every element involved in a case (the location, people involved, their goals, what they do, etc.) in a way that remains entirely accurate while still focusing on language that will be understandable by the target audience. It may be difficult to hold the audience's attention if too many cases of this type are presented at once that contain an immense amount of in-depth information.
- Purpose
    - Illustrative Case Studies bridge the gap in the understanding of a topic between the researcher and the target audience, providing a common language with which to discuss the topic.
    - These studies are used to inform an audience about a topic of which it was previously uninformed.
- Design
    - Site Selection
        - The researcher must select what locations, or sites, the data will be collected from. In order to develop a useful description of a situation or a phenomenon for the target audience, the researcher should investigate a site that is either typical for the research topic or representative of any important variations in the topic. Best case or worst case sites do not often provide a general description of the situation.
    - Case Sample Selection
        - The number of cases in an Illustrative Case Study should be kept small.
    - Data Collection
        - The data collected for an Illustrative Case Study should be visually descriptive. The researcher should make observations of the environment, the people, what

the people do and anything else that may be important to the researcher's topic.
        - Some data may not be visual, but should still be descriptive in nature (the goals of the people involved, the specific times that certain things happened, etc.).
    - Reporting the Results
        - The reports on Illustrative Case Studies should consist of self-contained descriptions of what the researcher observed and narratives about how the individual people or other elements involved in the situation acted during the length of the study.
        - Explanations of any complex information must be provided.
        - The report must be written in a way that is clearly readable and understandable by the target audience and not only by subject matter experts.
        - While the language must be clear and understandable, the researcher should avoid over-simplifying in the report. Over-simplifying may not provide a strong enough description to bridge the understanding gap between the researcher and the target audience.
- Pitfalls
    - Illustrative Case Studies are not made to span over a vast number of cases or to generalize any results. Because the data is based on only one or two cases, the results may not be sufficiently accurate if a high level of diversity exists in a situation. In such a situation, an Illustrative Case Study may not be the best choice of study.
    - If there are many elements to report on in a situation, the high number of in-depth descriptions of those elements may make it difficult for the report to hold the reader's attention.

Exploratory Case Study

- Description
    - Exploratory Case Studies should be used to come to an educated initial perception of what is going on in a situation. These studies frequently precede larger-scale investigations, offering insight into a situation and helping to develop analytic strategies, questions, measures, designs, and goals. If substantial information is not required for reporting purposes, then this form of study can be useful for improving confidence about a researcher's understanding of a situation and what has been observed.
- Purpose
    - Exploratory Case Studies provide guidance for developing a larger study on a topic where considerable uncertainty exists.
    - This type of study improves confidence about the researcher's understanding of a situation or of observations.
    - Exploratory Case Studies may be used to justify and design a large-scale investigation by aiding in the design of research goals and questions in an inexpensive way.

- Design
    - Site Selection
        - Due to the high level of uncertainty involved with the situation in an Exploratory Case Study, a researcher should not attempt to select sites based on research goals alone, nor should site selection simply consist of a convenience sample without consideration. The sample of sites should include at least one site for every meaningful variation in the phenomenon being studied. Convenience sampling is only acceptable if it meets this criterion.
    - Case Sample Selection
        - The number of cases sampled should be large enough and collected from enough sources to accurately represent the diversity of the phenomenon being studied. Keeping this in mind, Exploratory Case Studies are meant to be short and small-scale case studies.
    - Data Collection
        - Data should be collected through exploration and observation of the phenomenon at the selected sites. Researchers should investigate the site for potential ways to measure data from the site in a larger-scale investigation in the future. Researchers should also consider potential questions for a future study of the phenomenon at that site, and consider whether or not the answers to those questions could be found through simple observation during the exploratory phase.
        - When an Exploratory Case Study is being conducted, it is possible that the researchers already have research goals in mind. Researchers should collect data to determine whether or not those goals would be useful and sufficient for a larger-scale investigation in the future.
    - Reporting the Results
        - Reports should present all of the observational data collected from the Exploratory Case Study and explain how it was collected.
        - Observational data in Exploratory Case Study reports does not require a strong chain of evidence to support it, as these studies frequently precede a larger study on the same topic.
        - The reports from these studies are often internal, as they are not conclusive and simply serve to improve understanding of a situation. The reports may be made public as part of a larger report on an investigation that followed the Exploratory Case Study.
- Pitfalls
    - The data collected from an Exploratory Case Study can be quite convincing about the conclusiveness of particular findings. Researchers must be careful to avoid prematurely releasing the results as conclusions, as Exploratory Case Studies are not thorough examinations of a phenomenon.

- It is tempting for researchers to spend a long time in the exploratory phase in an attempt to gather more observations. While it is important for researchers to gather a sufficient amount of data and it is sometimes difficult to determine what is sufficient for the needs of an individual study, Exploratory Case Studies are not meant to be longitudinal. Prolonging these studies reduces their worth as an inexpensive initial investigation.
- Site selection must be appropriately representative. It may be tempting for a researcher to explore a sample of sites out of convenience, but the data found at those sites may not sufficiently represent the phenomenon being studied.

Critical Instance Case Study

- Description
  - Critical Instance Case Studies are ideal for examining a specific event or situation, focusing on only one or very few sites. Because of the focus on a specific event or situation, these studies are used to thoroughly investigate that single instance rather than attempting to generalize.
- Purpose
  - Critical Instance Case Studies allow for a thorough investigation of a specific instance of a phenomenon, rather than a generalization.
  - This type of study can provide answers to questions raised about a highly generalized or universal assertion through a detailed study of a single instance.
  - These studies can be used to find cause-and-effect relationships for the studied subject.
- Design
  - Site Selection
    - In Critical Instance Case Studies, the researcher will be studying a specific situation of interest. Consequently, the site is often predetermined and need not be selected.
    - When more than one site is available, a researcher must select one or very few sites to focus on. Convenience sampling is acceptable for Critical Instance Case Studies.
  - Data Collection
    - The type of data being collected is dependent on the phenomenon being studied and loosely dependent on the researcher's goals. When studying a single instance, there is no need for the researcher to create rules about data collection across sites. The data sample collected by the researcher should be as exhaustive as the site and the available resources allow.
    - When testing a hypothesis about the specific phenomenon, data should be collected both to support the hypothesis and to reject other hypotheses.
  - Reporting the Results
    - The researcher should present a complete description of the phenomenon being studied.

        - If there was an inquiry being addressed by the case study, the data should be presented in a way that addresses that inquiry when possible.
        - All of the data collected during the investigation should be clearly described and explained in the report. If any collected data is excluded from the report or the results, the researcher should provide a detailed explanation as to why that choice was made.
        - If the Critical Instance Case Study was testing a hypothesis, that hypothesis should be described and explained. Any data that rules out alternative causes or any evidence that supports the hypothesis should be presented, and any conclusions made from this data should be described and explained.
- Pitfalls
    - This type of study cannot be used for generalization, as any evidence collected from a single instance is not guaranteed to exist in another instance.
    - A researcher must make sure to thoroughly collect data from all of the available resources in a Critical Instance Case Study. It may be tempting for a researcher to prematurely conclude the investigation due to the collection of a seemingly sufficient amount of data, even if there are still data sources that have gone unexamined. However, such a premature conclusion is not guaranteed to accurately represent the phenomenon.
    - A researcher must be absolutely sure about the research goals of a study before conducting a Critical Instance Case Study, especially if the study was requested by another party that may plan to use the results for some other means. If the data collected by the study needs to be generalized at any point, it is not acceptable to use a Critical Instance Case Study.

Program Implementation Case Study

- Description
    - Program Implementation Case Studies focus on identifying whether or not a program has been successfully implemented, and what difficulties the program faced or is currently facing during the implementation process. These are long and thorough longitudinal studies that generally require a fairly large sample of cases due to the need to generalize the results over the population involved. Program Implementation Case Studies can also be used to address concerns about whether or not a program is in compliance with congressional intent. These studies usually require more people to work with the large amount of resources and data, and therefore they are often more costly to conduct.
- Purpose
    - Program Implementation Case Studies provide a large scale generalization about the difficulties being faced by a particular program during implementation. These difficulties could be a result of basic structural problems with the program or simply indications that the program needs more time for installation adaptations to occur.

- This type of study provides answers about whether or not a program has been successfully implemented.
- These studies are also used to provide answers about a program's consistency with legislation and compliance with congressional intent. This is particularly useful when the associated legislation offers considerable flexibility.

- Design
  - Site Selection
    - The researcher must select what locations, or sites, the data will be collected from. Site selection for this kind of study depends on the diversity of the program the researcher wants to study. A sample of sites could be, but is not required to be, a representative sample of all of the locations where the program exists. The researcher may instead choose to sample sites that represent the best cases or the worst cases to focus on what went right or wrong at those sites. The researcher may also choose to sample from sites that seem typical in an effort to examine the general state of a program's implementation.
    - For an accurate generalization, a large sample of sites should be investigated. For this reason, convenience sampling for Program Implementation Case Studies should be often be avoided as the number of cases in such a sample will likely be too small.
  - Data Collection
    - Program Implementation Case Studies frequently collect both qualitative and quantitative data. Data should be collected on-site using any available resources such as recorded statistics related to the program, previously conducted research and published documents on the program, as well as researcher observation.
    - Rules for data collection at each site should be established and consistent across sites. This ensures that each site is represented using the same criteria in order to avoid skewing the data for generalization.
  - Reporting the Results
    - Reports on Program Implementation Case Studies should be presented in a way that addresses the inquiry of the study (whether or not the program has been implemented, what difficulties the program faced or is facing during implementation, whether or not the program is consistent with the legislation, etc.).
    - Reports should specify the dates that information was collected at each site, and describe the differences between each site. Any findings such as trends or notable observations should be reported based on the time and the site at which they were found, and separated by theme if necessary.
    - Any rules used for data collection across sites should be clearly defined and explained in the report.

- Pitfalls
    - Rules used for collecting data across sites may be bias or inadequate. The researchers must consider the possible existence of a diverse range of opinions about a program's implementation from site to site and from person to person.
    - Due to the immense amount of data that can be collected from the large sample of sites, Program Implementation Case Studies require a large number of researchers for data management and quality control. This can make it difficult to ensure that each researcher is conducting the same quality of research. The high demand for researchers also makes Program Implementation Case Studies costly to conduct.

Program Effects Case Study

- Description
    - Program Effects Case Studies are used to determine the effects of specific programs, whether the programs are failing or succeeding and why. These case studies are best used in conjunction with prior reports or data collections and surveys conducted with people involved in the studied situation either just before or just after the case study. This allows the researcher to maximize their understanding of the failures or successes of a specific program.
- Purpose
    - Program Effects Case Studies determine the effects and the impact of a program, as well as the reasons for the program's successes and/or failures.
- Design
    - Site Selection
        - The researcher must select what locations, or sites, the data will be collected from. Site selection for this kind of study depends on the diversity of the program the researcher wants to study. A sample of sites could be, but is not required to be, a representative sample of all of the locations where the program exists. The researcher may instead choose to sample sites that represent the best cases or the worst cases to focus on what went right or wrong at those sites. The researcher may also choose to sample from sites that seem typical in an effort to examine the general effects of the program.
    - Data Collection
        - Program Effects Case Studies frequently collect both qualitative and quantitative data from the examined sites. The researcher should predetermine some sources from which they plan to collect data on site (measurements recorded on computers or machines, word of mouth information from employees and/or clients, etc.), but should also be aware of and open to

emergent themes (unexpected findings, trends or data sources) that may present themselves during observation of the site.
        - Surveys of the people involved with the studied program, taken either before or after the case study, can be used to confirm the generalizability of the case study findings. Prior reports or previously collected data can be used to confirm the findings as well, but these sources should not be outdated.
    - Reporting the Results
        - Reports should document the predetermined data sources that the researcher planned to collect from, as well as any themes that emerged during investigation.
        - A list of the selected sites should be included, and reasons should be clearly presented to explain why the sites were chosen as the sample. Any differences between the sites should be described and explained.
        - The results of the findings should be presented in a form that addresses the inquiry of the study either by describing the effects of the program or explaining the reasons for the program's successes and/or failures. Any difference in the findings between sites should be clearly presented and explained, if possible.
- Pitfalls
    - The need for a researcher to be aware of emergent themes creates the possibility of introducing bias, where a researcher will identify a trend that may have insufficient evidence to support it simply because the trend fits the researcher's goal. While this may be prevented by a more strict set of rules about data collection, restricting the researcher could result in an incomplete representation of the available data. Another way to prevent this is to increase the number of researchers on the team and encourage or require researchers to consult one another before introducing a new theme into the research.
    - Insufficient data collection or an insufficient sample of sites can result in an insufficient representation of the program and its effects.

Cumulative Case Study

- Description
    - Unlike many types of case studies, a Cumulative Case Study does not focus on one site over an extended period of time (longitudinal) nor does it take a snapshot of the data from multiple sites collected at the same time (cross-sectional). Instead, Cumulative Case Studies aggregate data from numerous resources that have been collected from several sites and at different times. The data used in Cumulative Case Studies is usually in the form of previously conducted case studies and contain information that can be sufficiently compared and aggregated into a single study for a useful purpose. Cumulative Case Studies can focus on case studies that have been completed in the past

(retrospective), or they can be planned to focus on a series of case studies that will be conducted in the future (prospective).

- Purpose
    - Cumulative Case Studies provide a greater generalization of the results of multiple case studies that have been conducted at different times and locations.
    - This type of study allows for a larger collection of data without the need to conduct an unmanageable amount of case studies at the same time.
    - These studies save the researcher time and resources, as the data that will be worked with has already been collected and the previous studies have already been completed.
- Design
    - Site Selection
        - The researcher must select what locations, or sites, the data will be collected from. This selection will depend on the purpose of the researcher's study, but each site must have previously conducted research that will be relevant to the study. The researcher should use caution when selecting sites to avoid bias and skewed results.
    - Case Sample Selection
        - The research must select a sample of cases from each site that will be aggregated together for the Cumulative Case Study. Suggestions on how to select cases can be found in the Case Survey Method below.
    - Cumulate Findings
        - Cumulative Case Studies use the Case Survey Method (found below) to analyze and aggregate the findings from the selected case sample.
    - Reporting the Results
        - The rules for sample selection and the checklist for aggregating the data during the Case Survey Method (found below) should be clearly presented, and the answers to the questions on the checklist should be provided for each included case.
        - Detailed reasons for excluding sites or cases should be provided to inform the reader that research was not insufficient and information was not withheld due to bias.
        - The final generalization of the results should be presented in a form that honestly addresses the purpose of the Cumulative Case Study.
- Pitfalls
    - The necessity for the researcher to select sites and cases from those sites as well as the researcher's ability to make the decision to exclude research literature presents a lot of opportunity for bias to be introduced into the study. The researcher must use caution and correct practices when making selections and exclusions, providing written descriptions of why such decisions were made and consulting other researchers when possible to avoid bias.

- Due to the fact that the research used in a Cumulative Case Study has already been conducted, the researcher may encounter a variation in the quality of research between cases. While a researcher must be cautious when excluding research literature, it is just as important to avoid including research with heavy bias or uncertain quality.
- Changes in contextual factors that have occurred over time at the selected sites may affect the results of the research, even if they are not directly related to the topic being studied.

Case Survey Method

- Purpose
  - The Case Survey Method provides an inexpensive way to aggregate existing research.
- Collecting Data to Aggregate
  - Many case studies are conducted on nonrandom samples for the purpose of observing a particular group, environment or phenomenon. With this in mind, a reviewer intending to aggregate data from different case studies should take note of the samples that were used in those studies and consider whether or not those samples cover the range of diversity that is necessary to study the desired topic, and have not been collected in a bias way. It is best for the reviewer to create a set of explicit rules that must be followed when collecting a sample of case studies to make sure that the aggregated data will provide thorough coverage within the boundaries required for the reviewer's research. Once a sample of case studies is selected using these rules, the sample should then be reviewed in order to make sure that the reviewer's own bias is not reflected in the selected materials.
- Aggregating the Data
  - Unit of Analysis
    - Case studies are observational studies and, because of this, case study reports contain a sample of observations made by the researchers who conducted those studies. There are many different methods that can be used to obtain observational data, and it is not uncommon for several researchers to conduct case studies on a single phenomenon. If more than one researcher conducts a case study on the same phenomenon at the same place and the same time, those two studies may contain different observational data and it may be tempting for a reviewer to collect both studies using the Case Survey Method. However, while the data may be different, the "case" (the same phenomenon at the same place and the same time) is identical for both studies. If it is the reviewer's intent to use the Case Survey Method to cumulate data from many different cases, then a single case is the unit of analysis. Only one report should be included per case to avoid double counting that case and skewing the results.
  - Rules for Aggregating

        - Different types of case studies with different goals and different focuses will most likely require different information. Therefore, it is not possible to come up with an exhaustive set of rules for aggregating data over all case studies. The reviewers conducting the study must carefully think about the details relating to the sample of cases they are choosing. For example, if a study will be dealing with frequent patent filers, it is important to consider whether or not the term "frequent" is too non-specific. If the number of patents filed is relevant to the study, cases may need to be aggregated into groups based on that measure: 6-10 filed in the last year, 10-15 filed in the last year, etc. Factors such as the dates that patents were filed or the technology center that the filer belonged to may be considered as well.
        - A single checklist of questions should be created by the reviewers that can be used to inspect each case for relevant data. This checklist should be multiple choice to allow for the inclusion of a range of data such as the different numbers of patents filed, mentioned above. It is vital that each question on the checklist includes the option to state that the inspected case did not provide the information necessary to answer that question. This helps to prevent researchers from making guesses about the data in order to answer the questions.
- Pitfalls
    - When selecting a sample of case studies to aggregate or when studying and reporting on research material, it is tempting for a reviewer to treat the research conducted in those studies as a perfectly representative sample of the subject that was studied. In reality, it is rare for any individual research piece to fully encompass all of the available knowledge on a particular subject and to present it in a non-biased way. It is important for the reviewer to be aware that there are likely aspects of the subject matter that are not represented in the report and that the findings may have been shaped by the original researcher's methods and goals.
    - Occasionally, the reviewer that is using the Case Survey Method to aggregate case studies will encounter a study that appears to have been poorly conducted or heavily biased. Excluding these studies may be the correct choice, but the reviewer should take consideration and, if possible, consult another reviewer before making this choice. If the choice is made to exclude any research literature, it may be tempting for the reviewer to ignore that literature in the final report. However, it is possible that someone who is aware of the excluded literature will read the final report and suspect that the reviewer used insufficient or biased methods to collect data for the research. To avoid this, all excluded research literature should be mentioned in the reports and accompanied by the reviewers reasoning for exclusion. This provides the reader with more understanding of the reviewer's methods.

When to Conduct Each Type of Case Study

When choosing what type of case study to conduct, it is important for the researcher to consider the situation's maturity. Maturity, in this context, can mean either how long the studied topic has existed or how deeply the subject has already been studied. These meanings depend on the topic of study and how the researcher is planning to study the topic. For example, when an office replaces an old procedure with a new procedure, that new procedure is "young" because it has just come into existence in that situation. This young state would make it difficult to determine the effects the program has on a typical population of employees at the office, because they have not had any time to adjust to the program and thus there is no frame of reference for what is a typical effect. A topic that has existed for a long time can also be considered young in maturity if there has been little to no research conducted on that topic. The following chart shows the different types of case studies and ranks them from "very low" value to "high" value at different levels of maturity:

Type of Case	Young	Middle	Old
Cross Case	Low	High	High
Critical Instance	Mid	High	Mid
Cumulative Prospective	Low	Mid	Low
Cumulative Retrospective	Very Low	Mid	High
Exploratory	High	Mid	Low
Illustrative	High	Mid	Low
Program Effects	Mid	High	Low
Program Implementation	Low	High	Low

Figure 2: Value of Different Case Studies by the Maturity of the Investigation

The reasons behind the values in Figure 2, and the reasons why a researcher should or should not conduct certain case study types at certain investigation maturities are described in the following list. It should be noted that these are simply guidelines and not rules for selecting case studies.

Young Maturity

- Cross-Case – Low Value
    - There is not often a sufficient amount of cases to cross-study at this point.
- Critical Instance – Mid Value
    - Many instances of interest may exist in a new situation, but it could be difficult to tell which ones are critical and worth studying at this stage.
- Cumulative (Prospective) – Low Value
    - It is expensive to conduct a series of case studies prior to a cumulative study, and it is unlikely that there will be a clear subject that needs studying at this point.
- Cumulative (Retrospective) – Very Low Value
    - There is not often a sufficient amount of cases to cumulate at this point.
- Exploratory – High Value
    - This will help define research goals and questions, and help the researcher understand the situation better at an early stage.
- Illustrative – High Value
    - This will help inform an audience about a situation at an early stage so that they can better understand and/or communicate with the researcher.
- Program Effects – Mid Value
    - It could be helpful to study the effects a new program has on a situation, but it is good to be mindful that some effects may be the result of the situation adjusting to the new program and may only be temporary.
- Program Implementation – Low Value
    - At this stage, a program will generally be in the implementation phase, so attempting to study whether or not it has successfully been implemented and why may be a bit premature.

Middle Maturity

- Cross-Case – High Value
    - At this stage, it can be helpful to examine a number of cases that span over the population of the studied topic to develop generalizations that may help the researcher to better understand the topic overall and may even guide future investigations.
- Critical Instance – High Value
    - At this stage, situations of interest are likely to become visible and can be more easily distinguished from the typical situations than they could have been during the early stage.
- Cumulative (prospective) – Mid Value
    - Research goals for a cumulative case study may become evident at this stage, especially after an exploratory case study. This should be used instead of the retrospective cumulative case study only if insufficient cases currently exist for the research goals.

- Cumulative (retrospective) – Mid Value

    - Research goals for a cumulative case study may become evident at this stage, especially after an exploratory case study. These should be used instead of retrospective cumulative case studies if a sufficient amount of cases exist for study.
- Exploratory – Mid Value
    - This type of study will help define research goals and questions, justifying a larger-scale investigation at this phase.
- Illustrative – Mid Value
    - If at this point it appears that an audience knows too little about the situation, this type of study can be used to create a common language between that audience and the researchers.
- Program Effects – High Value
    - This stage is best for examining the effects a program has had on a situation because the situation has had some time to adjust to the program and the long term effects start to become visible.
- Program Implementation – High Value
    - This stage is best for examining whether or not a program has been successfully implemented because the implementation phase should have been completed by this point, but should still have been recent enough that the reasons for successes or failures can be studied clearly.

Old Maturity

- Cross-Case – High Value
    - At this stage, it is much more likely that a large sample of research literature will exist for a Cross-Case study. Conducting one of these studies can provide valuable information that can be generalized over the population of the studied topic.
- Critical Instance – Mid Value
    - It is possible for a situation of interest to arise even in a more mature stage. This study can be used to understand what caused that situation of interest.
- Cumulative (prospective) – Low Value
    - This study is only reasonable at this stage if the research goals require information that has not been collected by a previous study. Otherwise, retrospective cumulative studies are more affordable
- Cumulative (retrospective) – High Value
    - At this stage, it is likely that a lot of information already exists about the topic of study. Using the available information, rather than new studies, allows for a large-scale investigation that is much less expensive than the prospective counterpart.
- Exploratory – Low Value
    - It is unlikely that this kind of study will be necessary to determine research goals or help to understand a situation at this stage of maturity. These can still be used to justify a larger-scale investigation if necessary.
- Illustrative – Low Value

    - It is unlikely that an audience will not understand a situation at this stage of maturity. However, this form of study should still be used if a large gap in understanding exists between a researcher and the target audience.
- Program Effects – Low Value
    - At this stage, it may be difficult to determine what the effects of a program are and what effects are caused by outside factors. It is still possible to do this by collecting data through surveys and quantifiable data that has been stored over time.
- Program Implementation – Low Value
    - At this stage, the state of a program's implementation should be clear and reasons why it succeeded or failed will likely have been previously investigated to some degree. This kind of study can be used when this is not the case.

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