



UNITED STATES PATENT AND TRADEMARK OFFICE

Patent and Trademark IT Modernization Is Progressing, but Improvements Are Needed

FINAL REPORT NO. OIG-15-004-A
OCTOBER 30, 2014

U.S. Department of Commerce
Office of Inspector General
Office of Audit and Evaluation

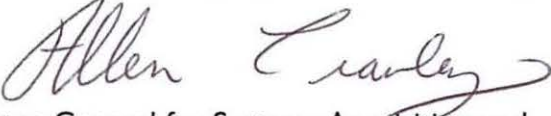
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October 30, 2014

MEMORANDUM FOR: Michelle K. Lee
Deputy Under Secretary of Commerce for Intellectual Property
and Deputy Director of the U. S. Patent and Trademark Office

FROM: Allen Crawley 
Assistant Inspector General for Systems Acquisition and
IT Security

SUBJECT: *Patent and Trademark IT Modernization Is Progressing, but
Improvements Are Needed—Final Report No. OIG-15-004-A*

Attached please find our final report on USPTO's information technology (IT) modernization projects. Our audit objectives were to:

- assess the impact of IT contract termination decisions made as a result of the \$110 million IT budget reduction, as well as the appropriateness of project funding in the reduced budget environment,
- review the progress USPTO has made in implementing the recommendations from the FY 2011 Patent End-to-End (PE2E) audit—specifically, the technical progress it has achieved to date, its use of the Agile methodology, and its plans for future PE2E development, and
- assess the project management and technical progress USPTO has made in its development and implementation of the Trademark Next Generation (TMNG) project, including its use of the Agile methodology.

We found that the following improvements are necessary:

- Completion of prior audit issues related to prioritization of high-level requirements and high-level service-oriented architecture designs for the PE2E portfolio.
- More sustained adoption of PE2E as well as tracking and monitoring of its usage.
- More refinement of Agile processes, specifically as it relates to user story and defect management, as well as improvements in software development practices both for the PE2E and TMNG portfolios. Software development practices that need improvement include: more robust automated and performance testing and testing integration; consideration of IT security controls earlier in development; and better conformance with USPTO coding standards.

In response to our draft report, the agency agreed with all of our recommendations. Where appropriate, we modified this final report based on the technical comments we received from your agency. Your formal response is included as appendix B. The final report will be posted on the OIG's website pursuant to section 8M of the Inspector General Act of 1978, as amended.

In accordance with Departmental Administrative Order 213-5, please submit to us within 60 calendar days of the date of this memorandum an action plan that responds to the recommendations in this report.

We appreciate the cooperation and courtesies extended to us by your staff during this audit. If you have any questions or concerns about this report, please do not hesitate to contact me at (202) 482-1855 or Angela Hoffman, Director for Systems Acquisition and Development, at (202) 482-5337.

Attachment

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Report In Brief

OCTOBER 30, 2014

Background

USPTO is the nation's single entity that examines, grants, and registers patents and trademarks to individual inventors, organizations, and businesses. USPTO's vision for the next 4 years includes plans to continue transforming its operations with next-generation technology and services. Its two major next-generation development efforts are Patents End-to-End (PE2E) and Trademark Next Generation (TMNG). Both are information technology (IT) portfolios made up of several projects. The goal of each is to develop automated, fully integrated, end-to-end systems to support patent and trademark processing, respectively.

Why We Did This Review

Our analysis of the progress the agency has made in developing its IT modernization projects was conducted based on three audit objectives:

- to assess the impact of IT contract termination decisions that were made as a result of the \$110 million reduction to USPTO's IT budget in FY 2013, and to assess the appropriateness of project funding in the reduced budget environment;
- to review the progress USPTO has made in implementing the recommendations from the FY 2011 PE2E audit conducted by OIG—specifically, the technical progress it has achieved to date, its use of the Agile methodology, and its plans for future PE2E development; and
- to assess the project management and technical progress USPTO has made in its development and implementation of the TMNG project, including its use of the Agile methodology.

U.S. PATENT AND TRADEMARK OFFICE

IT Modernization Is Progressing, but Improvements Are Needed

OIG-15-004-A

WHAT WE FOUND

We conducted an audit of PE2E during the early stages of the portfolio's lifecycle in 2011 to provide proactive, value-added feedback that could identify potential issues that might hamper the success of the overall project, and published a report of our findings and recommendations on September 29, 2011. In that report, we recommended that USPTO improve development and acquisition planning as well as portfolio oversight. In the current audit, we reviewed the actions USPTO has taken regarding the above-mentioned recommendations, and we found that USPTO has not fully implemented our first recommendation to improve development planning.

We interviewed and observed a sample of the 39 pilot users from the PE2E pilot, begun in November 2012, and identified that their usage of PE2E was inconsistent and ad hoc. Only 30 percent of the users interviewed were using PE2E frequently enough to assess its functionality. In an expanded pilot in 2014, frequent PE2E usage improved to 50 percent, still only making its usage slow to moderate. We also found that there was no monitoring or tracking of PE2E usage in either pilot.

We performed a comprehensive review of Agile development methodologies and software development practices in the PE2E and TMNG portfolios. Overall, we found that USPTO's implementation of the Agile development methodology is maturing, but improvements are needed, specifically in the management of user stories—which are brief descriptions of features—and defects. We also found that improvements in software development practices are necessary, including more robust automated and performance testing and testing integration, consideration of IT security controls earlier in development, and better conformance with USPTO coding standards.

WHAT WE RECOMMEND

We recommend that the USPTO Director

1. fully implement unsatisfied recommendations from our 2011 audit by prioritizing all user stories at the portfolio level, and by developing a high-level model of reusable services for the entire portfolio;
2. identify and implement methods to increase adoption and monitor usage of the PE2E examination tools prior to deployment to the full patent corps;
3. fully define and estimate user stories as well as improve scheduling and estimation of defects;
4. develop and implement a plan to conduct more robust automated testing, earlier integration of functional quality testing (FQT) testers, and performance testing more representative of the production environment; and
5. develop and implement a plan to integrate IT security controls earlier in design and development activities and better align automated code reviews with USPTO coding standards.

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*COVER: Detail of fisheries pediment,
U.S. Department of Commerce headquarters,
by sculptor James Earle Fraser, 1934*

Introduction

The United States Patent and Trademark Office (USPTO) is the nation's single entity that examines, grants, and registers patents and trademarks to individual inventors, organizations, and businesses. Its mission, as explained in its 2014–2018 strategic plan, is “fostering innovation, competitiveness and economic growth, domestically and abroad by delivering high quality and timely examination of patent and trademark applications, guiding domestic and international intellectual property policy, and delivering intellectual property information and education worldwide, with a highly-skilled, diverse workforce.”¹

USPTO's vision for the next four years includes plans to continue transforming its operations with next-generation technology and services.² Its two major next-generation development efforts are Patents End-to-End (PE2E) and Trademark Next Generation (TMNG). Both are information technology (IT) portfolios made up of several projects: 11 active for PE2E, and 9 active for TMNG.³ The goal of each is to develop automated, fully integrated, end-to-end systems to support patent and trademark processing, respectively.

The PE2E portfolio is now in its fourth year of development and has made progress in the deployment of examination tools and infrastructure. A fundamental set of examination tools has been released to a pilot group of 316 patent examiners. These tools include a docket viewer that lists patent examination cases assigned to an examiner, an application viewer that provides patent application documents in text-based—rather than image-based—formats, and the ability to electronically issue one type of office action.⁴ PE2E has also completed several back-end capabilities, such as the conversion of approximately 110 million pages of patent applications from images to text. It has also made progress toward international data-exchange and patent classification projects.

However, USPTO has not completed all of the PE2E capabilities it planned to have released by now, such as the complete roll-out of examination tools to the examination corps, full office action automation, and full integration of text-based searching of previous patent applications within PE2E. This is because USPTO's priorities shifted to developing automation for international patent agreements. The agency was also impacted by lower-than-expected fee revenues and the federal budget sequestration of fiscal year (FY) 2013. Despite these challenges, the president of the Patent Office Professional Association (POPA) expressed how impressed he was with how quickly USPTO got back up to speed after budget sequestration. In remarks made at a meeting of the Patent Public Advisory Committee on May 22, 2014, he noted that the most recent demonstration of PE2E (held two weeks prior) was “significantly improved from the last demo.” He further noted that the USPTO's Office of Chief Information Officer and the PE2E user community had worked together more cooperatively on PE2E than

¹ USPTO 2014–2018 Strategic Plan, Introduction, page 2.

² USPTO 2014–2018 Strategic Plan, Introduction, page 3.

³ The number of active projects changes over time as projects are added, combined and/or canceled.

⁴ An *office action* is an official notification to the applicant from USPTO regarding problems with a patent or trademark application.

on previous efforts and that POPA anticipates that examiners will be able to effectively use the PE2E tools.

For FY 2015, PE2E plans to deploy enhanced examination tools to the entire patent corps, release a pilot for searching prior applications, continue text-based conversion of patent applications, and further develop international data exchange and patent classification projects.

The TMNG portfolio is also in its fourth year of development and to date has successfully deployed two public service applications: (1) the Electronic Official Gazette (eOG), which provides public access to a Web-based record of trademarks issued each week; and (2) the Trademark Status and Document Retrieval (TSDR) application, which allows the public to view status reports and documentation related to the prosecution of trademark filings. The TMNG portfolio has also made progress on several projects to enhance internal processes and improved the Trademark Office's IT infrastructure. The TMNG team has deployed an internal quality review system, begun work on examination tools and reporting, started a project to synchronize legacy data with newer systems, and has stabilized legacy applications. However, progress has been slower than originally anticipated on some projects, such as stabilization of legacy applications (completed in FY 2014 rather than FY 2013) due to increases in the scope of work and technical challenges with legacy applications.

For FY 2015, TMNG plans to deploy enhancements to the eOG and TSDR, develop trademark examination tools and electronic trademark filing capabilities, and make various IT infrastructure and back-end improvements.

Objectives, Findings, and Recommendations

Our analysis of the impact of USPTO's FY 2013 budget reductions and the progress the agency has made in developing its IT modernization projects was conducted based on three audit objectives:

1. Assess the impact of IT contract termination decisions made as a result of a \$110 million IT budget reduction, as well as the appropriateness of project funding in the reduced budget environment.
2. Review the progress USPTO has made in implementing the recommendations from the FY 2011 Patent End-to-End audit,⁵ specifically the technical progress it has achieved to date, its use of the Agile methodology, and its plans for future PE2E development.
3. Assess the project management and technical progress USPTO has made in its development and implementation of the Trademark Next Generation project, including its use of the Agile methodology.

As it relates to objective 1, overall, given the funding outlook during most of FY 2013, we did not note any audit findings with USPTO's budget reduction actions.

Related to objectives 2 and 3, we found that:

- high-level requirements are not prioritized for the PE2E portfolio, and high-level designs for the service-oriented architecture for the portfolio have not been developed, as recommended in our 2011 audit (see finding I);
- adoption of the current PE2E functionality has been slow to moderate, and usage is not monitored and tracked (see finding II); and
- overall, USPTO's implementation of the Agile development methodology is maturing, but some improvements related to user story⁶ and defect management are needed. Software development practices also need improvement, in particular: more robust automated and performance testing and testing integration; consideration of IT security controls earlier in development; and conformance with USPTO coding standards (see finding III).

To assess our first objective, we reviewed for reasonableness the budget reduction approach, impacts of the budget cuts, and spending after the budget cuts.

Six months into FY 2013, USPTO projected that an approximate 5 percent sequestration of fee revenue (estimated to be \$134 million) required by the Budget Control Act of 2011, and

⁵ U.S. Department of Commerce Office of Inspector General, September 2011. *Patent End-to-End Planning and Oversight Need to Be Strengthened to Reduce Development Risk*. OIG-11-033-A. Washington, DC: Department of Commerce OIG.

⁶ A *user story* is a short, simple description of a feature that should be told from the perspective of the user.

lower-than-projected patent fee revenues (\$110 million less than expected) would result in a \$244 million shortfall (see table I).

**Table I. April 2013 Projected USPTO Budget Reductions
(in millions of dollars)**

	Original projected collections (as of 10/1/12)	Projected sequestration of collections	Projected reduction in fee estimates (as of 4/18/13)	Projected budget shortfall ^a
Total USPTO fees	\$2,760	(\$134)	(\$110)	(\$244)

Source: OIG, adapted from USPTO documentation

^a projected budget shortfall = sequestration amount + estimated fee reduction

USPTO assumed that the sequestered 5 percent would be applied against its spending authority, in lieu of being drawn from its fee revenue.⁷ However, the Office of Management and Budget (OMB) informed USPTO in mid-March 2013 that its fees would be sequestered at 5 percent. By April 2013, USPTO cut a total \$264 million to compensate for the projected \$244 million shortfall. These cuts exceeded the amount needed to cover the projected shortfall by \$20 million. The excess was initially retained in the event any additional adjustments were required; however, a portion of these funds (approximately \$13 million) was restored. Approximately \$110 million of the FY 2013 cuts were made to discretionary IT spending⁸ that funded development, modernization, and enhancement efforts.

As part of our assessment of the impacts of the budget cuts, we determined that the most significant impacts were to IT portfolios for fee processing and enhanced reviews of patent applications. For example, several PE2E contracts were suspended or terminated, which resulted in the dismissal of approximately 140 contractors. PE2E senior project officials estimated in August 2013 that it will take approximately 9 to 18 months to restore PE2E work to pre-sequestration levels. In total, PE2E's budget⁹ was reduced by approximately \$11.7 million, which represents 65 percent of the portfolio's remaining uncommitted budget for FY 2013 (\$18 million). USPTO estimates that the budget cuts resulted in an increase of \$27 million to the total cost of the PE2E portfolio.

As it relates to spending after the budget cuts, we determined that patent revenues rapidly improved beyond initial expectations. By mid-July 2013, a \$245 million surplus was expected for FY 2013. We determined that USPTO resumed some suspended IT efforts in FY 2013, but discretionary IT spending was not fully restored until FY 2014.

Overall, we found that given the funding outlook for most of FY 2013, USPTO senior officials directed budget reductions in several major business units within USPTO. The impacts of the

⁷ Sequestration impacts were described in the Sequestration Transparency Act (August 2012). However, USPTO officials were unsure how much would be sequestered because of the agency's unique user-fee-funded budget.

⁸ Spending cuts were not made to IT efforts supporting the Trademark Office's business functions, because its budget included sufficient financial reserves to compensate for the FY 2013 financial variances.

⁹ The PE2E budget for FY 2013 started at \$42 million.

cuts were both identified and accepted by USPTO business unit management and USPTO senior management. Thus, no audit findings are noted with USPTO's budget reduction actions.

Our assessment of objectives 2 and 3 (see page 3 above) included a review of USPTO's development activity to date, including its development methodology, practices, and tools.

Both PE2E and TMNG are using Agile software development methods based on the Scrum framework to develop capabilities for each project within their respective portfolios. Agile methods can reduce risk by dividing software development into increments that are deployed iteratively to end users as the project progresses. Scrum provides a framework for the development effort that promotes flexibility and strong collaboration among stakeholders and all project team members. In following the Scrum framework, USPTO has broken development for PE2E and TMNG into releases that are further broken down into sprints. Sprints are short two- to four-week development cycles that have the goal of developing potentially deployable capabilities at the completion of each sprint.

I. Previous Audit Recommendations to Improve Development Planning Have Not Been Fully Implemented

We conducted an audit of PE2E during the early stages of the portfolio's lifecycle in 2011 to provide proactive, value-added feedback that could identify potential issues that might hamper the success of the overall project, and we published a report of our findings and recommendations on September 29, 2011.¹⁰ In that report, we recommended that USPTO improve development and acquisition planning and also improve portfolio oversight.

In the current audit, we reviewed the actions USPTO has taken regarding the above-mentioned recommendations, and we found that USPTO has not fully implemented our first recommendation to improve development planning. In our 2011 report we recommended that USPTO develop

1. a description and schedule of releases based on prioritized high-level requirements for the entire project, and
2. high-level designs for the service architecture¹¹ for the entire project.

A. *Prioritization of High-Level Requirements for the Entire PE2E Project Has Not Been Completed*

We found that USPTO developed a description and schedule of releases as recommended, and by FY 2013 it had also partially prioritized requirements for a planned upcoming release of the examination tools project. However, in our current

¹⁰ OIG, *Patent End-to-End Planning*.

¹¹ A *service-oriented architecture* is an architectural style that organizes systems into a flexible suite of system services that can be reused by multiple business functions. Examples of reusable PE2E services could include searching for patents, retrieving patent applications, and checking the status of patent applications.

audit we found that USPTO has yet to prioritize high-level requirements for the entire project referred to as the PE2E portfolio.

The Scrum framework for software development calls for requirements to be defined in user stories. User stories are prioritized and developed in priority order to ensure that users first receive the features that provide them with the most value. At the individual project level, we found that 55 percent (or 552 out of 1,011) of the stories in the product backlogs¹² have not been prioritized for the five active PE2E projects we reviewed. As we noted in our 2011 audit, the first steps in Scrum, in particular for large, complex projects such as PE2E, are to define high-level requirements for the entire project and prioritize those requirements based on business and technical value.

Without effective prioritization, USPTO cannot be assured that the most valued user features are given precedence. Further, lack of prioritization could lead to rework, as dependencies may not be adequately understood or identified between projects.

B. High-Level Service Architecture Designs for the Entire Project Have Not Been Fully Completed

USPTO has continued its practice, which we identified in 2011, of only defining services for the next release. In response to our recommendation, USPTO defined and anticipated services for FY 2011 and FY 2012 development. However, these services were specific to each project and did not identify anticipated shared services at the portfolio or enterprise level. As we noted in 2011, “Best practices for service-oriented architectures indicate that a high-level model of fundamental reusable services, such as retrieving a patent application or checking its status, should initially be defined for the entire patent process rather than for a limited set of requirements for a single application.”¹³

Service-oriented architectures provide greater benefit when services are shared across applications, so separate implementations of similar functionality are not developed. USPTO officials explained that work on the portfolio has been focused on deploying functionality quickly, with the understanding that rework to integrate different projects in the portfolio would need to be conducted at a later time. They further explained that defining high-level services has not been necessary, as to date the projects have little overlap where portfolio-level services would be beneficial. Recently, however, USPTO officials indicated that plans are underway to begin identification of portfolio-level services, starting with development of a new content management system (CMS), which is intended to integrate and share capabilities across the portfolio.

While these plans for the CMS are a step in the right direction, PE2E’s architects and developers are identifying services as they go, potentially making it more difficult to integrate PE2E’s multiple projects into a cohesive end-to-end system. Opportunities could have been missed to identify, develop, and use shared services, which could have

¹² A *product backlog* is a list of all features, functions, enhancements, and bug fixes not yet in the software product.

¹³ OIG, *Patent End-to-End Planning* at 4.

potentially provided cost and schedule savings through central maintenance and reuse of code.

II. Adoption of PE2E by Pilot Examiners Has Been Slow to Moderate and Usage Is Not Being Tracked

Our FY 2011 audit reviewed PE2E early in its development, before its release to production. However, much preparation was underway for a release to a specialized pilot group of examiners, the Central Reexamination Unit, in September 2011. User representatives for this group had been assigned to the project to ensure that the system would meet their requirements. Nonetheless, the roll-out to this group was less than successful, as it did not completely meet their operational requirements. The group required more document conversion (that is, images converted to optical character recognition) than was initially expected and a quicker-than-anticipated turnaround time on reexamination of cases. Therefore, USPTO concluded that the costs and time associated with attempting to meet the requirements were prohibitive.

As the initial pilot was less than successful, the application was rolled out to a second pilot group in November 2012: 39 patent examiners representing all technology centers within USPTO.¹⁴ In advance of this roll-out, all 39 examiners participated in user-centered design sessions to gain familiarity with the PE2E application and to provide feedback to enhance its capabilities. This group was expanded by 66 users to a total of 105 users in May 2014, when several new PE2E features were rolled-out. We found that usage of PE2E was slow with the November 2012 pilot group but increased following the May 2014 roll-out. However, we found that USPTO is not tracking PE2E usage by the pilot groups.

To assess the success of these roll-outs, the users' experience, and their adoption of the system, we interviewed and observed 10 of the 39 pilot users (25 percent) from the November 2012 group using the production version of the PE2E application. We also surveyed the 2014 pilot users to assess their usage of the application. Seventy users from this group of 105 users (67 percent) responded.

Our interviews and observations of the 39 pilot users from November 2012 identified that their usage of PE2E was inconsistent and ad hoc. Their familiarity with, and use of, PE2E ranged from "no use" to "frequent use." We also found that there was no monitoring or tracking of usage. Only 3 of 10 examiners (30 percent) of the 39 pilot users that we interviewed and observed were using PE2E frequently enough to comment on the effectiveness of its functionality. The reasons cited for lack of use included the examiners' dockets not being consistently updated and the need to keep up with production quotas. In addition, we observed that PE2E was not sufficiently mature to provide full docket management capabilities. Instead, users were using the legacy Electronic Desktop Application Navigator (eDAN) application in conjunction with PE2E to manage their

¹⁴ At USPTO, patent examiners are assigned to one of nine technology centers that specialize in examining patent applications of specific technologies, such as biotechnology and organic fields, or computer architecture software and information security.

dockets. USPTO officials said that they were not surprised by this group's inconsistent use of PE2E. Among the reasons the officials cited were the FY 2013 budget reductions that limited development of additional PE2E features and the fact that no additional work time beyond that allotted to meet production quotas had been provided to examiners to assess PE2E.

Of the 70 users who responded to our survey of the expanded 2014 pilot group, 50 percent said they were using PE2E at least weekly.¹⁵ Fifty-six percent responded that they thought PE2E would improve their effectiveness as an examiner. Thus, our survey results indicate that usage has increased. However, USPTO should work toward increasing usage of PE2E beyond the current 50 percent.

At the conclusion of our fieldwork in July 2014, PE2E officials notified us that they had again expanded the pilot group to 316 users. Enhanced examiner capabilities and tools are being made available to more users and usage is increasing, which is an encouraging trend for PE2E. However, to adequately determine the operational value of the functionality provided by this system to date, USPTO would be best served by developing a PE2E adoption plan before full roll-out to the patent examination corps. Such a plan should include metrics for tracking PE2E adoption and usage and should define success criteria for adoption.

III. Agile Development Methods and Software Development Practices Need Improvement

To evaluate use of Agile development methodologies and software development practices in the PE2E and TMNG portfolios, we performed a comprehensive review of portfolio activities, including planning, designing, developing, and testing. We also examined the tools and processes used to direct, control, and oversee development activities on both portfolios. Overall, we found that USPTO's implementation of the Agile development methodology is maturing, but improvements are needed. We also found that improvements in software development practices are necessary.

A. User Stories Are Not Clearly Defined to Ensure User Needs Are Met and Delays Are Avoided

In the Scrum development framework, user stories briefly describe features. They include details that identify the user and the reason the user needs the feature.¹⁶ User stories should also include a rough estimate of the effort needed to complete them for planning purposes. Criteria for determining when they are complete, commonly referred to as acceptance criteria, should also be identified prior to development. We found that many user stories for both the PE2E and TMNG portfolios did not include these essential details (see figures I and II). These details are important for successful planning and development of user stories in a manner that reduces confusion, failed

¹⁵ For the purposes of the survey, "weekly" is defined as two to three times a week.

¹⁶ User stories begin as simple statements such as, "As a <type of user>, I want to <some goal> so that <some reason>." As projects progress, user stories are further defined as they are researched and better understood.

tests, and rework from miscommunication.¹⁷ However, we note that after briefing USPTO officials on this finding, the definition of acceptance criteria for user stories improved for the PE2E portfolio.

B. Many Defects Have Not Been Scheduled for Correction, Nor Estimated

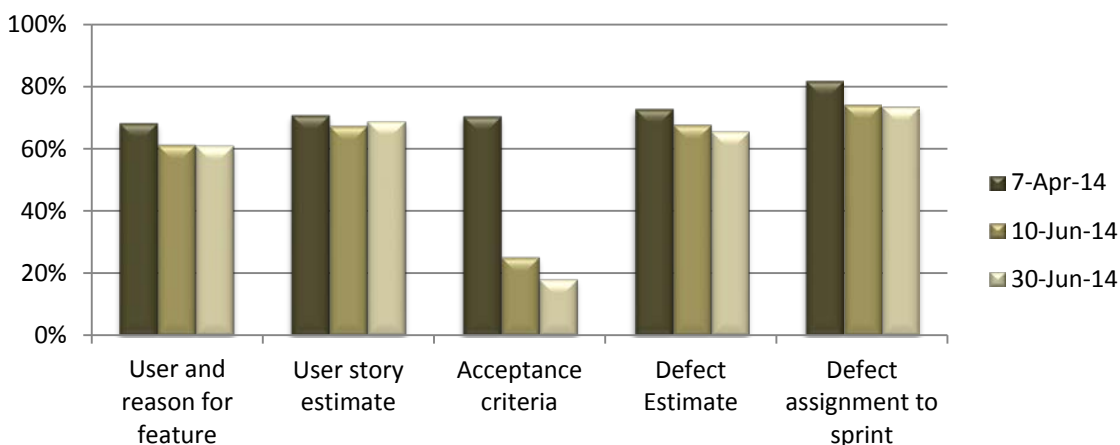
Across both the PE2E and TMNG portfolios, we found that the majority of unresolved defects were not scheduled for correction (see figures I and II). While it is understood in software development that all defects may not be scheduled (either because they are low priority or the defects are new), we observed that most unscheduled defects (more than 64 percent on both portfolios) were not low priority or new, and on average had not been resolved for 170 days or longer. Moreover, we observed that one PE2E sprint had to be interrupted mid-stream to resolve defects prior to release. USPTO officials explained that challenges with its testing contractors, along with a prolonged procurement process to replace them, contributed to the difficulty of handling these defects in a more timely fashion. Nevertheless, such disruptions reduce developer productivity and may delay the release of planned features.

Prior to scheduling defects for correction, it is important to provide rough estimates for the level of effort needed to correct them. Such estimates are necessary to determine the business value of fixing the defect. We found that for many unresolved PE2E and TMNG defects, estimates had not been made (see figures I and II).

As Agile development is iterative, we assessed the completeness of user stories across active PE2E and TMNG projects on three separate dates for each portfolio to identify trends (see figures I and II). We also performed our assessment of scheduling and estimation of defects on three separate dates for each portfolio to identify trends with this issue as well (see figures I and II).

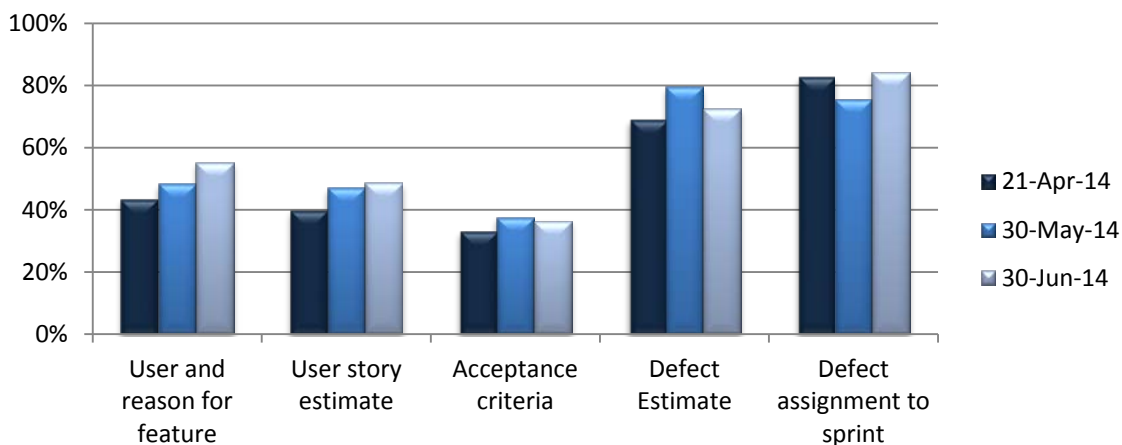
¹⁷ User stories act as placeholders for conversations between developers and user representatives to further refine the story and ensure it meets user needs. It is important that the stories include enough details to ensure that these conversations are focused on understanding the full details of the feature and the value it brings to users.

Figure I. Percent of Details Missing from User Stories and Defects for PE2E Software Development Projects



Source: OIG analysis of USPTO documentation

Figure II. Percent of Details Missing from User Stories and Defects for TMNG Software Development Projects



Source: OIG analysis of USPTO documentation

C. Software Development Practices Need Improvement

- Use of Automated Testing Needs to Be Increased.** Regression testing assesses whether previously developed features are still functional after changes have been made to add new features or fix defects. High levels of automated regression testing are necessary for Agile development because new features are deployed frequently. We found that automated regression-testing coverage was low for the PE2E and TMNG portfolios. Unit testing—a commonly automated process performed by developers to test the smallest units of code—was performed for 47 percent of the code for PE2E and 30 percent for TMNG. Of the releases we reviewed, automated

functional quality testing (FQT)¹⁸ was performed for 34 percent (373 of 1,097) of test cases for TMNG and 31 percent (78 of 254) for PE2E. USPTO officials explained that the low levels of automated testing we observed were—as with the problems USPTO experienced with the resolution of defects—caused by challenges with the performance of its testing contractors and by challenges with replacing them. Low levels of automated testing can result in reduced software quality and delays. Defects from previously released functionality might be missed or might need to be identified through manual testing, which takes much longer.

- **Functional Quality Testing Needs to Be Fully Integrated into the Development Process for TMNG.** In Agile development, FQT needs to be fully integrated with the development process, so it can be conducted on an ongoing basis for each sprint rather than just prior to release. This practice identifies defects earlier, when there is less impact to development and operations, and ensures that potentially deployable functionality is completed with each sprint. Integrating FQT into the development process has been a particular challenge for the eOG project. FQT testers have not been getting involved on an ongoing basis and user stories are not being tested until just before release. Consequently, significant defects may be found shortly before release, which can result in unexpected delays.
- **Performance Testing Sufficient to Prepare for Release to the Entire Patent Corps Has Not Begun.** Although USPTO has been proactive in conducting PE2E performance testing to date, it has done so using a small subset of examiner data and simulated users (about 100). These subsets are not similar to, nor typical of, the expected usage and load of the actual production environment. In the second quarter of FY 2015, examination tools will be released to the entire patent corps of approximately 8,500 examiners. PE2E has not yet conducted performance testing under this user scenario. Additional performance testing is planned for late 2014, with 300 actual patent examiners using the system concurrently. But this represents only 4 percent of the total user base. Performance testing that is more representative of examiner usage in a test environment more similar to production is needed to ensure the system will be able to support its intended users.
- **IT Security Controls Need to Be Considered Earlier in Design and Development.** IT security professionals were assigned to the PE2E and TMNG projects at their inception and attend some development meetings. However, they have little impact on projects until just before release, when they assess the implementation of security controls.¹⁹ Prior to performing these assessments, they do not conduct formal reviews, nor ensure the use of secure development practices, nor regularly influence user stories. During our fieldwork, USPTO began using a checklist of selected IT security controls (e.g., identification and authorization, access control, and auditing) on five PE2E projects to determine if designs included

¹⁸ Functional quality testing (FQT) is a quality assurance process that assesses whether software meets its design specifications.

¹⁹ These assessments may include manual as well as automated assessment of applications, databases, and operating systems as needed.

appropriate security controls. While this is a step in the right direction, USPTO needs to apply this practice to all PE2E and TMNG projects and improve IT security professionals' participation during design and development.

- **Methods for Validating Compliance with USPTO Coding Standards Are Not Consistent.** Automated code reviews are conducted every time code is checked-in to the configuration management system for both PE2E and TMNG. However, USPTO does not have a consistent method for performing automated code analysis to ensure compliance with USPTO coding standards. Thus, developers are checking their code for quality, but the coding standard violations they are checking vary from project to project. This practice could lead to nonconformance with USPTO coding standards and potential integration problems.

Recommendations

We recommend that the USPTO Director:

1. Fully implement unsatisfied recommendations from our 2011 audit by prioritizing all user stories at the portfolio level, and by developing a high-level model of reusable services for the entire portfolio.
2. Identify and implement methods to increase adoption and monitor usage of the PE2E examination tools prior to deployment to the full patent corps.
3. Fully define and estimate user stories; as well as improve scheduling and estimation of defects.
4. Develop and implement a plan to conduct more robust automated testing, earlier integration of FQT testers, and performance testing that is more representative of the production environment.
5. Develop and implement a plan to integrate IT security controls earlier in design and development activities, and better align automated code reviews with USPTO coding standards.

Summary of Agency Response and OIG Comments

USPTO Response

In its response, which we have included in full in appendix B of this report, USPTO stated that it concurred with all of our recommendations. USPTO identified actions it has taken or will take to address the recommendations. Those actions include: their method and strategy for identifying and implementing reusable portfolio-level services; increasing user adoption of examination tools and monitoring usage; better management of user stories; improved automated testing; and earlier integration of security controls during design and development.

USPTO stated that it concurred with our first recommendation; however, in its response, it indicated that it is taking a different approach than we recommended. Specifically, in lieu of identifying reusable services at the portfolio level during application design and development, USPTO is identifying reusable services after applications have been developed and implemented.

OIG Comments

We appreciate USPTO's response and its concurrence with our recommendations.

Concerning USPTO's response to our first recommendation, we recognized in our report that USPTO's current method is a step in the right direction. Development of shared technical solutions needed by existing applications, such as those mentioned by USPTO (i.e. content management and data services), is a benefit of their chosen approach and will result in efficiencies through reuse. However, in our opinion, this approach primarily focuses on meeting the technical needs of applications through infrastructure level services. We encourage USPTO, while implementing this recommendation, to consider exploring other types of services—such as those related to business processes—which could uncover additional opportunities for reuse.

We look forward to receiving USPTO's plan for addressing our recommendations within 60 days of the date of this report.

Appendix A: Objectives, Scope, and Methodology

This audit was initiated in June 2013, with fieldwork ending in July 2014. Our objectives were to: (1) assess the impact of IT contract termination decisions that were made as a result of the \$110 million reduction to USPTO's IT budget in FY 2013, and to assess the appropriateness of project funding in the reduced budget environment; (2) review the progress USPTO has made in implementing the recommendations from the FY 2011 Patent End-to-End audit conducted by OIG—specifically, the technical progress it has achieved to date, its use of the Agile methodology, and its plans for future PE2E development; and (3) assess the project management and technical progress USPTO has made in its development and implementation of the Trademark Next Generation project, including its use of the Agile methodology.

The scope of our audit included a review of actions taken as a result of significant IT budget reductions and the resultant impact on development and operations. It included review of the current implementation status of prior audit recommendations for PE2E. It also included a review of current development to date, future plans for development, and engagement of Agile as a development methodology for both PE2E and TMNG.

Our audit methodology included interviews with key executives and managers, review of budget and project status reporting, review of implementation of past audit recommendations, and physical observation of engagement of the Agile/Scrum development process and tools. Specifically, we assessed:

- various documentation that supported contract termination and discretionary budget reduction decisions and the expected impacts of the reductions on IT operations;
- implementation of recommendations and action plans from the 2011 PE2E audit;
- project planning, management, and achievement of milestones;
- current PE2E functionality and the user experience;
- implementation of Agile methodology, tools, and supporting artifacts for PE2E and TMNG; and
- application-coding standards and tools used to assess code quality, secure coding, and various other documentation related to information security for PE2E and TMNG.

We conducted our review under the authority of the Inspector General Act of 1978, as amended, and Department Organization Order 10-13. We performed our work in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence that provides a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Appendix B: Agency Response



UNITED STATES PATENT AND TRADEMARK OFFICE

UNDER SECRETARY OF COMMERCE FOR INTELLECTUAL PROPERTY AND
DIRECTOR OF THE UNITED STATES PATENT AND TRADEMARK OFFICE

October 15, 2014

MEMORANDUM FOR Allen Crawley
Assistant Inspector General for Systems Acquisition and IT Security

FROM: Michelle Lee *Michelle K. Lee*
Deputy Under Secretary of Commerce for Intellectual Property and
Deputy Director of the U.S. Patent and Trademark Office

SUBJECT: Response to Draft Report: "Patent and Trademark IT Modernization
Is Progressing, but Improvements Are Needed"
(September 25, 2014)

Executive Summary

We appreciate the Office of the Assistant Inspector General for Systems Acquisition and IT Security's review of the United States Patent and Trademark Office's (USPTO's) Information Technology (IT) Modernization initiatives. The assessment of our efforts, and the thoughtful recommendations, will assist the USPTO in delivering high quality next generation IT products.

Our response to each recommendation is discussed in detail below.

Response to Recommendations

IG Recommendation (1): Fully implement unsatisfied recommendations from our 2011 audit by prioritizing all user stories at the portfolio level, and by developing a high-level model of reusable services for the entire portfolio.

USPTO Response: The USPTO concurs with this recommendation. With respect to the prioritization of user stories, the PE2E next generation team arranges the stories at the project level, and then evaluates projects in order to prioritize them at the portfolio level.

With respect to developing a high-level model of reusable services for the entire portfolio, the USPTO has chosen to implement applications that will consume enterprise services as independent applications (*i.e.*, they are decoupled and not highly integrated). The USPTO then abstracts from those applications' services to drive the design and implementation of reusable enterprise services. The use of this methodology is done for the following reasons:

1. External dependencies are a key factor in project delays. The USPTO makes every effort to align product approaches to ensure easy integration through the informal collaboration of technical leads and project teams, and also seeks to decouple application timelines by maintaining independence of development prior to release. Delays decrease

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value to the users, and the USPTO believes that the early release of independent applications, without waiting to integrate an entire suite of applications, compensates for cost incurred later, in order to reduce the overall cost of ownership.

2. Services that address actual application needs (as opposed to projected application needs) that are abstracted from actual services used by deployed applications will be of higher quality, require less design revision, and be less likely to be discarded for lack of value.

The USPTO has developed re-usable services for the Patents Content Management System in keeping with the above principles. Modifications of previously released PE2E applications (e.g., Application and Docket Viewer being produced in the Examiner Tools & Infrastructure (ET&I) project) to leverage the Patents Content Management system through its reusable services are planned for Fiscal Year 2015. All subsequently developed applications will leverage these services.

The USPTO is currently in the process of developing Central Enterprise Data Services for the Patents Central Enterprise Data Repository (CEDR) based on current requirements from the Application and Docket Viewer, PE2E Office Actions, and the requirements of legacy systems. The USPTO will port existing applications (PE2E and legacy) to use these services, as will all subsequent applications.

The USPTO will continue to identify reusable enterprise services.

IG Recommendation (2): Identify and implement methods to increase adoption and monitor usage of the PE2E examination tools prior to deployment to the full patent corps.

USPTO Response: The USPTO concurs with this recommendation. Currently, Examiner Tools & Infrastructure (ET&I) functionality has been deployed to over 300 examiners in a pilot program with an additional 188 examiners approved for the first week of October 2014. Incentives have been implemented to encourage examiners to adopt and utilize these examination tools. Consistent with the recommendation, we are now tracking usage of the tools through the use of specific time codes by our beta users along with bi-weekly feedback which has improved the usability of our tools. In addition, the adoption of the tools has increased as additional functionality has been included with each release. The Trademark Next Gen portfolio will also have this capability.

IG Recommendation (3): Fully define and estimate user stories; as well as improve scheduling and estimation of defects.

USPTO Response: The USPTO concurs with this recommendation. In utilizing our user-centered design process described in response to Recommendation 1, we are working to fully define user stories well in advance of when they are needed for a sprint. Patents, Trademarks, and the Office of the Chief Information Officer (OCIO), have improved their definition, scheduling, and assessments of their backlog of user stories—a result of an on-going process in an Agile development framework. Currently, these offices are planning two to three sprints ahead, defining user stories based on goals set for each release, and estimating the number of user stories per each sprint in order to achieve timely project completion. Additionally, the USPTO tracks user stories to allow the USPTO to monitor sprint velocity and predict any issues

that may arise. We are not planning for defects, but we track, record, and monitor any that do occur. As part of the Agile process, we are continuously updating the estimated cost of correcting defects.

IG Recommendation (4): Develop and implement a plan to conduct more robust automated testing, earlier integration of FQT testers and performance testing that is more representative of the production environment.

USPTO Response: The USPTO concurs with this recommendation. Plans are in place for improved automated testing, including hiring additional automation testers (software engineers) and consolidating and re-organizing our test resources for better integration on the sprint teams earlier in the development process. Performance testing, especially in a production environment, will be a key focus. Currently, in-sprint testing is still done manually until automation scripts are built; regression testing, however, is automated and performed overnight.

IG Recommendation (5): Develop and implement a plan to integrate IT security controls earlier in design and development activities and better align automated code reviews with USPTO coding standards.

USPTO Response: The USPTO concurs with this recommendation. PE2E and TMNG teams have already taken action to better automate code reviews of deliverables based on the documented standards, as well as to obtain IT security employee involvement earlier in the design of products in order to improve the integration of IT security tools. Code is developed to Java Standard and then reviewed for compliance with architectural design. OCIO has added additional milestones and checkpoints in our System Development Life Cycle (SDLC) process that enable improved integration of IT security controls. Additional Security Engineer and Government Information System Security Manager employees have been hired. IT Security employees are included in PE2E project kick-offs and planning. PE2E will continue to look at other avenues to further integrate IT security involvement early and often in our processes. Additionally, the Cyber security team has designated POCs for each PE2E project.

Conclusion

Thank you for providing us with this report. We greatly appreciate OIG's efforts to improve the management of the USPTO's Patent and Trademark IT modernization.