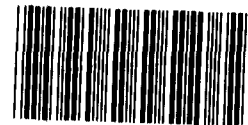


September 1993

PATENT AND TRADEMARK OFFICE

Key Processes for Managing Automated Patent System Development Are Weak



150003

**Accounting and Information
Management Division**

B-247066

September 30, 1993

The Honorable Dennis DeConcini
Chairman, Subcommittee on Patents,
Copyrights and Trademarks
Committee on the Judiciary
United States Senate

The Honorable William J. Hughes
Chairman, Subcommittee on Intellectual
Property and Judicial Administration
Committee on the Judiciary
House of Representatives

The Patent and Trademark Office (PTO) houses one of the largest collections of technical information in the world—a resource critical to the continued growth of technology and to the improvement of U.S. international competitiveness. Faced with an increasing patent application work load and a growing paper burden, PTO began a \$1 billion automation effort—the Automated Patent System (APS)—in 1983 that will last well into the next century. Through APS, PTO expects improved patent quality and increased productivity of its clerical and administrative staff. Concerned with the uncertain impact, cost, and schedule of APS, you asked that we determine PTO's ability to adequately establish benefit, cost, and schedule baselines, and monitor progress against these baselines. Details of our objectives, scope, and methodology appear in appendix I.

Results in Brief

PTO, faced with uncertain user requirements and rapidly evolving technology, adopted an evolutionary approach to developing APS. Such an evolutionary approach recognizes system uncertainties and risks up front, builds and implements the system in a series of increments to address these uncertainties and risks, learns from each of these increments, and then uses this knowledge in developing the next increment. As such, determining whether total benefits will exceed total costs, how much the system and its subsystems will ultimately cost to develop and deploy, and when they will be fully operational are questions whose answers are uncertain. Instead, the focus in terms of benefits, cost, and time frames is primarily on the current and next increment.

While an evolutionary approach clearly has merits, it, like any system development approach, requires effective processes for management to

exercise control over the project. However, PTO's processes for exercising effective management control over APS are weak. PTO has not developed a systematic process to (1) justify each increment of APS on the basis of expected benefits, and (2) provide objective, verifiable evidence that improved patent quality and other expected benefits are being achieved, and thus that the APS increments completed to date have been worth the money PTO has invested. In the absence of reliable, experience-based benefits data, senior PTO officials stated that they are relying on management judgment in setting APS development and deployment priorities.

PTO's processes for establishing reliable cost and schedule baselines for activities broader than individual contractor deliverables, or task orders, are also weak. Cost baselines for APS increments or subsystems are based on individual managers' memories, unspecified assumptions, and best judgments; no rigorous techniques commonly advocated by system development experts are employed. Further, APS schedule baselines above the task-order level are not linked to the cost baselines, making uncertain exactly what will be accomplished, by when, and for how much.

PTO's processes for systematically tracking performance against some cost expectations and learning from earlier experiences, a basic underpinning of an evolutionary development approach, are also limited. PTO tracks progress against cost baselines at the task-order level, but these task orders are not aggregated with other direct and indirect costs, such as in-house labor, hardware, and software, to provide a complete view of PTO's performance in incrementally delivering a subsystem. As a result, information meaningful to senior management in PTO and the Department of Commerce and congressional oversight committees on APS' progress against cost baselines, reasons for deviations from these baselines, and lessons learned to apply to the next cycle of development are absent. To PTO's credit, it does track and report performance against schedule baselines above the task-order level. However, as noted earlier, the schedule baselines are not linked to the cost baselines.

Background

The mission of the Patent and Trademark Office (PTO) is to promote industrial and technological progress in the United States and strengthen the national economy by administering the laws relating to patents and trademarks. A critical part of this mission is met through the examination of patent applications and the issuance of patents. PTO estimates that

70 percent of information on emerging technologies is disclosed solely in patent applications.

In fiscal year 1992, PTO received over 185,000 patent applications and issued nearly 110,000 patents. PTO estimates this work load will grow at an annual rate of 4 percent. In addition, PTO's patent files contain about 33 million documents, generally ranging from 7 to 10 pages each, and these files are expected to grow by about one million documents each year. PTO has repeatedly cited the growing work load of patent applications and the difficulty in managing the volumes of paper associated with patent processing as impediments to carrying out its mission.

In addition to internal users such as patent application processors and examiners, PTO has external customers such as inventors, patent researchers, investors, and corporations. These customers use the information disclosed in patents to develop new products, identify research trends, make investment decisions, and allocate research and development resources. PTO is fully funded by revenues paid by its external customers for products and services; it is one of several federal agencies for which user fees were increased by the Omnibus Budget Reconciliation Act of 1990, in order to reduce the federal budget deficit.

What Is APS?

In 1983 PTO initiated APS to automate all aspects of the paper-intensive patenting process. Through APS, PTO expects significant improvements in patent quality and productivity. When complete, APS is to consist of five integrated subsystems:

- Patent Application Management (PAM) is expected to fully automate incoming patent applications and the management of these applications as they move through PTO.
- Text Search allows examiners to electronically search the text of U.S. patents granted since 1971 and provides access to selected abstracts of foreign patents.
- Classified Search and Image Retrieval (CSIR) relies on advanced imaging and optical storage technology to scan and retrieve images of documents stored on high-speed optical drives. CSIR will allow examiners to perform searches by class and to retrieve, display, and print the images of U.S. patents. Eventually, PTO plans to add foreign patents and non-patent literature to the image database.
- Classification Data System (CDS) helps examiners classify patents. It is also intended to support image and text search functions.

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- Patent and Trademark Copy Sales (PTCS) is designed to support on-demand printing of copies of patents and trademarks.

APS Status

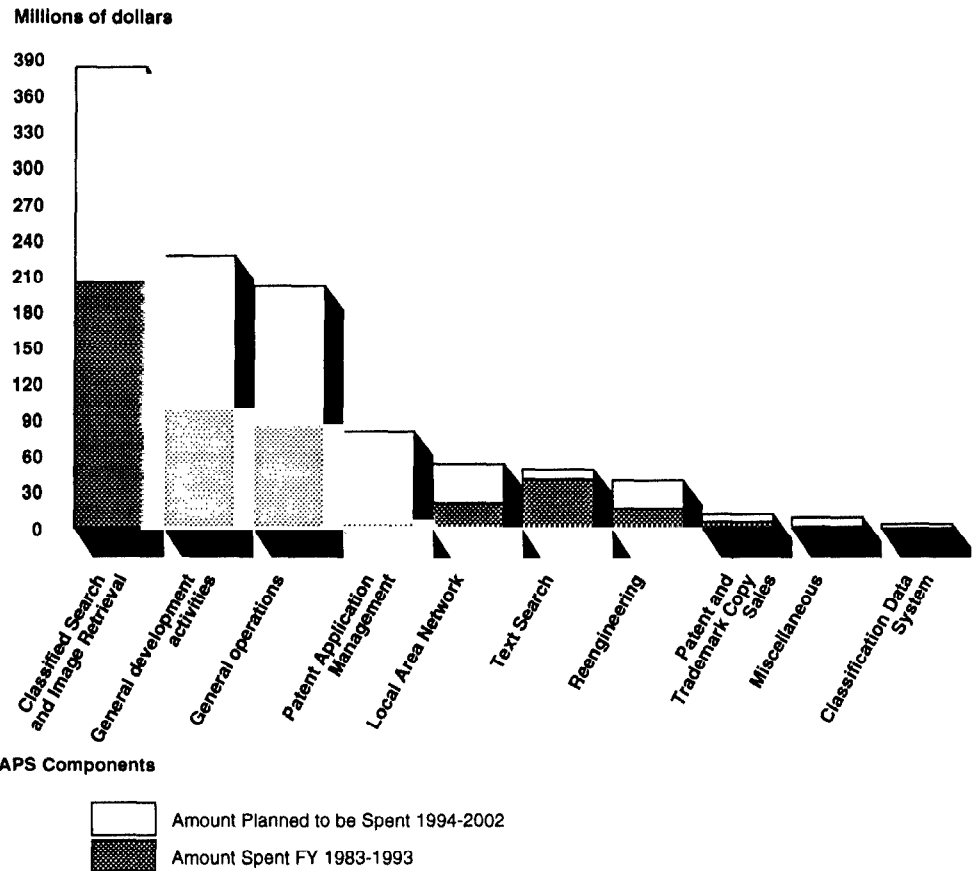
After 11 years and about \$480 million, PTO has deployed, and is operating and maintaining, parts of APS. Text Search has been in use throughout PTO since 1987; CSIR has been operating since 1987 and is currently deployed, with varying degrees of patent availability,¹ to all examiners and to the public; PTCS order entry and printing capabilities were deployed in 1992; and existing CDS classification activities formerly performed by a contractor were brought in-house in 1992.²

With about \$580 million more planned to be spent by 2002, PTO intends to load remaining U.S. patent images to the CSIR database and to supply workstations to all examiners; add foreign patents and non-patent literature to the image database; develop and deploy PAM; upgrade Text Search, PTCS, and CDS; integrate PAM and CDS with the rest of APS; and operate and maintain increments of APS subsystems as they are deployed. Figure 1 shows the amount spent on APS subsystems (Text Search, CSIR, CDS, PTCS, and PAM) and crosscutting activities (such as general development, general operations, and other infrastructure development activities) through 1993, and the amount still planned to be spent through 2002. These amounts are also shown in a table in appendix II.

¹As of July 1993, PTO had deployed images of U.S. patents issued since 1790 to 4 of 16 examiner groups, with each group receiving two clusters of workstations. Images of U.S. patents issued since 1971 were made available to the remaining 12 examiner groups; however, these 12 were not provided workstation clusters and thus must use the workstations deployed to the other 4 examining groups. PTO also provided public access to patent images through workstations in its public search room.

²The cost of this CDS effort is not included in the \$480 million spent on APS to date.

Figure 1: Actual and Planned Spending on APS Subsystems and Crosscutting Activities



APS Development Time Frame and Life Cycle Have Been Extended

As envisioned in 1983, APS would be deployed by 1990 and maintained through 2002 for an estimated life-cycle cost of about \$1 billion (in constant 1992 dollars).³ PTO continues to estimate that APS will cost about \$1 billion over this same period; however, full deployment has been delayed until 1997, 7 years later than originally planned. The schedule changes, according to PTO, are due to changes in the system development approach, shortages in funding, shifts in APS subsystem priorities, and modifications to the envisioned functionality that APS is to provide. As a result, the 20 years between 1983 and 2002 no longer encompass the system's life cycle; instead APS is expected to incur operations and

³Life-cycle cost includes all costs related to the design, development, production, and operation and maintenance of a major system over its expected useful life, according to Office of Management and Budget major system acquisition policy.

maintenance costs well past this 20-year period. A senior PTO official stated that PTO has always believed that operations and maintenance costs would be incurred after the system's 20-year life cycle. Appendix III provides details on the history of APS cost and schedule estimates.

Previous Reviews Critical of PTO's Ability to Manage APS

Previous reviews have raised concerns about PTO's ability to adequately plan and manage this major program. In 1986 we reported that planning and oversight of the program were inadequate.⁴ In 1987, because of concerns raised by us, the Office of Management and Budget, and others, the Secretary of Commerce convened an Industry Review Panel (IRP)⁵ comprised of representatives from private industry with experience in the development and implementation of large-scale automated systems. In 1988 the panel issued a report that identified weaknesses in APS requirements, technical design, and program management. Among other items, the report criticized PTO's management of the APS program as being overly focused on individual contract deliverable schedules rather than on an integrated effort devoted to planning and monitoring all aspects of the program. In 1990, after reviewing PTO's progress, the panel reported that PTO had made dramatic improvements in APS, but noted that there were still several essential improvements to be made. However, the panel did not specifically comment on PTO's focus on individual contract deliverables.

PTO Is Developing APS Using an Evolutionary Approach

In its 1988 report, the IRP advised PTO to manage APS using an evolutionary development approach. Prior to this, PTO had been following a more traditional waterfall model for system development. The waterfall model emphasizes (1) an early, fixed definition of user requirements; (2) the sequential progression of the entire system through life-cycle phases (i.e., requirements definition, design, development, deployment, and operations and maintenance); and (3) go/no-go decisions at the conclusion of each phase. The waterfall model has been criticized for not recognizing the iterative nature of user requirements definition as well as not effectively dealing with the risks inherent in developing complex systems.

In contrast, evolutionary development recognizes system risks and uncertainties up front, and provides for the definition and development of the system in increments. The decision on whether to undertake the next

⁴ADP Acquisitions: Patent Automation Encountering Major Planning and Procurement Problems (GAO/IMTEC-86-19, July 17, 1986).

⁵This panel was later officially chartered as the Industry Review Advisory Committee.

increment is based on lessons learned from previous increments and the relative costs and benefits of the next increment. The emphasis is on (1) developing a series of increments, each composed of activities to address defined risks and each pursued based on its own expected value relative to costs; and (2) focusing on one increment at a time rather than building the entire system at once. The argument for this approach is that such iteration allows better risk control by avoiding or recognizing problems before total system delivery, thus permitting system adjustments and corrections earlier in the development process, when they are cheaper to do. An evolutionary development approach generally applies to systems where it is not possible to fully determine user needs without actual hands-on experience with the system, and where the technology is rapidly evolving.

Because evolutionary development focuses on producing one increment at a time and applying lessons learned from that increment when developing the next, the details associated with successive increments (e.g., what activities will be performed, what functionality will be developed and deployed, how much the increments will collectively cost, when the total system will be completed, etc.) are understandably more uncertain and are at best a range of goals rather than supportable, precise estimates. It is only as increments are completed that ultimate benefit, cost, and schedule estimates become more precise. The focus in terms of establishing reliable objectives and baselines and determining progress against those baselines is thus the current and next increment rather than the complete system.

Strong management control is as important for evolutionary system development as it is for any other development approach. Since risks are identified early in system development, management is obligated to address and manage these risks. The IRP recognized the need for strong management control under an evolutionary approach when it recommended in 1988 that PTO develop a clear, coherent, up-to-date plan for APS, to be supported by a planning and control system that would link and monitor cost and schedule. The panel also advised PTO to develop an up-to-date, accurate cost model to be used as a planning and forecasting tool.

PTO Lacks a Process for Demonstrating That APS Incremental Benefits Are Worth the Investment

Key system development decisions, whether associated with life-cycle phases or increments of development, should be based on reliable data showing that resource investments will produce commensurate value. As systems are developed, expected benefits and estimated costs should be periodically validated through actual experience. From the outset, PTO justified APS primarily on its improving patent quality, with secondary emphasis placed on improving productivity and achieving cost benefits.⁶ PTO has already spent roughly \$480 million and plans to spend an additional \$580 million in an attempt to deliver and operate APS through 2002. However, PTO has not developed a process for systematically providing and using objective evidence on expected and actual benefits associated with each APS increment, and it has not demonstrated that patent quality has improved. Although PTO has conducted a series of studies to evaluate the effect of APS text and image subsystems on search quality and examiner productivity, these studies have not demonstrated that expected benefits are being realized. In the absence of objective evidence on the realization of expected benefits, senior PTO officials stated that they rely on management judgment in making APS investment decisions.

Several senior PTO officials, however, told us they are certain that APS benefits exist. To support this statement, PTO cited a handful of statements made by public users of Text Search in PTO's patent search room and 14 select libraries across the country, and the demand for the installation of two additional terminals. PTO also cited several positive comments made by examiners regarding advantages they have experienced through text and image (CSIR) searching. These comments range from the quality advantages of being able to perform broader and more effective patent searches to the processing advantage of avoiding the movement and management of tons of paper. While we acknowledge that such ad hoc statements are indicators that benefits are possibly accruing, they do not constitute the type of thorough assessment needed to conclusively show benefit realization, particularly when other evidence, albeit equally ad hoc, suggests user dissatisfaction with APS. For example, some public searchers stated that the systems were clumsy, hard to understand, and slower than manual searching. Additionally, some examiners complained that they found the systems to be so slow and unreliable that they still did much of their searching on paper documents.

⁶According to PTO, APS text and image search subsystems will improve patent quality and maintain examiner productivity, while the PAM subsystem will greatly improve the productivity of clerical and administrative staff.

The officials also stated that PTO anticipates a number of benefits to accrue once APS is fully deployed. The expected benefits cited include cost savings from the PAM subsystem, enhancement of the U.S. research and development community's access to advances in foreign and domestic technology, facilitation of the preparation and defense of valid patents by the U.S. intellectual property community, and cost avoidances associated with keeping pace with the growing number of applications under a paper-based approach. The Assistant Commissioner for Finance and Planning also cited a 1986 study that led to PTO's decision to deploy text search which showed that examiners can conduct a more thorough search using an on-line system. These, however, are projections of potential benefits. After spending about \$480 million, PTO should have evidence of actual benefits accruing from the systems.

At the conclusion of our audit work, and in response to our concern that realization of actual APS benefits had not been verifiably demonstrated, PTO compared the cost of developing Text Search to the cost of leasing time on a commercially available patent database. This comparison showed savings ranging from \$125 million to \$250 million from fiscal year 1983 through fiscal year 2002. However, this is not a valid comparison because the study did not include Text Search system hardware and operations costs. The manager who performed the study stated that he did not include these costs because they are too difficult to determine.

The Assistant Commissioner for Finance and Planning stated that APS has demonstrated benefits by enabling PTO to obtain European and Japanese Patent Offices' complete patent documentation electronically at a fraction of the cost of obtaining it commercially—about \$1.1 million versus \$32.5 million (we were unable to validate these figures because they were provided to us just before this report was printed). Additionally, the Assistant Commissioner for Finance and Planning stated that PTCS has produced visible improvements in the readability of patent copies and provided two examples to support his point. Our examination of these copies clearly showed that the PTCS copies were more legible, and thus that an actual benefit from APS is accruing. However, this improvement does not demonstrate the accrual of the primary benefits upon which APS was and continues to be justified - improved patent quality.

In a more recent attempt to demonstrate benefits, PTO officials initiated a project aimed at modeling APS' relationships with its internal and external constituencies. This initiative is an attempt to identify the value users see in APS and the trade-offs associated with potential investment decisions.

To date, PTO management has not committed to use this model as a basis for investment decisions.

APS System-Level Cost and Schedule Baselines Are Uncertain

The reliability of cost and schedule baselines for APS and its subsystems are questionable due to weaknesses in the processes PTO uses to establish these baselines. To be reliable, system development cost estimates must use rigorous estimating techniques. Likewise, schedule baselines are credible only when linked with reliable cost baselines. However, PTO's system-level cost baselines are not determined using such techniques and its schedule baselines are not linked to its cost baselines.

APS System-Level Cost Estimating Process Is Weak

PTO has two levels of APS cost baselines—a task-order level and a system level. The task-order baselines are for relatively small, imminent contractor activities that generally span a period of less than one year. The system-level baseline is broken down into APS' major subsystems (e.g., Text Search) and crosscutting activities (e.g., general development). This baseline includes not only contractor work, but also in-house labor, hardware, software, and indirect costs, and provides annual cost estimates through the year 2002.

The cost estimates in the system-level cost baseline that PTO uses in formulating its budget requests and in making funding allocation decisions are not based on any of the formal estimating techniques advocated by system development experts. PTO managers develop these estimates on the basis of their own individual knowledge, experience, and judgement; no attempt is made to follow a more rigorous and repeatable approach that systematically captures and applies lessons learned from actual cost experience. Senior PTO officials stated that in their experience, formal estimating tools have not been found to be valuable in developing estimates for broad, generic, long-range projects such as APS. Instead, they found that the experience of managers who have participated in similar developmental activities has proven to be the best basis for estimating costs. While we recognize the value in using managers with similar experiences to estimate system-level costs, our interviews with the managers PTO identified as primarily responsible for cost estimating showed that none used any systematic and consistent processes for capturing and learning from previous experiences.

Another concern with PTO's cost estimating process is that the system-level estimates are not kept up-to-date with task-order cost estimates, and thus

the system-level estimates do not reflect PTO's best cost information. Specifically, the task-order estimates are separately derived through negotiation with the APS contractor using a more rigorous process, and thus provide a more reliable picture of expected costs. While we did not attempt to determine the frequency and amount of differences between the system-level and task-order estimates because there is not a one-for-one match between items, one example became evident through the course of our review. In this case, the task-order cost estimate was about \$400,000 higher than the system-level estimate, representing an 80 percent increase in the estimated cost of the task.

PTO officials agree that APS cost estimates are not kept up-to-date with these negotiated cost estimates, but because they view their system-level baseline to be long term, they do not see the value in updating the estimates throughout the fiscal year. We disagree. According to the Directors of Program Management Support Services and the Office of the Budget, the out-of-date estimates are used to (1) negotiate budgets, and (2) analyze the impact of shifting money among APS activities and adjust funding emphasis based on this analysis. Without using the most current and reliable estimates, infeasible and unwise shifts in resource investments among activities could result. For example, in allocating expected funding for the next fiscal year, PTO managers may be using cost estimates for various activities that are higher or lower than the latest available and more reliable negotiated estimates. Had a different mix of cost estimates been used, the package of allocation decisions made could be completely different.

APS System-Level Schedule Estimates Are Not Linked to Cost Estimates

As part of the annual budgeting process, PTO commits to meeting various high-level milestones on the major APS subsystems to Commerce and the Congress (see app. IV for specific commitments). PTO's Office of Information Systems, charged with managing the program, schedules the activities that support meeting these high-level milestones. The Assistant Commissioner for Information Systems described the schedule baseline that is used to help meet these milestones as an ever-changing, never-final baseline. The schedule is affected by (1) fluctuations in revenues and funding, (2) lessons learned on prior increments, (3) further definition of desired functionality, and (4) changes in the priorities of senior management. He stated that the schedule baseline is firm in the short term—that is, the next 9-15 months.

However, this schedule baseline is not linked to the system-level cost baselines. Linking cost and schedule is critical to establishing realistic baselines for both and for evaluating the cost and schedule impact of changing priorities. Because PTO's cost and schedule baselines are derived independently, they describe activities differently, and may in fact be based on different expected levels of activity. The possibility of such inconsistency is evidenced by the fact that PTO's accounting of past activity varies between the two baselines. For example, the cost baseline shows that no money has been spent on the interim version of CDS, a 2-year effort deployed in fiscal year 1992, while the Office of Information Systems schedule shows activity during this time frame. According to the Acting Commissioner, CDS is a unique example in which the project was not begun or budgeted as a part of APS, and is relatively small compared to other APS subsystems. As another example, while the schedule baseline shows several completed and ongoing PAM development activities, including the development of a plan for PAM, a risk assessment, and preliminary development of a PAM subsystem, the cost baseline shows one line-item associated with all internal PAM activities. The manager responsible for the cost baseline told us there never was a cost associated with individual PAM projects; rather, the cost reflected in the baseline is a gross estimate for unspecified PAM preparatory activities. Without a clear link between the two baselines, the reliability of both is questionable at best.

The Assistant Commissioner for Information Systems, recognizing the value in linking cost and schedule, recently attempted to link costs to APS projects in the information systems strategic plan. While this effort failed because cost estimates were so poor, the Assistant Commissioner said he hopes to coordinate cost estimates with schedule estimates in the future. PTO's official position, however, is that PTO maintains and rigorously monitors costs and schedules at the task-order level, and that this process maintains consistency between cost and schedule for work that is underway. While we agree that PTO links cost and schedule for individual task orders, these task orders represent only part of APS development, operations, and maintenance (projected to be 63 percent in fiscal year 1993). They are not combined with in-house and indirect activities into either an overall cost and schedule plan or monitoring system. Without such a link, APS cost and schedule plans may not be consistent or realistic, and the impact of shifting priorities cannot be adequately determined.

Schedule Monitoring Is Occurring, but Limited Cost Monitoring Makes Cost Performance Uncertain

A basic underpinning of evolutionary system development is to “build a little, learn a little, and adjust.” Successfully employing this development methodology, therefore, requires management processes in which performance can be systematically and comprehensively tracked against expectations, reasons for deviations can be assessed, and future plans and expectations can be adjusted accordingly. While schedule monitoring is occurring, PTO’s process for tracking cost performance and learning from earlier experiences is limited.

PTO Is Monitoring Progress Against Schedule Baselines

PTO monitors progress against schedule baselines at both the task-order and system levels. The Office of Information Systems, responsible for managing the development of APS, uses an automated management tool to track the progress of task-order level milestones as well as aggregations of these milestones up to the system level. Deviations from schedule baselines will show up in this automated system and be identified up through the management chain. Also, the Office of Finance and Planning, responsible for setting and monitoring the official APS schedule baseline, tracks select near-term milestones reported in PTO’s budget submission through monthly management briefings and discussions with users.

PTO Performance Against System-Level Cost Baselines Is Unknown

To its credit, PTO monitors actual task costs against the task-order baselines; however, it does not monitor APS cost baselines at a system or subsystem level. That is, cost performance on task orders is not aggregated with cost performance on in-house activities to provide a comprehensive view of a subsystem or increment. As a result, it is impossible to determine if a subsystem is coming in above or below cost, the reasons for any variance, and whether changes are necessary in light of a variance. The Assistant Commissioner for Information Systems agreed that monitoring at a level higher than task orders would be valuable in that it would (1) allow him to make decisions based on all of the costs associated with a certain project; (2) permit better analysis of tradeoffs between contractor-led and in-house work; (3) help differentiate between development and operational activities; and (4) provide senior management in PTO, Commerce, and Congress better information regarding project costs. In fact, the Office of Information Systems is currently assessing the feasibility of developing a framework for such monitoring. PTO’s official position, however, is that it already has sufficient controls and monitoring devices in place to monitor cost performance.

Conclusions

PTO does not have all the necessary processes in place to permit sound management of APS. While such processes are important to any system development project, they are especially crucial to APS because of PTO's use of an evolutionary development methodology, in which the focus is on managing and controlling near-term development activities and the ability to learn from past experiences and then adjust is so crucial. The inability to effectively measure progress against defined goals and determine causes for deviation forces PTO, Commerce, and Congress to make major investment decisions using uncertain system benefits, uncertain cost and schedule baselines, and uncertain performance against baselines.

Recommendations

We recommend that the Secretary of Commerce ensure that the Commissioner, Patent and Trademark Office immediately:

- Establish a process that (1) identifies expected benefits to internal and external users in justifying each new APS increment before investing money in that increment, (2) establishes performance measures for these expected benefits, and (3) measures attainment of the expected benefits.
- Implement a rigorous, systematic, and repeatable process for estimating APS costs. This process should (1) retain original and revised cost estimates, as well as data comparing actual performance against these estimates; (2) analyze reasons for deviations; and (3) allow adjustments to the estimation process based on this analysis of deviations. These cost estimates should be reflected in PTO's budget planning documents.
- Link APS system-level cost baselines (incorporating task orders, in-house activities, and indirect costs) and schedule baselines, and monitor progress against these baselines.

Once accomplished, the Secretary should require the Commissioner to use the resulting information to determine whether PTO's plans for APS are justified. The results of this analysis should be reported to PTO's House and Senate authorization and appropriation committees.

Agency Comments and Our Response

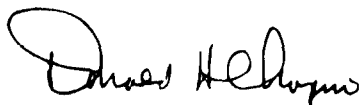
In its written comments on a draft of this report, PTO agreed with our recommendations, stating that implementing them will improve its management of APS. However, PTO disagreed with our position that it has been unable to show that APS benefits have accrued. PTO further stated that it is both wrong and unfair to create such incorrect impressions. PTO said that it has shown that certain APS benefits are tangible, significant, and

measurable. To support its point, PTO reiterated the benefits that we identified and addressed in this report.

Our point, which we have clarified in the report, is that after spending almost \$480 million to develop and deploy considerable APS functionality, the actual accrual of benefits from this investment, determined through the systematic collection and analysis of data on APS' operational use, has not been demonstrated in a way that can be independently and objectively validated. Moreover, PTO's own organization responsible for measuring the benefits from APS' implementation determined in late 1992 that conclusive proof of benefits has not been found. In the absence of such data and analysis, we found the arguments posed by PTO senior officials about whether actual APS benefits have been realized to be largely based on management judgement, and were in fact described to us by some officials as such. The full text of PTO's comments are in appendix V.

We are sending copies of this report to appropriate congressional committees; the Secretary of Commerce; the Commissioner of PTO; and other interested parties. Copies will also be made available to others upon request. We conducted our review between October 1992 and June 1993, in accordance with generally accepted government auditing standards.

This work was performed under the direction of Dr. Rona B. Stillman, GAO's Chief Scientist for Computers and Communications, who can be reached at (202) 512-6412. Other major contributors are listed in appendix VI.



Donald H. Chapin
Assistant Comptroller General

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Abbreviations

AIMD	Accounting and Information Management Division
APS	Automated Patent System
CDS	Classification Data System
CSIR	Classified Search and Image Retrieval
GAO	General Accounting Office
IRP	Industry Review Panel
PAM	Patent Application Management
PTCS	Patent and Trademark Copy Sales
PTO	Patent and Trademark Office

Objectives, Scope, and Methodology

- On October 30, 1992, the Senate Subcommittee on Patents, Copyrights and Trademarks and the House Subcommittee on Intellectual Property and Judicial Administration asked us to (1) determine PTO's current baseline of expected APS benefits, how PTO is measuring and plans to measure the realization of actual APS benefits, and what benefits are actually accruing; (2) document APS cost and schedule history; and (3) determine APS's current cost and schedule baselines, and how PTO is measuring performance against these baselines.

To meet these objectives, we

- reviewed literature on, and discussed with experts, evolutionary system development and accepted cost and schedule estimating practices;
- reviewed key planning documents, including historical Automation Master Plans and PTO's Congressional budget requests;
- examined previous reviews of APS, including the 1988 Findings and Recommendations of the Automated Patent System Industry Review Panel, and the IRP's January 1990 follow-up study entitled Report of the Automated Patent System Industry Review Advisory Committee;
- discussed cost estimating practices and cost and schedule baselines and performance monitoring with the Assistant Commissioner for Information Systems; Assistant Commissioner for Finance and Planning; Director, Program Management Support Services; and Director, Program Management Division;
- analyzed cost and schedule baselines, reports generated by PTO's Office of Information Systems' automated program management system, and contract task-order management reports;
- discussed APS benefits and future plans for determining APS value with the Acting Assistant Commissioner for Patents, the Assistant Commissioner for Public Services and Administration, and the Administrator for Search and Information Resources;
- reviewed 24 benefits studies conducted between 1986 and 1993, including 17 identified by PTO as representative of all studies undertaken by PTO; the 1990 APS Cost/Benefit Analysis; and the 1993 Analysis of Advantages of APS; and
- received comments on a draft of this report from PTO's Acting Commissioner and Assistant Commissioner for Finance and Planning, and modified the report as appropriate.

Our work was performed at the Patent and Trademark Office in Arlington, Virginia.

Spending Plans for APS Projects Through Fiscal Year 2002

APS Project	Amount Spent FY 1983-1993 (in millions)	Amount Planned to be Spent FY 1994-2002 (in millions)	Total Cost Estimate FY 1983-2002 (in millions)
Classified Image Search and Retrieval System	\$204.670	\$178.129	\$382.799
General development activities	\$99.833	\$126.813	\$226.646
General operations	\$85.356	\$115.642	\$200.998
Patent Application Management System	\$5.907	\$74.192	\$80.099
Local Area Network	\$20.096	\$33.050	\$53.146
Text Search System ^a	\$39.830	\$8.386	\$48.216
Reengineering ^b	\$15.824	\$22.750	\$38.574
Patent and Trademark Copy Sales System	\$5.174	\$5.951	\$11.125
Miscellaneous	\$.950	\$7.702	\$8.652
Classification Data System	\$.020	\$3.640	\$3.660
Total for APS Program	\$477.660	\$576.255	\$1,053.915

^a Text Search System includes costs associated with providing public access to text search.

^b Reengineering activities continue throughout this evolutionary system development and include such activities as systemwide engineering and system architecture studies.

History of APS Cost and Schedule Estimates

Date and Source of Estimate	Estimated Date of Deployment^a	Time to Develop and Deploy	Life-Cycle Cost Estimate (1983-2002)	27-year Cost Estimate (1983-2009)	20-year Cost Estimate (1983-2002)
1983, 1st Master Plan	1990	8 years	\$1,170 million		
1987, 3rd Master Plan	1991	9 years	\$1,033 million		
1990 Decision Paper	1996	14 years		\$1,317 ^b	
1992 Cost Baseline and Official APS Schedule	1997	15 years			\$972 million
1993 Cost Baseline and Official APS Schedule	1997	15 years			\$1,054 million

Note: Costs are in constant 1992 dollars.

^aThese are the dates by which all APS subsystems will be deployed. The Text Search subsystem has been deployed since 1987; the CSIR subsystem was deployed to a fourth examining group and, with limited patent availability, to remaining examiners and the public in 1993.

^b Actual dollars spent through 1989 plus PTO's estimate for 1990-2009 in constant 1992 dollars.

APS Official Schedule Commitments

Major Milestones	Current APS Schedule (reflects 1994 Congressional budget)
Text Search replacement deployed	by September 1996
CSIR deployed in shared environment	by September 1995
Complete loading U.S. patents on Rapid Access Devices	by September 1995
Complete loading 67 percent of foreign images	by September 1998
Complete U.S. and foreign image data load	by September 2000
CDS fully deployed	by September 1997
PTCS fully deployed	by September 1994
PAM fully deployed	by September 1997
PAM integrated into APS	by September 1998

Comments From the Department of Commerce



UNITED STATES DEPARTMENT OF COMMERCE
Chief Financial Officer
Assistant Secretary for Administration
Washington, D.C. 20230

JUL 23 1993

Mr. Donald H. Chapin
Assistant Comptroller General
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Chapin:

Thank you for the opportunity to review your draft report entitled "Patent and Trademark Office: Key Processes for Effectively Managing Automated Patent System Development are Weak."

We have reviewed the enclosed comments of the Acting Assistant Secretary and Acting Commissioner of Patent and Trademarks and believe they are responsive to the matters discussed in the report.

Sincerely,

A handwritten signature in cursive script, appearing to read "Gloria Gutierrez".

Glória Gutiérrez
Acting Chief Financial Officer and
Assistant Secretary for Administration

Enclosure

Appendix V
Comments From the Department of
Commerce



UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
ASSISTANT SECRETARY AND COMMISSIONER
OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

JUL 20 1993

Mr. Donald H. Chapin
Assistant Comptroller General
Accounting and Information
Management Division
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Chapin:

Thank you for your letter requesting the Department's comments on the draft General Accounting Office report entitled "Key Processes for Effectively Managing Automated Patent System Development are Weak."

The specific recommendations contained in the report have been reviewed with Department of Commerce officials. In addition, a copy has been shared with the Assistant Secretary of Commerce and Commissioner of Patents and Trademarks-Designate. GAO's recommendations are accepted in their entirety. We believe they will enable us to improve the management of the Automated Patent System project. At the same time, we believe that some of the critical statements included in the draft report should have been tempered if the positive information that was provided to the auditors had been given careful consideration. We have provided a few examples in the enclosed document for your consideration.

We have the following comments on the specific recommendations:

Recommendation 1 - "establish a process that (1) considers expected benefits to internal and external users in justifying each new APS increment before investing money in that increment, and (2) measures attainment of these expected benefits."

The Patent and Trademark Office (PTO) has begun to formalize the process which considers the benefits of each new increment of APS. The analysis and approval of the Patent Application Management sub-system will be used as a baseline model. We also intend to refine the cost-benefit decision model which we established in 1986 to measure actual versus planned benefits. An integrated process is expected to be operational by the third quarter of 1994.

Appendix V
Comments From the Department of
Commerce

Recommendation 2 - "implement a rigorous, systematic, and repeatable process for estimating APS costs. This process should (1) retain original and revised cost estimates, as well as data comparing actual performance against these estimates; (2) analyze reasons for deviations; and (3) allow adjustments to the estimation process based on this analysis of deviations. These cost estimates should be reflected in PTO's budget planning documents."

We will implement the recommended process by the end of fiscal year 1994, but plan to begin monitoring costs immediately by accumulating current negotiated task-order costs into system-level cost estimates. In addition, we will continue to include APS cost estimates in the Automation Master Plan Summary of its budget submissions, but will modify the budget tables to show any cost and schedule deviations at the sub-system level.

Recommendation 3 - "link APS system-level cost baselines (incorporating task orders, in-house activities, and indirect costs) and schedule baselines, and monitor progress against these baselines."

We will modify the existing automated management tools used by our Information Systems staff to link cost baselines with schedule baselines. While this tool currently tracks the progress of task-order level milestones as well as aggregations of these milestones up to the system level, our planned modifications will enable the PTO to provide cost estimates at the corresponding sub-system level beginning in FY 1994.

We appreciate this opportunity to comment on the draft report.

Sincerely,



Michael K. Kirk
Acting Assistant Secretary
and Acting Commissioner of
Patents and Trademarks

Enclosure

Enclosure

**Patent and Trademark Office Comments on GAO Draft Report
"Key Processes for Effectively Managing
Automated Patent System Development are Weak"**

- On page 2 of the report, it is stated that "PTO has been unable to establish that APS benefits have accrued" and on page 7, it is stated that PTO's senior officials believe that "APS benefits are intuitive." We strongly disagree that PTO has been unable to establish APS benefits and believe it is inaccurate to imply that we have indicated that APS benefits are solely intuitive. We believe it is both wrong and unfair to create such incorrect impressions. On the contrary, we have shown that the benefits of APS are tangible, significant and measurable. In our written response to the GAO's exit interview, we identified over fifteen tangible benefits resulting from full deployment of APS. Examples of these benefits include international agreements to exchange patent data with the European and Japanese Patent Offices, and remote access by the public to information contained in patents. At the same time, we believe the assumptions and methodology used in quantifying the expected twenty-year net savings of \$711 million resulting from implementation of the PAM system are sound and reliable.

Major Contributors to This Report

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Washington, D.C.**

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Sharon E. Heidtman, Technical Adviser**

Related GAO Products

Patent and Trademark Office: Information on PTO's Program to Automate Patent Information and Processes (GAO/T-IMTEC-92-19, May 12, 1992).

Automated Patent System: Information on PTO's Program to Automate Patent Information and Processes (GAO/T-IMTEC-92-20, May 28, 1992).

ADP Acquisitions: Patent Automation Encountering Major Planning and Procurement Problems (GAO/IMTEC-86-19, July 17, 1986).

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