

GAO

Report to the Ranking Minority Member,  
Committee on Science, House of  
Representatives

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May 1995

# PERFORMANCE MEASUREMENT

## Efforts to Evaluate the Advanced Technology Program







United States  
General Accounting Office  
Washington, D.C. 20548

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**Resources, Community, and  
Economic Development Division**

B-259591

May 15, 1995

The Honorable George E. Brown, Jr.  
Ranking Minority Member  
Committee on Science  
House of Representatives

Dear Mr. Brown:

This report responds to your request concerning the Advanced Technology Program (ATP), which is administered by the National Institute of Standards and Technology (NIST) within the Department of Commerce. ATP's purpose is to provide support on a cost-sharing basis to research and development (R&D) projects in industry. These projects are intended to have a significant potential for stimulating economic growth and improving the competitiveness of U.S. industry. Funding for ATP has grown from \$68 million in fiscal year 1993 to \$431 million in fiscal year 1995, more than doubling each year. The President has set a goal for the program's funding to reach \$750 million by 1997.

In light of these significant budget increases, the Congress is interested in ATP's impact. Although NIST recognizes that it is too early to measure ATP's long-term economic effects, the agency has reported short-term results that, it says, indicate the program is making an impact. As agreed with your office, we (1) analyzed these short-term results and (2) reviewed NIST's plans for evaluating ATP in the future, as reported in the NIST document entitled Setting Priorities and Measuring Results at the National Institute of Standards and Technology, dated January 31, 1994. In addition, we are presenting information on other ATP evaluation efforts that NIST has planned or under way.

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## Results in Brief

Evaluating the Advanced Technology Program poses many challenges. For example, while funded projects are intended to be technical successes and to have a commercial impact, several years can elapse between the end of technical work and the realization of such an impact. NIST has, however, identified six short-term results in the Setting Priorities document that it believes demonstrate the program is making an impact. While all six have limitations, our analysis shows that four are overstated or lack adequate support. For example, NIST projected ATP's impact from one joint venture to the entire industry of approximately 800 companies.

NIST also summarized its plans for evaluating ATP in Setting Priorities. This summary includes indicators, such as the number of technical milestones completed and the number of joint ventures formed, that we do not believe reflect the long-term economic success of the program. Setting Priorities does, however, provide descriptive information that may be useful to NIST officials in managing the program.

According to NIST officials, NIST has other evaluation efforts planned or under way besides those included in Setting Priorities. These efforts include engaging the advice and services of the nation's leading economists in impact assessment and evaluation. NIST has also put in place an extensive data collection system to support ATP's evaluation. The results of some of these evaluation efforts may not be known for some time.

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## Background

ATP was established by the Omnibus Trade and Competitiveness Act of 1988 (P.L. 100-418). The program is intended to assist U.S. businesses in creating and applying the generic technology and research results necessary to (1) commercialize significant new scientific discoveries and technologies rapidly and (2) refine manufacturing technologies. Funding for ATP is awarded through announced competitions. Single companies that receive awards are reimbursed for the direct costs of their proposed research but must pay for all overhead costs. Joint ventures, which consist of two or more companies, are reimbursed for both their direct and overhead costs but must provide more than 50 percent of the total funding for their project. ATP supports high-risk projects that have the potential for eventual substantial widespread commercial application. Since the first competition in fiscal year 1990, NIST has funded 177 ATP projects. As of April 1995, 12 projects had been completed.

NIST summarized the results of its initial evaluation efforts and future plans in Setting Priorities, which received wide distribution. NIST distributed 3,800 copies of this document to the Congress, administration officials, and industry. NIST officials also submitted the document to the Congress during the fiscal year 1995 appropriations hearings.

Evaluating ATP poses many challenges. For example, ATP research projects are intended not only to be technical successes but also to have commercial results. The linkage between technical work and commercial results may not always be direct and may be subject to interpretation.

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Also, several years can elapse between the end of technical work and the realization of commercial results.

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## ATP'S Results Reported in Setting Priorities

NIST cites six examples of ATP's short-term results in Setting Priorities. While all six have limitations, four overstate ATP's success or lack adequate support. Specifically, NIST reported that as a result of ATP

- total U.S. research on advanced technologies for printed wiring boards has quadrupled,
- participants have pursued research they otherwise could not have pursued,
- participants have forged new relationships with companies and government or academic laboratories, and
- the number of joint R&D ventures in private industry has increased.

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## ATP's Impact on Printed Wiring Board Industry Overstated

NIST overstated ATP's impact on the printed wiring board industry. On the basis of ATP's impact on one five-member joint venture, NIST concluded that total U.S. R&D in the U.S. printed wiring board industry had quadrupled. NIST reported that "total U.S. R&D work on advanced technologies for printed wiring boards essential to all modern electronic devices more than quadrupled as a result of the ATP." According to NIST officials, this statement is based on a third-party review that resulted in a report entitled Advanced Technology Program: Economic Study of the Printed Wiring Board Joint Venture After Two Years. This study was designed to measure the impact, after 2 years, of a 5-year ATP-supported project undertaken by a five-company joint venture and does not assess ATP's impact on the entire U.S. printed wiring board industry. Specifically, the statement is based on the study's finding that

"of the 29 major project areas under investigation [in the joint venture's research project], the participants reported that on average only 6.5 projects would have been started in the absence of the ATP award. In fact, a number of critical projects would not have been attempted in the absence of the joint venture."

According to an industry association representative, however, there are approximately 800 merchant manufacturers in the printed wiring board industry, many of which are active in R&D.<sup>1</sup> Discussions with the industry association indicate that the industry spent at least \$26.5 million on R&D in

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<sup>1</sup>The industry association is the Institute for Interconnecting and Packaging Electronic Circuits (IPC). Merchant manufacturers make printed wiring boards and sell them to companies.

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1992. In comparison, the ATP-supported joint venture spends \$5.7 million per year, on average, on printed wiring board research.

We believe that NIST's conclusion that total U.S. R&D on printed wiring boards quadrupled as a result of ATP was an overstatement because the third-party study was limited to a single five-member joint venture in an industry that contains over 800 merchant manufacturers, many of which engage in R&D. The evidence presented by NIST supports statements only about the five-member joint venture, not about the entire U.S. industry.

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### Claims of Increased High-Risk Research and New Relationships Not Adequately Supported by Survey Data

In reporting the most important effects of ATP on the basis of a survey of early award recipients, NIST was selective in its use of the survey data. NIST reported that the most important effect cited by award recipients was "the ability to pursue promising lines of research that they otherwise could not have followed." According to NIST officials, this statement is based on responses to the survey's question "What would you say is the single most important effect that the ATP award has had on your organization thus far?" Fifteen out of 28 responses in the study were categorized as saying "the ability to afford and engage in this kind of high-risk, long-term research."<sup>2</sup>

However, responses to another question in the same survey provided conflicting information. When asked "In the absence of this ATP award, would your organization have pursued the development of this technology?" nearly as many respondents—14 out of 26—responded affirmatively. Four respondents said they definitely would have; 10 said they probably would have; 7 said they probably would not have; and 5 said they definitely would not have. In response to a subsequent question, the 14 respondents said they would have pursued the development of the technology at a different level of effort. Thus, although 15 participants believed that ATP enabled them to pursue this kind of high-risk, long-term research, 14 participants in the same study believed that they would at least probably have pursued the technology even without the ATP award, although at a different level of effort.

On the basis of the same survey, NIST reported that the second most important effect cited by early ATP participants was "forging new relationships between companies, and between companies and government or academic labs." However, several discrepancies exist. First,

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<sup>2</sup>Twenty-six organizations participated in the study. However, two participants provided two answers to this question about ATP's "single most important effect." Two of these answers are included in the 15 responses classified as "the ability to afford and engage in this kind of high-risk, long-term research."

the survey results do not refer to a second most important effect, nor were the participants asked to identify a second most important effect. NIST officials said this statement was supported by the second most frequent response to the question about the “single most important effect” of the ATP award. However, the second most important effect cannot be inferred from the second most frequent response because the frequency of the response to this question does not say anything about the relative importance that individual respondents would have ascribed to this effect. The survey would have to have asked the participants specifically what they believed the second most important effect of ATP was in order to make that determination.

Another discrepancy is that the second most frequent responses were categorized as “the benefits that can flow from industry-industry collaboration,” but made no mention of “government or academic labs,” as NIST reported. To support its conclusion that the second most important effect was “forging new relationships between companies, and between companies and government or academic labs” NIST officials said that they had also included information from responses to another survey question. The other question asked participants to rate a list of potential effects of ATP. According to NIST officials, the item rated second highest on the list of potential effects for this question was the basis for NIST’s statement about the “second most important effect.” This item was “enhanced the technology infrastructure by strengthening linkages between sectors (industry-government, industry-university) and/or within sectors (industry-industry).”

However, NIST did not base its “most important effect” on the same question. Since NIST based its “second most important effect” on this question (respondents were asked to rate a list of potential effects of ATP), in order to be consistent, the highest rated response to the same question should have been the “most important effect.” However, the highest rated item on this list is “collaboration and strategic alliances.” This conflicts with the responses mentioned previously, which said that the “single most important effect” was “the ability to afford and engage in this kind of high-risk, long-term research.” This inconsistent methodology casts doubt on NIST’s reporting of ATP’s most important effects.

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## Relationship Between ATP and Increase in Number of Joint Ventures Not Adequately Supported

NIST's conclusion that ATP has increased the number of joint R&D ventures in private industry is not adequately supported. NIST states that ATP was responsible for an increase in U.S. joint ventures, despite a variety of possible causes. According to NIST,

"Profiles also suggest that the ATP has led—as desired—to an increase in joint R&D ventures in private industry. In the first four competitions, approximately 125 joint ventures involving over 800 organizations were formed to apply to the ATP."

However, the only support NIST gave us for this statement is the fact that 125 joint ventures submitted proposals to ATP. Although the number of joint R&D ventures has increased, there are several reasons to question a direct relationship between this increase and ATP. The number of joint R&D ventures has steadily increased since 1986—years before NIST made its first ATP award. Some explanations for the causes of this trend and for the formation of joint ventures are unrelated to ATP. For example, the National Science Foundation cites the passage of the National Cooperative Research Act of 1984 as one reason for this growth. The Foundation explains that this act encourages research collaboration among industry competitors by better defining joint R&D ventures and protecting them from antitrust suits by limiting potential liability. We believe that NIST's conclusion about the causal relationship between ATP and an increase in the number of joint ventures lacks adequate support.

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## NIST's Future Plans for Evaluating ATP in Setting Priorities

The evaluation plan, as presented in Setting Priorities, includes several measures that NIST expects will indicate the long-term economic success of ATP projects. However, some of these measures may not indicate the economic success of ATP.

One of the measures that NIST believes will indicate the long-term economic success of ATP projects is "straightforward tracking of technical milestones."<sup>3</sup> However, achieving technical milestones may not be a valid indicator of the economic success of ATP projects because technical advancement does not always lead to economic success. For example, earlier versions of the ATP evaluation plan pointed to one ATP project that was achieving all of its technical milestones as evidence of the project's likely success in stimulating economic growth. The lead company involved in this joint venture, however, went bankrupt before the project was

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<sup>3</sup>Technical milestones are significant points in the course of a research project. They consist of individual research tasks with estimated completion dates that are part of the project's overall timetable. Technical milestones might consist of the estimated completion dates of experiments or tests in the project.



completed. Although the other company in the joint venture has stated its intention to continue the joint venture's commercialization plan, the lead company's bankruptcy reduces the likelihood of future economic effects being realized from this ATP project.

Tracking the completion of technical milestones for ATP projects provides helpful information to ATP managers who need to know whether this vital step in the commercialization process is being achieved. However, using this information as an indicator of "long-term economic success" may create the false expectation that technical success will result in commercial success.

"Increased collaborations and strategic alliances [between companies]" is another measure that NIST expects to indicate long-term economic success. However, the number of collaborations and strategic alliances may not indicate ATP's economic success. A joint venture is one form of collaboration or strategic alliance that can occur between companies. As the previously cited example of the bankrupt company and its collaboration shows, the use of this measure to indicate "long-term economic success" may create the false expectation that collaboration will lead to commercial success.

The ATP evaluation plan summarized in Setting Priorities shows that NIST intends to continue providing descriptive data on the program and its operations. Two of the five major components of the evaluation plan focus on obtaining this type of information and are descriptive in nature: (1) assessing ATP's operational activities and (2) profiling applicants, recipients, technologies, and projects. This information will include descriptive data about the program's operations, participants, and monitoring activities as integral parts.

This information is helpful to ATP officials in managing the program. Collection of these data, however, does not provide the Congress with information about the program's impact and economic success.

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## Additional ATP Evaluation Efforts

According to NIST officials, program evaluation has been a part of ATP from its beginning, and the development of a long-term evaluation strategy is an ongoing NIST process. NIST says that at this point in ATP's history, its approach to evaluating ATP is to lay the groundwork to provide metrics for the program's results at the earliest possible time.

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NIST's evaluation efforts include engaging the advice and services of the nation's leading economists in impact assessment and evaluation. NIST has also put in place an extensive data collection system to support its ATP evaluation efforts. In addition, NIST says it is conducting microeconomic case studies and supporting the development and use of economic models for projecting outcomes of ATP.

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## Conclusions

It is too early to determine ATP's long-term economic impact; therefore, there has not been a complete assessment of ATP. Evaluating ATP will be challenging. For example, ATP research projects are intended not only to be technically successful but also to have a commercial impact. The linkage between technical work and commercial results may not always be direct and may be subject to interpretation.

NIST has reported short-term results in Setting Priorities that, it says, indicate that the program is making an impact. However, our analysis indicates that these results are overstated or lack adequate support. Thus, judgments about the economic success of ATP should not be based solely on the information in Setting Priorities. In addition, some of the indicators contained in Setting Priorities that NIST proposes to track for future evaluations of ATP, namely technical milestones and the number of collaborations and strategic alliances, may create false expectations of the program's economic success. Neither of these indicators necessarily reflects the long-term economic success of the program. According to NIST, other efforts are under way that will support studies of the program's long-term outcomes as soon as such studies are feasible.

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## Agency Comments and Our Evaluation

We provided a draft of this report to the Department of Commerce for written comments. These comments, along with our detailed responses, are provided in appendix I. In addition, at the Secretary of Commerce's request, we met with the Under Secretary for Technology and the Director of NIST to discuss the draft report in more detail. Specifically, NIST made the following observations about our draft report:

- It overestimated the amount of "advanced" R&D in the printed wiring board industry by citing industry figures that include R&D that is not "advanced." However, we point out in our response that the broader industry figure is appropriate to use for comparison purposes because the ATP project also includes R&D that is not "advanced."

- It introduced a negative bias to our conclusions by including only partial responses to a survey question. We have added language to the final report reflecting the additional information contained in responses to this survey question. However, this does not change our analysis or conclusions because the information still suggests that as many as half of the ATP projects would have been undertaken even without ATP support, although at a different level of funding. Moreover, a Congressional Budget Office study reached a conclusion similar to ours on the basis of the same data.
- It overlooked evidence and made it appear that NIST's conclusions about ATP's impact on forging relationships between companies and government or academic labs lacked support. Our review of this evidence is included in this report and shows that NIST's conclusions are based on an inconsistent methodology used in analyzing the evidence.
- It overlooked evidence supporting NIST's statement that ATP has led to an increase in the number of joint ventures. However, the evidence provided by NIST still does not demonstrate that ATP has caused an increase in the number of joint ventures for primarily two reasons. First, the National Cooperative Research Act was influencing the number of joint ventures over the same time period. Second, NIST has no evidence that shows why joint ventures that applied to ATP formed in the first place. NIST currently has a study under way to determine that information. The fact that the joint ventures registered with the Federal Trade Commission or the Department of Justice when applying to ATP is irrelevant because joint ventures are not required to register with these agencies when they form.

NIST's comments on our draft report also include important qualifications that help dispel false expectations about the indicators of long-term economic success in Setting Priorities. Had these qualifications appeared in Setting Priorities, one would have been less likely to arrive at false conclusions about the program's impact.

Our draft report contained a proposed recommendation that the Secretary of Commerce direct NIST officials to develop an evaluation strategy that includes measures of the program's outcomes. In commenting on our draft report, NIST said that it intends to continue to refine the ATP evaluation plan through the use of microeconomic case studies and economic models for projecting ATP's outcomes. Therefore, we have withdrawn that proposed recommendation.

## Scope and Methodology

In conducting our analysis, we interviewed the NIST senior economist responsible for evaluating ATP and examined Setting Priorities. The NIST

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economist said that this document summarizes the evaluations of the program conducted to date, as well as the plan for evaluating ATP in the future. We investigated all statements about ATP in this document by reviewing the supporting studies and data to determine their consistency with NIST's reported statements. We analyzed the ATP evaluation plan's "indicators of future economic success" but were unable to analyze the usefulness of those indicators that were too general for understanding the effects of ATP. For example, indicators that include terms such as "technological infrastructure" and "enabling technologies" do not clearly identify what they measure or how they are related to the economic success of ATP. In addition, NIST supports some of its statements about ATP's effects with references to two NIST-supported studies. Although we examined these studies, we did not evaluate them for their validity. NIST's evaluation of ATP is an ongoing process. When we had nearly completed our work, NIST provided us with a copy of NIST Industrial Impacts: A Sampling of Successful Partnerships, which contains anecdotes about ATP awards. We did not evaluate this document. We also consulted economists, the R&D evaluation literature, and a trade association representative. We conducted our review from January 1994 to April 1995 in accordance with generally accepted government auditing standards.

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As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days after the date of this letter. At that time, we will send copies to the Secretary of Commerce; the Director, NIST; the Director, ATP; the Inspector General, Department of Commerce; the Director, Office of Management and Budget; and other interested parties. We will make copies available to others on request.

Please contact me at (202) 512-3841 if you or your staff have any questions. Major contributors to this report are listed in appendix II.

Sincerely yours,

A handwritten signature in black ink, appearing to read "Victor S. Rezendes". The signature is fluid and cursive, with the first name "Victor" and last name "Rezendes" clearly distinguishable.

Victor S. Rezendes  
Director, Energy and  
Science Issues

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# Comments From the Department of Commerce

Note: GAO comments supplementing those in the report text appear at the end of this appendix.



**THE SECRETARY OF COMMERCE**  
Washington, D.C. 20230

JAN 7 1995

Mr. Victor S. Rezendes  
Director, Energy and Science Issues  
Resources, Community, and Economic  
Development Division  
U.S. General Accounting Offices  
Washington, DC 20548

Dear Mr. Rezendes:

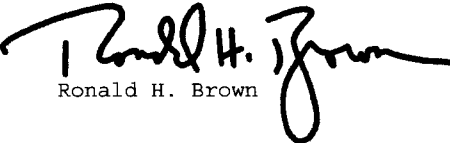
Enclosed is the Department of Commerce's response to the General Accounting Office's (GAO) recommendations and conclusions in the draft report, *"PERFORMANCE MEASUREMENT: Completed and Planned Evaluations of the Advanced Technology Program."*

We note that GAO did not raise most of the issues cited in the draft report at the October 20, 1994, exit interview and that GAO has not allowed us the usual 30 days to respond to the conclusions and recommendations of the draft report.

In view of the substantial disagreement by the Department with the facts, conclusions, and recommendations presented in the GAO draft report, we request that a meeting be held between the appropriate GAO officials and the Under Secretary for Technology, Dr. Mary Good, and the Director, National Institute of Standards and Technology, Dr. Arati Prabhakar, to discuss your conclusions and recommendations and the factual basis for them in more detail.

If your staff requires additional information about the Department's response to your report, they may contact the Advanced Technology Program's Senior Economist, Rosalie Ruegg, at 301-975-3189.

Sincerely,

  
Ronald H. Brown

Enclosure

cc: Charles A. Bowsher

**U.S. Department of Commerce**  
**Comments on GAO Draft Report Entitled**  
***"PERFORMANCE MEASUREMENT: Completed and Planned Evaluations***  
***of the Advanced Technology Program"***

**GAO/RCED-95-68**  
**dated January 11, 1995**

**January 27, 1995**

**EXECUTIVE SUMMARY**

The National Institute of Standards and Technology (NIST) finds that the GAO draft report inaccurately portrays the Advanced Technology Program's (ATP) evaluation plan and progress in implementation, and that it misrepresents NIST's statements of short-term ATP results as lacking supporting evidence and being overstated. NIST stands by ATP's evaluation plan and its statement of short-term results as appropriate, informative, and well founded.

The GAO draft report contains a number of inaccuracies and omissions which combine to misrepresent the results of early ATP evaluations as well as the program's planned methodologies for future evaluations. The GAO draft report's assertions that NIST statements of impact are (generally) extravagant and not to be trusted are erroneous and without grounds.

The GAO report's conclusion that the ATP evaluation plan focuses only on outputs, not outcomes is in error; in fact, the ATP's plan provides for a well-balanced combination of measures that include both output and outcome measures. The GAO report is in error that ATP relies on measures of technical progress as the mainstay in assessing economic success; in fact, technical progress is only one of a set of intermediate measures that indicates the promise of future economic success (i.e., technical progress is viewed as a necessary, but insufficient condition for economic progress). The GAO draft report's assertion that NIST's future evaluation includes indicators that may create false expectations is groundless; in fact, the ATP has a comprehensive set of indicators that have been developed and reviewed by leading economists in the field and can be expected to provide a reasonable indication of future potential.

The GAO's analysis is based primarily on only six pages of a NIST document that was intended only to summarize other more comprehensive documents and data. Other information was provided, but the GAO's analysis ignored it. By excluding available information, the GAO draft report gives a distorted view of ATP's evaluation.

The salient fact is that the ATP is a new program with the bulk of its multi-year research projects funded only in the last several years, and with most of its projects still very much in the research or pre-product development phase. Under the circumstances, it would be premature for the ATP to assert that it now can perform meaningful *ex post* measures of long-term economic outcome.

At present, a responsible and responsive approach for the ATP is to lay the ground work to provide these metrics at the earliest



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possible time -- which it is doing. The ATP can promote sound evaluation of long-term economic impacts by establishing a solid information collection system, by conducting detailed microeconomic case studies, by supporting the development and use of economic models for projecting outcomes, by supporting a variety of approaches to economic evaluation of R&D projects, and by having this process reviewed by outside experts in evaluation to assure that ATP is on the right track -- all of which ATP is doing.

In reviewing the accuracy of four statements of results made by NIST in the paper *Setting Priorities and Measuring Results*, the GAO made the following errors:

- GAO overestimated the baseline amount of R&D directed towards pushing the state of the art of printed wiring board technology by approximately \$24 million per annum. The GAO also underestimated the ATP-induced increase in advanced R&D by \$5.2 million. These two errors by GAO led it to conclude that NIST's figures were exaggerated. (GAO's error in the baseline was confirmed with the source that GAO cited.)
- GAO overlooked information critical to understanding the results of the contractor survey concerning the impact of the ATP on the scope and level of R&D funding. By including only partial results of participant response, the GAO draft report introduced a negative bias.
- GAO overlooked evidence that forging new relationships with academic labs and government was important to participants, in addition to establishing new relationships with other companies. By omitting a critical part of the survey evidence, the GAO draft report made it appear that NIST's statements lacked support.
- GAO overlooked strong available evidence supporting NIST's statement that the ATP has led--as desired--to an increase in joint R&D ventures.

NIST stands behind the ATP's evaluation plan and its implementation. NIST stands behind its statements of short-term results contained in *Setting Priorities and Measuring Results* (the NIST source document upon which the GAO based its report) as valid and supported by solid evidence.

NIST rejects as unnecessary the GAO recommendation that the Secretary of Commerce direct NIST officials to develop an evaluation strategy that, consistent with the Government Performance and Results Act, includes outcome measures of ATP.

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See comment 9.

NIST concludes that it had met the requirements of the Government Performance and Results Act to include in its evaluation plan outcome measures of the program long before the GAO draft report was initiated. NIST intends to continue to refine the ATP evaluation plan and to pursue aggressive implementation of the plan.

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**U.S. Department of Commerce Comments on  
the General Accounting Office (GAO) Draft Report  
"Performance Measurement: Completed and Planned Evaluation  
of the Advanced Technology Program" (dated January 11, 1995)**

See comment 1.

See comment 9.

The GAO draft report contains a number of inaccuracies and omissions which combine to misrepresent the results of early ATP evaluations as well as the program's planned methodologies for future evaluations. We reject the GAO recommendation that the "Secretary of Commerce direct NIST officials to develop an evaluation strategy that, consistent with the Government Performance and Results Act, includes outcome measurements of the Program." From the inception of the ATP, NIST has developed performance measures and a data collection plan to ensure that long-term outcomes would be evaluated in a systematic and rigorous manner. NIST has led the government in this regard and its methods are being adopted by other agencies. NIST will continue to improve and refine its methods for evaluating outcomes.

See comment 1.

The GAO draft report's assertions that NIST's claims of impact are (generally) extravagant and not to be trusted are without grounds. In these comments on the GAO draft report, NIST addresses each of the points raised by the GAO, and demonstrates why NIST stands behind the conclusions contained in the GAO-cited NIST paper as reasonable descriptions of early ATP results that are supported by evidence.

See comment 10.

1. Nowhere does the GAO draft report clearly lay out the full scope of the ATP evaluation plan. The GAO draft report incorrectly suggests that short-term project measures such as technical milestones and the formation of industrial research consortia are being used by the ATP as measures of long-term economic impact.

The ATP's evaluation strategy is not accurately presented in the GAO's draft report. Almost immediately after the ATP became operational, it began to plan for evaluation;<sup>1</sup> and, soon thereafter, to implement the plan.<sup>2,3</sup> That plan, as refined and extended by the ATP (and clearly summarized in the NIST paper *Setting Priorities and Measuring Results*) has five components:

- 1) assessing the ATP's operational efficiencies,
- 2) profiling the ATP's portfolio of projects,
- 3) evaluating industry's implementation of the projects,
- 4) tracking short-to-medium term project results, and
- 5) measuring long-term economic impacts (outcomes).

Recognizing that a major obstacle to comprehensive, accurate measurement metrics typically is the lack of good data, the ATP has put in place an extensive data collection system<sup>4</sup> to support

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the five evaluation components listed above. In addition, because the accurate evaluation of long-term outcomes for technology development projects presses the state of the art of economic methods, the ATP has engaged the advice and services of the nation's leading economists in impact assessment and evaluation metrics.<sup>5,6</sup> Intense interest in early results of the program has led the ATP to commission evaluation studies of intermediate results<sup>7</sup> and of projected long-term outcomes.<sup>8</sup>

Although it is not yet possible to perform comprehensive *ex post* studies of long-term outcomes because virtually all of the ATP projects to date are still in their short-to-medium term phase, the ATP has launched modeling and data collection efforts to support such *ex post* studies as soon as they become feasible. For example, the ATP is developing collaborative research with leading economists in the field to develop a common framework for its detailed microeconomic studies to increase their usefulness in performing long-term impact studies.<sup>9</sup> The ATP is exploring the feasibility of developing new approaches for estimating economic externalities of technological innovation. It is putting in place methods to collect data needed to extend the private rate of return measures supported by its existing data collection system to national (social) rate of return measures.

The ATP's comprehensive evaluation program has been presented to many groups, including numerous professional evaluators. For example, the GAO's Special Assistant for Methodology and Data Systems, recently invited ATP's Chief Economist to discuss ATP's evaluation program at the annual meeting of the American Evaluation Association, in a session titled "Research and Development Evaluation: Methodological Issues."<sup>10</sup> The ATP's evaluation program has received considerable attention and praise from other agencies, members of Congress, foreign delegations, academics, and private industry.

NIST made every effort to see that the GAO was aware of its multi-part evaluation plan and ongoing evaluation activities. For example, on March 14, 1994, NIST sent the GAO a descriptive overview of ATP's new information system, sample data, an ATP evaluation planning study which addressed the use of long-term impact measures, a newly completed case study of an ATP-funded joint venture, and a description of ATP's plans for a survey of all companies funded during ATP's pilot phase. In the late summer of 1994, NIST offered to demonstrate its data-collection software to the GAO, and described its investigation of economic modeling tools for forecasting long-run impacts of the program. The GAO, however, did not reflect additional ATP evaluation materials in writing its draft report. By excluding available information, the GAO draft report gives a distorted view of ATP's evaluation program.

See comment 4.

See comment 3.

The GAO draft report presents ATP statements out of context thereby giving the impression that the ATP considers achievement of technical milestones as adequate evidence of economic success. The ATP has always stated that accomplishment of technical milestones is a necessary, but insufficient, condition for the achievement of long-run economic success. The ATP's entire evaluation effort is based on the premise that technical success is **not** a sufficient condition for economic success.

At the same time, NIST recognizes that without technical success, there can be no economic success for the projects funded by the ATP. Hence, it is of keen interest to the ATP to track technical progress as the award recipients carry out their R&D projects, and to include achievement of technical milestones in the list of "intermediate indicators" that help to signal whether or not a given project is continuing on a path that has the potential for long-run success.

A previous GAO report (GAO/RCED 93-221; *Advanced Technology Program's Indirect Cost Rates and Program Evaluation Status*), issued in 1993, presents a more accurate (but still incomplete) summary of the ATP's evaluation strategy. The 1993 GAO report states (p. 5) that "ATP staff have also established 11 criteria for measuring ATP's long-term success including (1) value added, (2) the creation of new industry; and (3) changes in sales, manufacturing costs, product quality, the time it takes to bring a technology to market, and market share." The 1993 report goes on to make an important point:

"However, ATP staff face barriers in evaluating their long-term objective of identifying ATP's impact and the factors that lead to a successful ATP project. First, ATP staff need to wait for more projects to be completed before they can evaluate the program. Second, ATP projects are evaluated on both their technical and commercial success. Even after a project is completed, its commercial success may not be evident for several more years. Even then, commercial success may be difficult to determine because the resultant technical developments might be incorporated into a different product that eventually reaches the market."

The 1993 GAO report recognized that the ATP does not fund product development and that it may take a number of years after an ATP project is completed to develop and commercialize products that incorporate the technologies developed through the program. Even now it is too early to see many bottom-line economic outcomes from this young program. The GAO has offered no reason for its apparent change in position between the 1993 and 1995 reports.

See comment 11.

2. In criticizing NIST's statement of short-term results of a project on advanced technologies for printed wiring boards, the GAO draft report misinterprets data on advanced

See comment 12.

technology development funding levels and uses a figure that is incorrect by an order of magnitude. GAO's use of incorrect data led it to reach erroneous conclusions.

The GAO draft report faults the 1994 NIST paper *Setting Priorities and Measuring Results* for stating that "total U.S. R&D work on advanced technologies for printed wiring boards essential to all modern electronic devices more than quadrupled as a result of the ATP." GAO's analysis in questioning the statement is, however, incorrect. The GAO draft report asserts that a conservative estimate of the baseline is \$26.5 million in 1992, and cites the Institute for Interconnecting and Packaging Electronic Circuits (IPC) as the source. But, according to the IPC, the GAO's estimate overstates the industry's expenditure in **advanced** printed wiring board R&D by at least \$24 million or more.

See comment 13.

NIST investigated the reason for the large error in the GAO's estimation of the baseline amount that the industry would have spent on R&D on advanced technologies in the absence of the ATP, by consulting with the IPC, the source of the GAO's numbers. According to an IPC official<sup>11</sup>, GAO's estimating error apparently stems from confusing the total annual industry R&D expenditure of approximately \$26.5 million, with the total annual industry R&D expenditure on **advanced technologies**. The IPC official estimated industry's expenditure on advanced technologies to "push the PWB envelope" as 10 percent or less of the total R&D expenditure, for an upper limit of \$2.65 million per annum. According to the IPC official, fewer than 10 companies perform R&D that pushes the envelope -- the type of high-risk R&D cost-shared by the ATP -- and 90 percent or more of the approximately \$26.5 million cited by GAO is aimed at very near-term (1 year or less), narrowly focused, low-risk objectives and, hence, is not comparable to the ATP-sponsored R&D.

See comment 14.

The GAO draft report also fails to take into account in its calculations the \$5.2 million that the Department Of Energy provided to Sandia National Laboratory to participate in the ATP project. Yet the underlying ATP source document explicitly states that the DOE funds were conditional on the ATP project.<sup>12</sup> This omission caused the GAO to underestimate ATP's contribution to PWB advanced research, thereby throwing GAO's conclusion farther off base.

See comment 15.

3. By reporting only the first part of a two-part question asked in an early ATP survey, the GAO draft report arrives at a conclusion almost exactly opposite to the ATP survey's true finding.

The GAO draft report contests NIST's statement that "a survey of early ATP award recipients found that they believed the most important effect of ATP was that it enabled them to pursue

promising lines of research that they otherwise could not have followed." The GAO faults this statement because at a later point in the interview, over half of the respondents said that they would probably have pursued this technology, even without ATP funding. However, the GAO draft report omits the second part of the survey question and the company responses that they would not have done the same research at the same level of effort without the ATP. This omitted part is essential for understanding the first part and critical to conclusions to be drawn. This omission significantly affected GAO's interpretation of the finding.

Here are the facts:

(1) When participants were asked, "what would you say is the single most important effect that the ATP award has had on your organization thus far," the most frequent answer was, "the ability to afford and engage in this kind of high-risk, long-term research." This was an open-ended question asked at the beginning of the survey (part A) and coded by the contractor.<sup>13</sup>

(2) Later in the ATP survey (part C), participants were specifically asked about the likelihood that their organization would have pursued the development of the technology without the ATP award. At this point, fifteen percent responded that they definitely would have; thirty-eight percent said they probably would have; twenty-seven percent said they probably would not have; and nineteen percent said they definitely would not have.

(3) Those that responded "yes, probably," or "yes, definitely," were then asked if they would have pursued development of the technology at about the same level of effort, with the same ultimate goal without the ATP award. This second part of the answer -- the critical part omitted from the GAO draft report -- was that the award recipients unanimously stated that they would **NOT** have been able to pursue the development of the technology without the ATP award at the same level of effort or with the same ultimate goal.

Nearly three-fourths of the participants went on to describe how the project would have been different without the ATP. Typical comments were:

"...the scale would have been smaller, the timeliness slower, and the goal ... not as far-reaching."

"Couldn't afford it. Might have skirted around the edges of it, but not pursued it at the same level of effort with the same resources."

"Probably would have been done, but at a much reduced level...would have taken 10 times as long to get there and we may never have accomplished what we have to date."

"Ten years down the road, we might have gotten there, but competitors might have gotten there before us."

Based on a complete understanding of the survey questions and the company responses, NIST stands behind its reporting of the survey results as accurate and fully supportable.

4. NIST stands by its statement that another finding of this same survey was, "that survey participants rated as the second most important effect of the ATP forging new relationships between companies, and between companies and government or academic labs".

GAO overlooked evidence that forging new relationships with academic labs and government was important to participants, in addition to establishing new relationships with other companies. By omitting a critical part of the survey evidence, the GAO draft report made it appear that NIST's statements lacked support.

The GAO draft report states that it does not understand NIST's reasoning, despite having assured ATP staff at the audit exit interview that they understood and accepted NIST's finding.

At GAO's audit exit interview on October 20, 1994, the GAO staff raised its concern with NIST that only the portion of the statement pertaining to relationships between companies was supported by the survey as "the second most important effect of ATP," and not the portion of the statement pertaining to relationships between companies and government or academic labs.

In response, ATP staff walked the GAO team members through the logic that led to the conclusions in the statement. The Assistant Director of GAO's Resources, Community, and Economic Development Division assured ATP staff that GAO understood NIST's rationale for the statement. Without the GAO's assurance that it understood NIST's statement and accepted it as reasonable, ATP staff would have taken further steps to clarify this issue at that time.

The NIST statement in question appears in the primary source document of the GAO draft report, NIST's paper *Setting Priorities and Measuring Results*. The statement combines participant responses to two separate questions in the contractor survey. Because *Setting Priorities and Measuring Results* was intended to provide a brief overview of all NIST evaluation activities, the space devoted to the Advanced Technology Program was necessarily limited. For brevity, the statement in question was intended to synthesize the following survey results:

See comment 17.

See comment 18.



a) On the entrance question, "what would you say is the single most important effect that the ATP award has had on your organization thus far," the second most frequently cited answer was "the benefits that can flow from industry-industry collaboration."

b) On an exit question intended to summarize the impacts and outcomes portion of the survey, participants were asked to rate the degree of impact that the ATP had to date on each of nine selected items. The second highest rated item was "benefits from strengthened linkages between sectors (e.g., industry-government; industry-university) or within sectors (industry-industry)" that they felt were stimulated by the ATP project.

To facilitate the ranking presentation, the contractor used impact classification labels in the report in place of the detailed descriptions. Hence, "benefits from strengthened linkages ..." was dubbed "technology infrastructure" in the survey report.

In explaining the synthesis of the two results to the GAO team during the audit exit interview, NIST pointed both to the survey instrument which made it clear that participants were specifically being asked to rank the degree of impact on industry-government, industry-university, and industry-industry linkages, and to Section L. of the survey report which states "The contribution that the ATP has made – even at this early stage – to enhancing the nation's technology infrastructure was measured by whether participants had experienced any benefits from strengthened linkages [contractor underlining] either between sector (e.g., industry-government; industry-university) or within sectors (industry-industry) that they felt were stimulated by the ATP project." Eighty-one percent of the 26 companies interviewed said they had experienced such benefits.

Given the strength of the survey evidence that participants rated highly (second on the interview summary ranking) ATP's role in promoting linkages among the cited organizations, there is no factual basis for GAO's assertion that NIST overstated the result or lacked support for it.

5. In arguing that NIST has no grounds for stating that the ATP has led to an increase in the number of joint research-and-development ventures in industry, the GAO draft report omitted available evidence from the ATP proposal evaluation process.

The draft report faults NIST for reporting "that the ATP has led – as desired – to an increase in joint research and development ventures in private industry," saying that this cannot be supported, and may well be due simply to the change in the R&D

See comment 19.

See comment 20.

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climate as a result of the National Cooperative Research Act of 1984.

Certainly the National Cooperative Research Act has had a significant effect on the formation of cooperative R&D ventures in industry. Given that the ATP was a relatively small pilot program before 1994, its effect to date on the number of joint industry R&D venture formations could be expected to be small when compared to the impact of this Act. Nevertheless, it is clear that the ATP is increasing the number of industry-led joint R&D ventures. Even for those joint ventures where there were possibly pre-existing relationships, the ATP is increasing high-risk, high-payoff research on advanced technologies.

NIST reached its conclusion -- that the approximately 125 joint ventures which applied to ATP in the first four competitions were formed to apply to the ATP -- on the strength of several pieces of evidence which are completely overlooked in the GAO draft report.

An analysis of the joint venture filings with the Department of Justice and the Federal Trade Commission (FTC) showed little or no overlap in the applications; that is, the great majority of ATP joint ventures to date had not already filed to conduct joint research prior to their ATP proposal. Although existing consortia sometimes administer joint ventures (hence, the impression of preexistence of the joint venture), the individual member companies typically come together in a unique collaboration specifically to cooperate on the ATP-proposed project.

The nature of ATP's joint venture process gives NIST confidence that the great majority of formal joint ventures proposed to it are for new research projects by newly formed alliances of firms. This confidence is supported by the findings of Professor Al Link, a contractor doing impact studies for the ATP, who informed the ATP that the four joint ventures that were investigated all formed in response to ATP's competition,<sup>14</sup> and by questions raised during oral reviews, when companies are often asked by the Selection Boards why and how the particular organizational structures were formed.

The formal joint ventures must submit a copy of the joint venture agreement to the ATP, at least in draft, at the time of an oral review. Prior to an award, the proposer must provide ATP with copies of the notification sent to the Department of Justice or the FTC under the National Cooperative Research Act, that a joint venture has been formed for the purpose of the proposed research. If two or more for-profit companies have merged in a legal entity prior to applying to the ATP, that entity alone is not eligible to apply as a joint venture, but would have to join with other entities. If the R&D project submitted to the ATP for funding is

deemed to duplicate existing on-going research, the ATP will not fund it.

There is additional information that suggests that the ATP stimulates future alliances to promote the economic benefits of ATP projects through key partnerships. Among the ways that participants achieve effective partnering for commercialization activities include forming strategic alliances for licensing agreements, joint production ventures, and informal and formal arrangements with end-users and suppliers. When participants in the contractor survey were asked whether they used these kinds of partnering mechanisms to further advance the technology associated with their ATP project, forty-six percent responded "Yes," and another fifty percent stated that it was either "too early" or that such alliances were "in process" of being formulated. Only one company in the survey said that they had not engaged in any collaborations to date and had none in their near-term plans.

The ATP is already seeking additional data that will allow it to learn more about the relationship between the ATP and the formation of joint R&D ventures in industry, as well as partnering arrangements to commercialize the technology. The new survey of ATP award recipients will question both joint-venture members and informal alliances of companies whether or not their collaborative associations predated their ATP application, and whether or not the ATP had any influence on their decision to collaborate.<sup>15</sup>

#### REFERENCES

1. Link, Albert N. *Measuring the Economic Impact of the Advanced Technology Program: A Planning Study* (Prepared in 1991; publication date, May 1992).
2. Link, Albert N. *Advanced Technology Program: Economic Study of the Printed Wiring Board Joint Venture After Two Years* (April 1993); *Advanced Technology Program: Economic Study of the Joint Venture Project on Short-Wavelength Sources for Optical Recording After Three Years of a Five-Year Research Program* (March 1994); *Advanced Technology Program: Economic Study of the Joint Venture Project on Advanced Manufacturing Technology for Low-Cost Flat-Panel Displays After Three Years of a Five-Year Research Program* (Forthcoming).
3. Solomon Associates. *The Advanced Technology Program: An Assessment of Short-Term Impacts: First Competition Participants* (February 1993).
4. ATP Information Reporting System. The system includes special software to facilitate the collection of data in a

See comment 23.

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systematic and structured way from recipients of ATP awards on a quarterly basis. Post-project reporting is planned.

5. *Griliches, Zvi, Harvard University. "Long-Term Economic Impact Assessment for the Advanced Technology Program," Seminar at NIST, August 11, 1994.*

6. Modeling Economic Impacts of Technological Innovations: A Workshop, December 15, 1994, ATP/NIST, Gaithersburg, MD. (Summary Proceedings forthcoming).

7. Studies of intermediate results include the joint-venture studies performed by Professor Link; the early survey of awardees by Solomon Associates; the forthcoming survey of all awardees in the first four competitions by Silber & Associates; industrial impact cases prepared by NIST's public affairs office, and various analyses conducted by ATP staff. Additional case studies of intermediate results are in process.

8. Examples of economic evaluation studies that focus on projecting long-run outcomes of ATP-funded projects include a study underway by Applied Economics, Inc., to evaluate the ATP/Diamond Semiconductor Group's jointly funded project to develop new ion implantation technology important for manufacturing larger semiconductor wafers; and a study underway by CONSAD Research Corporation of ATP/Automobile Body Consortium jointly funded "2mm project" to develop improved dimensional controls for manufacturing automotive body parts and other manufactured products. Additional studies are in the planning stage.

9. Jaffe, Adam, and Josh Lerner, Harvard Business School. A Study to Develop a Framework for Performing Microeconomic Case Studies for the Advanced Technology Program. (In contract negotiation, December, 1995.)

10. "ATP's Economic Evaluation Plan and its Implementation," a presentation by R.T. Ruegg, Chief Economist for ATP, in the session titled *Research and Development Evaluation: Methodological Issues*, chaired by Dr. M.J. Wargo, GAO's Special Assistant for Methodology and Data Systems, U.S. General Accounting Office, Resources, Community, and Economic Development Division. The Annual Meeting of the American Evaluation Association, Boston, MA, November 2-5, 1994.

11. Estimates and descriptions of industry R&D funding were provided by Mr. Thomas Dammrich, Executive Director of the IPC, Telephone Interview, January 13, 1995.

12. Link, Albert. *Advanced Technology Program: Economic Study of the Printed Wiring Board Joint Venture After Two Years* (April 1993, p. 2 and p. 13, fn 19).

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13. Solomon Associates, *The Advanced Technology Program; An Assessment of Short-Term Impacts: First Competition Participants* (February 1993), p. 10.

14. Interview with Professor Link, January 13, 1995.

15. Survey of participants in ATP projects funded from ATP's inception in 1990 through 1993. Silber & Associates. (Survey underway)

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The following are GAO's comments on the Department of Commerce's letter dated January 27, 1995.

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## GAO's Comments

1. Our work focused specifically on the information provided by the National Institute of Standards and Technology (NIST) in its document entitled Setting Priorities and Measuring Results at the National Institute of Standards and Technology. We examined (1) the short-term results that NIST says indicate the impact of the Advanced Technology Program (ATP) and (2) the measures that NIST expects will indicate ATP's long-term economic success. We did not address the progress made by NIST in implementing its evaluation plan. After reviewing additional support provided by NIST, we maintain that our original assessment of NIST's conclusions about short-term results is valid. None of the information provided in the comments refutes our original conclusions. We have included additional information about NIST's ongoing evaluation efforts beyond those cited in Setting Priorities. We also maintain that the indicators of long-term economic success included in Setting Priorities may create false expectations. Although NIST's comments on our draft report included important qualifications that help dispel false expectations (e.g., "accomplishment of technical milestones is a necessary, but insufficient, condition for the achievement of long-run economic success"), Setting Priorities did not include any of these qualifications.
2. The draft report said "ATP evaluations would better assist the Congress in making budget decisions if the evaluations focused more on outcomes, which reflect the impacts of the program, than on outputs, which describe the activities of the program." This statement was not intended to be a broad conclusion about the plan. The report now discusses this topic within the context of the descriptive information that ATP collects. As the report notes, this information does not necessarily provide the Congress with information about the program's impact and economic success.
3. We continue to maintain that "tracking technical milestones" and "increased industrial collaborations and strategic alliances," when presented as indicators of long-term economic success, may create false expectations. Presenting additional information, such as NIST provides in its comments, would help avoid creating false expectations.
4. Since we focused our work specifically on the statements about ATP in Setting Priorities, we reviewed the studies and data supporting these statements to determine their consistency. We did not ignore any

information provided that was relevant to this work. In addition, we have added information about NIST's evaluation efforts that does not appear in Setting Priorities.

5. We maintain that our analysis and estimates are appropriate and accurate. The details are provided in the body of the final report and in comments 13 and 14. Moreover, the evidence NIST provided—a report on a single five-member joint venture—cannot be extrapolated to the entire U.S. printed wiring board industry.

6. See comment 15.

7. We included all of the relevant information in our analysis and maintain that NIST's statements lack support and are based on a selective use of data. See comment 19.

8. Comment 23 summarizes our rationale for questioning NIST's statement about ATP's impact on the formation of joint ventures.

9. We have withdrawn the proposed recommendation in light of additional information about plans to refine the ATP evaluation plan.

10. We agree that our draft report did not lay out the full scope of the ATP evaluation plan. That was not our intent. Our work focused on the information contained in Setting Priorities, which states on page 15 that "A number of measurable short-term effects are expected to provide indicators of long-term economic success. In addition to straightforward tracking of technical milestones, these indicators include: . . . increased industrial collaborations and strategic alliances; . . ."

11. We have not changed our position. Our 1993 report did not evaluate NIST's ATP evaluation strategy but did present a NIST-provided summary of the ATP evaluation strategy. In addition, the current report contains similar language concerning the barriers and challenges facing NIST in evaluating ATP. For example, our report states, "Evaluating ATP poses many challenges. For example, ATP research projects are intended not only to be technical successes but also to have commercial results. The linkage between technical work and commercial results may not always be direct and may be subject to interpretation. Also, several years can elapse between the end of technical work and the realization of commercial results."

12. According to NIST, the statement about ATP's impact on the printed wiring board industry is based on a study that is limited to a single five-member joint venture. We maintain that it is an overstatement to project the impact of this joint venture to the entire industry of over 800 manufacturers. For purposes of comparison, in the draft report we estimated spending for research and development (R&D) for the entire printed wiring board industry. We still maintain that these estimates are the correct figures to use for such purposes and that the figures further reinforce our conclusion.

13. Our analysis is based on the industry's overall expenditures for R&D for the following reason. As NIST comments, only a portion of the industry's R&D is focused on advanced technology. But similarly, only a portion of the joint venture's R&D is focused on advanced technology, and the larger balance is devoted to incremental improvements in existing technology.

14. NIST's suggested analysis still does not demonstrate that ATP has quadrupled total U.S. R&D work on advanced technologies for printed wiring boards. Taking into account the Department of Energy's contribution of \$5.2 million, or \$1.04 million annually, the total annual spending on R&D by the ATP-supported joint venture is that amount plus the joint venture's original annual expenditure of \$5.7 million, for a total of \$6.74 million. Since less than half of that total is spent for R&D on advanced technology, \$3.37 million, or a half, is a high estimate of the amount spent annually by the joint venture on advanced technology R&D. NIST's claim remains overstated because the joint venture's annual expenditure of \$3.37 million still does not quadruple the industry's expenditure of \$2.65 million per year for advanced technology research on printed wiring boards.

15. Language has been added to the final report reflecting the information provided by responses to this question. This information, however, does not change our analysis or our conclusions. Our conclusions are reinforced by a Congressional Budget Office (CBO) report, which arrives at a similar conclusion about this evidence. According to the CBO report, "One privately funded study of the 11 projects supported by the first [ATP] competition in 1990 suggests that as many as half of them would probably have been undertaken even without ATP support, although at a lower level of funding."<sup>4</sup>

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<sup>4</sup>Reducing the Deficit: Spending and Revenue Options, CBO (Feb. 1995).



16. Language has been added to the body of the final report reflecting the information provided by these responses. This information does not change our conclusions.

17. We included all of the relevant information in our analysis, and our conclusions remain unchanged. See comment 19.

18. At the exit conference we said we understood NIST's logic and rationale for making the statement. We did not say we accepted it as reasonable.

19. As stated in our final report, this is an inconsistent use of survey data. NIST's synthesis of the results of two different questions, one open-ended and one closed-ended, does not adequately support NIST's statements, nor does the information provided by another question in the survey (section L.).

20. We included all of the relevant information in our analysis, and our conclusions remain unchanged. We agree with NIST's comment on the National Cooperative Research Act and feel that NIST should have included references such as this in *Setting Priorities* to avoid overstating any potential effects of ATP on the formation of joint ventures. As we pointed out, the effects of the National Cooperative Research Act make it difficult to determine the effects of ATP on the number of joint ventures during ATP's first four competitions.

21. Joint R&D ventures exist throughout industry and are not required to register with the Department of Justice or the Federal Trade Commission. Therefore, the joint ventures may have been formed before applying to ATP and may never have applied to the Department of Justice or the Federal Trade Commission.

22. None of this information shows that ATP caused 125 joint ventures to form. As shown in comment 21, registration with the Department of Justice or the Federal Trade Commission does not mean a joint venture is new and did not exist before the time of registration.

23. As noted in comments 20, 21, and 22, the current evidence supporting ATP's impact on the formation of joint ventures is inconclusive and anecdotal. Moreover, the NIST statement says that "approximately 125 joint ventures," i.e., all of the joint ventures that sent in a proposal to ATP, were formed because of ATP. We look forward to the completion of NIST's new survey, which is under way, for more definitive information on "whether

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or not the ATP had any influence on [ATP award recipients'] decision to collaborate.”

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