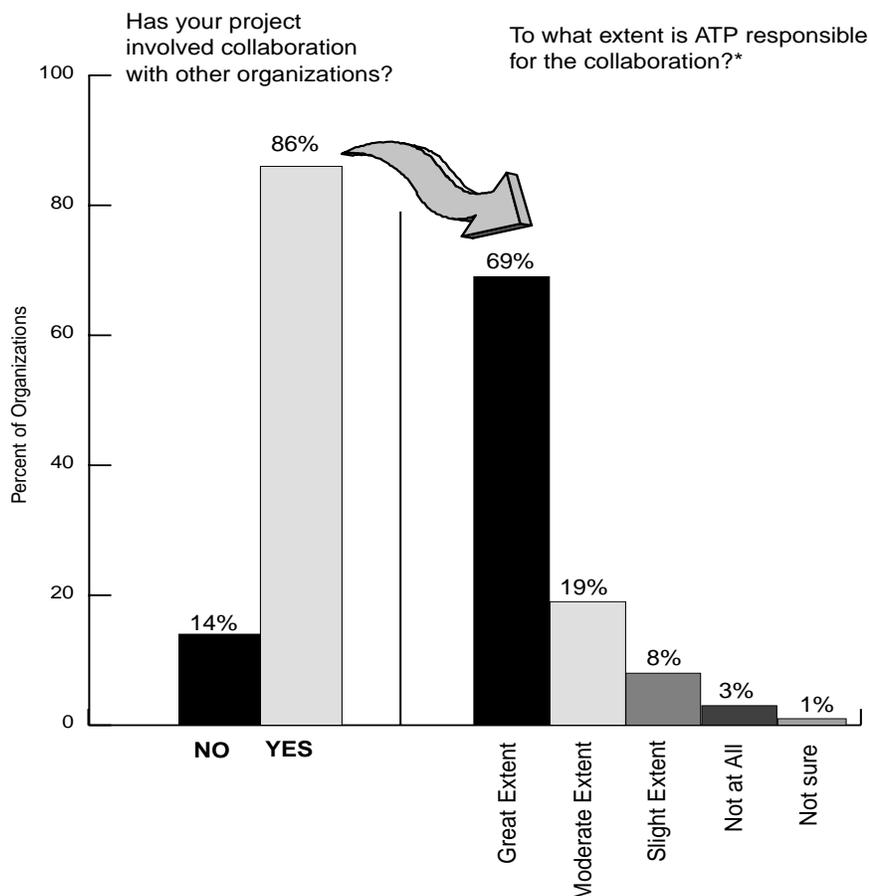


4. STIMULATION OF COLLABORATION AND RELATED EFFECTS

Stimulation of R&D Collaboration

Stimulation of collaborative R&D relationships among companies, universities, and other research organizations is part of ATP's legislated mission. The objectives are to increase research efficiency and effectiveness, expand capabilities, reduce R&D cycle time, and accelerate commercialization and competitiveness. The level of collaborative activity has been considerable from the beginning of the program. In the first competition, ATP funded five joint venture projects among the first 11 awards. From 1990 through 1999, the ATP funded 157 joint ventures, involving over 750 participants. Many of these joint ventures involve companies which had never worked together before and were formed explicitly to apply for ATP funding (Silber, 1996, p. 23). Of the 424 organizations in 199 FY 1993-1997 projects for which data are available after one or more years of ATP funding, 298 are members of 73 joint ventures. (See Chapter 1, Figure 2.) In addition to the formal joint ventures, the ATP has found that most of the "single company projects" it funds are, in fact, also rich in collaborative relationships. These are implemented through subcontracting arrangements and informal alliances.

Figure 14. Stimulation of Collaborations



Note: *Includes responses from organizations indicating "YES" to prior question.

Source: Business Progress Reports from 415 organizations in 198 ATP projects funded 1993-1997--after one or more years of ATP funding.

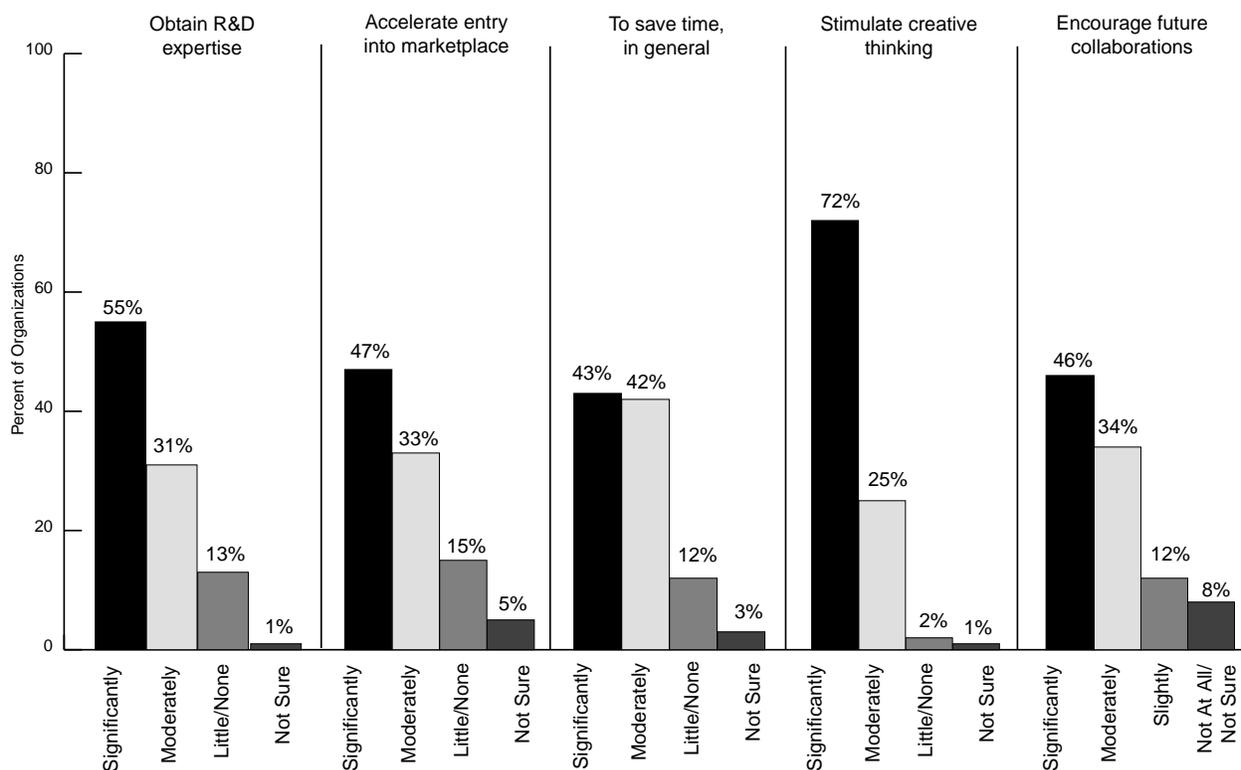
As shown in Figure 14, 86 percent of respondents reported their ATP project involved collaboration with other organizations. Of the group indicating their project involved collaboration, 69 percent indicated that the ATP was responsible for the collaboration to a great extent. Eighty-eight percent indicated ATP was responsible to a moderate or great extent.

As indicated above, many ATP collaborations reach beyond the formal joint venture relationship. Both single company award recipients and joint venture members form collaborative relationships through subcontractor arrangements and informal alliances. A total of 581 subcontractor arrangements, for example, have been reported by single company awardees and joint venture awardees filing BRS reports. Fifty-two percent of the subcontractors reported are small companies. Universities comprise 30 percent, and 18 percent of these subcontractors consist of medium-to-large companies, government-funded laboratories, and non-profit laboratories.

Collaboration Effects

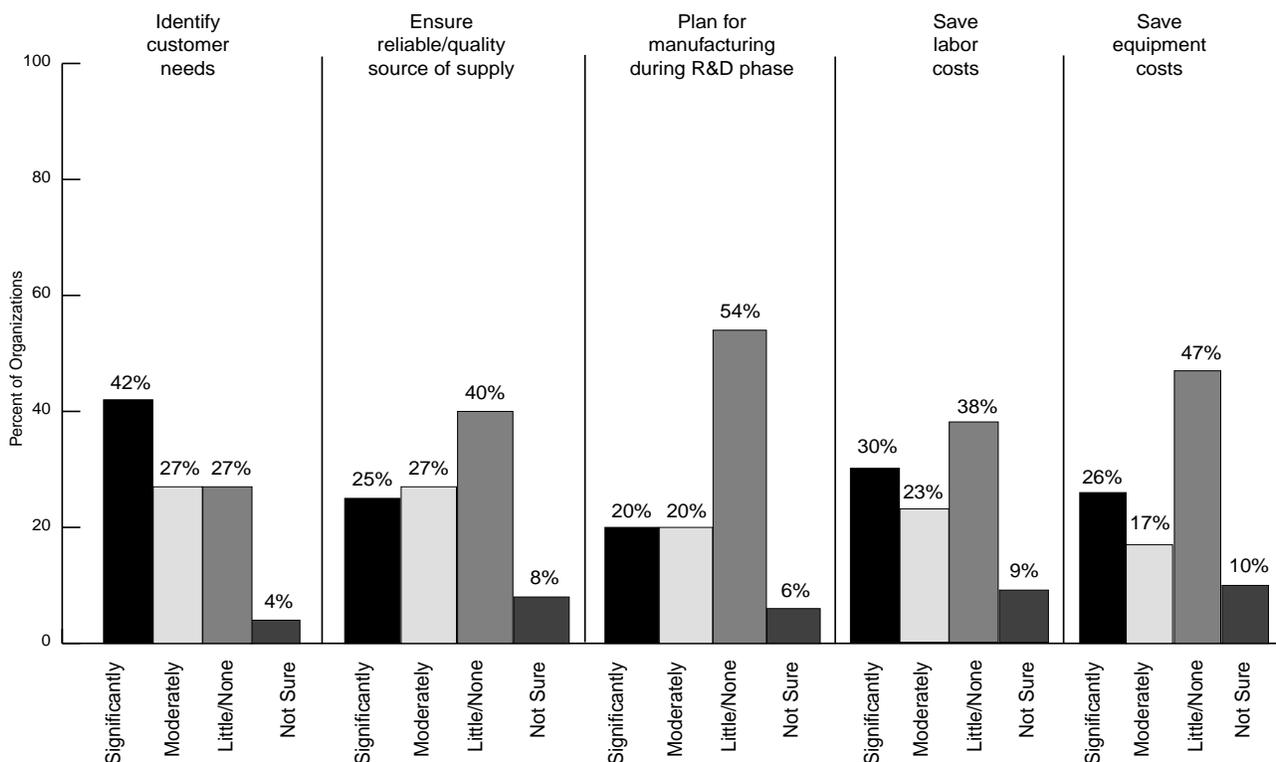
Figure 15 shows effects most significantly enabled by ATP collaborations of these multiple types. At least 80 percent of respondents indicated that collaboration enabled these effects significantly or moderately. Ninety-seven percent indicated that collaborations had "stimulated creative thinking;" 80 percent indicated that collaborations had enabled the company to accelerate entry to the marketplace, and 85 percent indicated a general time savings (corroborating acceleration effects cited in Chapter 3); 86 percent reported that collaboration had enabled the company to obtain R&D expertise; and 80 percent indicated that their experiences with ATP collaborations had encouraged them to consider future collaborations.

Figure 15. Effects Most Enabled by Collaboration



Note: Includes responses from organizations indicating "YES" to question--Has your project involved collaboration with other organizations?

Source: Business Progress Reports from 415 organizations in 198 ATP projects funded 1993-1997--after one or more years of ATP funding.

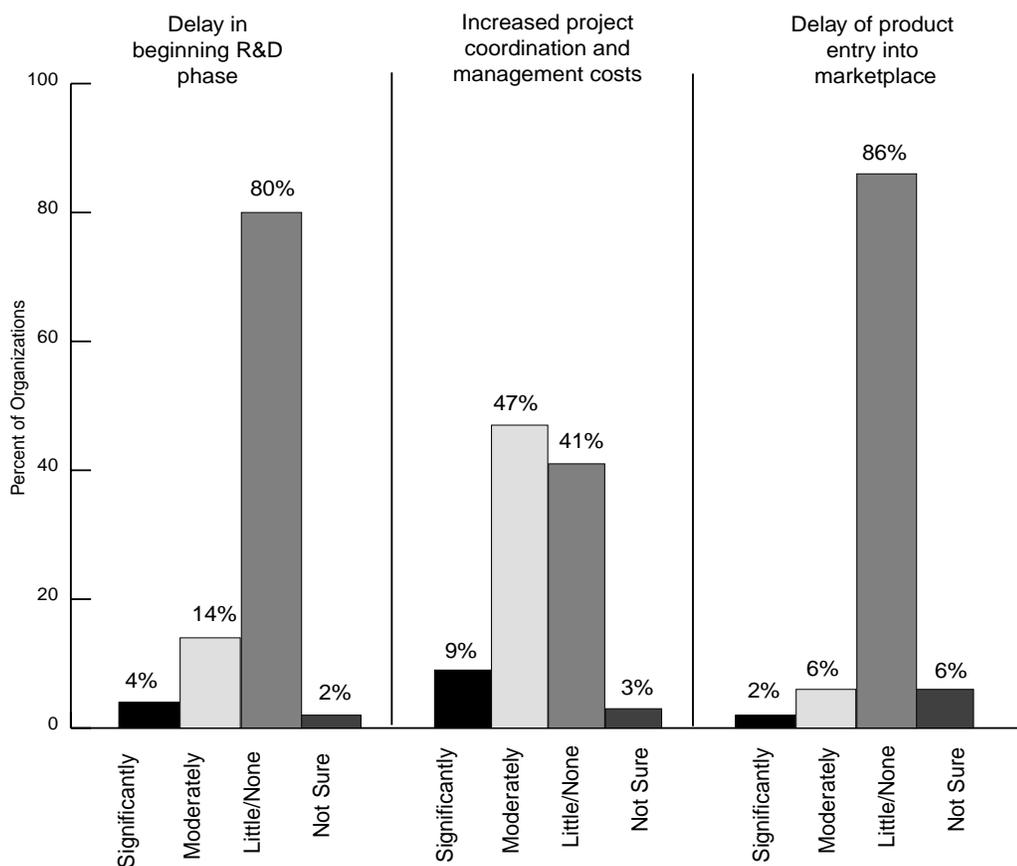
Figure 16. Other Effects Enabled by Collaboration

Note: Includes responses from organizations indicating "YES" to question--Has your project involved collaboration with other organizations?

Source: Business Progress Reports from 415 organizations in 198 ATP projects funded 1993-1997--after one or more years of ATP funding.

Figure 16 shows other effects of ATP collaborations. Among the other effects analyzed, "identifying customer needs" was cited as significantly or moderately enabled by 69 percent. Over 50 percent of respondents reported "ensuring a reliable/quality source of supply" and "labor cost savings" as significant or moderately enabled by collaboration; "planning for manufacturing" was cited by 40 percent; and "saving equipment costs" was cited as significantly or moderately enabled by 43 percent. These effects may be indicative of the relatively early project stage of many of the projects, and some may become more important as the companies move closer to commercial deployment.

There is no doubt that R&D joint ventures/consortia involve some project start-up time and costs, and possibly continuing costs not experienced by single-company awardees. However, these difficulties appear to have been relatively insignificant for the vast majority of ATP participants. As shown in Figure 17, of the organizations which reported collaboration experience in their ATP project, only nine percent reported a significant cost increase, although nearly half confirmed that project coordination and management costs had increased moderately as a result of collaboration. Eighteen percent indicated that associated delays in starting projects had resulted significantly or moderately as a result of collaboration, and only eight percent anticipated a delay of product entry into the marketplace as a result.

Figure 17. Costs Attributed to Collaboration

Note: Includes responses from organizations indicating "YES" to question--Has your project involved collaboration with other organizations?

Source: Business Progress Reports from 415 organizations in 198 ATP projects funded 1993-1997--after one or more years of ATP funding.

Anecdotal Comments

Anecdotal information from the BRS provides additional insight into effects of collaboration experienced by ATP-funded organizations and amplifies the statistical analysis. Some comments elaborate on the positive and negative impacts of ATP collaboration; others address issues not covered in specific reporting questions.

Obtaining expertise not otherwise available

"The work with our subcontractors [has] enabled us to utilize their expertise in fields [where we] are not staffed. The interactions with our joint venture partners provide us access to work they are doing in fields [where] we are not active." [Joint venture member]

"Critiques of work conducted independently [have] provided invaluable outside perspective to stimulate creative thinking and exposed several oversights early in the development process." [Single applicant]

"The breadth of experience brought in on these projects is extensive." [Joint venture member]

"Excellent collaborative environment and complementary technical capabilities have improved the quality of technical output and effectiveness of the team. There has been tremendous synergy between the companies that are collaborating on this project. Each company brings a particular expertise that the others don't have and which would be difficult to develop. Each party is an enabler for the others." [Joint venture member]

"Collaboration has provided [us] with access to compounding, conversion, and fabrication resources, complementary ... materials and technical expertise that would not otherwise have been available." [Single applicant]

"In general, [subcontractor] has a wealth of experience and knowledge on ... processing and control. Their insight has been a primary driver on overcoming several technical problems and developing process simplifications." [Single applicant]

"Our collaboration with other partners has helped us to access first hand data for medical vocabularies, and understand size and complexity of that data." [Joint venture member]

"Exposed to new ideas, technologies that would otherwise not have been exposed to. Enabled us to leap forward with newer approaches into our architectural design." [Joint venture member]

"No one company has all the expertise required for the entire project. Collaboration has allowed in-house knowledge to be directly available to the overall effort." [Joint venture member]

"Medical expertise and related product requirement insight would not have been possible from within our own organization." [Single applicant]

"Through collaboration we have been able to bring experts in this field to our test facility and work with live systems." [Single applicant]

"The principal benefit of the collaboration has been to bring together a diverse team of varied expertise to address highly complex ... engineering problems. Systems development projects such as ... require individuals with many different technical and clinical skills to be successful. Collaboration has enabled us to bring professionals together from academia, the non-profit sector, and industry in a way that would not be possible within a single medical center." [Joint venture member]

Obtaining assistance from universities

"Our collaboration with [university] brought a very significant amount of experience in the basic technology that is underlying the diagnostic tests that we are developing; testing of our methods and comparison to those that they have developed in parallel allowed us to overcome technical hurdles faster." [Single applicant]

"Our collaboration involves working with two universities and an equipment vendor. The universities have done early work to explore ... possibilities. We have then followed up with more results-oriented experiments. This saves us time in helping to identify things that work and provides us with an estimate of the process regime in which decent results can be obtained." [Single applicant]

"1. Significant input on optimized structural shape design from Dr....at [university]. 2. Structural testing facilities and equipment at [university] utilized for testing ATP prototype shape. Could not perform test with in-house laboratory facilities." [Single applicant]

"We have just begun the first phase of a collaboration with the ... center at [university], which involves the use of their clean room facilities. Duplicating those facilities at [our company] would have been completely impossible. In addition, we are being trained in various ... techniques, which speeds up the research phase considerably. The only negative impact has been the time required for setting up the legal structure of this collaboration." [Single applicant]

"There have been a number of positive collaboration effects, particularly with our work with the [university]. He has a group of excellent students, that have helped us to produce ... software, better ... layout technology, and also increase our research standing in the community of international researchers. Our company always had strong people working for it, but we have been able to attract, and keep several very talented people because of the NIST funding and are grateful for this. So I would say that the research collaboration with this university, sponsored through NIST has been very positive." [Single applicant]

"Our ability to use subcontractors from academic medical centers has greatly improved our ability to achieve the goals of our project. These collaborators have given us both a lab for testing and a reality check on what works." [Single applicant]

"University students are exposed to industry as summer students so they become acquainted with the needs of industry and the workings of an R&D industrial lab. The resulting collaborations result in joint publications and patents. [Single applicant]

Learning more about potential markets and customer needs and accelerating entry into the marketplace

"The most significant collaboration has come from securing a contract ... to install a pilot demonstration.... This has facilitated a number of discussions which has identified the real customer needs and therefore accurate functional and performance requirements of the products. In this process the team at ... working on the project have been introduced to domain knowledge that would have otherwise been difficult to obtain." [Single applicant]

"The manpower-multiplying and synergistic creative effects of using subcontractors has accelerated the R&D process to make it possible to plan and begin to initiate business alliances for the technology that capitalize on a fast-approaching market opportunity." [Single applicant]

"[We] have forged excellent strategic alliances with leaders in the ... industry which provide valuable customer input and resources during the development stages of the technology and will allow us to quickly commercialize this application." [Single applicant]

"Our collaboration with [a joint venture member] led to a rapid prototype development with a strong emphasis on customer needs.." [Joint venture member]

"The partnership which was established for this ATP project is a true vertical partnership of suppliers and a manufacturer. Unlike other R&D alliances in which [these companies] have participated, which were horizontal partnerships of manufacturing companies, this project had no

inherent conflicts of interest. There is a single motivation in this project: to advance the state-of-the-art of the ... technology ... to allow for broad substitution of composites for traditional materials. And to date the NIST/ATP project has been central to achieving this goal." [Joint venture member]

"The collaboration has allowed us to understand healthcare needs for the technology to which we have been able to focus our R&D. This has greatly increased commercialization chances and technology impact. Collaborator has already started to use our technology and has hired our students as interns and employees, which represents an important form of technology transfer. More collaboration has occurred than originally planned." [University joint venture member]

"In general, the collaboration has allowed us to contact new potential collaborators and markets. Some of these markets are for new equipment using our technology in ways we had not considered. Due to the success of the JV, the various members are investigating projects outside the ATP." [Joint venture member]

"Without the joint venture and collaborations from the other members it would have been almost impossible to assess the market needs and define the customers and requirements." [Joint venture member]

"The vertical structure of our joint venture (2nd tier vendor, 1st tier vendor, OEM) assures that our project direction is kept focused on real customer needs and addresses real customer concerns." "Better coordination of program brainstorming to advanced technology has enhanced the commercial focus. Has accelerated the commercialization effort." [Two members of a joint venture]

"Collaboration with [our JV members] has been extremely positive. All members of the group have really worked together to solve common problems and foster creative solutions. This has allowed all of us to gain greater speed to market." [Joint venture member]

"It has created a greater awareness of the complete HDTV product environment. It has allowed [us] to pursue alliances outside of our narrowly defined ... product environment and work towards a greater understanding of new product and services offerings." "Complex system architecture issues are better studied in industry teams. This is made possible by the ATP grant." [Two members of a joint venture]

"There have been no negative impacts. Positively, the collaboration has increased our awareness of our partners' need for advanced materials and the partners' efforts in identifying opportunities in emerging markets which might match our long-term R&D material development work." "Assisted greatly in development of understanding of manufacturing costs and customer requirements, eventually leading to the abandonment of the ... effort." [Two members of a joint venture]

"The collaboration would have happened, eventually, but ATP has been the catalyst. The program has moved along much faster than anticipated and has been able to obtain managerial support and external assistance which would not have happened without ATP affiliation." "Intercorporate collaboration has fostered business relationships which are likely to continue beyond the ATP into product development and commercialization. This should greatly accelerate the application of the ATP-developed technology." [Two members of a joint venture]

Formation of stronger supplier-customer relationships

"The other joint venture partners are also customers for [company]. General understanding of business practices and other developmental needs have had a positive impact on all parties." [Joint venture member]

"Our collaboration with the equipment vendor has led to a promising new area of development. We hope to build a better _____ using their technology. It may allow us to surpass our original throughput goals." [Single applicant]

"Established enhanced relationships with strategic suppliers of software necessary to perform our ... services, and to focus our software suppliers toward the directions we see as necessary in developing the next generation of ... tools, techniques, and methodologies." [Joint venture member]

"Our subcontractor has a good deal of credibility in the marketplace. We have gone farther with prospects and vendor alliance discussions because of the choice of the subcontractor." [Single applicant]

"Collaboration has helped to align ideas of users and suppliers greatly." [Joint venture member]

"As an end user of the core technology being developed for this program, we would not have early access to the technology without the collaboration. Collaboration at this phase allows us to influence the design to meet our end product needs during the development. We have no intention to manufacture the [component], but to use it in our product; therefore collaboration is essential." [Joint venture member]

"There has been an awakening to the advantages of networking with our suppliers on an informal basis. This has resulted in leveraging research within [our] supply chains." "The collaboration with [lead company] has given us much insight and understanding as to the interests, needs, values, and talents of one of our largest international customers." "Without collaboration on this project with a major customer, this project probably would not exist. Collaboration provides us an unusual opportunity to work together." [Three members of a joint venture]

Strengthening credibility within the organization and with other organizations

"The fact [our company] has an ATP award has added credibility to our commercialization effort and in fact it has attracted some of our early collaborators and has been a major source of interest for our partners." [Single applicant]

"There is heightened credibility obtained from the concurrence of our competitors that we are doing the right things; i.e., if we tried to get this project approved in house alone, it might be perceived to not be as big a problem." [Joint venture member]

The joint venture with [partner] has focused our R&D effort to a specific application and our price performance objective.... We anticipate the most significant impact will come in the near future when [partner] can assist us in gaining the capital investment for the transition to manufacturing and in the well-established market share [partner] currently enjoys." [Joint venture member]

"Provided visibility into automotive market segment which we wouldn't normally have had access to." [Joint venture member]

"Through our collaboration with [our subcontractors] we now have access to potential customers (the colleagues of our collaborators) who would have been less receptive had we approached them on our own." [Single applicant]

Elaboration of the "benefits and costs" of collaboration

"This vertical teaming has enabled a free flow of ideas between the two companies and has made this collaboration a positive experience to date. The only negative of the collaboration, which is a result of the "large company syndrome," is that while large companies such as ... offer tremendous manufacturing resources, scheduling these resources can be difficult at times." [Joint venture member]

"The main positive of collaboration is the sharing of expertise, and the stimulation of new approaches to the problem. The main negative has been that one of the companies was not really committed to provide sufficient resources to execute tasks on schedule and this slowed down all tasks in the critical path. Another negative (not major) has been the added approvals to change program directions, and the slow down in schedule due to co-ordination of tasks (technical and administrative)." [Joint venture member]

"Positive: Reduction of "not invented here syndrome"; reduction of capital cost on equipment available from JV partner; positive factor in negotiating other contract research with outside company that involves complementary technologies of both JV partners. Negative: Difficulties experienced in initial collaboration with JV partner revolving around issue of trust (viewing the other company as a potential competitor)." [Joint venture member]

"Positive: Direct contact with potential customer led to development of a prototype that matched customer needs. Exposure to different management and engineering approaches contributed to improvements/evaluation of our respective processes. Negative: Collaboration of multi-disciplinary teams located in various geographical locations was difficult. Different companies had different priorities and goals that at times conflicted with program goals." [Joint venture member]

"Positive Impacts: Elevated awareness of Healthcare marketplace. Understanding the healthcare information technology requirements. Negative Impacts: Very difficult to settle the intellectual property rights between multiple collaborators." [Joint venture member]

"On the positive side, there was a great exposure to other technologies and transfer of technical knowledge between large multinational companies and research institutions. On the negative side, the research has been delayed because of the effort required to establish collaborative agreements and work through conflict resolutions." [Single applicant]

"On the positive side, the collaboration has allowed a group of companies to come together that otherwise wouldn't have and work jointly through a leveraged investment of R&D efforts. On the negative side, not all of the business models of the participating companies were compatible which resulted in some serious business negotiation problems relative to intellectual property." [Joint venture member]

Formation of Strategic Alliances Outside the ATP Project for Commercialization of ATP-funded Technologies

The numerous ATP joint ventures represent concrete evidence of ATP's ability to stimulate strategic alliances. Some are largely horizontal R&D collaborations attacking problems of mutual interest across an entire industry. Most involve complex R&D and commercialization collaboration across the supply chain. For example, one project in the area of photonics manufacturing brings together a vertically integrated team of photonics manufacturing companies supplying optical devices (SDL, Inc.), and network systems (Nortel Systems) with software developers (RSoft and Hewlett-Packard as a subcontractor), consulting service providers (Telcordia Technologies and Science Applications International Corp.), and Columbia University. Led by Telcordia Technologies (formerly Bellcore), the project aims to develop an open architecture, integrated simulation tool for evaluating photonic components, systems, and network designs quickly, reliably, and inexpensively, and thereby reducing design-build-test cycle times across the supply chain of the communications sector by a factor of five, with potential application to other industries. Another project, led by Xerox, brings together a number of manufacturers with different applications of micro-opto-electro mechanical systems (MOEMS), a university, and a commercial foundry jointly to develop infrastructural process technologies supporting mass production of MOEMS at low cost. Ultimately each manufacturer (Xerox, Maxim Integrated Products, Microcosm Technologies, MicroScan Systems, and Optical Micro-Machines) will co-develop with the foundry (Standard Microsystems) its own products employing the technologies developed in the ATP project. These products span applications in telecommunications, imaging, medicine, entertainment, and information systems. The research joint venture between 3M Company and Perkin-Elmer Biosystems funded by the ATP in 1998 has resulted explicitly in joint commercialization plans. Building on the foundation provided by their ATP project, 3M Company and Perkin-Elmer Biosystems have entered into an agreement to jointly develop genetic analysis products. This agreement facilitates an anticipated long-term complementary relationship leveraging 3M's strengths in material science and manufacturing and Perkin-Elmer's capabilities in genetic analysis.

Some relationships between ATP-funded companies and their R&D subcontractors have evolved into strategic alliances for commercialization. Among the publicized alliances, PharmaSeq (a one-person start-up company when funded by the ATP in 1998) and Sarnoff Corporation, one of the subcontractors on the ATP project, announced an agreement in early 1999 to develop jointly a prototype system that integrates PharmaSeq's novel DNA diagnostic method employing an assay of 3-D arrays of DNA molecules with Sarnoff's microtransponder technology. The aim of this alliance agreement is a highly accurate and cost efficient DNA detector system for use in biomedical research, drug discovery, infectious agent monitoring, genomics, industrial processing, and environmental monitoring.

Many other strategic alliances have been formed outside the ATP research project to commercialize ATP-funded technologies. Although information concerning negotiations with potential commercialization partners, and the resulting alliances, is provided to ATP on a confidential basis, articles published by the industry and trade press and company press releases sometimes provide public substantiation. Public sources confirm that partnering between ATP-funded small businesses developing DNA diagnostics technologies and pharmaceutical and medical instrumentation companies has been particularly active. Integra LifeSciences, recipient of ATP awards in 1993 and 1998, has announced strategic alliances with Linvatec and Bionx for developing fixation devices, e.g., screws, tacks, and anchors, using Integra's polymer technology funded in its first ATP award for reconstruction of ligaments and tendons in knees and shoulders. Affymetrix, a 1994 award recipient in the Tools for DNA Diagnostics Focused Program competition, has recently entered into agreements with OncorMed to collaborate in development of clinical validation of genetic testing services utilizing their GeneChip™ for analysis of genes associated

with cancer. Under a separate distribution and instrumentation alliance between Affymetrix and Hewlett-Packard, Hewlett-Packard is developing and supplying a next-generation scanner to read the GeneChip™ (Regalado, 1996, p. 22). Affymetrix has other collaborations with Genetics Institute, Roche Molecular Systems, Incyte Pharmaceuticals, and Glaxo Wellcome (Regalado, 1996, p. 18). Hyseq, a tiny company funded by the ATP to develop a different DNA chip technology, has teamed up with Perkin-Elmer to market its chips (Perkin-Elmer and Hyseq Press Release, June 29, 1998). All of these partnerships are outside the ATP projects, but occurred while the ATP-funded R&D was ongoing relatively early in the R&D phase as a means of accelerating commercialization of the ATP-funded technology and raising capital for continuing R&D.

Table 3 summarizes strategic alliance activity focused on commercialization of technologies funded by the ATP during 1993 to 1997. The data reveal that a substantial amount of negotiation and discussion activity is underway. One hundred fifty-six alliances had been formed by March 31, 1998: 37 with suppliers; 52 with customers; 37 for joint production; and 30 with distributors. Forty-two license agreements had been signed by that time. Some of these alliances for commercialization evolve from R&D partnerships among ATP joint-venture companies, but many companies are forming alliances with companies outside of their ATP projects.

Table 3. Strategic Alliances and Licensing Agreements for Commercialization

	Number of Projects	Number of Companies	Number of Applications
Negotiations/discussions held with potential strategic partners	97	113	184
Alliances formed with suppliers	37	37	48
Alliances formed with customers	49	52	71
Alliances formed for joint production	34	37	45
Alliances formed with distributors	30	30	39
Total alliances formed	150*	156*	203
Negotiations/discussions held with potential licensing partners	53	53	81
License agreements signed	42	42	59

Note: *Companies reporting more than one type of alliance are included twice.

Source: Business Progress Reports for 747 applications being pursued by 356 companies in 198 ATP projects funded 1993-1997 – after one or more years of ATP funding.