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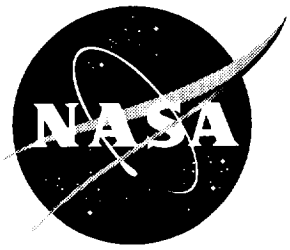

(Re)inventing Government-Industry R&D Collaboration

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Introduction

Reinventing government has spawned some unexpected surprises. In the NASA Aeronautics Advanced Subsonic Technology Program (AST), new enterprise charters and government business instruments enabled capabilities to reach for goals that would have not have been attainable with traditional government business tools. For the public and private sector partners in a new aeronautics technology development effort, doors were opened to new ways of thinking about revolutionary capabilities for the nation's intermodal transportation system. The strategic nature and importance of these advanced transportation capabilities necessitated imaginative thinking about the political, legal, and economic relationships between government and industry.

As the Administration and Congress press federal agencies to do more with less, perhaps they realize that breakthroughs in government capabilities might occur. Whatever the underlying motivations, the pressures of government contraction has forced "out of the box" thinking by NASA and its aviation industry partners. This thinking led to the establishment of the Advanced General Aviation Transport Experiments (AGATE) element of the AST program as a unique, public/private joint venture.

The AGATE Consortium is one of NASA's major experiments in new ways to do business. The experimental phase of AGATE reaches completion at the end of the 1996 fiscal year. This article describes lessons learned during creation and operation of one of the newest kind of government-industry-university partnerships for joint research and technology development. All three of these partner groups had to learn new ways of thinking and doing business for the partnership to succeed. These lessons serve as guidance in the development of future public/private joint R&D collaboration. They illustrate new, more effective relationships that are possible between government and industry.

Past paradigms for public/private sector relationships are based on law and policies as well as perceptions. For U.S. public/private R&D collaboration to succeed, partners in both sectors must leave certain perceptions, myths, and misconceptions behind. These misconceptions include:

- The government has set rules and procedures that cannot be altered.
- Government funding for industry research is "corporate pork," or industry welfare.
- Government-industry collaboration represents national industrial policy.
- Government-organized collaboration with industry is anti-competitive.
- The government (or the industry) loses control in collaboration.
- A government-industry alliance is focused on the near term at the expense of the far term.

Through past law and policy, federal agencies had three means for strategic management. The advent of strategic alliances adds a new, fourth means for a government R&D agency such as NASA to build strength and capabilities. The previous three are through internal institution and programs (research personnel, facilities, and R&T base programs and MOUs), arm's-length transactions for research (contracts and grants), and restructuring of agency charter and mission (rarely used). The strategic alliance adds the means to pursue strategic goals that are beyond the practical limits of a government agency with the previous three means. In an era of contracting government, the strategic alliance becomes a vital tool to strengthen government capabilities.

AGATE

NASA, the FAA, the U.S. general aviation industry, and universities formed the AGATE Consortium in 1994 in response to both threats and opportunities. The motivating threat behind the formation of AGATE was a decade-long decline in small aircraft deliveries, general aviation fleet size, flight hours, public use airports, pilot population, and student pilot new starts. The motivating opportunities lay in emerging technologies in cockpit systems, propulsion systems, and airframe design and manufacturing. AGATE development was

guided by the priorities agreed to by the leaders of the U.S. general aviation industry and the NASA Administrator, Daniel S. Goldin. These priorities were published in the 1993 report of the NASA Aeronautics Advisory Committee, General Aviation Task Force.

AGATE's goal is to create the technical and operational bases and infrastructure for a small aircraft transportation system. This system will improve the availability of light aircraft for personal and business transportation. Improved availability means making this transportation choice available to more people, in more parts of the country, in more weather conditions. The partners' motivations include revitalization of the U.S. general aviation industry, increased capacity of the National Airspace System, and quality of life for those who are served by the general aviation infrastructure. A safe and affordable small aircraft transportation system infrastructure brings the mainstream of business, commerce, trade, tourism, health care, and education opportunities to small communities and rural areas that can benefit from a point-to-point, on demand, personal air transportation system that is competitive in cost and safety with alternative modes.

To undertake this far-reaching endeavor, NASA and the FAA (through various programs), industry, and universities have pooled nearly $300 million in combined resources among more than 30 cost-sharing partners. More than 30 other partners have joined the effort as non-cost-sharing, supporting members of the AGATE Consortium, for a total of over 60 members (see Table 1). AGATE Principal members match government resources one-for-one with cash or in-kind resources. In matching the government resources from their own internal R&D budgets, the industry brings corporate commitment and motivations to the partnership that would be difficult to engage using traditional federal R&D contracts. The resulting R&D plans for the partnership's projects are sharply and efficiently focused on the shortest critical path to completion.

AGATE was formed and operates under the 1958 U.S. Space and Aeronautics Act (as amended) as a Joint Sponsored Research Agreement (JSRA). The AGATE JSRA establishes the Terms and Conditions for governance of the partnership. AGATE members elect an Executive Council that serves as a board of directors for technical and business philosophy, policy, and strategy. The Executive Council implements consortium operations through the AGATE Business

Operating Handbook (BOH). Day-to-day business operations are supported for the partners by the AGATE Alliance Association, Inc. (AAAI), a 501 (c)6 member services not-for-profit corporation in Virginia. Partnership methods development is supported by American Technology Initiative (AmTech), Inc., a 501 (c)3 not-for-profit corporation for research on public-private sector R&D collaboration in Menlo Park, California.

Collaboration in America

Consortia in the U.S. counter a century of 1884 Sherman Anti-Trust Law-based governmental and legal policy and a long standing business tradition of unfettered competition. In fact, these traditions are the institutions and values long associated with our nation's economic strength and vitality. Success in collaboration in America requires compelling vision and motivation to move us out from our anti-collaborative heritage. Government and industry must view each other as strategic partners who mutually advance each others' strategic position, share higher risks for higher rewards, and leverage financial and human resources for these gains.

The emerging paradox in modern U.S. economic development is that to compete effectively in the international marketplace, U.S. corporations must collaborate with their domestic competitors. The paradox is that this cooperation enhances and increases competitiveness, both internationally and domestically. The increased competitiveness results from increased quality in industry standards that provides bases for competition at higher levels of product quality, price, and performance. Collaboration creates win-win situations for the government and industry collaborators and their customers.

For U.S. companies, collaboration with competitors is a relatively new strategic business tool. U.S. companies and government R&D organizations increasingly find themselves partnering in or competing against partnerships. Japan established laws enabling public-private collaboration in the 1960's, Europe did the same in the 1970's. In the U.S., the foundations for reinventing government and alliance building were laid in 1994 with Vice President Al Gore's mandates for Federal Lab Reviews and other examinations of the roles and missions for the nation's more than 700 government labs. The U.S. law permitting industry collaboration was enacted as the National Cooperative Research Act in 1984. This law permits U.S.

companies to collaborate in precompetitive R&D without the threat of treble damages under anti-trust law. In the emerging global marketplace, alliances are becoming a major source of competitive strength for U.S. industries.

NASA's response to the challenge to reinvent government included research on the management and development of alliances. Two prominent business mechanisms, the Space Act Joint Sponsored Research Agreement (JSRA) and the Chiles' Act Cooperative Agreement with for-profit corporations, were established out of these efforts. These new instruments responded to the recently changing nature of the relationships between NASA and their industry and university partners in technology development.

These economic, political, and legislative activities established the environment for change. That environment fostered opportunities for paradigm-shifting thinking about both new ways of doing business as well as new applications of technologies to solve problems that challenge our quality of life on this planet. This new environment lays the foundations for government R&D agencies to collaborate in ways that meet the challenge for government that costs less and does more than ever before.

Alliance Structures and Classes

Government and industry partners have four basic structures for alliance operations: a) a formal corporation-supported alliance, b) a formal government-supported alliance, a hybrid of a) and b), or a formal agreement (such as an MOU or Space Act Agreement (for NASA)). Consortia may be organized and coordinated by either government or industry, or the government may sponsor competition to establish the partnership. The most appropriate path to follow will be determined by the objectives and products of the alliance. For NASA, three broad purposes for alliances exist including vehicle systems class alliances, technical discipline class alliances, and research institution class alliances. AGATE is a vehicle systems class alliance implemented as a hybrid corporation- and government-supported joint venture. Table 2 compares and contrasts the various business instruments available to NASA for working with industry.

The limits to which alliances of the three classes above can fulfill a federal laboratory's mission are not yet well defined. Several of the "focused" programs that constitute NASA's Office of Aeronautics

Enterprise have been crafted as alliances. The questions are how to balance externally focused alliance-based collaborative efforts with independent core-competency-based in-house research and how and whether to use technical discipline class and research institution alliances for in-house core competency-based research.

NASA's traditional aeronautics R&D strength is founded on the talent, skills, and expertise of in-house researchers along with their world-class facilities. At the same time, the value to the nation of NASA's aeronautics programs is based on the transfer of technology from in-house to the outside world. The management challenge is in balancing the Aeronautics Enterprise portfolio to include an appropriate mix of externally focused alliance-based with independent in-house efforts. The existing NASA Aeronautics Enterprise alliances are externally focused. NASA has not yet ventured into alliance-based core-competency research. As NASA shrinks in the coming years to meet federal budget constraints, alliances will be a vital tool for both.

The New Business Instruments

The process to design and implement the business side of the AGATE Consortium governance and business operations required about 24 months by a team of about six core individuals in government and industry. The integrated product team that crafted the AGATE joint venture included technical, legal, procurement, industry, and organizational development facilitator representatives. Replication of these steps could be accomplished for a new government-industry joint R&D venture in 6 to12 months depending on size and complexity of the partnership.

Development and operation of AGATE under the Space Act versus under the Federal Acquisition Regulations provided speed and flexibility to implement optimal design solutions unconstrained by traditional contracting practices. Optimal design solutions were negotiated between the public and private sector partners covering financial management, auditing, flight safety assurance, and intellectual property rights. Such negotiation processes are not readily accessible or even barred under the Federal Acquisition Regulations. Partnering under the Space Act provides additional features for building strong alliances.

Under the Space Act, the deliverables or products of the partnership are exempt from the Freedom of Information Act (FOIA) for 5 years following completion. For decades, NASA-industry partnerships have been hobbled by the requirement that R&D results from public funds be disseminated as widely as possible. This dissemination has resulted in a litany of NASA-developed aeronautics technologies that have been first taken to market by foreign competitors before U.S. industry. The Space Act FOIA exemption substantially eliminates the risk to industry members in partnering with the government under the AGATE JSRA. The public's interests are ultimately served both through public dissemination after 5 years and the resulting lead times for U.S. industry to reach the market first with innovations from national R&D investments.

Alliances under the Space Act can significantly enhance motivation for government partners to collaborate. Motivation for government facility managers to partner with industry can be weak using certain past practices. In the past, to protect the results of the work from public dissemination, companies sometimes purchased time in NASA facilities as "fee jobs." The funds paid by industry for fee jobs go to the U.S. Treasury, not to the facility used. Using a JSRA or CAN, these industry funds can be pooled with government resources for use by both parties. Such partnering practices can improve the motivation for partnering by government facility managers.

Space Act partnerships provide additional business operations benefits to the industry partners. Under the terms and conditions of the AGATE JSRA, for example, the industry partners may use Generally Accepted Accounting Principles (GAAP) instead of FAR Part 31 Costing and Accounting Principles. This practice reduces partners' accounting expenses. For small businesses unaccustomed to government contracts and accounting, this feature can be a deciding factor in whether to collaborate in a government joint venture. The government is well served to rely on industry business practices where feasible. It is duplicative and expensive to require industry partners in a collaboration to submit their own investments to the scrutiny reserved for traditional contracted R&D. In deciding to invest corporate R&D resources in a joint venture with the government, industry first must pass their decisions through corporate decisionmaking boards.

For an alliance to benefit from their partners' prior organizational decisions, checks, and balances, the alliance must establish credible means for self-governance. That self-governance must include appropriate financial management and auditing practices. Use of GAAP for a partnership under the Space Act can provide important simplification for a joint venture. Currently the FOIA exemption and use of GAAP are only available to joint ventures under the Space Act. CRADAs and other business instruments do not provide these features.

Collaboration Entry Criteria

What kinds of challenges, programs, and problems are candidates for the collaborative model? Collaboration in a strategic alliance strengthens all partners capabilities. A series of questions can aid in determining whether a proposed collaboration is a candidate for a strategic alliance. The applicability of the collaborative solution is assessed by asking the following questions:

- *Is the vision beyond the corporate charter or business scope of any one or two of the partners?* If the answer is yes, then collaboration between diverse partners is likely the most desirable approach. This is especially true if the products of the partnership must be planned and developed with users, technology developers, producers, certifiers, and regulators working together. If the answer is no, then simple contracts under the FARs, Chiles' Act Cooperative Agreements, or CRADAs may be logical. For AGATE, the users are the nation's general aviation pilots, airport operators, and air traffic controllers; the technology developers include NASA, the FAA, industry, and universities; the producers are industry; and the certifiers and regulators are represented by the FAA partners.
- *Does sufficient common ground exist in competitors' business plans to collaborate on pre-competitive objectives?* If the answer is yes, then both the legal bases and business motivations exist for collaboration to succeed. A "no" answer to this question is a deal-breaker; that is, the basis for collaboration does not exist. The pre-competitive objectives for AGATE include development of industry design tools and guidelines, systems standards, and Federal Aviation Administration certification methods (GS&Cs). These GS&Cs allow industry to bring new technologies to the marketplace more rapidly for flight systems, propulsion controls,

airframe structures, materials, and crashworthiness, ice protection systems, pilot training systems, and airspace and airport systems infrastructure.

- *Is industry the customer for the result?* If the answer is that the industry partners have a primary stake in commercialization of results of the effort, then collaboration is likely most appropriate. If the government is the customer for the result, then a FAR research and development contract is more appropriate.
- *Do the partners share common levels of risk tolerance and learning capacity for new technology development?* If their answer is yes, then the collaboration has a sufficiently level playing field for collaboration to proceed. If the answer is no, then either some means must be found to level the playing field between competitors for the purposes of collaboration, or the bases for teaming do not exist. In the AGATE Consortium, the leveling of the playing field between larger and smaller business partners was established by three categories of partnership, Principal, Associate, and Supporting Members.
- *Do the partners share a common level of sense of urgency for the result?* If the answer is yes, then the teams will have sufficient motivation to invest the hard work and energy required to make a partnership work. If the answer is no, then one of the important constituents of the "glue" to hold the partnership together is missing. For the members of AGATE, this sense of urgency is driven by the decade-long decline in the general aviation industry and their shared need for revitalization.
- *Do the partners share sufficiently homogeneous business and personal interests to work together toward the vision?* If the answer is yes, then one of the key ingredients exists for the "glue" that will hold a partnership together. If the answer is no, then the energy required to hold the partnership together may be too great. Within AGATE, teams with common interests were developed around industry sectors (cockpit systems, propulsion systems, airframe systems, and so on) to strengthen the business interest ties between partners. In addition, the AGATE Consortium members, beyond their common business interests, share in what might be euphemistically called the brotherhood and sisterhood of aviation and aviators.

If the answer to each of these questions is yes, then the bases exist for establishing a joint public-private sector R&D collaboration. A more complete set of entry criteria questions and conditions is found in The Practical Guide to Joint Ventures & Corporate Alliances by Lynch.

In some situations, the bases for collaboration on pre-competitive technologies may not exist, but a streamlined government-industry collaboration may still be desired. An alternative to the FAR contracting business instrument does exist for such cases. A cooperative agreement with for-profit companies under the Chile's Act is a new valuable tool for sharing resources between government and industry. The process of implementing a program using these agreements is called a Cooperative Agreement Notice (CAN). The CAN process is useful where the government wishes to stimulate industry competition to produce technological advancements. The CAN process offers some of the collaborative benefits of the JSRA and is appropriate for technology competitions.

NASA and other government agencies bring significant, unique values to strategic alliances with industry and universities. Researchers, organizational leaders, and program managers in NASA are internationally respected for skills and knowledge of vital importance to joint ventures with industry and universities. NASA has the ability to make R&D investments over a time scale and with a longer term ROI than typical industry partners. NASA can commit world-class research facilities to joint ventures. NASA has well proven skills and tools in management and systems engineering for complex, large-scale technical programs. In many cases, these skills and tools are not readily available in any one company. The values available from NASA and other government agencies for joint ventures are national assets. Joint public/private collaboration offers a means of leveraging these assets for even greater national gain that has been possible under past government practices.

Candidate Joint Ventures

Various national programs currently underway or in planning could be candidates for a joint public/private R&D collaboration. Some examples include the following:

- As satellite communications technology moves into the next millennium, numerous challenges face industry and government.

These challenges include radio-frequency allocation strategies, industry system standards and protocols, methods for compliance with regulatory requirements, database standards, and manufacturing technologies. Many of these challenges can best be met through joint ventures.

- The National Airspace System faces challenges in capacity and safety as the number of people traveling by air nearly doubles over the coming decade. The FAA and NASA have already begun planning for the future air traffic management capabilities called "free-flight." Development of these capabilities requires collaboration between partners from the user community, the technology developers in government, industry, and universities, the manufacturers, and the government certifiers and regulators. The user community includes general aviation pilots, airline pilots and operators, air traffic controllers, and state and local public service aviation organizations. The FAA brings vital representation of the certifiers and regulators of air transportation vehicles, users, and operating infrastructure. An alliance of these partners can produce the greatest advancements in the least time for the least resources.
- The U.S. aerospace industry faces a critical need for advanced, domestic wind-tunnel testing capability to regain and maintain international competitive strength. Current U.S. wind tunnels do not meet requirements for measurement capabilities and productivity required for U.S. companies to achieve desired product development cycle time goals and technological advancements. The resource requirements for R&D, design, construction, and operation of these capabilities is beyond reach of either government or industry independent economic means. An alliance of the government (civil and military), industry, and university partners for such an endeavor is an essential ingredient for success of such a venture.

Alliance Lessons Learned

The lessons learned in the AGATE experience potentially apply as design parameters for a broad range of public-private R&D partnerships. These lessons apply to the creation and operation, as well as development and training of the individuals and teams of people required for a public-private joint venture. The AGATE

lessons learned are reinvention of old lessons as well as discovery of new ones.

Government-industry alliances lack traditional bureaucracies of bosses and workers, buildings and shops, payroll and stock value of classical corporate organizational structures. While the consortium must create the collaborative versions of some of these bureaucracies, it is their very absence that gives the consortium its greatest strength--flexibility. This flexibility permits faster speed, lower cost, and higher risk payoff endeavors by joint ventures. The boundaries of risk and time scale are expanded in a joint venture beyond the practical limits for an individual private-sector company.

The lessons learned provide parameters for designing and operating a new collaborative effort. In applying these lessons to new ideas for government-industry-university collaboration, keep in mind that such collaboration requires significant change and that change is not for the timid. Change requires sponsors, champions, and change agents with vision, zeal, and vast energy.

Below are the lessons learned from AGATE and other alliances:

- Establish a compelling vision. Establish a vision based on mutual benefits and shared values that responds to a common threat and/or opportunity. The more bold, compelling, yet achievable the vision, and the stronger the sense of threat, the stronger the ties that bind the partnership together. The vision and goals must create a win-win situation for all partners from government, industry, and universities. The threat of survival and the opportunities for revitalization provide the compelling vision and motivations for AGATE.
- Every alliance is unique. Every alliance has a unique mix of government-industry motivations, products, time-scale, intellectual property concerns, leadership candidates, funding sources, and organizational structure. A vital strength of the Space Act Joint Sponsored Research Agreement process is its flexibility to allow all of these factors to be negotiated in the best mutual interests of all parties across traditional public/private sector boundaries. The AGATE JSRA, BOH, Executive Council governance, and supporting non-profits structures are uniquely designed for one consortium.

- Incorporate life-cycle planning. Plan the collaboration to include all appropriate phases in the life cycle of a technology development effort. The consortium must organize its efforts in integrated product teams that incorporate considerations from the marketing to the production to the sales and service for the products to be derived from the efforts. Use the "Third Generation R&D" (Roussel, et al.) as a model for strategic organization of the partnership. This model contemplates integrated product teams that pool the resources required for full life-cycle R&D. This R&D model integrates marketing organization guidance into the R&D plan. This step alone is very challenging for both government or industry organizations. Government R&D organizations view traditional industry marketing functions as insufficiently far term in scope to contribute to longer range R&D planning. Industry marketing organizations view R&D as beyond their usual sanctioned purview. Success in implementation of a third-generation alliance requires that this gap be bridged. Industry marketing organizations will be extremely cautious about discussing marketing information for fear of raising Justice Department flags regarding price signaling between joint venture partners who may also be competitors. The Practical Guide to Joint Ventures & Corporate Alliances by Lynch offers furthers discussion on this matter. However, the presence of a government partner in a joint venture appears to provide for additional protection from this concern in ways not available in strictly private-sector joint ventures. This is one example of the boundaries for additional research in public/private joint ventures. The AGATE Consortium formed a team of industry marketing organizations with government leadership to pool market analysis efforts. These pooled market analyses provided vital marketing guidance to the technical teams in the consortium.
- Balance the portfolio. Alliances operated as consortia must provide return on investments in both the near- and far-term. Productive consortia have successfully balanced their program plans between near-term objectives and products that build toward those in the far term. These lessons from past consortia are well elucidated in R&D Collaboration on Trial (Gibson & Rogers). The portfolio in a public/private joint venture brings the strength and longer term view of the government partners into a balanced plan with the shorter term strategies of the private

sector. AGATE deliverables include technologies for both the retrofit aircraft market and the new small aircraft transportation system.

- Use a facilitator. Engage an independent third party facilitator for development of the business side of the collaboration. The roles for the facilitator include research on best business practices appropriate to the uniqueness of each partnership, auditing of members, dispute resolution, training advisor, and legal counsel for the industry members of the partnership. These roles are inappropriate for the government member of collaboration to undertake. AGATE was developed using American Technology Initiative, Inc. (AmTech) as the facilitator.
- Implement sound systems assurance processes. With an alliance of diverse membership, wide variance in systems engineering resources and skills will exist. Systems assurance supports the program office in management of the technical requirements documents, the master schedule, and specialty studies required by the technical teams. A successful systems assurance process requires leadership by a member with the requisite capabilities. The government partner may be the logical member to lead the overall systems assurance process. In AGATE, the systems assurance team is lead by NASA and composed of industry systems engineers assigned from all of the technical teams in the partnership.
- Communicate, communicate, communicate. Plan communications with members and the public as though the life of the consortium depended on it, because it does. Establish a public affairs strategy, including a newsletter and video products to share the vision, and an electronic file server with a home page. Plan for as much trade and public exposure for the effort as is warranted by the nature of the public role (as users for example) and budget constraints. Until collaboration becomes commonplace in the U.S., the champions who lead the partnership will be called upon to be extraordinary communicators with the members. The decision by a company to collaborate with competitors is made at the senior corporate levels. As those senior leaders and their managers change, renewed communications must be undertaken with current members to support continued clarity of focus, commitment, and education on these new (unfamiliar and even

counterintuitive) ways of doing business. The principal communication instrument for the AGATE vision is an interactive computer animation that can be demonstrated from a laptop computer, video tape, or accessed from the consortium's World Wide Web home page (http://agate.larc.nasa.gov/). Without such a communications tool, it is unlikely that the AGATE vision could have been communicated with sufficient clarity to establish the partnership.

- Train, train, train. Train to prepare government and industry members for operation as high performance teams. Consortia are Integrated Product Teams (IPT). IPT training establishes clarity in roles and empowerment boundaries for leadership teams, management teams, and technical teams. It is vital that the these teams develop shared ground rules to achieve high levels of performance. Clearly, such team building is valuable in any organization. For a consortium, however, with teams composed of members of diverse organizations, team building creates the vital relationships required for success. Include both the industry and government partners in joint training. Use such guides as The Skilled Facilitator (Roger M. Schwartz) to train teams in group processes. Though training for alliance leaders is not readily available, The Practical Guide to Joint Ventures & Corporate Alliances (Robert Porter Lynch) is an excellent guide. AGATE has undertaken Integrated Product Development Systems (IPDS) training with its FAA partners to develop clarity in integrated product teams' (IPT) roles, responsibilities, empowerment boundaries, and inter-relationships. Consortia can be thought of as large-scale IPTs.
- Establish ground rules for groups. Take the time to establish process improvement mechanisms for teams and groups. While process improvement is important in any organization, it is no less than vital in a partnership. Participants from diverse companies, universities, and government organizations bring a wide variety of organizational cultures, skills, and operating practices. Team leaders must create opportunities for groups to create effective working relationships, built on trust that is based on predictability of partners. The most rapid means for teams to accomplish this goal is to take the time to establish and follow ground rules. Expect that as long as 1 year may be required for groups of

participants from diverse organizations to become high performance teams. The Skilled Facilitator, (Schwartz), provides excellent guidance toward process improvement for teams. The AGATE members maintain the BOH as a guide for team operations.

- Expect resistance. Alliances offer a means to trade traditional control for more valuable influence. On the government side of the partnership, it is difficult for a civil service contracting officer and the Contracting Officer's Technical Representative (COTR) to relinquish control associated with contracts. Civil servants are imbued with their responsibilities as stewards of public funds. Control by management chains of command in traditional R&D organizations is difficult to relinquish. On the industry side, many companies do not have a partnering mentality and may view collaboration very skeptically. However, once the government and industry parties to a collaboration share the value of the partnership's goals, then it will be more acceptable to relinquish traditional control mechanisms. This realization occurs when the parties understand that they are trading the controlling mechanisms appropriate to contracted R&D for the ability to influence each other for purposes that are not achievable using traditional means. Remember that for every person with a vision for the future, there are one thousand guarding the past. Resistance to these new ways of doing business will begin to fade only once the lessons of AGATE and other public-private joint R&D ventures are well communicated and understood at program management levels.

- Anticipate culture shock. The nature of consortium operation requires establishment of an integrated product team with representation from marketing, legal, procurement, research, production, maintenance, and product operations by the user community. In most government R&D organizations, such breadth of scope in projects is often not part of a researcher's or research manager's experience. R&T consortium leaders face a great challenge. That challenge is to strike the proper balance between flexibility that supports spontaneous creativity and control required to effectively manage projects. Conducting research to fit schedules in an IPT is anathema to research engineers at worst, challenging at best. All participants in a joint R&D venture must prepare for the culture shock that will affect their research

organizations. This is as true for industry members as for those in government. Training and continuous open communications throughout the consortium and the organization within which it operates are keys to managing culture shock. The level of effort in a joint venture is greater than many traditional research activities. The conflicts will be greater and the challenges to learn new skills in teaming and negotiation greater. In the end, the choice to participate in a joint venture requires a personal commitment by each participant. For some individuals, traditional ways of doing business may be more rewarding and appropriate. For those choosing collaboration, the rewards will include the satisfaction of contributing to advancements that would not otherwise be possible. The experiences of the MCC Consortium provide additional useful background (R&D Collaboration on Trial, Gibson & Rogers) on cultural challenges. The government and industry members in AGATE have transitioned through changes in personnel that could be described in some cases as culture-shock based. NASA managers for AGATE endeavored to make the experimental nature of AGATE clear to both government and industry partnering organizations. This provided an environment for individuals and organizations to explore their abilities to participate in the manner required for collaboration. As the experimental phase of AGATE draws to a close in 1996, government and industry staffing has stabilized.

- Organize for change. Establish clear roles in the organizational change being undertaken to establish a collaborative structure. Successful change requires clear understanding of who the sponsor, champion, and change agents are. This clarity is especially important in the government organizations undertaking the change required to implement collaborative alliances. The sponsor is the senior manager with budget and personnel control to serve as "patron" for the champions and change agents. The champion is the person responsible for developing the vision, partnership, and organization of the collaboration. The change agents are those who will be asked to make the joint venture operate and do the work of the partnership. AGATE benefited from the sponsorship for change by a visionary NASA Administrator, from enthusiastic champions for change in both government and industry at the program management level, and from dedicated agents for change at the technical team level.

- Manage outside-in. Traditional government organizations manage inside-out. This means that their dominant communications, decisionmaking, and management paths are internally focused. As a partner in an alliance, much greater attention by the government partners on the industry partners (and visa versa) is required than is typical of contracted R&D relationships. Alliances create new external communications, decisionmaking, and management paths that may duplicate or possibly conflict with traditional internal systems. These new relationships challenge traditional internally focused management systems to establish effective means of operations that fulfill both parties internal responsibilities for sound program management.
- Segregate the change organization. Protect champions and change agents from traditional line organization pressures and procedures. This step can minimize the conflict between the changes sought in the new ways of doing business with the traditional practices. Establish expectations from senior agency leaders (change sponsors) that resources will be provided to document lessons learned. The flip side of this lesson suggests an opposite approach. In other words, it can be valuable to integrate the change-group into a line organization. This approach can facilitate transfer of the new alliance operating capabilities to established line organizations. The success of either approach relies on the management styles, attitudes, and support of the organization's leaders and managers. AGATE operates as a largely independent element of the NASA AST Program. This relationship has provided important opportunities for collaboration between AGATE and other AST elements.
- Clarify alliance career paths. An individual's participation in an alliance may be will outside the traditional career paths in most government and industry organizations. This is specially true for government R&D organizations that reward researchers for traditional research products and publications. In the private sector, companies can compensate by providing shares in profits derived from the joint venture. Government organizations face greater challenges in re-engineering reward, recognition, and compensation for participants in a joint venture. NASA and other government agencies must meet these challenges if alliances are

to become a primary mode for implementation of more government programs.

- Avoid mixing old with new business practices. It will be tempting for government leaders and managers to take "short cuts" to implement certain functions in a joint venture by using traditional practices. For example, if certain program support, systems engineering, systems analysis, market research, or other contractors are conveniently accessible, it may appear that the startup can be accelerated using these old mechanisms. The short term gains will not likely carry over to the buy-in and commitment of the principal consortium members in the long term. It is best to operate all functions in the joint venture as complete partnerships with co-planning, co-funding, and co-execution. AGATE was initially implemented with a mix of collaborative and contracted efforts. These different modes caused complexities in consortium operations. The solution was to realign the mis-aligned efforts in the collaborative mode.
- Streamline oversight management. Alliance developers should avoid duplicating external program oversight functions that are built into the alliance itself. Government agencies make extensive use of both ad hoc and formal, Congressionally approved advisory groups. NASA operates the Space Advisory Council under which the Aeronautics Advisory Committee (AAC) conducts program reviews for the agency. The AAC in turn establishes Aeronautics Research & Technology Subcommittees (ARTS). The AAC and ARTS review NASA programs to provide industry and university oversight. The purpose of this oversight has historically been to advise NASA on relevance and priorities for agency programs. Alliances can build these oversight functions the partnership through the business plan alignment and alliance governance processes. Therefore, use of traditional oversight functions can become duplicative in an alliance.
- Anticipate operational support requirements. A large-scale collaboration may involve 10 or more partners with numerous technical tasks per partner and multiple teams and subteams. Such an organization requires support for meeting planning (and the unavoidable replanning) and operations, communications, legal consulting, consortium property ownership (intellectual as well as physical property), and data and documentation archiving

and control. In an era of contracting government, it is impractical to support from the government partners' workforce. The practical solution employed by AGATE was to establish a member services non-profit corporation (501(c)6) to provide the support required by the alliance members. The non-profit operations are funded by both government and industry partners.

- Celebrate progress. Establish the means for recognition of progress in the alliance. This is important because conduct of the alliance business takes place apart from the participants' home companies and agencies. Recognition and rewards for alliance progress may not typically be in the mainstream of those home organizations. Celebration through press releases, newsletters, awards, and recognition provides vital visibility of alliance progress to the alliance members themselves.
- Prepare for management technology transfer. Transfer and apply alliance management technology lessons through the "tennis shoes" approach. That is, success in transferring these new management technologies requires the active participation of those who have lived and worked in these new ways of doing business. Prepare to transfer alliance management technology by assigning personnel to work in existing joint ventures or assign existing alliance personnel to develop new alliances. The cultural differences, organizational understanding, and negotiation skills for alliance development are not readily learned through academic approaches. Those in government with alliance experience and who have the trust and credibility with industry partners are top candidates to lead alliance development.

These lessons are based on experience, observations, and self-study from the government leaders' perspective in the AGATE Consortium. Some of the lessons can be described as "We got lucky in figuring that out early," others as "I sure wish we'd thought of that sooner," and a few as "We should have fought harder with management for this one." The AGATE lessons learned apply to certain endeavors and not to others (not all alliances are alike). Simpler conventional methods of one-on-one/two or three collaboration between government, industry, and university partners exist. However, even these partnerships should start down their path questioning the suitability of traditional contracts or grants for their purposes.

Alliance Design and Implementation

Four steps describe the design and implementation of an alliance. These steps follow background planning, advocacy, and public announcement of intent by the government to form the candidate alliance. To be responsive to the government's obligation to fairness, the intent to establish an alliance is announced in the Commerce Business Daily. The four steps may be accomplished in workshop settings separated by sufficient time for preparations. Use of a professional, knowledgeable facilitator can speed and smooth these steps. The steps include:

1. Establish commitment by industry and government partners to shared vision and goals. This step must engage those individuals from the government, industry, and university partners with authority to commit their organization to the collaboration. For industry and government, these individuals typically come from senior management.
2. Negotiate specific objectives. This step may benefit from use of survey instruments. The candidate partners can be surveyed by the government member or the facilitator to assess those strategic objectives of common interest that will lead to the partnership goals. The survey instrument measures partners' technology development priorities on scales of risk, time, payoff, and willingness to commit specific resources.
3. Negotiate specific tasks, resources, and performing organizations. This step is the one most distinct from FAR contracted R&D. The industry partners are requested to define the tasks (statements of work) required to accomplish the partnership objectives. They are asked to allocate resources to these tasks and to recommend performing organizations to the government partners.
4. Sign agreements and establish governance. Partners negotiate and finalize intellectual property rights and execute their partnership legal documents (e.g., JSRA Terms and Conditions). This step commits their organizations to the matching resources for their assigned tasks. The partnership then establishes their governance representatives (for AGATE, the partners elect their representatives to the Executive Council).

In FAR-based R&D contracts, steps 2 and 3 are government responsibilities and cannot be conducted with the benefit of open dialogue between partners. In FAR contracts and CAN competitions, the government employees are sequestered and prohibited from discussions with industry during the competition. The ability to maintain open dialogue is one of the important flexibilities of the joint venture approach under the Space Act. As a result, these four steps can be accomplished with high levels of quality in as little as 6 months. In comparison, even a simple R&D contract under the FAR can require 12 to 36 months, depending on the nature of the bid competition and the potential resulting dispute resolution process.

University Roles

Universities in the U.S. face challenges similar to government and industry as organizations clarify core competencies and undertake downsizing and contraction. Alliances involving universities bring the unique expertise, facilities, and longer term strategies to bear on the goals. In AGATE, universities are in the Principal, Associate, and Supporting Member categories. These are institutions whose charters and missions are aligned with those of the general aviation community and AGATE.

Universities with "products" in the marketplace related to pilot training services and with related research capabilities have joined AGATE as cost-matching Principal Members. Those with commercialization interests through university-affiliated spin-out companies have joined as resource-sharing Associate Members. Others with interests in supporting AGATE R&D as funded performing organizations have joined as Supporting Members. A few universities have been unable to work with the restrictions on data dissemination, members dues requirements, or cost-sharing and have chosen not to participate in AGATE.

University participation in AGATE research and in a national design competition brings an important dimension to revitalization of the U.S. general aviation industry. Beginning in 1995, NASA, the FAA, and the Airplane Owners and Pilots Association (AOPA) instituted the National General Aviation Design Competition. This competition engages the university academic community in the national revitalization efforts. These university roles in AGATE help position the general aviation workforce for revitalization. The economic and technological health of this industry sector from the mid-1980's to

the present has declined precipitously. This decline has created a situation making it extremely difficult to attract the best and brightest graduates to the general aviation community. Universities participating in AGATE generate excitement and commitment to the general aviation community among their best and brightest students. The results of their efforts bode well for the level of talent this industry will attract to its workforce in the future.

Small Businesses

The developers of the AGATE Consortium faced an early challenge to include small businesses as members. The challenge was how to integrate innovative small businesses who have higher levels of risk tolerance, and flexibility, but who did not have established products in the marketplace. To complicate matters, established businesses in any consortium shun partnering with companies of lesser strengths in research, engineering, certification, manufacturing, sales, and service.

The solution for AGATE was to establish the Associate Membership category. This category provided access to certain membership rights and privileges for small businesses that had won either Small Business Innovation Research (SBIR) or Small Business Technology Transfer (STTR) contracts. The small business and the AGATE team members negotiate on an exchange of technical results of value to both parties. If successful, then the small business is invited to join as an Associate Member.

The NASA small business programs leaders recognized the opportunity offered by AGATE to small businesses. Those leaders established general aviation focused subtopics in the SBIR and STTR programs. NASA aligned the objectives of the subtopic solicitations with the technology strategies in AGATE and other government and industry programs in support of industry revitalization. The result is strengthened quality and pace of innovations reaching the marketplace from small general aviation businesses. These results benefit NASA through higher return on small business investments. These results also benefit large companies whose vendors are those small businesses. The strategic integration of small business programs in a government-industry alliance can bring significant benefits in this win-win situation.

AGATE Successes

Early AGATE success stories illustrate the power and benefits of joint government-industry R&D collaboration in strategic alliances. Members of AGATE have very rapidly converged on standards for databus systems, composite materials properties, electronic engine control system architectures, and communications/navigation/surveillance (CNS) system design and operational specifications. In some of these cases, the general aviation industry has struggled for years to accomplish such industry consensus. The AGATE successes can be attributed to the collaborative process, the consortium's technical teams' leadership, and to the emergence of lower-cost technologies that motivate the partners to rapidly reach consensus.

The 1996 Olympic Summer Games in Atlanta provided the backdrop for one of these early success stories. In partnership with the Atlanta Vertical Flight Association, Helicopter Association International, and Georgia Tech Research Institute, eight AGATE member companies developed the world's first free-flight system for use in Atlanta. Working together as Project HeliStar, the team created a "highways in the sky" capability. The effort was accomplished in less than 7 months with a joint government-industry investment of less than $2 million. Satellite-based navigation, digital radio datalink communications, and advanced flat panel displays technologies were integrated to produce a CNS system providing pilots and controllers with graphical traffic, weather, moving maps, and Olympic venue status information in real time. The Atlanta Olympics project sets the stage and accelerates the pace for modernization of the nation's emerging air traffic management free-flight system.

This "highway in the sky" system was installed in 50 aircraft and operated during the 1996 Atlanta Olympics. An additional 60 units were produced at the request of the White House to meet requirements for special security forces. Using this system, the pilot sees the "highways in the sky," the traffic on those highways, real-time weather affecting the highways, and the color-coded restriction status of each Olympic venue. The system provides pilots of commercial cargo, security, emergency services, and law enforcement aircraft with free-flight access to the restricted airspace during the Olympics.

The commercial cargo operators estimate that over $20 million will be generated in revenues that would have been lost without the AGATE technology. Government partners estimated that such an endeavor would have required more than 3 years (vs. 7 months) and much greater funding to accomplish under the FARs. Furthermore, had the project been funded under a traditional FAR R&D contract, there would have been little "buy-in" by the users and producers of the system hardware, software, and operating procedures. The Atlanta Olympics provide a shining example of the benefits of the collaborative approach to R&D in a strategic alliance.

Benefits

The benefits of a successful collaboration can be summarized for government, industry, and university partners as follows:

- Improved competition. Increased industrial competition results from collaboration that is focused on industry-wide bases in technologies, standards, design guidelines, tools, and certification. This increased competition results from the ability of the industry to compete domestically and internationally at a higher level of product performance, price, and quality. Most importantly for industry, increased sales of consortium-derived products results through the strength of coordinated R&D leading to product standards.
- Cost savings. Cost sharing multiplies the return on R&D investments with each partner sharing the results of collaborative projects. This sharing supports higher-risk and higher-cost R&D and reduces the cost of "failures" in high-risk endeavors.
- Shortened product development cycles. Speed and efficiency of R&D result from more consortium flexibility and reduced duplication of efforts. Product development cycle times are reduced by developing standards, guidelines, protocols, certification bases and methods concurrently with technology. This benefit results by teaming with the certifiers and regulators at the front end of the technology development cycle.
- Rapid technology transfer. Companies can more rapidly adjust to emerging technologies through sharing of technical and market research information. Collaborative efforts substantially reduce or eliminate the Not Invented Here (NIH) effect that permeates independent R&D efforts. Alliances virtually automate technology transfer for government R&D labs. This efficiency results from

the strategic alignment of industry and government business plans toward common goals.

- Increased relevance of government and university labs. Most importantly for government agencies today, the role of government labs can become more substantially integrated into the business plans of U.S. industry. Universities simplify the challenge to be relevant to industry through partnering in an alliance.
- Reduced in-house support staffing requirements. A consortium-based program has the potential to shift administration and staffing requirements from traditional government procurement toward legal counsel organizations. This shift can substantially reduce the procurement workforce and associated calendar time required to administer major programs. However, to obtain full advantage of these potential gains, the industry partners must be willing to support a member-services nonprofit (or similar) organization to move certain of these functions into the private sector. A limited amount of increased legal counsel staffing must be planned for; however, the overall effect is reduced in-house support requirements.

The joint venture partners have much more access to these benefits in a skillfully managed joint venture than they could hope to achieve independently or through other traditional means (contracted research for example).

Summary

Federal R&D investments can be significantly leveraged for greater national benefit through strategic alliances with industry and university partners. AGATE is a large-scale collaboration with lessons applicable to various public/private joint venture candidates. As of the end of 1995, AGATE was the largest member consortium in the U.S. Only because of the 1984 NCRA, the recent government reinvention initiatives, and the JSRA Space Act mechanism, could an endeavor with the boldness of the AGATE vision have been undertaken. The benefits of AGATE will be felt in every one of the communities, counties, and states served by this nation's vast infrastructure of over 18,000 general aviation landing facilities. AGATE's small aircraft transportation system goal is one example of a surprising result of reinventing government.

The AGATE Consortium offers many lessons for future public/private joint R&D collaboration. These lessons counter past myths and misconceptions.

- *Myth:* The government has set rules and procedures that cannot be altered.

  Fact: New rules and procedures are highly flexible. The JSRA and other new (non-FAR) business instruments provide highly flexible means to negotiate the terms and conditions required for a successful government-industry partnership.

- *Myth:* Government funding for industry research is "corporate pork," or industry welfare.

  Fact: Strategic alliances turn federal labs into strategic partners with industry. In joint R&D collaboration, government, industry, and university partners share in the resource commitments. Industry commits resources from within their strategic R&D investment plans. This process aligns investment planning using federal and private sector resources (personnel, facilities, and funds) toward goals of national strategic importance. To label such investments as "corporate pork" is to seriously underestimate the value to the nation of technology strategy and federal labs as strategic partners.

- *Myth:* Government-industry collaboration represents national industrial policy.

  Fact: Technology strategy is not industrial policy. Joint public-private R&D collaboration such as in the AGATE Consortium strengthen the nation's technology strategies. The timescales for such collaboration stretch beyond typical ROI timescales for industry R&D investments. The private sector partners assume full responsibility for the technology strategy undertaken in the partnership. To label such collaboration as industrial policy is to miscomprehend the long-term timescales required for successful technology strategy.

- *Myth:* Government-organized collaboration with industry is anti-competitive.

  Fact: Collaboration increases competitiveness. The focus of any R&D collaboration in the U.S. must by law be on precompetitive deliverables. The industry competitors who collaborate in the

joint venture must have common interests in achievement of those deliverables. Finally, the efforts to achieve those deliverables must require resources beyond the means of individual companies or government agencies. The result of collaboration raises the tide of industrial competition to higher planes of quality, performance, and price competitiveness.

- *Myth:* The government (or the industry) loses control in collaboration.

  Fact: Partners in collaboration increase their influence. A strategic alliance provides a tool that offers both partners influence over each other to achieve strategic goals. In fact, each partner gives up traditional control over resources and efforts toward those goals. Clearly, the goals must be of sufficient (strategic) value to both parties to merit such a decision.

- *Myth:* A government-industry alliance is focused on the near term at the expense of the far term.

  Fact: Strategic alliances are for the long term. U.S. industry alliances have spanned more than 20 years, and R&D Consortia in the U.S. have operated over 10 years. Strategic alliances, by their very nature, tend to set far-term goals. Success in an alliance requires coordination of far-term and short-term objectives. At the same time, shorter term objectives are essential to provide strong participation by industry, but they must all contribute to the farther term goals.

The advent of strategic alliances adds a new means for a government R&D agency such as NASA to build strength and capabilities. In an era of contracting government, the strategic alliance becomes a vital tool to strengthen government capabilities and relevance for national benefits.

TABLE 1. AGATE Consortium Members (July 1996)

PRINCIPAL MEMBERS

1. Aircraft Modular Products, Inc.
2. AlliedSignal Aerospace
3. ARINC
4. ARNAV Systems Corporation
5. AvroTec
6. Cox and Company
7. BFGoodrich Corporation
8. Cessna Aircraft Company
9. Cirrus Design Corporation
10. Digital Equipment Corporation
11. Embry-Riddle Aeronautical University
12. Global Aircraft
13. Florida Institute of Technology
14. Harris Corp.
15. Hartzell Propeller Company
16. Honeywell, Inc.
17. Impact Dynamics
18. Innovative Dynamics Incorporated
19. Jeppesen Sanderson
20. Kestrel Aircraft Corp.
21. Lancair
22. Lockheed Martin
23. NavRadio
24. Ohio State University
25. Pan Am Systems
26. Raytheon Aircraft-Beech Hawker
27. Raytheon E-Systems, Montek Division
28. Rockwell Collins Avionics
29. Ross Engineering
30. Sensenich Propeller Company
31. Simula Corporation
32. Stoddard Hamilton Aircraft, Inc.
33. Teledyne Continental Motors
34. Terra Corporation
35. Textron Lycoming Engines
36. Trimble Navigation

TABLE 1. AGATE Consortium Members (July 1996)

-Continued-

37. University of North Dakota
38. United Technologies -- Hamilton Standard
39. Unison

SUPPORTING MEMBERS

40. Advanced Creations, Inc.
41. Airsport Corporation
42. Allison Engine Company
43. Airplane Owners and Pilots Association -- Air Safety Foundation
44. Birhle Applied Research
45. General Aviation Manufacturers Association
46. Mississippi State University -- Raspet Flight Research Center
47. Mitre Corporation
48. ModWorks
49. Mooney Aircraft Corporation
50. National Air Transportation Association
51. National Business Aircraft Association
52. Research Triangle Institute
53. Seagull Technologies
54. Seemann Composites
55. Small Aircraft Manufacturers Corporation
56. Technology Systems Incorporated
57. The New Piper Aircraft Corporation
58. University of Central Florida
59. University of Illinois
60. University of Kansas
61. University of Tennessee Space Institute
62. University Corporation for Atmospheric Research
63. Williams International

TABLE 1. AGATE Consortium Members (July 1996)

-Concluded-

ASSOCIATE MEMBERS

64. Systran Corporation
65. Wichita State University -- National Institute for Aviation Research

GOVERNMENT MEMBERS

66. National Aeronautics & Space Administration
    - Ames Research Center
    - Langley Research Center
    - Lewis Research Center
67. Federal Aviation Administration
    - General Aviation & Vertical Flight
    - Civil Aero-Medical Institute (CAMI)
    - Small Aircraft Certification Directorate
68. U.S. Air Force Wright Labs

TABLE 2a) Business Instruments Compared and Contrasted

PROCESS	F.A.R. CONTRACTED R&D	JSRA JOINT R&D VENTURE	CAN COOPERATIVE AGREEMENT NOTICE
Purpose	Government acquires goods & services	Government & industry partners collaborate in pre-competitive, industry-wide advancements	Government sponsors competitive selection of R&T relevant to Agency mission requirements
Business instrument	Federal Acquisition Contract	• Federal Partnership "Contract" (Gvt. Consortium Agreements) • Customized agreements • Meet JSRA P.I.P. requirements • Not subject to F.A.R. or NASA Coop Agmts Hndbk	• Chiles' Act Cooperative Agreement (single "contract" to team) • Meet Gvt. Research Grant & Cooperative Agreements Handbook (5800.1c) requirements (F.A.R.-based)
Participants & roles	Contractors deliver goods & services	• Partners • Gvt. stimulates industry, has significant technical role	• Partners • Gvt. stimulates industry, has significant technical role
Early planning process (Goals & Objectives)	Government & Industry share pre-solicitation information	• Gvt. sets broad goals • Industry establishes specific R&T objectives and determines R&T Task plans	• Gvt. sets broad goals • Industry establishes specific R&T objectives and determines R&T Task plans
RFP preparation	Gvt. prepares RFP; communications are sequestered	Government & industry collaborate in JSRA R&T Task definition, resource allocations	Industry develops technical plan response to Gvt.-developed CAN; sequestered communic'n's
Qualification of participants	Government qualifies bidders	Government establishes membership criteria, industry partners concur	Industry develops teams and proposals; Gvt. qualifies proposals

TABLE 2b) Business Instruments Compared and Contrasted

PROCESS	F.A.R. CONTRACTED R&D	JSRA JOINT R&D VENTURE	CAN COOPERATIVE AGREEMENT NOTICE
Statement of Work	Government writes work statements	Government & Industry collaborate on work statements	Industry writes work statements
Performing organization selection	Sequestered government Source Evaluation Board (SEB) selects contractor	Industry leads in consensus selection of performing organizations; Gvt. approves.	Sequestered government Source Evaluation Board (SEB) selects team.
Financial reporting requirements	FAR-based, non-negotiable requirements	GAAP-based, negotiated; Government audit option; Consortium self-audit	FAR-31-based; Government determines schedule & audit options
Technical reporting	Government-established contract requirements	Government-industry negotiated communications plan	Proposed by industry team
Program redirection	Government & Industry collaborate; government decides	Government & industry jointly, rapidly establish requirements for redirection and implementation	Program redirection directed by Gvt.
Task redirection	Contract modifications recommended by government & industry participants, negotiated by procurement	JSRA Task redirection jointly recommended and negotiated by government and industry members; implemented with NCA modifications	Task redirection managed by industry team members; Gvt. technical support redirection negotiated with Gvt. performing organizations

TABLE 2c) Business Instruments Compared and Contrasted

PROCESS	F.A.R. CONTRACTED R&D	JSRA JOINT R&D VENTURE	CAN COOPERATIVE AGREEMENT NOTICE
Technology transfer controls	By controlled distribution (LERD, *etc.*	All results and deliverables 5 year exemption from FOIA by legislation; shared by members only	Chiles' Act promotes wide dissemination of results; 2 to 5 year delay in dissemination negotiable
Technology transfer & Intellectual Property rights	To contracted party initially, then to other industry participants in program	Negotiable To all members as agreed to in JSRA Terms and Conditions partnership	Through Articles of Collaboration
Program responsive-ness to industry	Constrained by FAR practices to 'clock speeds' of procurement system	• Provides immediacy of tasking of partners at 'clock speeds' of technological innovation • Reduces lag for insertion of rapidly emerging technologies	• Provides immediacy of tasking of partners at 'clock speeds' of technological innovation • Reduces lag for insertion of rapidly emerging technologies
Resource commitments	Government resources as contracted (Fixed Price, Cost Plus, *etc.*)	Cost equitably borne by government and non-government partners; typically 50/50	Cost equitably borne by government and non-government partners; typically 50/50
In-Kind Allowables	Not applicable	IR&D allowable In-kind as defined in JSRA Program Information Package (Substantially identical to OMB Circular 110)	IR&D allowable Non-cash contributions as defined in OMB Circular 110; also see 14CFR Part 1274

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13. ABSTRACT (*Maximum 200 words*)

This paper describes the lessons learned in developing & operating a large-scale strategic alliance whose organization & coordination is U.S. Government-led using new means for R&D collaboration. Consortia in the U.S. counter a century of 1884 Sherman Anti-Trust Law-based governmental and legal policy & a longstanding business tradition of unfettered competition. Success in public-private collaboration in America requires compelling vision & motivation by both partners to reinvent our ways of doing business. The foundations for reinventing government and alliance building were laid in 1994 with Vice President Al Gore's mandates for Federal Lab Reviews & other examinations of the roles & missions for the nation's more than 700 government labs. In addition, the 1984 National Cooperative Research Act (NCRA) set in motion the abilities for U.S. companies to collaborate in pre-competitive technology development. The budget realities of the 1990's for NASA & other government agencies demand that government discover the means to accomplish its mission by leveraging resources through streamlining as well as alliances. Federal R&D investments can be significantly leveraged for greater national benefit through strategic alliances with industry & university partners. This paper presents early results from one of NASA's first large-scale public/private joint R&D ventures.

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