AGATE, The Turning Point for General Aviation

"Without innovation enabled by technological advancement, general aviation within the United States will fail to respond to opportunities for expanded use and is destined to continue its decline. NASA is the most capable logical source of such enabling technology."

General Aviation Task Force Report, September, 1993

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Case Study

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Approach

This case study was developed in the interest of continuously improving program and project management at NASA. To augment a traditional case method approach, a theoretical framework adopted was from the sociotechnical systems tradition. Research for this case included comprehensive literature review, and detailed interview. To augment this case study, there is an available instructor's guide. In addition, learning modules have been developed based on the sociotechnical systems framework. These exercises prompt participants to understand AGATE success from the perspective of the NASA Project Life Cycle. Project Life Cycle variances and key practices and tools are identified in the context of project management.

It should be noted that the focus of this case study series is in the area of project management. Projects were selected based on the potential of providing lessons learned to current and future program and project managers. Because some of the projects were not complete at the time they were studied, an outcome-based assessment of the projects studied may determine that mission objectives were ultimately not realized. Nevertheless project management lessons can be transferred for the betterment of program and project management at NASA and elsewhere.

AGATE, The Turning Point for General Aviation

When the U.S. general aviation industry experienced more than a 15-year period of decline, it was clear a solution was needed to boost the ailing industry, to revitalize general aviation, and to provide the foundation for industry growth.

In the early '90's statistics indicated the general aviation industry, often referred to as just "GA", was long past a thriving growth period of the 1950's and 1960's. Although GA production peaked in 1978, the industry still provided more that 540,000 jobs and $40 billion input into the American Economy (AGATE Flier, 1994). Despite its decline, GA was viewed as a significant contributor to the general manufacturing sector.

Signs of decline included recent trends of a 1% annual reduction of public use airports, regulations on noise reduction, and legal liability issues for aviation manufacturers. These factors bred growing concern for the industry catering to all 'civilian non-scheduled aviation'.

Any plan of attack for the revitalization of GA had to engage the entire industry — designers, manufacturers, regulators, trainers and pilots — in order to sustain the momentum required for rejuvenation.

For NASA, responding to the needs of GA was an acknowledgment of the congressional directive for government agencies to engage in innovation that is both beneficial and aligned with the needs of "industry customers and partners". In fact, Congress advocated that the agencies "explore new ways to make government less costly, more flexible, faster in responding to needs" of the American public in all capacities including industry and consumers. NASA's administrator Daniel S. Goldin initiated the discussions about the problems facing GA with industry representatives at the Experimental Aircraft Association Convention in Oshkosh, Wisconsin in 1993 (NASA Facts, 1996). In that same year, Dan Goldin commissioned the General Aviation Task Force to examine the issues and make recommendations.

In response to the problems the American GA industry faced, Dr. Bruce Holmes, the program manager of the Advanced General Aviation Transportation Experiments (AGATE) envisioned a plan that would unite the industry under the guidance of government in a program to revitalize GA. This plan would differ from the traditional agreements used to facilitate government and industry partnership. Rather than a contract, which means government buys industry's services or goods, or a grant, which means government sponsors industry's generation of goods or services, AGATE would allow government and industry to partner through a program that allowed government and industry shared R&D financial investment.

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Creating an Alliance

In September 1993 when the General Aviation Task Force published their report on the status of the GA industry, many of the concerns about the industry's decline were documented, but, not without presenting a plan for growth in the future. The report presented an in-depth environmental scan of both the positive and negative forces shaping the GA industry.

The report acknowledged the serious decline in GA. For example, the report made the following comments about some of the industry's prominent manufacturers *"Cessna, which produced 9,000 aircraft in 1978, had not manufactured a piston-powered aircraft since 1986. Piper is in bankruptcy. Airframe manufacturing employment had dropped by 50 percent" (GATFR, 1993).*

Other examples from the task force included the success of foreign manufactures in this market; the shift of US general aviation from exporter to importer; the challenge of foreign producers to the US leadership role in "technology, production, marketing, and service support of general aviation aircraft"; and, the abandonment of general aviation research and development by NASA.

The task force also made several recommendations. First, NASA's General Aviation program should be revitalized. Second, the task force saw the need to rebuild NASA's infrastructure and promote the availability of NASA's resources to General Aviation. Last, the task force also named four technical areas where rapid technology development would be most productive for the industry (GATFR, 1993).

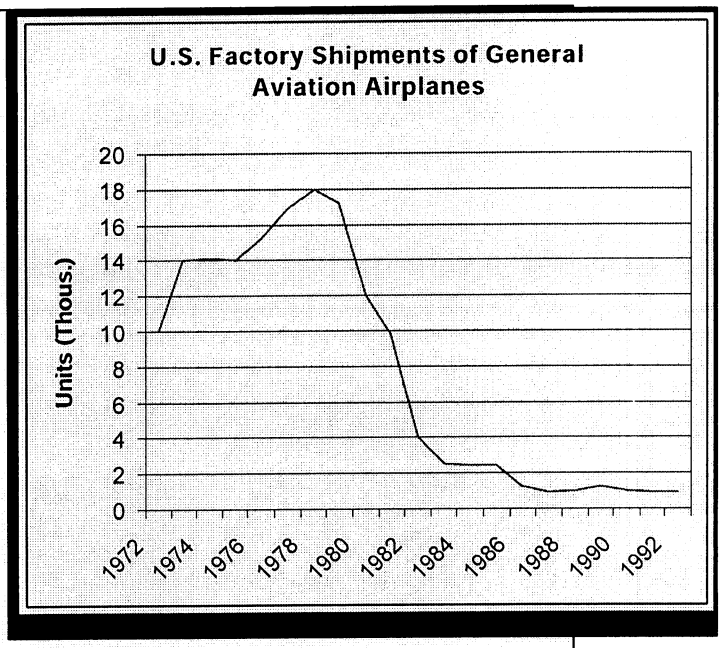
The report also stated the need for coordination at three levels. At the agency level, NASA and the FAA needed to work together to ensure any research efforts, policies, and standards developed were acceptable to the FAA. At the industry level, the group saw the need for reliable information dissemination. Information on new research needed to be shared with the community. At the agency and industry level combined, the committee envisioned NASA serving as a focal point for research, funding, and information sharing.

Engaging an entire industry in a collaborative and focused plan is not unheard of in the global arena and has been achieved by creating industry-wide consortia and strategic alliances (Drucker, 1995). Although the purpose of each strategic alliance may be unique, consortia share many similar characteristics. They are typically used as an alternative for market-share maintenance or growth. Often, businesses unite to form a consortium to combat common obstacles in their industry's environment. Obstacles may include government regulations, declining sales, increased competition, the rapid rate of technology advancement and many other possibilities.

The task force report confirmed that the status of GA had all the ingredients to form a consortium that comprised both industry members and government agencies. But it would take a lot of planning and drive to put a working model in place.

The Forces of Decline

- Cost of Purchase and Operations
- Time for Learning and Proficiency
- Complexity of Airspace
- Disposable Income Growth Rate
- Small Business Growth
- New Business Formation Rate
- Airline Deregulation
- Used Airplane Prices and Performance
- Interest Rates
- Investment Tax Credits
- Luxury Tax
- GI Bill
- Oversupply (Airplanes per 100 Pilots)



The Forces of Growth

- AOPA: Project Pilot
- DOT: ISTEA, Intelligent Transportation System
- EAA: Young Eagles Program
- GAMA: GA Revitalization Act of 1994
- NASA/FAA/Industry: AGATE
- NATA: 1-800 I CAN FLY
- NBAA: "No Plane - No Gain"
- SAMA: Small Aircraft Certification Program

Dr. Bruce Holmes outlined several environmental forces pivotal in the formation of the revitalization effort for the general aviation industry at the AGATE Program Review in Lakeland Florida, April 1995.

Vision

Like any community that wishes long-term success, the GA industry required many elements to maintain the balance necessary for survival and

growth. Therefore, revitalization could not address any single viewpoint of the industry but instead needed to incorporate the holistic vision of all of general aviation. Engineers, aviators, manufacturers and regulators in the industry had clear visions of the requirements for change.

Vision for the Alliance

As early as 1989, the seeds for the alliance were planted in Bruce Holmes' vision for general aviation. The National Policy Workshop, held that year, affirmed that GA supporters in industry and NASA had cause for hope in revitalizing U.S. general aviation. At the workshop, participants focused on the technical requirements and used the meeting to discuss and gain consensus on the question, *'Is there a role for technology in the future of general aviation?'* The results of these discussions were documented in a white paper: *The Role of Technology in the Future of General Aviation*.

Bruce often describes the societal and technical events leading to and supporting a renaissance in general aviation in terms of a technology timescape. His method of envisioning the future required looking forward through time from 1992 to 2015:

> The two major forces at work behind any vision are the technology push and the market pull. The process that I personally used in this particular case, was what I called conducting an analysis in the form of a Technology Timescape. It's where you lay out the time say from now to say 20 years in the future and you insert on that timescape the technology events and societal events and forces that shape this timescape into a future. And I wound up presenting that at an AIAA meeting in 1992.
>
> We knew for example in 1992 looking forward to the year 2015 or so, was you could draw a line or you could put a milestone marker on that timescape that would say GPS [Global Positioning Satellite] ... in about the year 2000.
>
> Low Earth orbit capabilities would appear in the market place about that time, about 2000. And of course at the time we hadn't even heard of Meridian, well yeah we had back then, Meridian started in the late 80's, so we actually knew some of the language that the communications companies were using. Direct broadcast satellite television, is another one you could put on the timescape because people had business plans.
>
> Computer speed, you could pretty much forecast, you know the processor speeds. You could forecast quite a bit about modem speeds, so you could forecast the speeds of digital radios out to the year 2005 – you know within plus or minus 50%. Let's see what else... Some materials technologies you could do some predictions on. You could also do some predictions on the potential for engine advancements, propulsion system advancements, in this market niche, called general aviation.
>
> So put all those on a timescape and then you step back from that timescape, in an attempt to fulfill this second step, as the obligation of the role of champion in translating the vision into proposals for plans. You could step back from that

> timescape and you could say Wow!. You know what you could do with that is you could create aircraft, small aircraft, which would cost less, be safer and be more convenient to use than the last generation of airplanes — now nearing 30 years of age on average and needing to be replaced someday.

Bruce felt industry events such as the National Policy Workshop (1989), the Technology Fest (1992), Oshkosh (1992), and the Task Force Formation (1993) were all responsible for a renewed understanding of the need for change. There was also definite opportunity to leverage industry willingness to embark on change. The question however was '*Where should the change agency reside*'? Bruce envisioned a collaboration where government acted as the managing partner and utilized its large-scale systems engineering ability to aid in technical coordination. Government would also provide the infrastructure to enable coordination among organizations, which included industry members, both small businesses and large corporations, non-profit organizations, and universities.

Vision for the Single Pilot Plane

Advanced technology could make planes easier to fly. However, in the face of stringent regulations and declining production, factory manufactured planes for general aviation purposes could not include much of the newly available technology. At the lowest point of the decline of general aviation, 3000 kit (home-built) planes were produced annually versus only 200 manufactured planes. Members of the FAA Small Plane Directorate speculated that one of the reasons why kit planes out-produced manufactured planes was the difference in regulations governing an experimental aircraft versus a commercially manufactured aircraft. But, nonetheless, the fact that kit planes were out-producing manufactured planes in the same class was a wake-up call for the FAA and industry. It appeared that modern day pilots could more readily attain the level of ease, safety, technology, and satisfaction from a plane that was home-built. Steve Hanvey former executive council chairperson from Raytheon provided his vision for the single engine plane.

> Like Bruce, I believe that the industry needed this...I've used this example as the simplest way to say it [the vision]. I have a 1930 Model A that my wife drove in high school and I rebuilt for my son to drive and my daughter to drive. When I crank it up, it reminds me of driving a Baron or Bonanza, which are aircraft products off the line. Due to the fuel mixture, when it was cold it was a bit harder to start. Yet, in my automobile, I have electronic fuel injection. I just turn the key, crank it, and go in virtually any conditions. I knew that there was technology in engines and other areas that if we could just apply it to the airplanes, then we would sell more airplanes... As a pilot myself, I recognized that we needed to put technology into the smaller airplanes.

Aviators, especially smaller plane pilots, had been voting with their kits for a plane that provided better technology to the pilot. Pilots in the FAA, NASA, and industry also articulated the need for a plane that was easier to fly. The general consensus was a manufactured plane that provided pilots with the best available information about weather condition, engine condition, flight location, etc. Pilots envisioned a plane that in optimal weather conditions was no more difficult to operate than a car. To date, no such manufactured plane existed on the market or could exist in the wake of small plane production dropping to such a low level.

Vision for General Aviation Manufacturers

Many of the manufacturers currently involved in general aviation are small companies with relatively low R & D budgets. In general, these companies are staffed with individuals who are committed to GA but have little time to spend on non-focused, non-product-related research. Their production efforts for the most part are focused on kit planes in the experimental aircraft category. Even in the midst of industry decline, several of the smaller general aviation companies like Lancair, for example, produced airplane kits and realized that a market for robust small aircraft existed.

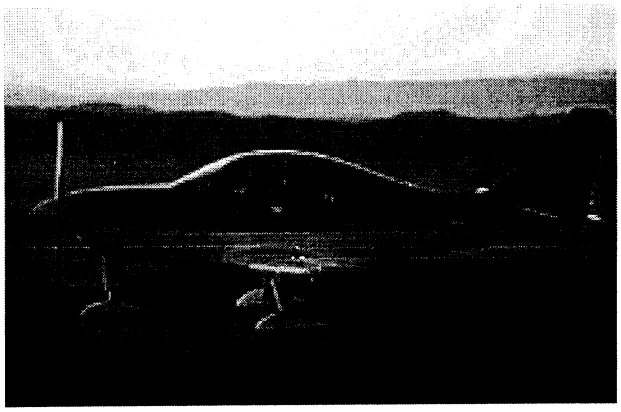


Figure 1 - Lancair ES (source http:/www.lancair.com/)

"Derived from the award-winning, world record setting Lancair IV, the ES (Figure 1) shares the same large cabin format, but departs from there in purpose and design. Elegance and simplicity define the ES. Long endurance, high climb rates and slow landing speeds enhance safety and make for a relaxed pilot. The ES will provide you and your family a level of comfort, style and true performance never before realized.

The Lancair ES-P is now moving toward production with first deliveries scheduled for the first quarter of 1998."

Source: http://www.lancair.com/

Small plane manufacturers envisioned changes in general aviation that enabled certification of new technologies. Manufacturers also knew they needed FAA approval to integrate the technology in order to move safety to a higher level. With FAA approval, manufacturers could build airplanes with the features that home builders already included in their kit planes. However, the cost associated with certification, in terms of person-hours and administration, were often a deterrent for any single company to bear when addressing production of planes with new uncertified technology. It was evident that GA manufacturers needed a means to facilitate quicker and less costly certification of new technologies with the FAA in order to boost production of their aircraft.

Tom Freeman and Paul Stough lead the revitalization effort for the Flight Systems and Integrated Design and Manufacturing teams respectively. They are both from the Langley Research Center and spoke candidly about how the revitalization effort will affect manufacturers:

> "We are developing lots of technology which can all be brought together in individual companies. In trying to develop a very low cost, a hundred thousand dollar airplane that has more capabilities than a two hundred thousand dollar airplane. An airplane that has a dashboard that is more sophisticated than anything that exists on a two hundred thousand dollar airplane, with crash protection integrated, unitized body construction, seats and airbags, and all sorts of safety features. It is to be very much like an automobile transportation system in the air. So we are developing revolutionary technology to reduce the cost and increase the capability of the airplane. We can't probably pull all of this together because the cost of pulling it all together would be enormous, to build the airplane with all the technology would be enormous. But to develop the pieces and then have the companies use them as they see fit allows them to...determine how to use it after the program is over.
>
> What we are doing is allowing them in some respects to reduce the cost of their products by not having to provide multiple interfaces when only one will ever be used. ... If we can agree on a common interface that doesn't change the performance of the products, it just does away with all these different interfaces, the development of them, the testing of them, and production of them."

Out of these visions NASA worked together with general aviation's key stakeholders to develop the alliance now called the Advanced General Aviation Transport Experiments (AGATE). The alliance focuses on pre-competitive R&D experiments that will further the testing and development for the AGATE cockpit concept. The end product of the alliance will be a standards and guidelines to be used by the industry in the new millenium.

Both industry and government were ready to face the challenges of revitalization in general aviation. However, due to the scope of the work, traditional contracting or sponsorship arrangements would not allow for the type of flexibility needed. In general aviation, flexibility was a key criterion for any long-term agreement into which government and industry ventured. The alliance would have to be industry-driven in terms of strategic direction but government directed in terms of its infrastructure. Traditional NASA contracts seldom accommodated these terms.

NASA would require a change in approach in order to overcome its existing paradigms. Popular agency philosophy supported that if any money passed hands between industry and NASA, it was done in the form of a grant, contract, or cooperative agreement.

NASA's Ames Research Center in San Jose broke that mold by developing, the Joint Sponsored Research Agreement (JSRA), a new method for NASA to conduct business with the aerospace industry. Maylene Duenas and George Lenehan were both instrumental when Ames entered into their pioneer JSRA with the University of Florida. The objective of this partnership was to allow NASA and a profit-making partner to fund a university to perform patented-producing research. The JSRA addressed the concerns associated with government funding of profit-making corporations without engaging in the normal procurement process.

Another by-product of the JSRA was the birth of a small company, American Technology Initiative (Amtech) in 1989. Amtech was formed out of NASA's need to fully investigate the transaction authority of the 1958 Space Act. This act was also used to interpret what legal instruments were appropriate to use when the agency conducted business with industry. Sally Mauldin, legal counsel at Langley Research Center, supported that implementations of the space act have not always utilized its full power. Amtech employees worked with the agency and its legal department to determine the benefits and repercussions of the JSRA to technical research. The initial interpretation of this type of collaborative development work defined NASA's only possible partner as a non-profit organization such as a university. As NASA gained experience in adhering to this type of agreement, both the varieties of partner organizations and work interpretations became broader.

Eric Brachhausen, Vice - President of Amtech, was able to define the limits of applicability of a JSRA:

A JSRA is not appropriate when

✗ Government recognizes it should be involved in a straight procurement.

✗ Transaction is reduced to the commodity level.

✗ Acquisition is for a known and articulated purpose.

A JSRA is appropriate when

✓ Pathway is not known and decisions need to be made jointly.

✓ Product is not a production quantity but a prototype.

✓ Objective is technology development rather than an acquisition.

Figure 2 – Applicability of the JSRA

Initial resistance to the use of the JSRA came in the form of nay-sayers who believed NASA would not attract industry partners into this type of arrangement. However, the first JSRA at Ames was well received and the research successfully generated three patents. The JSRA, as it was crafted for Ames Research Center, demonstrated the agreement had the flexibility to represent the needs of a dynamic technical environment.

From a legal perspective, the JSRA addressed the issues surrounding collaborative development. It set a framework for *management of collaboration* by describing the working boundaries and organization structure for the parties involved. The JSRA also served as the working document for the high-level *allocation of responsibilities* and described the primary roles of all parties. Administrative tasks such as *payments for development services* were also addressed in the JSRA. The agreement outlined a fund-matching strategy for industry and government to meet the cost of shared technical development. Both industry and government had basic *reporting commitments.* Industry partners were obligated to report both budget and project status to NASA. According to the agreement, government held the primary responsibility of overseeing information sharing through reporting to all parties. The last recommended section of a collaborative agreement from a legal perspective deals with *ownership of joint inventions.* The JSRA clearly addressed the intellectual property and disclosure issues associated with joint development.

The experience at the Ames Research Center confirmed that the JSRA was a viable option for the formation of general aviation's AGATE alliance. However, a great deal of planning would be required and in order to gain industry buy-in. Kevin Cooksy from Amtech recalled that Bruce Holmes did a lot of the work of circulating through the universities and industry in terms of pre-selling what could be done if everyone would work together.

Bruce Holmes said the following about the type of partnership government had hoped to accomplish:

> "When you're trying to work as a partner with someone, if you have to write it into the contract, you don't have a partnership, you don't have a mutual strategic alliance of mutual strategic interests. So it's a little bit different, and what I wound up doing, because I had developed relationships of trust with folks in industry over a long period of time. I mean I was able to rely on them to give me information for planning that the government would have had to pay for if we had done things conventionally. We would have put a contract out there and said hey give us your plans. Instead ... we had a trusting relationship and could say let's talk about your plans. Can they be relevant to this vision, for our future if we asked you to work with your competitors? And we sat down at a lot of tables over a lot of late night dinners and a lot of midnight phone calls and a lot of weekend phone calls and visits, that were necessary in order to get the job done, in order to get the plan done. Of course, folks who work in programs in NASA already do these things. They already work long hours, they already work on weekends and they already take phone calls at home and all this kind of stuff. But typically, that's what they do with their other government partners, other government employees. They don't very often do those kinds of things with their private sector partners and their university partners. So what I'm suggesting here is that what you do is you expand the way you treat others from just the way you treat other government employees to the way you treat and make yourself available to and accessible to private sector organizations. So it's a little different dimension than from the way we began. And still at the same time recognize that we have a responsibility to the ethics laws that we need our private sector partners to understand in a way they've never understood before."

The AGATE Alliance applies the JSRA

Bruce's legwork was instrumental in helping industry adjust to the idea of the JSRA. Amtech supported him throughout the process and together they worked to resolve many of the strategic issues surrounding the design of the consortium.

The JSRA used for the AGATE alliance had a broader scope than its predecessor. It had to address the needs of NASA, industry, universities, non-profit organizations, and other government agencies. As an R&D consortium several decisions had to be made about the operating procedure and purpose of the alliance. The JSRA was used to outline most of these procedures. It was decided up-front that the alliance would focus on pre-competitive development. And, the overall objective of the alliance would be to establish standards and guidelines that would serve the entire industry. Sally Mauldin, Senior Attorney at Langley Research Center, recalled drafting the AGATE JSRA:

"We basically wrote the agreement from scratch. I received a lot of support from the general counsel's office, in particular from the intellectual property lawyers. I had a lot of discussions with the general counsel's office, and ... the procurement legal counsel, as to the extent that they could put their eyes on it even though it wasn't a procurement... But the fact was that this agreement because of the dollar value involved had to be signed by the Associate Administrator. So that person would have looked to them [procurement counsel] at some point for legal review of the agreement. My thought was, and frankly I think it was a good one, was that I should get them involved in the developmental stages. Instead of doing the JSRA without their counsel then sending it off and having to withstand a lengthy review process before it was signed. They were more than willing to sit down and talk with me in terms of the drafting of the agreement. The intellectual property lawyers did a lot of the drafting of the IP conditions.

When we were getting close to having what we thought was a final draft, it was sent out to a number of key potential participants for their comment... universities and companies that Bruce knew were going to be interested. I don't remember the number, but I would say approximately a dozen. My involvement at that point was to field questions, concerns, and deal with issues that were raised by those people who were reviewing the first draft. To the extent that we could negotiate a particular term or condition, we were more than willing to do that. So I spent a lot of time doing that. We definitely took into consideration all of their input and made those changes that we thought were A) appropriate and certainly B) legally acceptable.

So that process basically occurred over I would say about a 9 to 10 month period of time. The agreement was signed by Wes Harris, who at that time was the Associate Administrator. I believe it was November of 1994. When Wes Harris signed the agreement, that was NASA's commitment to enter into this relationship with whomever agreed to sign up to the terms and conditions of the JSRA. Previous JSRA's had involved only one other party. Until the other parties began to sign up there was no bilateral agreement, but once they did they became bound to the terms and conditions of the JSRA."

From Eric Brachausen's perspective, as vice-president of Amtech, three important factors needed to be addressed for the alliance to work. These were (1) the degree to which the work is pre-competitive or competitive, (2) agreement in terms of sharing of information or technology rights, (3) type of cost sharing between government and industry. The AGATE JSRA addressed all of these issues.

An organizational structure was defined in the JSRA where the executive council, who are primarily industry members representing each technical area, was named as the governing body. Technical teams, which Bruce Holmes called work packages, were positioned as the primary organizational unit within the alliance. A member of each technical team would also sit on the technical team

council, whose objective was to prioritize R&D goals for the entire alliance prior to technical team presentations to the executive council (Figure 3).

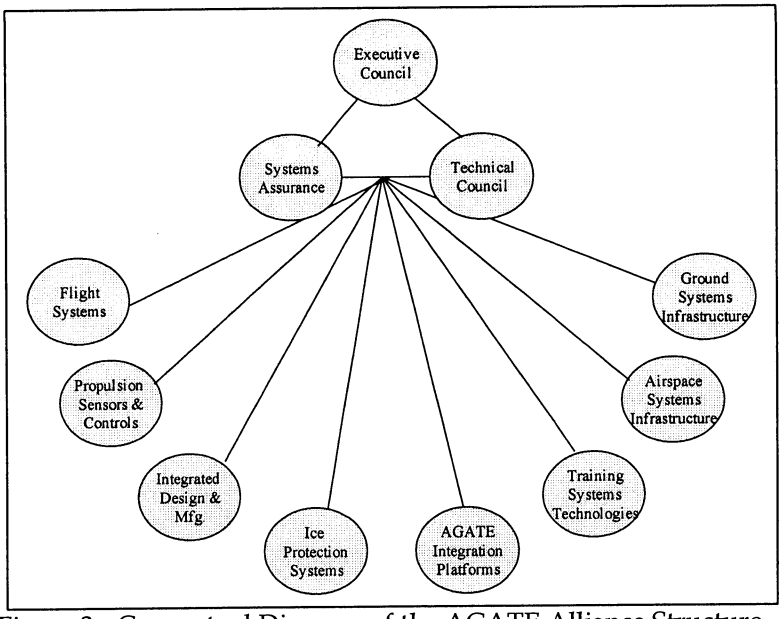


Figure 3 - Conceptual Diagram of the AGATE Alliance Structure

The JSRA also defined membership categories for the participating organizations. Each membership category had its own funding arrangement. Reporting arrangements were outlined for all members. The agreement also detailed framework for intellectual property issues that could emerge due to collaboration. The advantage of the JSRA was the degree of flexibility it provided to all of the consortium members.

Within the structure of the AGATE alliance (Figure 4), the industry partners retained much of their autonomy and were able to contribute fairly (based on the membership category) to the decision making process within their work packages. Each work package had the flexibility to make its own sharing arrangement. According to the JSRA, sharing arrangements must be disclosed at the time each work package proposed its work in the upcoming year to the Executive Council.

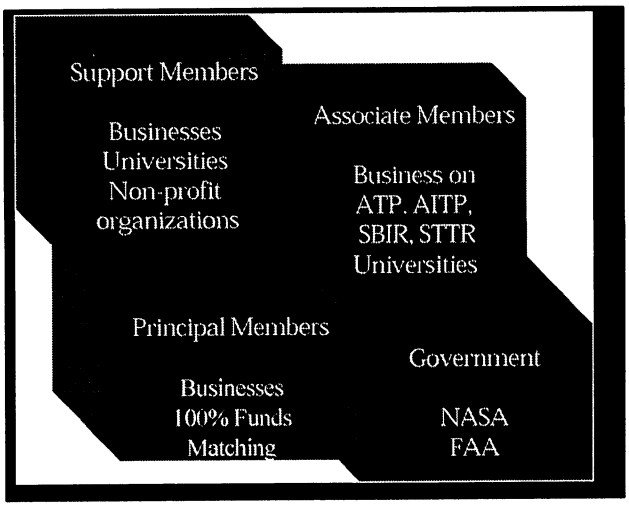


Figure 4 – AGATE Alliance Members

In fact, the AGATE alliance has really helped the use of JSRAs to come into vogue at NASA. The agreement provided both structure and flexibility to address the needs of the alliance and each of the consortia working within the alliance. Bruce Holmes' commented on the subject of flexibility:

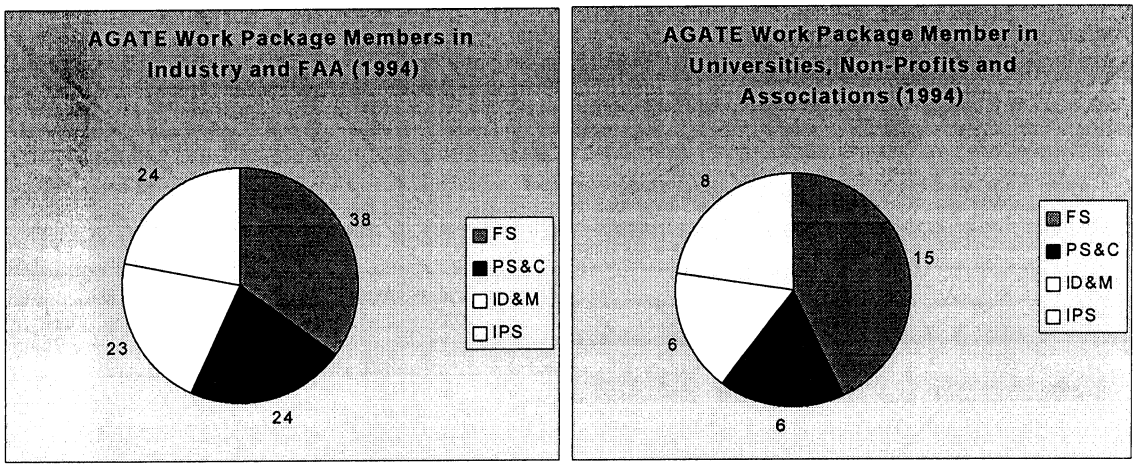
> The only reason AGATE could succeed in designing its solutions is because we had the flexibility allowed under the policies that the office of general council and the chief councils at the centers were able then to work with us to develop the JSRA, terms and conditions, flexible. We never ran into a problem we couldn't solve. We never ran into a management problem we could not solve. And the reason was because of the flexibility of the space act and the JSRA under the space act, to make things work.

Work Packages

In 1994 when the consortium was officially formed, there were five work packages: Flight Systems, Propulsion Sensor & Controls, Integrated Design and manufacturing, and Ice Protection Systems corresponding to the four technical areas recommended for revitalization in the GA Task Force Report. In their report, the task force recognized the following areas as most important for industry revitalization: (1) Propulsion, Noise and Emissions; (2) Aeronautical Systems; (3) Structure and Materials; and (4) Aerodynamics. According to Paul Masson, originally of Amtech, the work packages were also formed to represent different technical areas of an intermodal transport plane relevant to revitalization. Grouping each work package by technical specialty also allowed the work packages to be viewed as a technical forum for participants to air untried competitive ideas.

Membership in the AGATE work packages grew in the last three years along with the number of work packages in the alliance. Membership in 1994

was in the first four work packages and is shown in Figure 3. In the 1996-97, the alliance proposed organizing six more work packages. Work package #5 - AGATE Integration Platforms, originally conceived in 1994, was also included among the new work packages because it held no industry members with a primary interest in that task.



1 = Flight Systems (FS)

2 = Propulsion Sensor & Controls (PS&C)

3 = Integrated Design & Manufacturing (ID&M)

4 = Ice Protection Systems (IPS)

5 = AGATE Integration Platforms*

6 = Training Systems (TS)*

7 = Airspace Systems (ASI)*

8 = Ground Systems Infrastructure (GSI)*

9 = Aero/Acoustics (A/A)*

10 = Program Analysis (PA)*

11 = Systems Assurance (SA)*

Figure 5 - Work Package Membership

Operations

There are three types of membership in the AGATE alliance: principal, associate, and supporting members. Each membership type has specific requirements and benefits. As stated in the AGATE Business Operating Handbook (1995), principal members receive all deliverables from the partnership and are entitled to NASA funds. They must contribute resources to match the NASA funds. Associate members who are non-profit organization must agree to provide matching contributions that could include reduced overheads, personnel time, facilities and background technologies. Associate members who belong to NASA's Small Business Innovation Research (SBIR) or Small Business Technology Transfer (STTR) program are not required to contribute matching funds. All associate members receive the deliverables from the partnership and are not allowed to receive NASA funds unless performing for a principal member. Supporting Members are invited to participate in meetings and workshops, are not required to contribute matching resources, do

not receive the deliverables of the partnership, and are not entitled to receive NASA funds unless selected as a performing organizations by the Principal Members. All work package members are expected to pay membership dues to defer administrative expenses and only Principal Members may vote.

It can take up to a year for a new member to climb the learning curve involved with belonging to a work package. This includes fully understanding the required reporting obligations. Although the JSRA allows industry and government to function as partners for the most part, many of the organizations involved view the amount of detailed reporting as the one area where the agreement falls short of the intended partnership. The JSRA is successful in achieving a cultural paradigm shift at NASA. At the legal, acquisitions and strategic business levels, NASA and industry have been able to achieve a true working partnership through the JSRA. However, industry and NASA seem to revert to contractor mode when addressing fiscal issues. Paul Masson, formerly of Amtech, made the following comments regarding the partnership:

> "Partnering unit at almost the day to day management level, a partnering unit at the financial management and disbursement level. One of the factors in this project is that some impressive private sector people have made the strategic level partnership along with day to day management level partnership and the project level partnership... And I want to put this in the right context, this tool [the JSRA] ... seems to be a tremendous improvement for the government. But in terms of language, the FMD [Financial Management Division at Langley Research Center] implementation of this particular alliance is the only place where customer to contractor language is still used. Every place else the language is partner, joint decision making, and providing support."

New members also have to buy-in to their work package. This means that a new principal member must provide matching or in-kind funds equivalent to that of each other work package members throughout the course of the work package. If the cost to buy into the work package in 1994 was $200,000 and in the subsequent years each member contributed $150,000, the 1997 cost to buy into the work package would be approximately $500,000.

Communication

Communication is vital to the survival of the AGATE Alliance. Although the exact membership numbers vary throughout the year, as of July 1996, AGATE members hailed from 31 states. They were at that time "40 principal members, 6 associate members from industry and universities, and 30 supporting members from universities, industry and non-profit organizations" (NASA Fact, 1996). Because the membership is across organizations and members are not collocated, except for a few times a year, one of the greater challenges work package leaders face is communicating with their group.

In general, work package leaders meet with their teams 2-4 times a year. These meetings last for at least couple of days. Meeting agendas for work packages include problem solving, planning, and operational items. Meetings are also a good time for the technical teams within each work package to share their accomplishments with the group. It has become routine for a work package to address several sub-problems within their team. The general process is as follows: work package members will decide to support a project, present their proposal to the Executive Council, gain approval, select a technical team leader, and finally form a technical team of those members who are interested in that project. Technical teams have more frequent communication than just their work package meetings. Technical teams in the Flight Systems Work Package lead by Paul Stough meets up to twice a week. They usually contact each other through e-mail, teleconferencing, and memos to work together on their projects.

Organization Structure

Each work package is headed by a work package leader and decides its own internal organizational structure. The work package leader is a NASA employee and may act as a facilitator, team builder, champion, troubleshooter and any variety of roles as needed. The team members negotiate among themselves what will work best to achieve their tasks. Not only is structure determined when the work package decides who does what and how. But deciding who owns which tasks also is an opportunity for the work package as a group to address each participating organization's agenda for involvement on the AGATE team. As a rule of thumb, smaller companies tend to have shorter-term goals and wish to participate in AGATE tasks with a 1-2 year end date. Larger companies tend to have longer-term goals and are interested in R&D oriented tasks with a projected completion date of up to 4-5 years.

Addressing the issues of agendas, goals, responsibilities, and structure helps each team find a group process that will work for their work package. In practice, however, most of the techniques used for team building depend on the work package leader. No formal decision making process is imposed on the work packages, however, in general each team usually chooses consensus decision making as its default method.

Councils

Paul Masson remembered the genesis of AGATE was an organizational structure and those involved with the design of the alliance set out to mimic the design of lean organization. Bruce Holmes recalled that the AGATE structure was determined by studying other consortia such as the MCC (Micro-electronics Communication Consortium). Others from industry felt the development of the AGATE consortium had a real grass roots feel. In reality, the formation of AGATE contained all of these characteristics. As an initial model, Bruce and

Amtech created an organizational structure based on what was known to be successful in R&D consortia. And, as the AGATE consortium was put into operation, there was enough flexibility in the model for the structure to adapt to the needs of its members.

The executive council was part of the original AGATE design. And, in the summer of 1995, the work package leaders formed the technical council once AGATE was already operating. Bruce recalled the formation of the first executive council:

> We established the AGATE executive council as a representative body elected from each work package. To be a board of directors, to act like a board of directors, for the AGATE consortium and be responsible for the strategic directions of the program. So that became the basis by which we did that.
>
> We held the first election of the board in 1994 down in Lakeland, FL at one of our two annual meetings. And, I still remember very vividly being able to announce the results of the election of the board of directors and step back myself, on the stage, and have them step forward as the governing body of AGATE.

Executive Council

The Executive Council is AGATE's ruling body. According to the AGATE JSRA, the executive council consists of one representative of each technical team, one representative of each federal agency that becomes a government member, invited parties by the GA Program office, and invited observers selected by the GA program office. John Gallman from Raytheon acts as the Integrated Design and Manufacturing (ID&M) representative on the Executive Council. He described the role of the executive council as reviewers and supporters of policy, procedure, and budget. John also viewed the executive council's role as one of establishing advocacy within the consortium. Bruce Holmes also stated that if the executive council was unable to review and support technical plans and budget of any work package than those issues immediately became his action items.

The executive council usually meets bi-monthly and is concerned with the success of all elements of the AGATE program. At this level, the focus for planning and implementation is less technical and more strategic. The chairperson sets the agenda for the council meeting and the discussion is generally focused on policies and procedures. Because of the volume of items on the paced agenda, non-voting members can no longer join in the discussion of all items but are instead restricted only to the items they have submitted to the agenda.

From a strategic standpoint, the executive council is an extremely cohesive group. Because of its size, the voting team members quickly develop

rapport. Steve Hanvey, Executive Chairperson 1995-96 and formerly of Raytheon Aircraft, recalled that non-voting members canvassed and lobbied informally at meetings in order to have their positions represented. Steve also met on occasion with Bruce Holmes to discuss team building and other miscellaneous tasks associated with the council. As the executive chairperson, Steve initially agreed to a time commitment of 4 hours per quarter for planning, communicating between meetings, and reviewing documents. In reality, he approximated spending about 24 hours per quarter on executive council business. Steve said that the time he spent on AGATE business, however, was also due to a personal commitment to general aviation. Actually, personal commitment to the industry seemed to be a consistent internal motivator for everyone involved in the project, government regulators, and industry giants alike.

Technical Council and Work Package Leader Meetings

Typically, organizations adhere to the following structure: "top level management begins with the Chief Executive Officer, then Chief Operations Officer, ...a management council, and at the lower levels project management", Paul Masson commented. It became quickly evident to the AGATE alliance there was no formal management council function in place. The purpose of a management team is to allow project managers to share ideas and prioritize tasks. This council represents an opportunity to provide a forum for formalized horizontal integration among the work packages.

However, after one year of operation, work package leader meetings emerged as a less formal and more organic forum at the work package management level. Tom Bond and Jeff Musgrave, work package leaders at the NASA's Lewis Research Center, recounted the formation of the first work package leaders meetings:

> "One of the things that really made, in my mind, the success of this program, is that it's so decentralized. It is quite surprising to me, how much extra work that added. Maybe it shouldn't have been, but when I actually got into trying to maintain, even the infrastructure of my work package element, let alone all the stuff we do between the NASA people, it just became more complex than I ever thought. One of the things we did as a group to try and manage things, we started what we called 'work package leader meetings.' There was an inability to communicate and resolve specific problems at our level in the program structure. We have what we call 'AGATE management team', and that still didn't address the issues specific to many of our problems just in terms of how to deal with constant problems that came up in a work package, and they turned out to be common in all the work packages, so we instituted these quarterly 'work package leaders' meetings."

The work package leader meetings along with the technical council serve the function of horizontal integration among the work packages. Although the issues discussed at the work package leader meetings have not been as pressing

as those of the first meeting, it is likely the meetings will again become consequential when the alliance moves towards finalizing the AGATE standards and guidelines. Bond and Musgrave agreed that the work package leaders viewed the their quarterly meetings as an opportunity to reduce the effects of being insulated technically and programmatically when in their own work packages. They saw the meetings as a great opportunity to acknowledge and address the ripple effect that decisions from any work package may have on the others. The technical council continues with a more formal agenda managed by the AGATE program office.

Embracing the Entire Community

No doubt AGATE's success will depend on its ability to effectively engage the entire general aviation industry into its plan. The alliance has already reached out to many of the players in general aviation. This includes the FAA, universities, as well as small and large manufacturers. The expectation from each of the players is the same — to have them share in the AGATE vision. The execution of each of their roles however contributes uniquely to the AGATE consortium.

The FAA

AGATE members are most directly involved with the branch of the Federal Aviation Administration called the Small Plane Directorate whose headquarters is in Kansas City, Missouri. This branch of the FAA is primarily responsible for the continued airworthiness of 90% of the aircraft fleet in the U.S., which includes all small non-commercial vehicles such as gliders, hot air balloons, and general aviation aircraft. Several smaller field offices responsible for management, direction, and oversight are located throughout the country.

The FAA has long been a significant force on the general aviation industry. Through regulation, policy, and certification, the agency can impact the level of production of general aviation aircraft just as strongly as changes in market conditions. Dan Goldin and Bruce Holmes recognized the impact of the FAA on general aviation and immediately involved the aircraft regulation agency in the revitalization effort. This new union between the FAA and the general aviation revitalization effort came at an ideal time. John Colomy, Manager of the FAA Standards Office, remarked that over the last decades into the early 90's the FAA was continually moving toward tighter standards for certification. In 1991, the FAA formed a committee, along with industry team members, to examine the rules and certification process. Two separate teams were involved with this simplification program and each came to the same conclusion. According to John Colomy, both teams concluded the FAA regulations were not the cause of complication in the process. Instead the teams identified that problems stemmed from the cost associated with the testing

methods used to show compliance. The teams identified that although the regulations were focused on enforcing the agency's airworthiness objectives, the methods used for certification had not been revised for decades. Often, antiquated methodologies for testing impeded the process for new technologies to meet compliance.

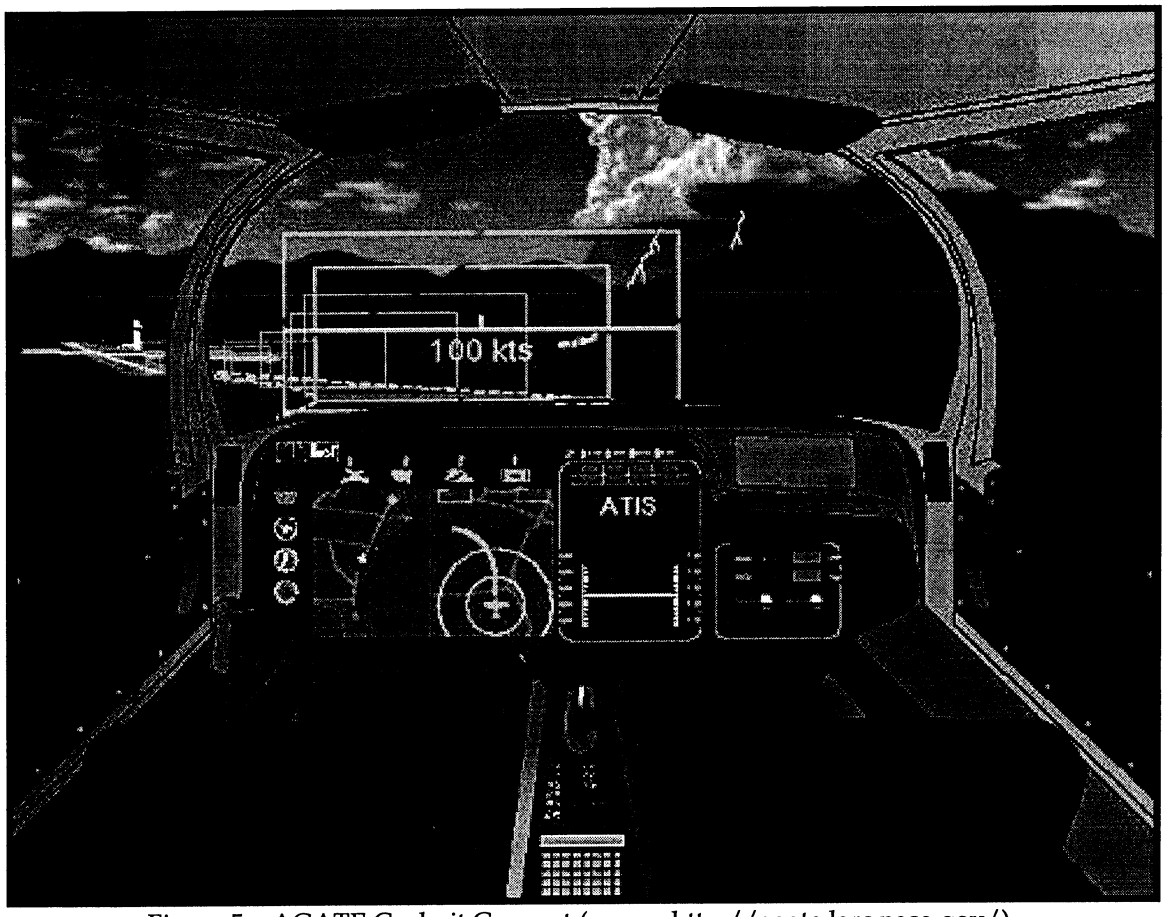


Figure 5 – AGATE Cockpit Concept (source http://agate.larc.nasa.gov/)

The time was right for change at the FAA. Working with AGATE provided the agency with a vehicle to promote change within their organization and within the industry. Prior to their AGATE involvement, the FAA was already investigating interim certification methods that could address new technologies and add value to the process. These included methods that would reduce cost of FAA approved products and services, an important strategy for the agency due to the availability and avid consumption of non-FAA approved technologies by the general public.

The AGATE cockpit concept will deliver a multitude of new technologies to the general aviation market. But, in order to mass-produce aircraft these technologies must be certifiable. Clearly, managers on all sides realized that including the FAA in the process would become the surest way to jointly and quickly create the standards required for benchmarking a satisfactory and

quality product. Tom Freeman and Paul Stough speak about the advantages and realities of AGATE involvement with the FAA:

> "Those are experimental systems that are leading towards what we hope will be improvement... The FAA is very slow in change...What's important here is these technologies are very rapidly happening and I think Bruce even relates this back to that there were cars before there were roads, there were ships before there was transoceanic navigation and all those sorts of things. So you really have to have the technology well advanced before there is a demand to generate a new system. We are moving in a direction away from the current FAA observation radar approach where the pilot follows the comments of the ground controller to a situation where the airplane will be virtually autonomous. Software will tell the pilot where he is at all times and where everybody else is. He will essentially be able to make his own choices."

> "The incentive to industry I think is that, as Tom pointed out, individually trying to change the way things are done might drive some of them bankrupt, trying to be competitive by introducing a new technology that makes a product better, they endure the burden of showing the equivalent level of safety or that they meet the requirements. Whereas, collectively industry can say, we agree that this element is something we all need and we can agree on some standard for it, therefore we can share in developing a database for convincing the FAA that this is an acceptable...They share the risks, they share the expense and all benefit equally."

John Colomy also expressed a personal commitment to the general aviation industry and has worked earnestly with Bruce Holmes to make the headway needed for FAA representatives to sit on work packages and for the FAA to become a government member of AGATE.

Each AGATE work package currently has an active FAA representative. These representatives agree that AGATE provides a unique opportunity for industry competitors and the FAA to work together to find a common solution to technical problems. Work package involvement has definitely provided a means for breaking down industry fear and mistrust of the FAA. Although each FAA work package representative views his role slightly differently - some consider themselves mentors, cheerleaders, researchers, and information providers but interestingly enough no FAA member in AGATE viewed himself as a representative of the old way of doing things. Jeff Musgrave, Propulsion Sensor and Controls Work Package Leader spoke about the initial difficulty his work package had had defining a clear role for their FAA representative:

> "Part of the problem is that everyone wants the FAA to tell them what to do, and that's not the FAA's job. The FAA's job is to determine if ...is certified. And for some reason, that is the hardest thing for people to

accept. They want the FAA to change its role. Instead of certifying technology, they want them to tell them what's acceptable. And they are not going to do it, and they shouldn't do it anyway, because that is like the government telling people how to be safe. Their job is just to take a look at policy and see what's been done hardware-wise, and say yes, this meets that criteria and it's acceptable. There are a lot of preconceptions even within the companies at the engineering level about what is acceptable to the FAA. So it is nice having our FAA representative there dispelling those preconceptions."

AGATE involvement was directly responsible for a recent meeting the FAA held in Washington, DC for all general aviation manufacturers. The purpose of this meeting was two-fold: first, to provide small plane manufactures with limited experience in FAA certification with the basics about current certification methods; second, to provide all general aviation manufacturers with a forum for open dialogue with the FAA about the changes necessary to allow certification of advancing aircraft technology. Overall, the meeting was a success, although some industry members felt more discussion of coming technology was needed to ensure participants left the meeting with a shared vision of upcoming changes.

Deep Pockets and Little Giants

The relationship between small and large companies in the general aviation industry is becoming increasingly symbiotic. AGATE has created a means for smaller companies to engage in R&D efforts that have potential benefit for larger companies who can later develop alliances with smaller companies to incorporate the new technology in their commercial aircraft. According to Ed Hooper, independent contractor for ID&M Systems Engineering and many of the work package leaders, the companies in the alliance can be broken into two types. The first group consists of companies with financial stability that can afford to take a long-term approach. These companies are looking for R&D development that can be incorporated into their product plan in the next five years. And, the other group of companies consists of smaller businesses with financial survival issues who are operating on a much shorter R&D horizon, generally about five months to year. These companies hope to gain almost immediate benefit from the technology developed or standardized in the alliance. For the work package leaders, it's a game of give and take to accommodate groups who have "long-term" goals on the opposite end of the spectrum.

Noel Duerksen, Technical Specialist, at Raytheon Industries and member of the Flight Systems Work Package commented on the dynamics involved as small companies and large companies struggle to have their agendas met:

"There's some really interesting dynamics that are happening, especially in the Flight Systems work package. Part of the background to that is the Flight Systems work package is very large and there are many different companies doing a lot of different things. Flight Systems is everything dealing with the cockpit of an airplane. It includes electronics companies, like Digital Equipment, who typically aren't involved in airplanes directly. It includes Raytheon Aircraft, who's a prime airplane builder and small companies who have just a few employees that are hoping to become avionics giants. So there's a lot of interesting dynamics.

The small companies, of course, are very interested in staying alive next year as a company, so their research interests are very much more short term, what they really want is for AGATE to help them get a product in the market place next year. Some of the larger companies aren't very much interested in that, especially from a pre-competitive point of view. The larger companies can't be involved in the consortia where they give away the secrets for next year's product. So we have this dichotomy of long term, short term. One of the really interesting things that has taken our work package quite a while, a couple years to figure out, is who has which agendas and are those agendas acceptable. Because of course, we all don't come to the meeting and say my agenda, besides So after a couple years you figure out what each company's agenda is i.e. Company X needs to get an avionics box out in the next two years. Then, we as a consortia have to decide, is that company a valuable asset to our consortia, with or without their agenda, because they come as a package deal. We just have to decide, if we think that they are a valuable contributor. We just have to accept their agenda along with it, and we may have to accommodate some of our planning and funding a little bit to keep them happy, if they are giving something in return which is worth the price that we're paying, to satisfy their agenda. And they of course then, don't get their agenda entirely either because they're as a company doing the same thing. Well we're

SBIR and STTR Funding

As Dr. Bruce Holmes began to fit the pieces together for the AGATE program there was one nagging question. How could he involve the small businesses in the program? These small businesses were highly interested and working hard in the general aviation area but they could not afford to share 50% of the cost of the development efforts like the larger companies. He begin to share his vision with Thayer Sheets who ran the Small Business Innovative Research (SBIR) Program at Langley Research Center (LaRC). The purpose of this program is to develop new industry, create jobs, and eventually to get a return on investment by broadening the tax base for the United States.

Together, Bruce and Thayer developed a plan in which small businesses interested in the general aviation work could propose their innovations to the SBIR program. These proposals would be peer reviewed just as the rest of the SBIR proposals, and if accepted, would be funded as part of the SBIR Program. Some of these funded efforts would become part of the AGATE program. Later, Bruce and Thayer took advantage of the newly formed Small Business Technology Transfer Pilot 'rogram (STTR) that was formed in 1992 to allow non-profit organizations and universities to participate in an SBIR type of program.

Today general aviation is listed as a topic under both the SBIR Program and the STTR program, as a specific area identified for receipt of proposals and for funding.

SBIR proposals are submitted for funding in two phases. The first phase is for a six-month feasibility study and is funded up to $70,000 dollars. Approximately 10% of the proposals received for this phase are funded. The second phase is for a two-year research and development effort and can be funded up to $600,000 dollars. Approximately 50% of the proposals are funded for this phase. The second phase of the program requires that the small business enter a partnership with a larger company. The larger company must commit to funding 50% of the effort and to aid in marketing the product. All companies involved must show intent to go to market with the product in 2 years.

As a result of the efforts of Bruce and Thayer over $30 Million dollars of the SBIR budget has gone to general aviation in the past 6 years.

not getting our agenda entirely out of this AGATE thing, but is it worth being involved in this AGATE consortia. It's a lot of give and take that has to do with companies' agendas. That's something that's taken our work package quite a while to figure out, but I think we've finally done a fairly good job of it!"

John Tomblin, assistant professor in the Department of Aerospace Engineering, at the University of Wichita, is a supporting member of the ID&M Work Package. He has also witnessed the struggle as the work packages try to decide how to accommodate both short and long-term goals. He stated that if consensus could not be found within the team, then when "worse came to worst in order to resolve conflict the work package can use principal member vote."

Another advantage of the work package format is companies are given equal access to decision making regardless of size. All principal members adhere to the 'one company - one vote rule. Jeff Musgrave's, Work Package leader from NASA's Lewis Research Center, and his engine control team met in June 1997 and planned to fully utilize the advantages that equal access provided when the work package met to complete their R&D plan. Jeff believed equal voting policy helped to give all team members a sense of empowerment.

What follows are two examples of AGATE involvement: Raytheon Aircraft is a large established aircraft producer; and, Seagull Technology is a younger, smaller company that has been supported by NASA STTR and SBIR funding programs. Each company represents the diversity of opinions and abilities in the AGATE alliance, however, regardless of size and means they are both strong supporters of the AGATE vision.

Raytheon's Dr. Noel Duerksen, Technical Specialist

"We are building a demonstration airplane, an experimental airplane and it's really interesting how that has evolved. Raytheon Aircraft owns the airplane. But there's a company, Avrotech, that's as far as I can tell it's got a grand total of employees of three, they are the lead for that project. Collins Avionics is doing a lot of the integration. I'm the major airplane company and I'm putting it all together in my airplane but I'm not managing the project – they are.

I'm comfortable with that, as a major airplane company because it has a lot to do with the quality of the individuals involved and their commitment to the project. There are a lot of complex things: software integration, avionics, electronic boxes, and ground transmitters. I'm not involved in that's happening. You might say wow, this is kind of odd. We don't normally do this. It's a real flip flop from normal business. Usually, the air framer makes sure he's got his finger in everything, but in this case I don't have to because they're doing their job. I just make sure the boxes fit ... They bring the boxes, they provide the boxes, and they make sure they all talk to each other. Kind of an interesting and very different way than we've done business before. So far it's working.

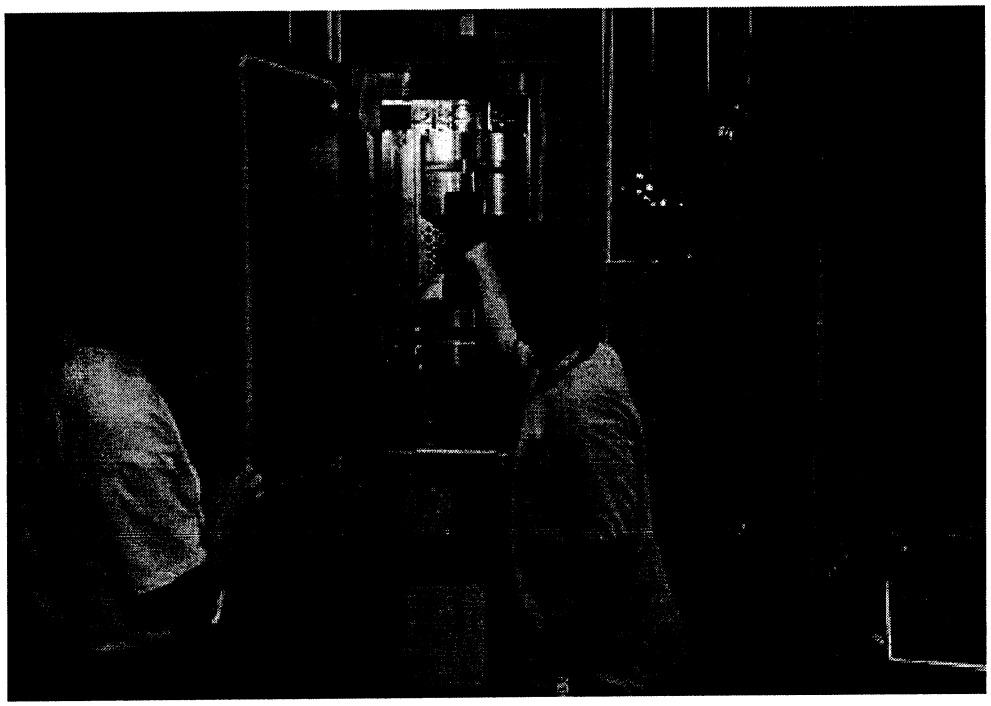
Seagull Technologies, Dr. John Sorensen, President

"The AGATE program was an opportunity for us to contribute some ideas. And so we first got an SBIR with NASA to develop an open architecture moving map display system that combines low cost PC, VHF radio and GPS technology and that has lead to our product line called General Aviation Information Management System (GAIMS). And now this year we're working with the AGATE consortium to evolve that to be basically the driving software for the multifunction display that's going into one of the demonstration aircraft. Part of what we're doing is adding the ability to put a layer of weather information and a layer of traffic information from a basic navigation display. We've got another contract which is called a STTR, which is a technology transfer, it's a derivative of the SBIR, but you work with a non-profit partner in doing the work. We're working with Stanford University to build a product which combines GPS sensors with rate gyros to build an attitude measurement system, drive the front of the flight display ... We're in our second year of that, that's coming along very nicely. We've got a product out there that's in a prototype stage. And, we're hoping to get further AGATE support, besides other industries, ... so we can take it all the way through a manufacturable prototype and then eventually go through the certification process. So that's ... involvement in AGATE. We have the moving map display and then the attitude sensor package."

University Contests and Contracts

There is no shortage of innovation in the AGATE alliance. The alliance has found two distinct ways to involve the university community in the revitalization effort. Much of the AGATE effort is focused on "Saving the Ailing Patient[1]" and the community has poured its heart and soul into what is needed to remedy the status of general aviation. However, AGATE's involvement with academia, as both associate and supporting members or through the National GA Design Contest, can be considered preventative medicine. Involving the universities in the revitalization effort provides young engineers, through their exposure to challenges currently facing the industry, the opportunity to develop an interest in this business sector. Many students are gaining hands-on experience in aircraft design and materials testing that might spawn a lifetime interest in general aviation.

[1] This is Ed Hooper's medical analogy for describing the AGATE effort.



Seventeen undergraduate and graduate students work under the direction of John Tomblin, Director of the National Institute for Aviation Research Composites Laboratory at Wichita State University. Through AGATE funding, these students are involved in hands-on research for the development of the materials properties database for the Integrated Design and Manufacturing work package. The students have developed a heightened awareness of the aviation certification process. Dr. Tomblin describes the lab's relationship with AGATE as a 'win-win' for the students and for the industry. (Picture provided by NIAR Composite Laboratory)

Membership

At last count, five universities held supporting membership and one other held associate membership in the consortium. A number of other universities are also involved in the alliance through specific contracts from principal members. For example, Wichita State University under the direction of John Tomblin, is conducting the development of a materials database for the ID&M work package. Rather than approach the problem of developing a database of material properties for new composites separately, members of the ID&M work package sponsored the university to generate a common database that could be shared. They agreed jointly on the material properties required in the database and benefit from the cost savings of each organization not producing its own proprietary database. Again, university involvement also has the added advantage of informing a new generation of engineers about the general aviation industry.

National General Aviation Design Competition

Enthusiasm about the potential success of AGATE is infectious and it seemed that everyone who spoke of the effort does so with great compassion. Mary Sandy, Director of the Virginia Space Grant Consortium, was no exception. Her office is involved with the promotion and execution of the design competition.

Goal:	*To create the basis for a small aircraft transportation system and revitalize U.S. general aviation through development and deployment of advanced technologies in new designs and retrofit products*
Members:	*Government, industry, and universities in a cost-sharing partnership*
Schedule:	*1994-2001*
Products:	*Industry standards for aircraft, training, and airspace systems; FAA certification methods; Engineering design guidelines for "best practices" in a user-friendly cockpit systems.*

AGATE Vision as presented in the National General Aviation Design Competition Guidelines

Each academic year, a bulletin about the competition is circulated to students nationwide at colleges with at least a four-year accredited engineering program. In the information package provided to students, they learn about the history of general aviation and the thrust behind the revitalization effort. Students and their academic advisors are asked to meet the design challenges set out for the following areas: *Integrated Cockpit Systems, Propulsion, Integrated Design and Manufacturing, Aerodynamics, and Operating Structure.* The intent of the contest is to incorporate the project into a course curriculum and this approach has been successful for the past three years.

Students submit a design package of up to 40 pages not including appendices. Each design package is evaluated and scored by industry members. Winners are announced at the Oshkosh EAA convention in July. First place award winners receive $5,000 for their academic institution and $3,000 for the design team. The second and third place design teams receive $2,000 and $1,000 respectively. In addition, there is a retrofit component to the design competition where students can address the challenges of housing new technology in existing aircraft. Winners of the retrofit competition are awarded $500.

AGATE Alliance Association Incorporation

The AAAI is a recent organizational development for the AGATE alliance and its main purpose is to provide administrative support for all non-government members. As a non-profit support organization, it hopes to address

many of the administrative setbacks the alliance has encountered throughout its operation. Regardless of the JSRA's successes in terms of fostering a strategic and legal cost-sharing partnership between government, industry, and universities, in the back office the JSRA still operates like a contract. Administrative tasks, such as financial transactions and reporting are very reminiscent of the standard NASA procurement contract.

For the most part, Amtech has maintained back office tasks for any participating member who chose to use this service. Back office functions included distribution of non-technology documents, maintenance of business operations, prompting members to comply with requirements, and, receiving and compiling the financial reporting documents. Amtech also could sanction those participants who did not comply with the reporting requirements up to $200 per month per document.

The AAAI has assumed all back office tasks originally maintained by the Amtech. Steve Hanvey former executive council member now acts as interim chairperson for this office as Bruce Holmes continues to look actively for a full-time replacement. The purpose of the AAAI office is to ensure small companies and large companies receive the service they require to survive financially. Part of the offices objective is to ensure efficient turn around of NASA reporting documents so that smaller companies can be paid for their services in a timely fashion. AAAI will assume the role of a central office for non-technical document and information sharing. Overall, AGATE supporters view this office's services as a necessary improvement because it frees the program management office from monitoring lower level details.

Looking Towards the Future

Looking forward on the AGATE timeline, there are four years remaining in the lifetime of the alliance. The original four work packages have had several years of experience working together to address issues and solve problems in their technical areas. These work packages are soon planning to author technical standards for their area. And, the work package leaders involved recognize that moving to this next phase will again cause a period of adjustment for their team members.

Systems Engineering

The role of systems engineering in the AGATE alliance has been a tumultuous one. This particular work package has been reorganized more than once during the AGATE lifetime. Part of the difficulty has stemmed from the recognized importance and value all of the work packages place on the systems engineering role. Everyone in the alliance views systems engineering as the glue that will hold all of these separate technical ideas from the work packages together — a rather daunting task for any single group.

This is an area where industry encourages NASA to take the leadership role. NASA has proven proficiency in this area and can provide staff with the dynamic range of skills necessary for the task. Because of the broad scope of the task, this work package may require more than a part-time commitment from industry members — more of a time contribution that most members are able to give.

Training Work Package

Agate's training work package also shares an eventful history. It is the only work package where the executive council has exercised its right to veto the annual proposal. John Gallman, ID&M representative on the executive council, recounted the decision:

> "If it's something that affects the overall health of AGATE or the overall health of the work package, then it will get discussed. Or the overall work package seems to be headed off in the wrong direction, which is a recent thing. The executive council did not support the training systems work package budget, etc. and it was basically sent back to be reworked."

The executive council viewed denial of the training budget as an opportunity to resolve some of the perceived internal struggle amongst the group members. The veto worked as an instigator for change. Since, then the training package has been re-invented and, because of the flexibility within the operation of the AGATE alliance, group members have chosen to move to a competitive bid structure.

Both of these work packages will have a more prominent role in the next phase of AGATE. Restructuring of both the training and systems engineering work packages, in the early phases will position them to meet the demands imposed on them while the AGATE guidelines and standards are generated.

Key Practices

The AGATE approach was revolution rather than gradual evolution to save the ailing GA industry. Bruce Holmes and Dan Goldin contributed to the **understanding for the need to collaborate** through communication to universities, agencies, and companies who held a vested interest in the success of general aviation. The **idea of collaboration was supported** by the creation of the AGATE consortium. This allowed R&D in general aviation to result from a **community of pooled resources**.

The desire to revitalize general aviation was shared by all levels of management in the industry. The alliance had **support from strategic level sponsors**, such as the NASA and FAA administrators; **from upper management**

champions, such as Bruce Holmes and John Colomy; and, from managers, engineers, and scientists acting as **change agents** through their involvement in AGATE work packages.

The **clear vision communicated** to AGATE members about the goals of the consortium can be attributed to its present successes such as Operation Heli-Star – where AGATE technology was demonstrated for the first time at the 1996 Olympic Games in Atlanta, GA. Bruce Holmes, Amtech, legal counsel and many others worked together to develop an **organizational template that would facilitate the vision**. The designers of the AGATE alliance incorporated those features they knew were important to the success of R&D consortia. This includes organizing team members to work together who held **shared technical and customer interests.**

The AGATE team structure, environment, and legal agreement all promoted a **high-level of flexibility**. **Extensive use of the JSRA** and the AGATE **Business Operating Handbook** allowed the alliance the right balance between formalization and the ability to choose the appropriate group processes which worked for each individual work package.

AGATE's strength also comes from its composition. The alliance has found innovative ways to **involve all of general aviation's allies**. Work package membership consists of three tiers: principle, associate, and supporting members, so that **companies of all sizes can be involved** in the effort. The special role that universities by involving students in AGATE projects which can play a part in **generating interest in the engineers, scientist, and aviators of the future** has been acknowledged and addressed.

Although each work package makes its own unique technical contribution to the AGATE cockpit, the training work package has the most potential to effect future pilots. Addressing the **issues of pilot training early** is one among many **forwarding-thinking strategies** the alliance chosen. Other strategies **include FAA involvement from the onset** of the alliance. This will ensure that the AGATE plane is certifiable once it is completely designed.

Continually improving the alliance is the key to satisfying the needs of all AGATE members. Bruce Holmes recognizes that every need of the consortium could not be anticipated at its inception. He is always willing to clear the path necessary for change, if and when changes to policy and procedure are needed. **Formation of AAAI** to manage and monitor NASA dollars on behalf of alliance members is a good example of AGATE's ability to adapt to member needs.

Case Summary

Like an airline hub at a major city, the AGATE alliance is efficiently and effectively structured. The alliance has had a powerful effect on technology transfer and application development in the R&D phase for plane manufacturers. AGATE fliers will have the choice of the best technology to provide information about fight systems, engine health, location and weather. They will be the first pilots to benefit from integrated information databases that link directly to the GPS satellite.

For all companies, agencies, and universities involved the AGATE investment is a valuable one. Together, by 2002, the alliance will have created a completely FAA certified AGATE plane that uses all newest technology. This plane will be affordable for its class and will present options for those commuters who live in remote sites, those families considering an 11 hour drive to vacation-land, and those pilots who just enjoy flying.

For those who hope to choose between a long car ride and a single-pilot state of the art plane that is just as economical for use for their transportation to their destination, keep a watchful eye on the success of the AGATE alliance.

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