



New Opportunities and New Boundaries: Accident Investigations Involving Engine Consortiums and Alliances

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Mike Gamlin is an Air Safety Investigation Manager for Rolls-Royce plc, responsible for the investigation of Accidents and Serious Incidents involving Airline and Defense engine types designed and manufactured by Rolls-Royce in Europe. He has worked for Rolls-Royce for 30 years, initially in the Bristol Engine Division, Defect Investigation Department as a Quality Engineer. He has been involved in the investigation process and multi-national consortia projects for over 20 years and has a wide range of investigative experience covering all of the companies Defense products. Involved in Air Safety Investigation since 1990 he has led the Air Safety Investigation team, responsible for European products since 2000.

New Opportunities and New Boundaries

Accident Investigations involving Engine Consortiums and Alliances

Michael S Bartron and Mike J Gamlin

Abstract

Aircraft accidents of decades ago are often looked upon today as much simpler than contemporary investigations. As aircraft designs grew in complexity and number, the related accident investigations also grew from component or hardware concerns to include complex systems and company processes. Over time, many propulsion system OEM's products also moved from in-house design and manufacturing to outsourced and vendor supplied equipment; finally assembled, tested, and shipped from the OEM. All along, the investigative approach still relied on the interested party members to gather and sort through their respective product.

Today, the lines between supplier and partner have blurred. Engine manufacturers have partnered and aligned with one another in order to share both costs and rewards in the highly competitive propulsion marketplace. While these partnerships consider the entire engine program life-cycle, the activity of accident investigations and safety processes across the partnership provides numerous challenges, new boundaries, and opportunities.

Investigations of consortium and alliance products face hurdles with on-scene investigator staffing, challenges with post-scene investigation of company-sensitive hardware, and barriers of proprietary product information.

This paper offers a look at the challenges of investigation from within a consortium and from the investigative authority, as well as the opportunities of communication and education toward safety processes. Ultimately, the success of accident investigations and safety actions within these alliances and consortiums rely heavily on communications across these new and sometimes blurred boundaries.

Intent

This paper is intended to provide insight to the challenges and opportunities of the investigative roles and functions resulting from the increasing variety of original equipment manufacturer (OEM) arrangements. The authors offer that investigative agencies and authorities, which have not yet worked with consortium or alliance OEM arrangements, may benefit from this familiarization to the subtle differences between these new organizations and the more traditional company participants to investigations. Additionally, these evolving company arrangements offer several opportunities to foster communication and education toward aviation safety concerns.

Participants to Air Safety Investigations

During the inception of powered flight, the early pioneers had their share of accidents and incidents. At that time, the investigations were focused on improvements in fundamental design and operations. These investigations helped propel powered flight into a commercially viable enterprise and forever changed the world. As the aviation industry grew and businesses began to compete for equipment sales and passenger and cargo revenue, aviation accidents continued to influence the existence of these companies. The revolutionary but ill-fated Comet pressured the de Havilland Aircraft Company's survival, but also brought about new approaches to accident investigation and aviation safety.

Recognizing the growing aviation industry, governments around the world identified both the need and benefits to either regulating or monitoring aviation operations. Consequently, in 1944 an international aviation conference was held in Chicago, attended by 52 'States', and as a result the International Civil Aviation Organization (ICAO) was founded and a Convention on

International Civil Aviation drafted. This draft convention was ultimately ratified in 1947, securing future co-operation across international civil air transport operations through 96 articles. ICAO continues this work today based in Montreal, as a United Nations agency.

Subsequent to the ratification of the Chicago Convention articles, eighteen Annex's, known as Standards and Recommended Practices (SARP's), were produced, which detail specific areas of operation. The SARP relating to aircraft accident investigation, designated as Annex 13 was adopted in 1951. Aircraft accident investigation activity continues today under the organizational structure outlined by Annex 13 (now in the 9th revision and agreed to by nearly two hundred States).

The context of Annex 13 provides contracting countries or 'States' the opportunity to identify a national (government) investigation agency to lead an investigation, if they are the State of occurrence, or to represent their State as an Accredited Representatives should the accident occur in another State. Additionally there is provision for the representation of national (State of) design or (State of) manufacturing organizations, by competent experts, through nomination by the national agency, for advice and consultation. Traditionally, the interested party's (technical advisors) were quite simply a single company, agency, or organization. But in today's world it may be necessary to recognize that individual companies within consortia and alliance companies may have the necessary expertise required to provide the best support for an investigation.

To preserve control of an investigation it is understandable that national agencies may want to minimize the number of people involved through party status at any investigation. Conflict may therefore arise as the OEM's attempt to provide support from different parts of their organization. This paper considers the issues and implications that arise with consortia support for the national agencies during an investigation.

Annex 13 provides an adequate framework for individual companies to join as advisors, but there is no recognition of consortia involvement.

The changing face of Air Safety Investigation

Aircraft accidents of only decades ago are often looked back upon today as having been much simpler than contemporary investigations. A review of investigation reports of the earlier era provides today's engineers with an insight to many of the design and safety requirements in place today. However the reports belie the engineering efforts required to reach the conclusions and identify the solutions that bought about many of these safety improvements, (and all done without the 'tools' we now take for granted.) The learning curve for early investigators must have been immensely rewarding, as investigations led to fundamental understanding, recommendations, changes, and actions.

So, in themselves the investigations may seem to have been easier, but the solutions rarely were. Often the boundaries of knowledge were pushed to identify new and innovative fixes to what were often 'simple problems'. In parallel, the solutions to the problems presented by the growing industry and the need to push the boundaries for bigger, faster, and heavier aircraft have led to today's complex and efficient designs and systems.

As aircraft systems grew in complexity and number, the related accident investigations also grew from component or hardware concerns to include these complex systems as well as company procedures and organizational arrangements. In 1994, with the loss of US Air flight 427, the investigative activity extensively considered systems design and operations, as well as maintenance procedures. The investigation continued for nearly four years and involved tests of components, systems, as well as flight tests. Today, we can expect accident investigations to consider aircraft and maintenance systems, as well as personnel actions and the related company procedures and policies. Having been prompted by the evolution from specific hardware designs to systems evaluations, today's investigators, similar to 100 years prior, help to feed continued improvements in aircraft design and operations.

Aerospace Globalisation

The aerospace business, like many others, has changed significantly in recent years. Technology advancements in materials, design tools, and complex systems, which ultimately lead to more efficient airplanes, were driven by business requirements and opportunities. By the same rationale, efficiency improvements within aerospace companies have been sought after through changes to organizational structures, from subtle reorganizations to mergers and partnerships. The companies have evolved,

like those in other high technology, capital-intensive manufacturing sector business', to become functionally integrated as well as globally aligned. Continued evolution and globalization of the aerospace business is resulting in the growth of collaborative alliances and contracting partnerships across North America, Europe, the Far East including the Pacific Rim, and Latin America, as companies seek to maximize the benefits of global markets, industrial capabilities, and systems integration [1]. These partnerships, alliances, joint ventures, and other arrangements involve both modest and dominant companies. They can often occur when an independent approach to a multi-billion dollar program becomes financially unreasonable or where partnerships offer companies new entrances to a market.

Partnerships and collaboration are an integral and important sector of the modern day aerospace business.

The advent of the consortium brings a problem that impacts not only the consortium companies but also the investigation agencies. It is in the interest of the consortium, for many reasons, to be involved in any accident or incident investigation. But the primary reason for any company to be involved in an investigation is the same as that of the investigation agencies; none of us want to have a second event, we all want to get to the root cause as expeditiously as possible. So when an accident involving a consortia product happens, who do the agencies want to act as advisors? One thing is for sure, they will not want representatives from all of the partners behind the consortium looking to join the investigation as advisors....whoever they are.

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Collaboration Agreement

Partnerships are not new; they have existed in aviation for nearly as long as powered flight. 2004 sees the celebration of the 100th Anniversary of the first meeting of Mr. C S Rolls and Mr. F H Royce, who were later to form a partnership that is today the continuing venture of Rolls-Royce plc. Today, Rolls-Royce, operating in a vast global market, finds partnerships and collaboration an integral and important part of its business. It is involved in many joint ventures, collaborative research programs and risk and revenue sharing agreements [2]. Unfortunately but ironically related to this subject, Charles Royce was killed in a French built Wright aircraft in 1910 and became the first Englishman to die on an aviation accident, only one month after becoming the first Englishman to fly across the 'Channel' and back again in one trip.

A current consortium, IAE International Aero Engines AG, was formed to produce the V2500 engine family. International Aero Engines (IAE) is a collaborative effort between Pratt & Whitney, Rolls-Royce, MTU, and the Japanese Aero Engines Corporation, which is much like a consortium in itself. Within IAE, these collaborative members are otherwise referred to as "partner companies".

IAE was formed in 1983, based on a 30-year collaborative agreement, registered in Zurich, with its corporate headquarters in East Hartford, Connecticut, USA. Pratt & Whitney and Rolls-Royce each hold a 32.5% share in the company, with JAEC and MTU holding 23% and 12% respectively.

Each of the partner companies took responsibility for one of the engine modules, JAEC are responsible for the fan and LP compressor, Rolls-Royce the HP Compressor, Pratt & Whitney the Combustor and HP Turbine, and MTU the LP Turbine. Engine assembly is the responsibility of Pratt & Whitney and Rolls-Royce. *Figure 1* depicts the allocation of responsibility of the V2500 engine.

For such an alliance to succeed, it was imperative that there were clearly defined responsibilities and resources if the desired results were to be achieved. A strong and well-organized company was created that established its own matrix structure able to function autonomously. IAE focused on achieving a seamless operation from IAE headquarters operations through the partner companies, irrespective of cultures, geography, or time zones. The partner companies, in agreeing on the division of hardware responsibility, also agreed that the proprietary concerns or intellectual property of each partner company's designs would not be disclosed to the other partners. This is an important point during the accident or incident investigation, as the responsible technical advisor supporting the investigation would be representing IAE as the engine manufacturer, rather than an individual partner company.

The US FAA issued the Type Certificate and Production Certificate for the engine in 1988, and the first V2500 aircraft was delivered early in 1989 following a successful 8-month flight test program. Subsequent development of the engine saw it installed on a range of Airbus and Boeing aircraft. IAE has now produced over 2,000 engines. The production of a highly

successful engine is testimony to the management of the consortium, the engineering skills based in the partner companies and the critical evaluation of managerial and professional challenges associated with an international aerospace project throughout its life cycle. This demonstrates the ability of the consortium to challenge the more traditional, single-company approach and successfully coordinate the design and manufacture of such a high-technology product.

However, even with the strengths arising from such alliances, unfortunately problems can and do arise. Eventually an accident or serious incident may occur and the investigation process would be invoked. The Executive team of IAE and the partner companies were aware of this likelihood and set out in its collaboration agreement the way IAE would manage its involvement in any major accident or incident involving a V2500 powered aircraft. Pratt & Whitney, having an established Flight Safety Investigation organization, accepted the investigation lead role, while also holding the responsibility for interfacing with FAA on certification and continued airworthiness issues. Further development within IAE found that a shared responsibility for safety investigations would benefit this consortium. Coordinating this development proved to be the genesis for the topics of this paper. Currently, both Pratt & Whitney and Rolls-Royce safety offices work in concert to support incident and accident investigations.

Safety Organizations

Just as we might look back on earlier accident investigations as having been easier, company organizational structures may have been "simpler" as well. Original equipment manufacturers quite often structured their organizations in a simple, hierarchical system, delineated by technical or financial disciplines.

More recently, organizational structuring has moved to a more complex arrangement of integrated engineering, manufacturing, and support functions in order to increase operating efficiencies across each company. When combined with globalisation efforts, today's aerospace companies offer tremendous reach and capability, but may resemble little of their former operations. This provides an added burden to the investigative offices, which have remained in many cases, tied to both the traditional external investigative systems as well as the contemporary company organizations.

Each of the major manufacturers maintains individual Safety Offices complimented by Accident Investigations disciplines. The overlap and potential conflicts of interest between the individual organizations require investigators and investigative authorities to recognize the position and boundaries of company representatives and technical advisors participating in Air Safety investigations.

Aviation safety offices have generally been support organizations to the company's core products, helping the company provide safe aviation products while also offering help to identify and direct product integrity concerns. Today, many safety offices maintain positions that can significantly affect a company's activity.

The IAE consortium offers to its customers one company in IAE, even though the support functions come primarily from the partner companies. This places organizational and functional challenges inside both the consortium and the partner companies. For the partner company, the manner in which safety efforts are managed within their respective company helps determine this organizational challenge. In a general view, there are essentially three models that are employed in the industry:

- Safety is managed through a central safety or airworthiness office, with safety personnel having visibility across all programs/projects and inserting themselves as needed within each program/project. This centralized approach tends to follow more closely the former organizational structures delineated by disciplines, which goes against the drive for operational efficiencies. However, this approach offers independence to the safety organization by removing program/project motivations from influencing safety office functions, and provides a path for visibility across problems and solutions identified during investigations.
- Safety is managed through a decentralized safety role, and safety personnel are positioned within each project/program. This approach ties the safety activity close and continuous to each program, which can lead to a reduced vision across programs as well as taxing the independence of the safety discipline. This arrangement could also restrict the ease with which lessons learned are cross-fertilized into other projects. However, safety personnel can focus on their specific project without the distractions of cross-program influences.
- Safety is managed through a combination of the two preceding approaches. However, with the continued focus on cost reductions and operating efficiencies, companies may find difficulty in maintaining the combined approach, which also requires additional support staff and communication activity to ensure that both program specific needs as well as cross-program issues are addressed.

Companies may attempt to emulate the combined approach through the use of specialized safety offices and safety reviews, allowing staff to address program specific concerns, while management or executive personnel review and respond to cross program issues.

The importance of understanding these approaches arises as the consortium, in supporting an investigation, attempts to function across partner company boundaries, namely in the manner that information flows between companies, which can impact the larger safety processes. These approaches, and their contributing factors, should be recognized in advance to maintain effective operations especially during an accident investigation. The least desirable situation may find the investigative authorities identifying concerns with a company's organizational structure, safety culture, or practices.

During an accident or incident investigation, the investigating authority has then the challenge to interface with several personnel, most of whom come from one of these corporate safety offices, with the goal of gaining an understanding for the cause and contributing factors behind an accident. From the perspective of the investigating authority, one point of contact – an accident coordinator, and one or more accident investigators from each company provides the necessary support to their party-system approach.

Challenges – Investigative Activity

Investigations of consortium and alliance products face hurdles with on-scene investigator staffing, challenges with post-scene investigation of company-sensitive hardware, and barriers of proprietary product information. Working with the guidance of ICAO Annex 13, IAE have looked at the challenges of their consortium in responding to and supporting these investigations. As a result, IAE have enhanced their procedures and awareness efforts across the consortium.

IAE are permitted to participate in an investigation as a Manufacturer. However, since it is often not clear at the outset of any investigation where the thrust of the investigation may lead, it was originally possible that a representative from each of the partner companies would want to attend the accident scene – recalling that each partner company retains responsibility and propriety for its respective engine hardware. This was the first of several challenges identified by IAE in response to accident investigation procedures.

Ron Schleede, International Affairs Advisor and retired from NTSB having been Deputy Director of the Office of Aviation Safety, offered, "private sector organizations, such as airlines, manufacturers, and insurers have an enormous stake in the results of an aircraft accident investigation. Consequently, the private sector plays a large role in the ability of States to meet the intent of Annex 13" [3]. With some of the engine company partnerships, consortiums, or alliances, the participating companies exist in different countries. Beyond the geographical challenges of having partners spread around the world, during the initial response to an accident, the partner companies may seek inroads to the safety activity of the investigation. As an example, IAE maintain a Type and Production Certificates issued by the US FAA, making the United States the State of Design and State of Manufacture. During an investigation, Annex 13 offers that the US NTSB would be the Investigative Agency or Accredited Representative depending on the location of the incident or accident. However, with four companies each having a primary responsibility in the design of a significant portion of the engine, at the start of an accident investigation it can be expected that each company would want to participate in the on-scene activity. Would the authorities in charge of an investigation permit or even want investigators from each parent company to arrive at the scene?

Clearly, the consortium needs to identify the accident response team members, but then also needs to gauge the reaction level of each of the partner companies. An agreement is required between the consortium and partner companies that details the participation and responsibilities during the initial phase and throughout the complete accident investigation.

Communications requirements, starting with the creation of a control room within which a core company response team could meet and talk with on-scene personnel all the way through reporting and documenting investigation findings, presents further challenges for developing accident response procedures.

Another challenge comes from appreciating the requirements of the other investigation participants. A primary concern originates with the airline or operator who experienced the accident. As well as expecting a level of support as a "customer", the operator will also be a "party member" during the investigation. However, during the investigation, the operator will be interacting with the engine company through both the official investigative team as well as their normal field service representative, as both investigation and business requirements dictate. The challenges and requirements placed on Field Service Representatives then uncover a series of additional challenges.

Field Service Representatives for the consortium company may likely be employees of one of the partner companies and as such, could be responsible for supporting products of both their parent company and those of the consortium company. To best supply their customers with company support, an OEM will usually issue to each Field Service Representative a handbook of company procedures. This handbook becomes the essential reference tool for Field Representatives when they find themselves in rare or unsettled situations with their customer, i.e. immediately following an accident. Each handbook often dedicates a chapter or section to the procedures and policies of the company and more specifically the reactions of a Field Service Representative to an accident or incident occurrence.

Because of the competitive nature of the aviation business, where customer accounts often translate into substantial dollar value, the Field Service Representatives are expected to provide continuous support to their customers, as many airlines also move to redistribute tasks that are outside their core business of passenger or cargo air transportation, many functions are being moved to their suppliers, i.e. engine companies. Therefore, company Field Service Representatives are adapting to provide nearly seamless support to delight their customers and help their employers succeed.

In the moment of an airplane accident, the airline operator is quite often leading the response activity, with the most relevant information concerning flight operations, accident location, persons on board, manifests, etc... The company Field Service Representative, working so closely with their customer, can also provide an early access to vital information. However, as the Field Service Representative works to support their customer, and their customer works to sort-out the early understanding of the accident, neither group may have the appropriate background to comprehend the magnitude and subtleties of their involvement. Until the formal (Annex 13) accident response system has been initiated and the hierarchy of responsible investigation personnel are positioned, including the OEM Air Safety Investigators, it is imperative that the company representatives demonstrate appropriate behavior. Nonetheless, their actions can be expected to reflect primarily the behavior that has been so strongly engrained in them by their day-to-day functions and relationships. The representative may refer to their handbook for accident procedure information, but may, in all likelihood, respond to their customer's requests as they have been conditioned to do. To this end, both repetitive awareness training and periodic updates to the Field Service Representative's handbook have shown to help guide representatives when responding to their customers in times of accidents or incidents.

Challenges – National Investigative Agencies

In a paper titled *'Accident Investigation Assistance: What Should the State of Occurrence Expect from a Manufacturing State?'*, Mr. Robert M. MacIntosh, Chief Advisor, International Safety Affairs at the NTSB has laid out the framework in which the Investigator-In-Charge (IIC) of a State of Occurrence can reasonable expect to work with the State(s) of Manufacture. [4]

The paper reflects the requirements of Annex 13 and importantly identifies that a key driver in the successful engagement of support from the State of Manufacture Accredited Representatives and manufacturer's advisors is timely notification of accidents in accordance with the procedures defined in Annex 13. Mr. MacIntosh considers the dynamics of the party system and points out the hierarchy of responsibility between the State of Occurrence, the State of Manufacture (Accredited Representative), and the Technical Advisor (Industry Specialist).

Recognizing the uncertainty that exists at the outset of an investigation into an accident or serious incident, an IIC understandably has to judge what is considered to be a reasonable number of persons (technical advisors) invited to aid the investigation process. All of the leading companies in the aerospace industry, and a large proportion of smaller companies, have trained personnel able to support national authorities when the need arises. The paper suggests that an IIC, through an Accredited Representative would prefer to have a single point of contact or focal point for specific disciplines. This fits well in the 'Party System' and 'Working Group' framework often employed by IIC's.

The national safety agencies then often prefer a single point of contact within the technical advisors from each manufacturer. In the case of a consortium or alliance, a look at current OEM practices offered guidance to this need of support. Rolls-Royce experience has started to identify benefits to the investigation process of having more than one person attend during the early phase of the investigation. Often this has been an experienced Air Safety Investigations team member supported by a Field Service Representative, or specially trained project personnel also termed Technical Support. The fully trained investigator understands the organization and protocols that surround an investigation, provides direct support to the IIC or Accredited Representative, and in the case of a consortium works as the representative for the consortium, and not the parent company. The Field Service Representative / Technical Support person, on the other hand, brings specific product knowledge or skills but may not fully appreciate the requirements and constraints of the arena into which they are now participating. This arrangement has been shown to bring both focus and seamless support to the investigation. This seems to address the State of Occurrence and Industry's needs, from both sides.

Discussions with investigators from both the US NTSB and the UK AAIB have offered very logical perspectives. Mr. Tom Haueter and Mr. Jim Hookey from the NTSB HQ in Washington, DC suggested that the IIC wants one coordinator from each party. "You can coordinate however you wish within your company team, but we [NTSB] need one person representing your party", Jim explained. This follows normal NTSB protocol. With the consortium arrangement however, one person may not be able to represent each of the partner companies. Mr. Haueter added, "With agreement from the IIC, the accident coordinator can change during an investigation. We can also add or remove investigators and even parties to the investigation as the investigation unfolds" [5]. This flexibility permits these new organizational arrangements to work within the current party system. Although the challenges continue well after the on-scene activity has completed, consideration must be given to limitations of the organizational arrangement.

From Challenges to Boundaries

Selected hardware recovered from the accident or incident scene may be subject to further examination at maintenance shop or laboratory locations. With consortium hardware rather than traditional OEM hardware, the investigative participants must recognize and respect new boundaries within the consortium parties. The concerns for intellectual property arise immediately, given that the partner companies retain design expertise. It is quite likely that the named accident coordinator from the consortium cannot completely represent the partner company responsible for the design of the selected hardware. In these cases, additional representation would enter the investigative effort and need to be recognized and accepted by the investigating authorities.

Considerable effort has been made in defining the working level arrangements between party companies of consortiums, alliances, and joint ventures. Where hardware design responsibilities, equipment part numbers, personnel ID badges, and even pay checks can easily establish proprietary boundaries, the investigation of the engine systems quickly crosses into partner company responsibilities. An accident investigation needs to respect these boundaries, in line with what would be normal working conditions. The investigative team must recognize that the available data to support the investigation can be gathered; however, access to the data may require additional formal requests and administration than occur during a more traditional company arrangement.

Within the traditional investigation framework, working through a party system, the party members cannot share proprietary information across the investigative team. Thus, the onus is on the company to establish and inform the other investigative parties when proprietary concerns are being broached. When this occurs, the investigative authority can discuss the concerns in a confidential manner with the specific party member owning the concern. In the consortium, the investigative authority, as well as the other parties, must again appreciate that discussions may require a change of personnel within the investigative team for the consortium.

Moving inside the consortium, the issue of proprietary information is handled in much the same way. Although, the partner companies maintain technical responsibility for their hardware, the partner companies can and often do assemble to discuss whole engine concerns while maintaining confidentiality of partner company information by limiting the scope of the discussions. To the investigative authority and other parties to the investigation, recognition of these limitations and the related administrative requirements can help guide progress of the investigation, while avoiding potential conflicts and delays.

Subsequent to the specific accident or incident investigations, the consortium must manage the same high level of integrity and recognition throughout the discussions, resolutions, and closure of the resulting safety concerns.

Practical Example

Ms. Anne Evans from the Air Accident Investigation Board (AAIB) of the UK explained a recent experience with a consortium organization. A particular occurrence found AAIB responding to an incident scene in the UK, where representatives from only one of the parent companies from the consortium arrived on scene, along with other parties to the investigation. The investigation progressed through the on-scene activity as needed. The on-scene team identified hardware that required further examination and evaluation. However, a different parent company within the consortium maintained responsibility for this hardware, and this company resided in another country. Importantly, the consortium not only kept effective communications between their parent companies from the start of the investigation, but also kept their respective ICAO representatives informed as well.

Following the decision to further examine hardware, the AAIB utilized the Annex 13 principles and forwarded responsibility of the hardware to the States' government agency of the other parent company. Only the hardware crossed international boundaries, while investigators of the respective States and resident companies completed the hardware examination and reported back to AAIB. In this case, effectively the States' government investigative agencies operated more like the consortium.

During the same investigation, discussions with both the airframer and the airline representatives found that the approach of the consortium, in this case, fit well into the normal "party system". However, the participants acknowledged that they were unaware of the organizational structure behind the consortium. "From our position, the investigation worked like most others, except that there were a few more levels of participation with the engine hardware," commented an airline representative.

Opportunities

From the perspective of a national agency investigation, the activity involving consortium or alliance companies essentially becomes a party system within a party system, with the consortium administering the roles and responsibilities of the investigation amongst the partner companies and then participating at the "Annex 13" level as a "party to the investigation".

For the consortium, the on-scene investigators may be from one or more partner companies, but would be responsible to the consortium through the consortium co-ordinator. With the appropriate permissions the on-scene team would provide daily communications to a team within the consortium office. The co-ordinator will share with the consortium only the information that is dependent upon actions from the consortium or partner companies. Issues of proprietary concerns would be handled through standard consortium business practices.

With the examination of hardware related to the investigation, the responsible partner company rather than the consortium needs to provide an important role. At this point, the onus falls to the investigating authority to decide the level of oversight and involvement with the partner company, whom may be located in a country that is not officially involved in the investigation. Recall that the country(s) that granted the Type and Production Certificate would be the State of Design and State of Manufacture respectively, and may not be the same country(s) in which the partner companies reside. This presents the situation in which the investigating authority, when desiring to return hardware to the responsible partner company that resides outside the State of Design (from a Type Certification perspective), may need to modify the boundary of the definition used for participants under ICAO Annex 13.

Each partner company then maintains proprietary information and offers investigation results to consortium-level review. If necessary, the partner company may provide confidential information to the national investigation agency, with the restriction that the information does not get distributed to other consortium companies. However, the agency must be aware of these limitations, as well as the organizational arrangement, in order to prevent inappropriate distribution of such data.

It is important during the later phase of the investigation activity that the responsibility for delivery of reports and other evidence required by the investigation agency be adequately coordinated. At this time the co-ordinator should act as the focal point for the consortia and the investigation agency alike. There should be clear recognition of deliverables and time scales agreed by both sides to ensure such requirements are not compromised.

As the investigation draws to a close, the comment periods for draft reports may require additional administrative coordination, as the parent companies need to formulate and approve their comments prior to assembly and final approval of the consortium's response to the investigative authority. Satisfying the added coordination requirements, which stem from the alliance and consortium arrangements, may be helped through effective development and execution of procedures that not only address safety activities of the consortium but also match the partner companies of the alliance or consortium. Developing these procedures offers the opportunity to generate example scenarios and test cases, which may identify many overlooked details. Executing within these defined procedures would then maintain consistency across the partner companies as well as with the investigative agencies.

Periodic reviews of these procedures and of personnel changes at the consortia level and into the partner companies may help drive lessons learned from each investigation back into the procedures and processes of all the participants. Introducing the lessons learned from each investigation into the activities of the consortium and further into the parent companies promotes the ultimate intention of investigative activity – safety information gets shared and utilized between organizations as part of normal business operations. Furthermore, training topics and activities can be a natural extension of the procedures and periodic review findings.

Training

The value of training company personnel at all levels, to understand the framework of the investigation process and its protocols, cannot be understated. In today's highly dynamic organizations, it is increasingly difficult to establish points of contact that are likely to remain in position for much more than 5 years. There is a tendency, particularly in shrinking companies, for personnel to be more mobile. With the rarity of aviation accidents, it is not uncommon for employees at all levels to cycle through the consortium or partnership without having experienced the activity and demands of an investigation.

One stable element in the process appears to be the safety investigation teams, where continual challenges presented by investigations tend to keep the investigative personnel in place. This stability can offer an invaluable pool of knowledge and experience, which as a result of the recent and significant evolution of the aerospace business is proving difficult to replace.

Planning and training activities should identify safety personnel required to support both external and internal company activities. External activities would be primarily focused on the on-scene response and subsequent hardware examinations, meetings with government agencies, and document and report coordination. The internal activities would include data gathering and analysis, hardware examinations, technical reviews and Management briefings and communications. We believe that there is a tremendous benefit to training personnel who may never attend or interact with investigative authorities on the investigative process and protocols. On more than one occasion, one well-intended but misdirected communication or lack of understanding has jeopardized a party's involvement with an investigation.

Training activity among engine manufacturers have tended to be limited to training with airlines and airline authorities. With these new organizational arrangements, interactions between personnel across the partner companies are vital to exercising the response and planning of the individual companies. Opportunities for scenario training, including the involvement of other potential investigative participants such as airframers and national authorities, have proven very successful to our consortium.

Conclusions

As the corporate environment continues to change in response to the business demands of the aviation marketplace, accident investigation functions must continue to adjust accordingly. These changes must be recognized by each countries investigative agency in order that subsequent accident investigations activities do not fall victim to organizational conflicts and difficulties.

An airframe manufacturer offered that these partnerships and consortiums shouldn't offer any additional challenges to the party system, as flexibility exists in membership participation. It is not uncommon to change participants during an investigation, due to changing requirements and personnel changes.

National investigative agencies should recognize and appreciate the subtle differences presented by involvement with an alliance or consortium venture. One agency offered their appreciation of the nature of the consortium arrangement and viewed their role as Accredited Representative to include working as an endorsement for the consortia participation into foreign investigations, in the same manner as they would a more traditionally organized company.

Make acquaintances before you need them, it's so much easier to work with someone you, at very least, have met before.

Consortiums and Alliances – An Evolving Industry

As the business of aviation changed during the latter decades of the 20th century, [alternate] forms of organizations were created. Consortiums such as International Aero Engines, and other partnerships such as were born into the aircraft engine OEM arena. Where once aircraft engines were designed, manufactured, assembled, tested, and shipped from primarily one location, has today become a myriad of contractual agreements representing a cost effective sharing of technical and program risks as well as business rewards. Today, the lines between supplier and partner may seem blurred. But the trend will continue nonetheless. In fact, the latest jet engine programs offered by a single OEM have established or continue to seek risk-sharing agreements for a majority of each engine program.

The recent trends in organizational structuring show a more complex arrangement of integrated engineering, manufacturing, and support functions. These trends have played out through years of mergers and reorganizations. With the move to matrix-type

organizational integration, partnerships and alliances, combined with the low number of aviation accidents, companies may benefit from a close review of the fundamental requirements of the investigative process and product integrity concerns.

Employees who are successful working within these partnerships provide a marked value to their parent company as well. The increased perspective of the joint venture or partnership allows employees to gain direct insight to alternate approaches and business practices, to continuously benchmark their parent company against their partners, and forces a teaming environment not always available in any one company.

Ultimately, the success of accident investigations and safety actions within these alliances and consortiums rely heavily on communications across these new and sometimes blurred boundaries.

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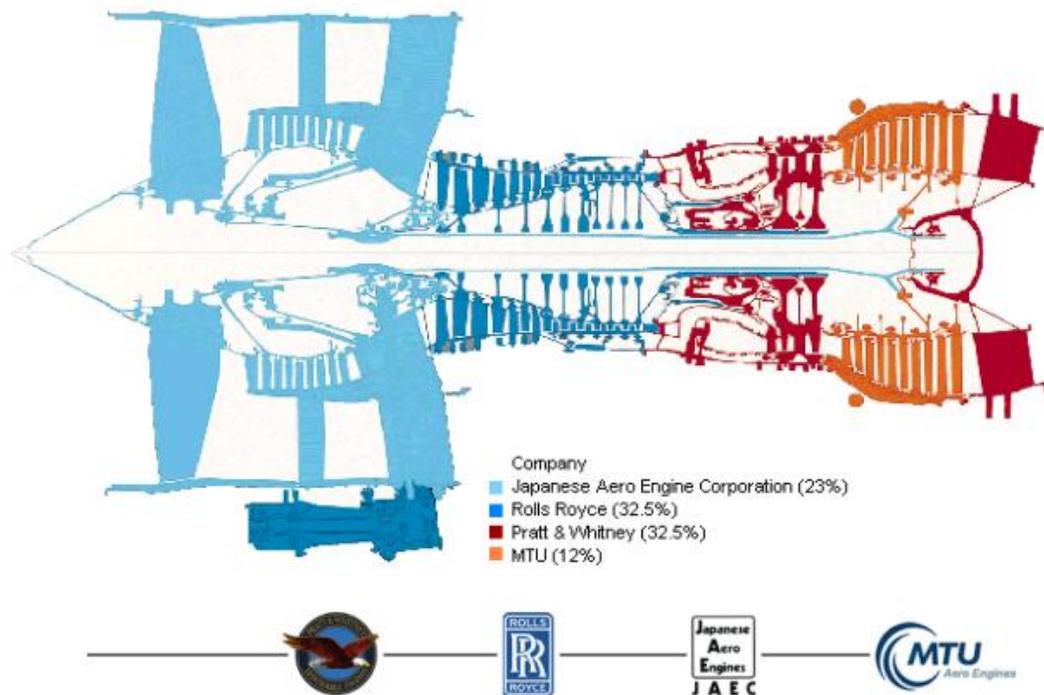
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V2500 Collaboration Partner Ownership



Produced by world leaders in aero engine technology

Figure 1: Share of Responsibility of the IAE V2500 Engine