

AEROSPACE RECOMMENDED PRACTICE

SAE ARP9090

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Requirements for Industry Standard e-Tool to Collaborate Quality Assurance Activities Among Customers and Suppliers

FOREWORD

This Aerospace Recommended Practice (ARP) is written by "e-Tools sub-team" chartered by Americas Aerospace Quality Group (AAQG). In December 1998, the Aerospace Industry had established the International Aerospace Quality Group (IAQG) with the purpose of achieving significant improvements in quality and reductions in cost throughout the value stream. AAQG, with representation from Aerospace companies in Americas, is one of three sectors of the IAQG. AAQG is working towards the same common goal of IAQG. AAQG, sponsored by SAE, has agreed to take responsibility for the technical contents of this ARP.

Global aerospace industry is increasingly moving towards standardization. The industry has a common supply base that is closely linked with each other. Additionally, being a regulated industry, the industry members collaborate, review, and approve various documents and manage "Knowledge". With this background, the Americas Aerospace Quality Group (AAQG) recognized a strong near-term need to have a common collaborative software tool that could be used by entire aerospace industry.

This document defines the requirements for a software solution (e-Tool) for the aerospace industry. It is expected that one or more software solutions meeting this ARP will be developed and the software will be a common vehicle for the aerospace industry to collaborate various quality documents and activities among customers and all tiers of suppliers.

"Collaboration" in the context of this ARP means exchange of information between two or more parties to achieve an agreed business objective. It is also recognised that the collaborative process does not change when you put an 'e' in front of it. Essentially, electronic facilitation (or "e") is an enabler for efficient collaboration.

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1. INTRODUCTION:

1.1 Author:

This Aerospace Recommended Practice (ARP) is written by “e-Tools sub-team” chartered by Americas Aerospace Quality Group (AAQG). In December 1998, the Aerospace Industry had established the International Aerospace Quality Group (IAQG) with the purpose of achieving significant improvements in quality and reductions in cost throughout the value stream. AAQG, with representation from Aerospace companies in Americas, is one of three sectors of the IAQG. AAQG is working towards the same common goal of IAQG.

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1.2 Background:

Global aerospace industry is increasingly moving towards standardization. The industry has a common supply base that is closely linked with each other. Additionally, being a regulated industry, the industry members collaborate, review, and approve various documents and manage “Knowledge”. With this background, the Americas Aerospace Quality Group (AAQG) recognized a strong near-term need to have a common collaborative software tool that could be used by entire aerospace industry.

This document defines the requirements for a software solution (e-Tool) for the aerospace industry. It is expected that one or more software solutions meeting this ARP will be developed and this software will be a common vehicle for the aerospace industry to collaborate various quality documents and activities among customers and all tiers of suppliers. Any software meeting the requirements of this ARP will ensure exchange of information to any other software that meets the requirements of this ARP. This ARP requires a common building block (ebXML OASIS/UNCEFACT) that will allow sharing of data between collaborating parties regardless of the software product that is being used.

“Collaboration” occurs when two or more parties exchange information to achieve an agreed business objective. It is also recognised that the collaborative process does not change when one puts an ‘e’ in front of it. Essentially, electronic facilitation (or “e”) is an enabler for efficient collaboration.

- ‘e’ facilitates operation of the collaboration
- ‘e’ integrates standardised steps and processes into a workflow for a shared “business process”
- ‘e’ opens new opportunities for process redefinition and refinement
- ‘e’ facilitates efficient data storage and retrieval

1.3 Advantages of an Industry-Standard Common e-Tool:

- Share cost of standardized software solution to perform common quality assurance (QA) processes.
- Reduce non-value added time and costs associated with existing processes
- Reduce new product development risks through dramatic improvements in visibility of activities and their status
- Identify and instantly implement 'best practices' and solutions across the supply chain network
- Eliminate quality escapes caused by
 - Missed requirements flow down
 - Currency of information
 - Conflicting requirements
- Enhance transfer of quality related data throughout the supply chain

1.4 Purpose of This Document:

The Requirements Specification ARP may be used as the basis for the establishment of the e-Tools project requirements, detail design, and testing.

The purpose of this Requirements Specification is to define requirements and establish an evaluation matrix to evaluate and compare candidate software solutions (or e-Tools).

2. HIGH-LEVEL BUSINESS PROCESS:

This section describes the current ("as-is") high-level business process as well as future ("desired") business process. It identifies how the customer (i.e. the intended user of the e-Tool) currently performs day-to-day business functions. It also further describes the specific customer scenarios that apply to the e-Tool software in an operational environment.

2.1 Current (“as-is”) and Future (“desired”) High-Level Business Process:

Supply Chain Pyramid: Figure 1 describes supply-chain “pyramid” in the aerospace industry and the associated hierarchy. It should also be noted that business relationship between tier 1, 2 and 3 is interchangeable within the tiers, depending upon the nature of a project and/or associated product.

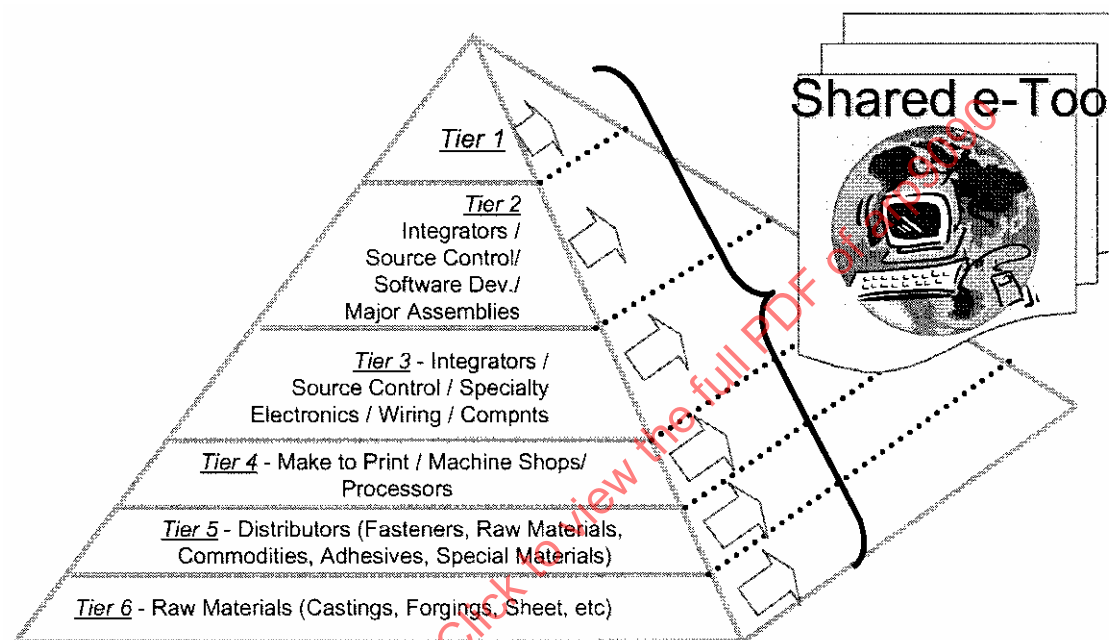


FIGURE 1 - Supply Chain Pyramid

Although the desired e-Tool may be beneficial to several business processes, this discussion is limited to the quality assurance processes used in the aerospace industry supply chain shown in Figure 1. These processes have some common characteristics and some differences:

- **Commonality:** Currently, the aerospace industry uses several Quality Assurance (QA) processes that seemingly look common across the industry. Some of these processes include: First Article Inspection, flight safety requirements, manufacturing/quality plans, process analyses and control plans, process qualifications/fixed process substantiation, corrective actions, nonconformance management and concessions, acceptance test procedures, quality improvement plans, Key Characteristics Management, and production readiness assessment. There is a strong trend in our industry to standardize the requirements for these processes.

2. (Continued):

- **Differences:** Even though we use several common processes, we also deal with our internal legacy systems (procedures, databases, software solutions, etc.) that are quite different from each other. Most of our common suppliers have to deal with several of these systems required by top-tier customers to perform similar tasks.

Current Process: The current process depends upon paper-copies or customized software dedicated to one-to-one relationship, as shown in Figure 2.

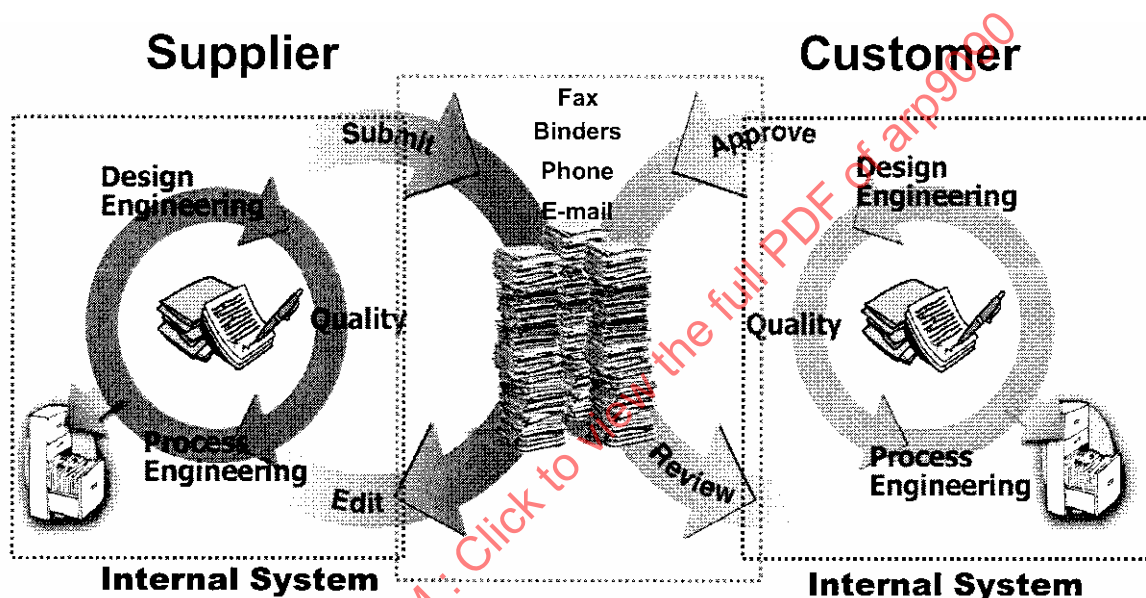
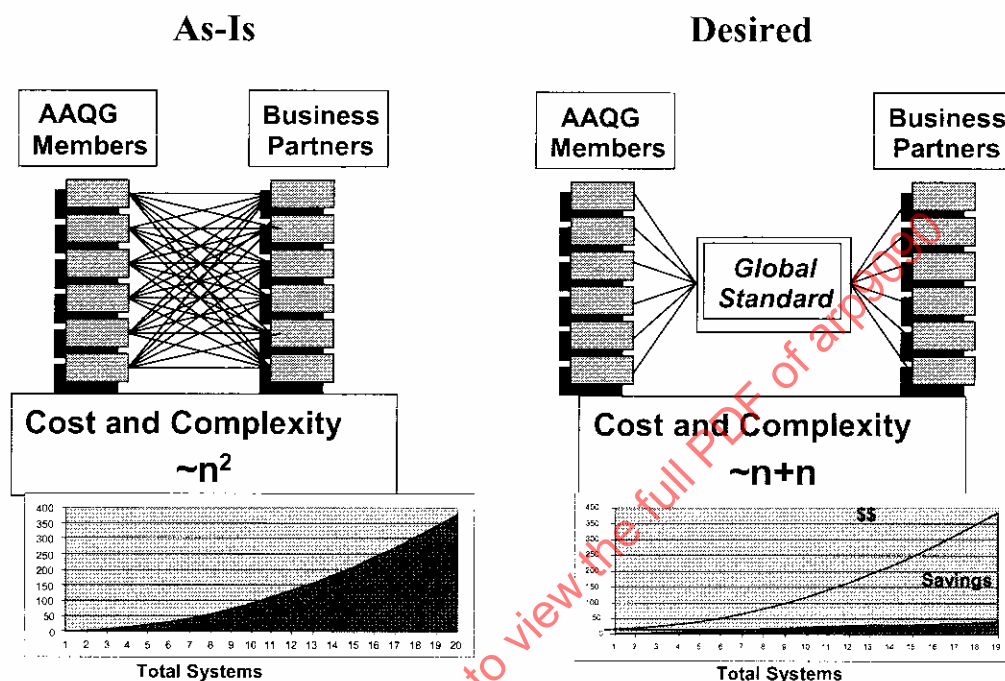


FIGURE 2 - Current to Level Process

The simplistic supplier-customer relationship shown in Figure 2 is, in reality, a very complex multi-layered interaction across entire supply chain.

Vision for “desired” Process: Figure 3 conceptually illustrates how the current process for QA collaboration can be transformed using a standard and common e-Tool. The left-hand side illustrates the current situation where several business partners (or supply chain links) have to deal with multiple customer systems – typically mandated by higher tier companies. This significantly increases cost and complexity, resulting in quality misses. The right hand side illustrates a future vision where all members of the supply chain use a common standard. Such a standard solution may be cost prohibitive for one company, however, when shared, it will reduce complexity significantly, and thus eliminating quality misses caused by such complex interactions.

e-Business Vision



Reduce cost and complexity through development of policy and e-business standards

FIGURE 3 - Business Vision with Common e-Tool

2.2 Applicable QA Processes:

Top Level QA Processes: The key quality assurance processes that the e-Tool will support are given below:

1. Product definition and flow down of requirements
2. Quality Planning and part acceptance
3. Process and product substantiation and control
 - Manufacturing process control
 - Engineering frozen process approval

2.2 (Continued):

4. First article inspection
5. Nonconformance handling: RMRA (request for material review action)/MRB (material review board)/notification
6. Audit processes (approved suppliers, systems audits, special process audits, etc.) and audit data management

These six QA processes cover high-volume quality assurance activities and touch most players in the supply chain.

Sub processes: Several other sub-processes link to either one or more of the top-level processes. These sub-processes include:

- a. Product acceptance process – acceptance data and comparison with spec requirements
- b. Contract review
- c. Design Review
- d. Product substantiation
- e. Corrective Actions – reporting, Root cause analysis, approval and objective evidence of implementation
- f. Key Characteristics management – access, view, statistical process control (SPC) data depository, reporting
- g. Bill of materials (BOM) management
- h. Approved sources – (special process, raw material, parts, etc.):
 - management,
 - usage
 - Ability to add custom rules
- i. Drop-ship process
- j. Return material authorization and handling

2.2 (Continued):

- k. Product delivery management – Schedule- management for shipment, Kan-ban, just-in-time (JIT), etc.
- l. Regulatory compliance processes

2.3 Possible Scenarios for Collaboration and Usage of e-Tool:

The top-six quality processes described in Section 2.2 are further explored in this Section. The purpose of this section is to shed some insight on the quality processes, possible collaborative scenarios associated with them as well as functional requirements to make the collaboration successful with an ideal e-Tool.

It is recognized that there may be many more possible scenarios and/or additional functional service requirements that one can use while demonstrating the usefulness of any candidate e-Tool. However, for the purpose of this discussion, the following scenarios are deemed sufficient.

- 2.3.1 Collaborative Scenarios: The top six QA processes described in Section 2.2 cover several interdisciplinary activities. These activities can be grouped in eight collaborative scenarios:
- 1. Co-working of Engineering, Manufacturing and Supplier organizations
 - 2. Separate & remote teams (e.g. multiple tiers of suppliers) working two or more elements of a product that must fit together
 - 3. Integration of subsystems in simultaneous development.
 - 4. Electronic invitation to tender, develop, and modify the product with information published to an Exchange to support the activity
 - 5. Compiling a large and complex information set originating from many different places
 - 6. Review and approval of information which require input by participants in different organizations
 - 7. Control and Management activities across partners (e.g. prime contractors, customers, tiers of suppliers)
 - 8. Integration of new information with multiple sources of legacy systems (e.g. suppliers, primes, customers and their individual legacy software and databases)

2.3.2 Functional Services: Additionally, in an ideal collaborative environment, certain service functions are necessary. Some of these service functions that shall occur in a secure environment are:

- a. Electronic mail
- b. File Sharing
- c. Threaded Discussion
- d. Whiteboard
- e. Text chat
- f. Forms and database
- g. Meetings Manager
- h. Document Review

NOTE: Electronic mail is the most common and required feature.

2.3.3 Cross-Reference Matrix: Table 1 illustrates the applicability of each of these eight collaborative scenarios and seven service functions to the top-six QA processes. "X" indicates applicability. Please note that electronic mail is an essential element of any collaborative process.

The purpose of this cross-reference matrix is to illustrate the applicability of the e-Tool to QA processes as well as to establish relative importance of several of its attributes.

**TABLE 1 - Top Level Quality Processes and
Associated Collaborative Scenarios, Required Service Functions**

Top Level Quality Processes		Functional Services							Typical Collaborative Scenarios (Tailored to QA Applicability)								
		Level of Collaboration (QA-centric View)	a) File Sharing	b) Threaded Discussion	c) Whiteboard	d) Text chat	e) Forms and database	f) Meetings Manager	g) Document Review	Co-working of Engineering, Manufacturing and Supplier organizations	Separate & remote teams (e.g. multiple tiers of suppliers) working two or more elements of a product that must fit together	Integration of subsystems in simultaneous development.	Electronic invitation to tender, develop, and modify the product with information published to an Exchange to support the activity	Compiling a large and complex information set originating from many different places	Review and approval of information which require input by participants in different organizations	Control and Management activities across partners (e.g. prime contractors, customers, tiers of suppliers)	Integration of new information with multiple sources of legacy systems (e.g. suppliers, prime, customer legacy software/databases)
1	Product definition and flowdown of requirements	High	X	X		X	X	X	X	X	X	X	X			X	X
2	Quality Planning and part acceptance	High	X	X		X	X	X	X		X	X	X	X	X	X	X
3	Process substantiation and control	High	X	X		X	X	X	X	X		X	X	X	X	X	X
4	First article inspection	High	X	X		X	X	X	X	X			X	X	X	X	X
5	Nonconformance handling: RMRA/MRB/ notification	High	X	X		X	X	X	X	X	X	X	X	X	X	X	X
6	Audit process (approved suppliers, systems audits, special process audits, etc) and audit data management	High	X	X			X	X	X	X		X	X		X	X	X

3. FUNCTIONAL REQUIREMENTS:

3.1 Current Functional Process Flow:

Current business process flow, as discussed in Section 2, is generally one-on-one communication. This typically happens using a dedicated software to perform a specific task, and/or using standard and/or non-standard forms to transmit the requirements/ approvals and/ or using traditional communications methods like phone, e-mails, fax, surface mail.

3.2 Proposed Functional Process Flow:

“Desired” process, as described in Section 2, is envisioned to be fully electronic communication/collaboration, using a web-based standard tool(s). The business processes, as such, are not changed; just the communication and collaboration process will be changed.

3.2 (Continued):

Key elements of “desired” process flow are:

- Efficient and fast multi-user communication via standard software
- Auto-notification and acknowledgement
- On-line meetings
- On-line data request, transmittal, approval and acknowledgement
- Activity management
- Secure communication
- On-demand data retrieval, data analysis
- Ability to map individual companies internal processes over standard processes
- Ability to link internal legacy systems and databases

3.3 Capability Requirements:

This section defines all capability requirements the software system is to satisfy. For each functional capability (function), the requirements are described in a subsection below.

- 3.3.1 Customer-Unique Process Mapping: Ability to map user-unique business processes into e-Tools domain. This attribute must be user friendly (i.e. push-button process mapping)
- 3.3.2 Open Architecture Design: Open Architecture Design allows ease of integration by designing software applications or components that exchange data between themselves using common data interchange formats. The common data interchange format recommended by this ARP is ebXML (OASIS/UNCEFFACT standard).
- 3.3.3 Scalability: The capability to efficiently deliver product, service, or functionality to varying numbers of consumers using the e-Tool.
- a. Ability to allow many concurrent users and large number of total users.
 - b. Ability to auto compress/decompress

3.3.4 Multi-User Connectivity:

- a. Supply Network Connectivity – The application architecture will need the ability to connect all tiers within a supply network, thus allowing full program (multi-tier) visibility from the Original Equipment Manufacturer (OEM) to the lowest tier supplier (see Figure 1)
- b. Link Key Stakeholders – The ability to connect (in real-time) global key stakeholders around a part/program to ensure compliance for any given business process.
- c. Online meeting – Ability to conduct on-line meeting with several participants

3.3.5 Project/Program Management:

- a. Program Tracking notification – The ability to capture and maintain relevant attributes of a part/program (e.g. requirements, timeline, parts, documents, team members, meetings, tasks and security).
 - Key events/milestones tracking and notification
 - Acknowledgement of files received- automatically
 - Failure notification
- b. Program management – Schedule management, cost management, risk management
- c. Issue Management – The ability to capture part/program-related issues and tie relevant lessons learned to them.

3.3.6 Document and Data Storage and Retention: The ability to manage, share and archive large volume of documents (including revisions). All records are to be available on line, with proper security.

- a. Light Document Management: This includes
 - collecting entered data to generate customer reports;
 - transfer test reports as attachments;
 - accept, store and transfer data with no additional actions

3.3.6 (Continued):

b. Heavy Document Management/vaulting: This includes

- manage multi-page complex documents including specifications, engineering drawings, etc.;
- extract applicable information from specifications or engineering drawings;
- secure, transfer and store intellectual property;
- combine already collected data into other reports or processes;
- transfer and extract applicable test data from multi-level complex testing, etc.

c. Attachments:

- ability to add attachments in any format

3.3.7 Change Management: The ability to track various changes (e.g. part, document, requirement, timing, supplier, etc.) and maintain an audit trail of these changes.

3.3.8 Output Requirements:

- a. Reporting Capabilities – The ability to self-extract data and create reports “at will” so as to enable organizations to identify and mitigate risk earlier in the process.
- b. Threaded discussion documentation: Record of what was discussed. Tied to project, part number (P/N) supplier, project, issue, etc.
- c. Output Data Format:
 - For review only
 - For data analysis
- d. Computer System and Software Performance Metrics: Ability to collect and report metrics related to
 - Performance
 - History
 - System Availability (up-time)

3.3.9 Rules Controlling Workflow and Processes: The e-Tool should possess multi layered level of controls on any QA process based upon well-defined phase gates, access-control and approvals.

- a. Related to product release process – Expedite QA process with user defined phase gates. For example, e-Tool may expedite receipt entry process for parts or project that has certain phase-gates such as data requirements, inspection requirements or inspection-skipping, etc.
 - 1. Soft-locks, hard-locks if certain data is not received
 - 2. Notification feature
 - 3. Ability to add custom rules
- b. Related to access: Single and controlled point of access for all business processes
- c. Related to approval: Authorized Electronic signature and approval (e.g. signatures associated with Certificate of Conformances (CofC)). Ability to send certifications, approved data, documents, etc. by authorized individuals

3.3.10 Traceability Services:

- a. Part Traceability: Ability to sort information related to parts using various part-attributes (for example, serial numbers, heat lot codes, lot codes, manufacturing date codes, etc.)
- b. Document Traceability: Ability to sort documents based on various document-attributes (e.g. Purchase Order (PO), project number, date, supplier code, etc.)

3.3.11 Link to Training and Other Reference Material: The ability for a customer to embed links (references) within their business process(es) that allows users to quickly obtain information pertaining to the intent and usage of specified requirements.

3.3.12 Software Quality Assurance: e-Tool shall be compliant to the quality assurance requirements defined in best commercial software assurance practices.

3.4 High-Level Security Requirements:

This ARP recommends standard industry security practices be followed. This subsection lists aerospace customer security requirements which the project is to satisfy. These security requirements are broken into the following categories

- a. Network and Infrastructure
- b. Application – user authentication and SSO (Single Sign On), functional access controls
- c. Data – secured storage and retrieval
- d. Business Process – for example, protect intellectual capital as required
- e. Export control – per applicable government regulations
- f. Secured and encrypted session - for example, secure sockets layer (SSL)

3.5 Data/Database High-Level Requirements:

This subsection lists all customer data/database support requirements e-Tool is to satisfy. The data may be physically transmitted or may be stored at a centralized location where any authorized individual can access it. Following are some of the types of requirements that should be included,

- Data retention for duration specified by customers
- Data archival
- Data recovery, irrespective of technology changes, and backup
- Initial development of the following documents:
 - Data flow
 - Work flow
 - Entity Relationship Diagram (ERD)