

Software Quality Management Guidance

Contents

Introduction	1
What is the purpose of the guidance?	1
Who is this guidance for?.....	1
What is the expected outcome?.....	1
What makes software different?	2
Quality Management Systems Introduction	2
Quality Management Systems - Supplier Selection Strategy	2
Appropriate Certification Mandate	3
Process Maturity Assessment.....	3
Quality Management Systems - Supplier Control Strategy.....	4
Software Quality Management - Functional Competences and Training.....	6
Useful Software related International Standards	6
Does this guidance meet your needs?.....	7
Where to find referenced information.....	7

Introduction

1. Fundamentally software is a product and as such the [mandated requirements for quality](#) apply. How they are applied; and specific quality assurance activities, tools and techniques need to be modified to address the differing needs of software life cycle.

What is the purpose of the guidance?

2. This Software Quality Management (SQM) guidance is intended to provide supplementary quality management guidance and information to help users to address the differing needs or risks related to software acquisition and support.
3. This guidance assumes that the reader is already familiar with general content of the '[Managing Quality](#)' website hosted on the [Acquisition Management System](#) (AOF), and in particular the sections titled [Achieving Quality](#) and [Project Quality Strategy](#).

Who is this guidance for?

4. This guidance is aimed at MoD personnel, Suppliers to the MoD and consultants (including 3rd Party Certification bodies) involved in activities that relate to MoD acquisitions with a software element.

What is the expected outcome?

5. The expected outcome of the application of the SQM guidance is:
 - Supplier selection criteria will include appropriate certification and process maturity assessment as appropriate to the software acquisition
 - Appropriate Quality Assurance standards will be invoked in contracts with a software element
 - Government Quality Assurance Surveillance (GQAS) will be applied according to risk, to assure contractual requirements relating to software quality are and will be met

What makes software different?

6. Within the software system life cycle, activities focus around design and development. The manufacturing phase is comparatively simple, and is often referred to as replication. Sources of software acquisition risk are likely to include:
 - Acquirers' difficulty in specifying requirements in other than general terms
 - Suppliers' difficulties in understanding customers' needs
 - The large quantities of information that need to be communicated and assimilated continuously in order to define and understand requirements, especially changing requirements
 - The intangible nature of software, much of the process of creating software is also intangible, involving experience, thought, and imagination
 - The many means of creating software which are highly sensitive to apparently trivial deficiencies such as punctuation errors
 - The difficulty of accommodating requirements when they do change, although software is seemingly easy to change
 - The schedule and cost considerations which often pressure suppliers to deliver code before requirements are fully understood by the developers and testing can be completed
 - The common lack of systematic use of analysis and design methodologies
 - The inability to exhaustively test software
7. Due to the almost infinite permutations within complex software, testing poses difficulties. It is impracticable to completely test software; rather testing is stopped based on the specific testing strategy. The impact of this can be felt later in the software life cycle. For example, support and maintenance requirements during the in-service phase are more difficult to determine. The extent of software testing should be determined by the complexity and criticality of the software under test.
8. Given the difficulties in detecting errors, greater emphasis needs to be placed on preventing errors in the first place; hence the importance of effective software development process controls.

Quality Management Systems Introduction

9. The complexities of software development can only be achieved successfully if the necessary methods and controls are in place from the start. Correction is too late, too costly, and too risky to implement when the project is nearing completion. Software design, development, maintenance and associated support need to be made visible and manageable at all stages in the development life cycle.
10. MoD Quality Policy requires that suppliers implement an appropriate Quality Management System (QMS) in order to assure the success of software acquisitions.

Quality Management Systems - Supplier Selection Strategy

11. The '[Managing Quality](#)' mandate to select Suppliers based on '**Appropriate Certification**' applies.
12. In the field of software there are a number of options for QMS certification schemes. The most prominent schemes in the UK are TickIT and ISO 9001:2008 (with a specific software scope).
13. The scope of the certification is the important aspect. It identifies the specific capabilities of the

supplier. It is vital that scope of the of the supplier's certification covers all the activities needed to fulfil the contract.

Appropriate Certification Mandate

3rd Party Accredited Certification

14. The SQM Policy recognises the following United Kingdom Accreditation Service (UKAS) accredited certification schemes in order of preference:

First Preference

15. TickIT, a specific to software scheme that couples the general principles of ISO 9001 with the software life cycle processes detailed in ISO/IEC 12207. This is recommended where software related risks are high.

Notes:

- *TickIT is a joint UK and Swedish certification scheme, and has limited international uptake*
- *The TickIT scheme is currently under going a revision. The objective is to improve TickIT as a process improvement model and supplier selection differentiator. For more details of the revision please contact the [DQA Helpline](#)*

Second Preference

16. ISO 9001 with a software scope, a globally recognised, but more general scheme. This is recommended, where the software related risks are moderate.

Third Preference

17. The SQA Guidance recognises certification to Allied Quality Assurance Publications (AQAP) 2210 with 2110 issued by other NATO governments as the only appropriate 2nd party certification scheme.

Note: *AQAP 2210 is not an Accredited Certification Scheme. Take caution using AQAP 2210 certification. The AQAP addresses many of the needs of the MoD 'Appropriate Certification' mandate, but the assessments are conducted on a second party basis. They will therefore, be biased towards the specific needs of that 2nd Party (Nation), which may differ from those of the UK MoD or your specific project.*

Process Maturity Assessment

18. Many suppliers choose to supplement their QMS certification with process maturity assessments. The most prominent example of which is, Capability Maturity Model – Integrated (CMMI).

19. CMMI is a globally recognised rigorous process improvement model. A statement of assessment against this model is usually indicative of the supplier's capability. Capability Statements range from level 1 to 5, level 1 being the lowest and 5 the highest.

20. The assessment must be understood in terms of the assessed organisation, the functions included (systems, software, project management etc), the formality of the assessment, the results and the currency.

21. CMMI is licensed by the Software Engineering Institute that controls training, qualification of assessors and formal assessment records. The model and other associated information is available from the [SEI website](#).

22. CMMI is not an 'accredited' (UKAS or overseas equivalent) scheme, nor does it require independence of its assessors. Companies can claim a maturity level based on self assessment; Acquirers should validate potential suppliers' claims against the lists published on the SEI website.
23. CMMI assessment does not replace QMS certification as CMMI is weak in the more general, but important business management areas like quality policy, management review, resource/skill data, calibration and non-conformance management. ISO 9001:2008 certification with a suitable scope and CMMI level 3, validated by the SEI, can be considered as equivalent to TickIT certification for the purposes of the 'Appropriate Certification' mandate.
24. The SQM guidance does not mandate a minimum CMMI level, however any relevant SEI recognised assessments should be utilised in a supplier evaluation.

Quality Management Systems - Supplier Control Strategy

Contracting

25. Software Quality Contractual Standards exist to cover the essential aspects of Software Quality Assurance and should be invoked based on contractual risk. The Mandate for Quality, to invoke appropriate contract Quality Assurance Conditions applies.
26. For MoD contracts that include development or maintenance of either deliverable or non deliverable software. **AQAP 2210 - NATO Supplementary Software Quality Assurance Requirements to AQAP 2110** is considered appropriate.
27. [AQAP 2210](#) must be invoked in addition to [AQAP 2110](#). AQAP 2210 requires the supplier to apply additional controls to assure software quality. For further details refer to [AQAP 2009](#) Annex E.
28. **AQAP 160 - NATO Integrated Quality Requirements for Software Throughout the Life Cycle** may be used when acquiring software. [AQAP 160](#) may only be used after having sought DQA Policy advice. Contact us via the [DQA Helpline](#).
29. For commercial off the shelf (COTS) software, **ISO 25051 Software engineering - Software Product Quality Requirements and Evaluation (SQuaRE) - Requirements for quality of Commercial Off-The-Self (COTS) software product and instructions for testing** is recommended.
30. COTS software products are ready-made packages bought off-the-shelf by the MoD either directly or through the supply chain. Selecting high quality COTS software products is of prime importance, because COTS software products may have to be operational in various environments and selected without the opportunity to compare performance among similar products.
31. Suppliers and MoD need a way to ensure confidence in COTS software product performance. This International Standard provides guidance to establish:
 - Quality requirements for COTS software products
 - Requirements for test documentation for the testing of COTS software products, including test requirements, test cases, and test reporting
 - Instructions for conformity evaluation of COTS software products
32. It also includes recommendations for safety or business critical COTS software products. MoD project teams and suppliers are encouraged to apply this standard when procuring COTS.
33. The Supplier Control Strategy should include Supplier monitoring. Audits, reviews and verifications of software processes and products are the responsibility of the Supplier and should be conducted throughout the life cycle as appropriate to assure that the software will fulfil customer needs. The

decision as to what to assure and when should be based on risk. Government Quality Assurance (GQA) can provide addition confidence to the Acquirer that the supplier is undertaking appropriate assurance activities.

34. Assurance activities should be planned to provide confidence in areas of risk such that, mitigation or corrective action can be implemented whilst sustaining the project schedule.

Supplier Monitoring - Joint Software Reviews

35. Software related assurance activities may be known under various headings; including design reviews, peer reviews, walk-throughs, inspections, document reviews, and bench-checks.

36. The purpose of the Joint Software Reviews is to maintain a common understanding with the stakeholders of the progress against the contractual requirements and what should be done to help ensure development of a product that satisfies the stakeholders. Software reviews are at both project management and technical levels and should be held throughout the life of the project.

37. As a result of successful implementation of the Software Review Process:

- management and technical reviews are held based on the needs of the project
- the status and products of an activity of a process are evaluated through review activities
- review results are made known to all affected parties
- action items resulting from reviews are tracked to closure
- risks and problems are identified and recorded

38. For more details refer to: **ISO/IEC 12207 - Software Life Cycle Systems and software engineering - Software life cycle processes.**

39. Key processes and activities where assurance should be considered include:

- Software Planning and Tracking
- Software Configuration Management
- Software Risk Management
- Requirements Specification
- Software System Requirements
- Software Module design
- Software Coding
- Code Level test
- Integration
- System Test
- Acceptance and Handover

40. Further essential information can be found in the '[Managing Quality](#)' topic: **Risk Based Government Quality Assurance.**

Software Quality Management - Functional Competences and Training

41. For details of Functional Competences related to Software Quality Management please refer to the links:

- Managing Quality Functional Competence Framework
- Skills Framework for Info Age Functional Competence Framework

Both available on the defence intranet - Functional Competence Frameworks M-Z [webpage](#)

- Skills Framework for the Information Age (SFIA) [website](#)

Useful Software related International Standards

ISO/IEC 12207 - Software Life Cycle Systems and software engineering - Software life cycle processes

42. ISO/IEC 12207 establishes a common framework for software life cycle processes, with well defined terminology, that can be referenced by the software industry. It contains processes, activities, and tasks that are to be applied during the acquisition of a software product or service and during the supply, development, operation, maintenance and disposal of software products. Software includes the software portion of firmware. ISO/IEC 12207 applies to the acquisition of systems and software products and services, to the supply, development, operation, maintenance, and disposal of software products and the software portion of a system, whether performed internally or externally to an organization. Those aspects of system definition needed to provide the context for software products and services are included. ISO/IEC 12207 also provides a process that can be employed for defining, controlling, and improving software life cycle processes. The processes, activities and tasks, either alone or in conjunction with ISO/IEC 15288 may also be applied during the acquisition of a system that contains software.

43. The purpose of ISO/IEC 12207 is to provide a defined set of processes to facilitate communication among acquirers, suppliers and other stakeholders in the life cycle of a software product. ISO/IEC 12207 is written for acquirers of systems and software products and services and for suppliers, developers, operators, maintainers, managers, quality assurance managers, and users of software products.

TickIT Customers Guide

44. This part of the TickIT Guide is to help those involved with the process of acquiring or commissioning software and systems. It comprises a step-by-step guide to actions and responsibilities that may be reasonably expected of customers when they work closely with their suppliers to satisfy their requirements, and thus maximise the benefits that may be derived from their investments. Such business benefits accrue to customers who value quality management system certification of their software and systems suppliers to ISO 9001 and regard certification as an important factor in their buying decisions. The TickIT framework is based on international standards and best practice. It serves to promote and maintain a healthy, co-operative relationship between customer and supplier so that suppliers can implement requirements and customers can make well-informed choices.

ISO 90003 Guidance for the application of ISO 9001 to software

45. ISO 90003 provides guidance for organizations in the application of ISO 9001:2008 to the acquisition, supply, development, operation and maintenance of computer software.

ISO/IEC 20000-1: 2005 Information technology - Service management

46. ISO/IEC 20000-1: 2005 is a conformity standard stating requirements for IT Service Management system, management responsibilities, service and processes. It defines the requirements for an IT service provider to deliver managed services of an acceptable quality for its customers.

Does this guidance meet your needs?

47. If you need any further assistance please contact the **DQA Helpline**. Military: (9)-679-32681, PSTN: +44(0)30-679-32681, Email: DESSEDQA-Helpline@mod.uk.

48. The Software Quality Assurance Working Group (SQAWG) is subordinate to the [Quality Assurance Consultative Group](#) (QACG) and [Defence Industries Quality Forum](#) (DIQF), and meets to develop Software Quality Guidance. For details of how to contribute to SQA Guidance Development please contact the **DQA Helpline**.

Where to find referenced information

Title	Internet	Defence Intranet (RLI)
Acquisition Operating Framework (AOF)	www.aof.mod.uk	http://www.aof.dii.r.mil.uk
AOF - Managing Quality website	www.aof.mod.uk/aofcontent/tactical/quality/index.htm	http://www.aof.dii.r.mil.uk/aofcontent/tactical/quality/index.htm
AOF - Configuration Management website	www.aof.mod.uk/aofcontent/tactical/ppm/content/configman/introduction.htm	http://www.aof.dii.r.mil.uk/aofcontent/tactical/ppm/content/configman/introduction.htm
Allied Quality Assurance Publications (AQAPs)	http://www.nato.int/docu/standards.htm#aqap	http://www.dstan.dii.r.mil.uk/aps.htm
International Organisation for Standardization (ISO) website	www.iso.org	
IHS - Standards Online website *	www.ihs.com	
Software Engineering Institute website	www.sei.cmu.edu	
Functional Competence Frameworks M-Z webpage		http://defenceintranet.diiweb.r.mil.uk/DefenceIntranet/Library/CivilianAndJointService/BrowseDocumentCategories/ManComm/PerformanceManagement/QualityManagement/DefenceIndustriesQualityForumdiqfInformation.htm
Skills Framework for the Information Age (SFIA) website	www.sfia.org.uk	
Quality Assurance Consultative Group (QACG) webpage		http://defenceintranet.diiweb.r.mil.uk/DefenceIntranet/Library/CivilianAndJointService/BrowseDocumentCategories/ManComm/PerformanceManagement/QualityManagement/QualityAssuranceConsultativeGroupqacgInformation.htm
Defence Industries Quality Forum (DIQF) webpage		http://defenceintranet.diiweb.r.mil.uk/DefenceIntranet/Library/CivilianAndJointService/BrowseDocumentCategories/ManComm/PerformanceManagement/QualityManagement/DefenceIndustriesQualityForumdiqfInformation.htm
DE&S Director Infrastructure - Electronic Library webpage		http://defenceintranet.diiweb.r.mil.uk/DefenceIntranet/Teams/BrowseTeamCategories/Orgbased/DesDirectorInfrastructureElectronicLibrary.htm

* IHS is a subscription website where standards can be obtained online. DE&S staff can obtain a Username and Password from the **DE&S Director Infrastructure - Electronic Library**.