

# **POLICY ON AN INTEGRATED SYSTEMS APPROACH TO QUALITY THROUGH THE LIFE CYCLE**

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**THE NATO POLICY ON AN INTEGRATED SYSTEMS APPROACH TO QUALITY  
THROUGH THE LIFE CYCLE**

**Foreword**

This document provides information and guidance on Quality management in NATO and the NATO Policy on an Integrated Systems Approach to Quality Throughout the Life Cycle.

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## **1. General**

### **1.1 Introduction**

The activities of the Armed Forces in NATO are carried out as a result of a political decision process, primarily in order to provide a defence service to society in the member nations. Collaboration between NATO and Partnership for Peace (PfP) partners is a way of mitigating some of the cost of defence systems and providing a mutual defence capability.

The defence capability depends, to a great extent, on the quality of defence systems<sup>1</sup> containing integrated hardware, software, facilities, people, and underlying processes. Quality is best achieved through an integrated systems approach throughout the life cycle. This document provides information and guidance on the NATO Policy for such an approach.

This policy recognises that quality management is a continuous process involving multiple participants, including industry, that supports the development, delivery and sustainment of military capability from concept to disposal. The overall aim is to acquire products that fulfil the requirements seen in a lifecycle perspective, to optimise internal and external interfaces, and to develop good commercial relationships with industry.

The structure of the document is illustrated in Annex A.

### **1.2 Scope**

This document should be used, as a part of the overall policy of an organisation, to ensure quality of life cycle processes, products<sup>2</sup> and services. The document is not intended to be used as a contractual document.

### **1.3 Normative references**

Documents relevant to this AQAP are Standardisation Agreement (STANAG) 4107 and the documents listed in Annex D and Annex G.

### **1.4 Terms and definitions**

The definitions of ISO 9000:2000<sup>3</sup> “Quality Management Systems – Fundamentals and Vocabulary” shall apply. In addition some definitions and acronyms used in this document are listed in Annex H.

## **1.5 The NATO Policy on an Integrated Systems Approach to Quality Throughout the Life Cycle**

### **1.5.1 Policy framework**

This policy provides the framework for an integrated systems approach to achieve quality of products and services throughout the life cycle. This approach establishes a structure that addresses both managerial and technical elements and is based on the following:

- a. an organisation must establish, manage and conduct processes<sup>4</sup> in order to effectively set and reach its goals;
- b. hardware, software, human interaction and other elements are integrated into a system and the corresponding disciplines<sup>5</sup> are harmonised;

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<sup>1</sup> “Defence system” will later in this document be considered synonymous with “Product”.

<sup>2</sup> Ranging from simple to complex combinations of hardware, software, facilities, people and underlying processes.

<sup>3</sup> At the time of publication of this document, ISO/DIS 9000:2000 was used.

<sup>4</sup> A process is a set of interrelated activities and resources that transform inputs into outputs. When related resources and activities are managed as a process, a desired result is achieved more efficiently. Resources can include personnel, finance, facilities, equipment, techniques and methods. Outputs (products) can be (any combination of) tangibles such as hardware or documentation or intangibles such as software or service.

<sup>5</sup> E.g. software engineering.

- c. the interests of all the interested parties in the life cycle, including the natural environment, are taken into account. The related needs are translated into appropriate functional and technical requirements;
- d. the life cycle participants<sup>6</sup> use a common framework<sup>7</sup> and terminology to create and manage the system/product; and
- e. the quality management process and the associated activities are applied continuously to the products and all life cycle processes.

### **1.5.2 The challenge for industry and for government**

The challenge for industry and for government is to emphasise the processes for planning, controlling, assuring, and improving quality early in, and throughout all the processes and activities of the life cycle as well as in project management itself. The goal is to design capable products, establish and use efficient and effective processes and prevent deficiencies. This contributes to the reduction of risks and quality costs, and set focus on the needs of the customer.

Industry has realised that, in harmony with change in business and industrial processes, there is a continual need for improvement in the skill and knowledge of personnel. There is a corresponding need for the government personnel<sup>8</sup> and personnel in NATO Agencies and Commands to maintain and improve their skill and knowledge. Effective performance demands a thorough knowledge of the quality management process and industrial practices and techniques as well as technical knowledge associated with the product.

## **2. Concepts**

The concepts of this document relate to one or more of the following four domains: Time, Function, Resource and Organisation:

- a. the time domain mainly deals with the phases of the life cycle;
- b. the function domain mainly deals with the life cycle processes;
- c. the resource domain mainly deals with the life cycle participants; and
- d. the organisation domain mainly deals with the management system(s).

The relationship among these domains and the related concepts is shown in Annex A.

The integrated systems approach to quality throughout the life cycle is based on the concepts described in the following paragraphs.

### **2.1 Life Cycle Phases**

The life cycle (ranging from conception through disposal) of the system is divided into well-defined phases that provide a framework for the project(s). The end of each phase is a decision point (milestone) in the project. A project may be in more than one phase at the same time.

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<sup>6</sup> In this AQAP the word “participant” is to be understood as people directly involved in the activities through the life cycle processes and phases. See §2.3. By this definition a user is a participant.

<sup>7</sup> “Common framework” refers to a set of processes shared by all life cycle participants, and may include common management systems, compatible/interoperable engineering environments/tools, etc.

<sup>8</sup> Including the personnel with responsibility for Government Quality Assurance.

## 2.2 Life Cycle Processes

In each phase of the life cycle there are processes which may be employed organisation wide or specific to a project (see Annex B for examples). The organisations of the life cycle participants should establish, document, maintain and improve effective and economical processes. Organisations can use international standards, as appropriate, to align and tailor the applicable processes with the organisation's structure, goals and business strategy. These standards may also contain the criteria that confirm the successful execution of the processes.

The activities of processes employed by the project should be structured into a Work Breakdown Structure (WBS). A typical profile of activities may be found in the NATO document "Phased Armaments Programme Systems (PAPS) Allied Administrative Publication (AAP-20)" or in a similar national document.

### 2.2.1 The application of the Quality management process

The quality management process is a process whose activities can be applied to all processes throughout the life cycle with a focus on a controlled execution of the processes and their improvement as necessary. This process includes the activities of planning, review, audit, measurement and monitoring, verification, validation, corrective and preventive action. The cost incurred in ensuring and assuring satisfactory quality must be balanced against the estimated cost from losses<sup>9</sup> potentially incurred when satisfactory quality is not achieved. Based on the contract requirements, including the contractual AQAP, quality management activities must be applied to all aspects of the processes.

## 2.3 Life cycle participants.

The participants directly involved in processes and associated activities throughout the life cycle phases can be expressed in generic terms: e. g. the user, the acquirer, the owner, the supplier, and the personnel with responsibility for Government Quality Assurance (GQA). Since quality is a shared responsibility, the responsibilities should not be allocated exclusively to any one of the participants.

### 2.3.1 The user

The user's<sup>10</sup> primary responsibility is to define needs with the greatest possible accuracy, clarity and completeness; not only operational and delivery requirements, but also requirements pertaining to readiness, logistics, training, environment, mission success and life cycle costs.

### 2.3.2 The acquirer

The acquirer's responsibility is to:

- a. Ensure the capture of the requirements to the necessary extent by:
  - (1) Translation of the user's needs into appropriate functional and technical requirements.
  - (2) Consideration of the interests of all the other interested parties in the life cycle.
  - (3) Consideration of all applicable national and international regulations, including environmental regulations.
  - (4) Reflection of the resulting requirements in the project documents, e. g. the contract, and in the continuing project management processes.

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<sup>9</sup> Loses are measured in terms of impacts from: higher rework/maintenance, lower reliability, safety issues, human casualties, etc.

<sup>10</sup> More than one, in all applicable organisational levels and in all the life cycle phases, e. g. staff, operators and maintainers. And in some cases the owner.

- b. Ensure the preparation of contracts that:
  - (1) Allow sufficient freedom and incentives for the suppliers, e.g. to use commercial products.
  - (2) Allow the acquirer the fullest view of the activities of the suppliers in order to gain confidence in the resultant product.
  - (3) Contain appropriate quality management requirements.
- c. Ensure compliance with contract requirements including cost and schedule.
- d. Ensure the integration of management, engineering and commercial practices.
- e. Ensure the existence of a strategy for co-ordinating and implementing quality management activities<sup>11</sup>.
- f. Ensure that quality management activities are applied continuously to all life cycle processes.
- g. Ensure that data are collected and the necessary updates/corrections initiated.  
Especially feed back from the user can create a knowledge base on which future modifications<sup>12</sup> to the product may be built and future projects influenced.
- h. Evaluate the risks associated with the product and the supplier in co-operation with the other members of the Project Management Team.
- i. Provide for the final contractual acceptance of the product.

### 2.3.3 The owner

The owner is regarded as a life cycle participant only in cases where he has also the role of the acquirer or the supplier and/or the user. Otherwise he is considered an interested party.

### 2.3.4 The supplier

The supplier's responsibility is to fulfil the contractual requirements including any part of the contract that might be sub-contracted<sup>13</sup>. This includes the responsibility to:

- a. Ensure that any uncertainty with the interpretation of contractual requirements is brought to the attention of the acquirer.
- b. Plan all the applicable processes necessary for the appropriate phase(s) of the life cycle. (See Annex B.)
- c. Control quality of products and services.
- d. Ensure that only products and services that conform to contract requirements are offered for acceptance to the acquirer.
- e. Provide the acquirer with proof and confidence that:
  - (1) The necessary measures to manage any risks are being taken.
  - (2) The required preventive and corrective actions are being taken.
  - (3) The products and services meet contractual requirements.

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<sup>11</sup> This is especially important for complex multinational projects.

<sup>12</sup> Including product improvement.

<sup>13</sup> NATO system supporting organisations can also act as suppliers, in particular during operation and support of an installed system.

### **2.3.5 The personnel with responsibility for GQA**

NATO nations have developed their national systems for GQA to gain confidence in the quality of a product or service. The range of activities associated with these systems may include the evaluation of the capability of potential suppliers quality management system and surveillance of the contract-related activities at an appropriate level. The most important aspect of GQA is the action of assuring that all contract requirements are fulfilled by the supplier.

In a specific project the primary role of the personnel with an appointed responsibility for quality management, usually the National Quality Assurance Representative (NQAR), is to support the acquirer GQA. An important part of that support, is to:

- a. Ensure that the quality-related paragraphs of the contract are formulated in a feasible manner.
- b. Take part in any pre-evaluation of the supplier's quality management system.
- c. Ensure that quality management activities are applied to the processes<sup>14</sup> of the supplier and any sub-contractor. The results are reported to the Project Management Team as agreed upon.

This can create a knowledge base on which it may be determined to increase or decrease the involvement of the NQAR at the supplier, and future projects may be influenced.

GQA cannot be performed in an exhaustive manner by GQA staff alone. For this reason GQA in NATO nations' procurement is based on co-operation with the other life-cycle participants and the allocation of resources where they are expected to be most effective.

Appropriate contract paragraphs (containing appropriate AQAP and other) and the complete visibility of the supplier's quality activities, supported by objective evidence, is necessary for the National Quality Assurance Authority (NQAA) to perform its task efficiently.

### **2.4. The use of risk based tasking**

With the prerequisite described above, the Project Management Team (PMT) is in a position to decide on the extent to which GQA staff should be involved at the supplier. This decision is taken, based on an evaluation of risk, contract by contract, depending on the category and the requirements of the product procured as well as on the NQAA's confidence in the supplier and his quality management system.

To obtain a cost effective use of the resources, GQA in the supplying country should only be requested when areas of risk, associated with, for example, the product or the supplier, have been identified. The delegate should evaluate whether GQA is necessary based on the information from the acquirer. If necessary, the delegate should define the minimum requirements for GQA. The AQAP-170 gives information of how risks may be considered.

### **2.5 Communication and information**

It is important that information from all interested parties is exchanged continuously in order to take all interests into account as early as possible in the life cycle. This is necessary in order to prevent problems occurring in the later phases<sup>15</sup>. The early exchange of information is also necessary during life cycle planning, in order to assess the ramification and consequences of all activities, design parameters etc. which may constrain or otherwise cause a disadvantage during subsequent phases of the life cycle.

The requirements resulting from the information obtained must be documented. Thereby it may be ensured that:

- a. Products and services for the armed forces are developed, produced, and provided in accordance with the contractual requirements in a cost-effective way.

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<sup>14</sup> Including process input and output, see Annex A.

<sup>15</sup> Such as unnecessary expensive maintenance and disposal.

- b. The service to society is balanced so that unwanted effects during the life cycle, e. g. on society, man, and nature, are taken into consideration.
- c. The life cycle participants down-stream<sup>16</sup> are provided with the prerequisites to do their jobs.

Each of the participants must develop effective interfaces and dialogue with the others in order to take all points of view into account and to ensure that important and honest information is shared.

Both the participants and the project would suffer from any weakness in these interfaces and dialogue.

The best way to obtain information and protect the interest of the interested parties and enhance the effectiveness of interfaces and dialogues is to establish integrated teams (See § 2.6 below ).

## 2.6 Project Management Teams

It is considered important that Project Management Teams (PMTs) are set up as early as possible and extended throughout the entire life cycle<sup>17</sup>. This must be done to ensure efficient and effective implementation of an integrated systems approach to quality and to assist the common understanding of the purpose and performance goals of the project, and the approach to meet them. A project may exist for all or only some of the product life cycle phases.

These teams are cross-functional and the team members should have complementary skills and be committed to common objectives. The PMTs should have the delegated authority to trade-off performance, time, cost, and risk, as appropriate, while maintaining a focus on quality. The responsibilities and accountability of participants within the PMTs should be defined unequivocally at project initiation and be updated as the project progresses, with the understanding that project management is a team effort.

The PMTs ensure that:

- a. All the interested parties are co-operating and their interests are taken into account
- b. Life cycle planning is performed and documented<sup>18</sup>.
- c. A project Quality Plan is developed considering the acquisition strategy, identifying measurable quality objectives.
- d. There exists a common understanding of the purpose and performance goals of the project, and the approach to meet them.
- e. A common terminology is used, including an agreed definition of life cycle phases.
- f. Data are collected and evaluated and the necessary actions initiated. Especially feed back from the user can create a knowledge base on which future modifications to the product may be built and future projects influenced.
- g. Product conforming to the functional and technical requirements of the contract is delivered.

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<sup>16</sup> Examples of these are producers, operational staffs, operators and maintainers.

<sup>17</sup> If the project e.g. is only a “development project”, the Project Management Team (PMT) can discontinue at the end of the “Development” phase.

<sup>18</sup> Information about planning in projects may be found in ISO10006 “Quality management – Guidelines to quality in project management”. (See Annex B, Table 1).

Figure 1 illustrates how interested parties and participants throughout the life cycle interface with the PMT.

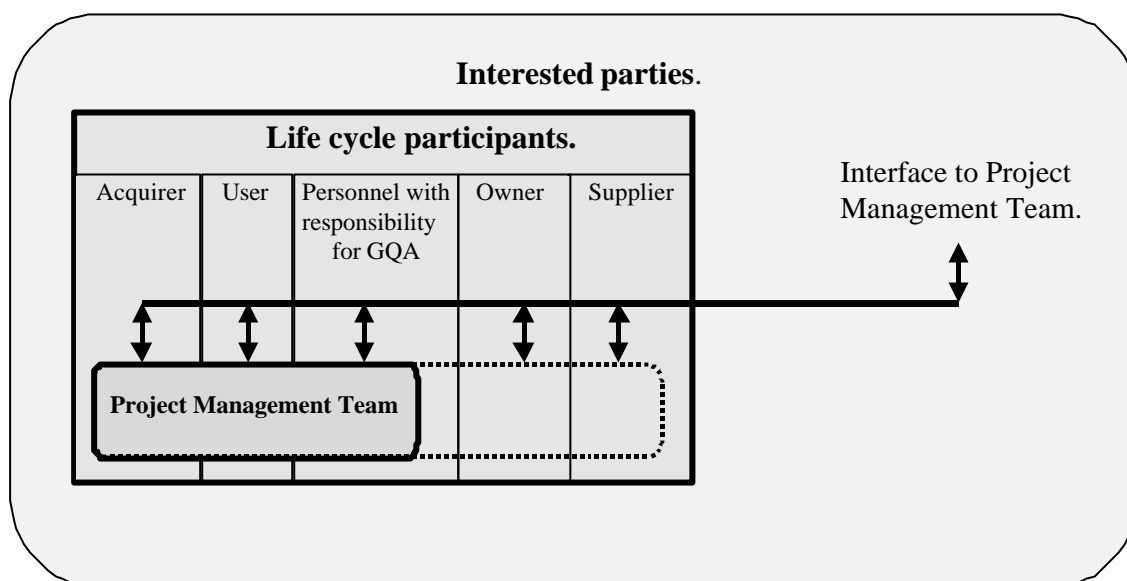


Figure 1.

## 2.7 Quality management system

In order to achieve maximum effectiveness, the organisations of the life cycle participants should establish, document, assess and improve an effective and economical quality management system.

There is a cause and effect between the Quality Management System and the processes of an organisation.

To implement the quality management system, the organisation shall:

- a. Identify the processes needed for the quality management system;
- b. Determine the sequence and interaction of these processes;
- c. Determine criteria and methods required to ensure the effective operation and control of these processes;
- d. Ensure the availability of information necessary to support the operation and monitoring of these processes;
- e. Measure, monitor and analyse these processes, and implement action necessary to achieve planned results and continual improvement.

### 2.7.1 Establishment

The quality management system is that part of the organisation's management system that establishes the quality policy and quality objectives and then focuses on the achievement of results according to the quality objectives. The quality objectives complement other objectives of the Organisation such as those related to growth, funding, profitability, personnel safety, and environmental effects of processes, products and services. The various parts of an organisation's management system that focus on the achievement of those other objectives (for instance relating to environmental protection) can be integrated into a single, cohesive and unified management system where they use common elements.

The quality management policy and objectives should provide a way of effectively managing resources and life cycle processes based on the participation of all members of the organisation. This approach aims at long-term success by creating a focus on continuous improvement, customer satisfaction and benefits to all interested parties<sup>19</sup>.

### **2.7.2 Assessment and improvement**

In order to survive in an environment where businesses are facing increasing competitive challenges every day, organisations are finding new ways to extend/augment their competitive edge and measure how far they are from “Performance Excellence” as it is expressed today. The use of internationally recognised “life cycle process models”, “capability maturity levels” and the use of “assessment type(s)” depending on the need is seen as a trend.

Assessment provides an insight into an organisation, which indicates the areas where corrections are required and opportunities for improvements exist.

There are three ways to conduct an assessment:

- 1<sup>st</sup> party (internal audit/self assessment),
- 2<sup>nd</sup> party (customer) and
- 3<sup>rd</sup> party (independent certification bodies).

Feedback from these assessments can be a way to improve their performance. In general, these assessments include:

- a. An analysis of the areas in the organisation itself where opportunities are identified (or improvement is needed the most).
- b. A “bench marking” against competitors, co-operative partners, business processes in general, technical processes, etc.

See Annex C for examples of methodologies for assessment and improvement. These methodologies, that enable quantitative evaluation of organisational performance, should be considered for use by all organisations.

## **2.8 The use of International Standards**

NATO AC/250 has decided to use international standards where they are appropriate. NATO Quality management requires that the AQAP document and related international standards must be used to form a complete standard for NATO use. The NATO community should seek to influence evolving international standards.

If standards from the ISO9000 series are used in contracts, NATO needs additional contractual quality requirements. These requirements are incorporated into the AQAP documents described in Annex D.

The present set of contractual AQAPs therefore includes requirements of the respective international standard plus NATO supplements as necessary.

## **2.9 The use of NATO Publications**

Since defence materiel may be purchased or developed as multinational projects, a set of NATO documents (including Allied Quality Assurance Publications) should be maintained and used for the mutual benefit of NATO and member nations.

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<sup>19</sup> This also covers the principles of “Total Quality Management”.

### 2.9.1 The two types of AQAPs

The basic document is the STANAG 4107, ratified by NATO nations involved in the procurement of defence materiel. STANAG 4107 concerns the "Mutual Acceptance of Government Quality Assurance and usage of the AQAPs" and establishes the rules for delegation of contract-related GQA activities from a purchasing authority to the NQAA in the supplier's nation. An overview of the AQAPs and an illustration of their structure are shown at Annexes E and D respectively.

According to their scope there are two types of AQAPs: (1) Contractual type and (2) Guidance type. The most essential AQAPs are the contractual type. These AQAPs require the supplier to provide objective evidence that he has established and maintained a contract-related quality management system. The system should contain the necessary elements to give the NQAR confidence that the product meets the contract requirements.

### 2.9.2 The contractual type AQAPs

Criteria for application of the contractual AQAPs are as laid down in Annex F to this AQAP and provide guidance for the proper selection of the applicable requirements for quality management for a contract.

- a. AQAPs -110, 120, and 130 are based on the ISO 9000 series of international standards.
- b. AQAP-131 is not based on an applicable international standard.
- c. AQAP-150 and AQAP-160 are available for software acquisition. AQAP-150 (Ed 2) is not based on an applicable international standard. AQAP-160 is based on ISO/IEC 12207 and ISO 9001.

### 2.9.3 The guidance type AQAPs

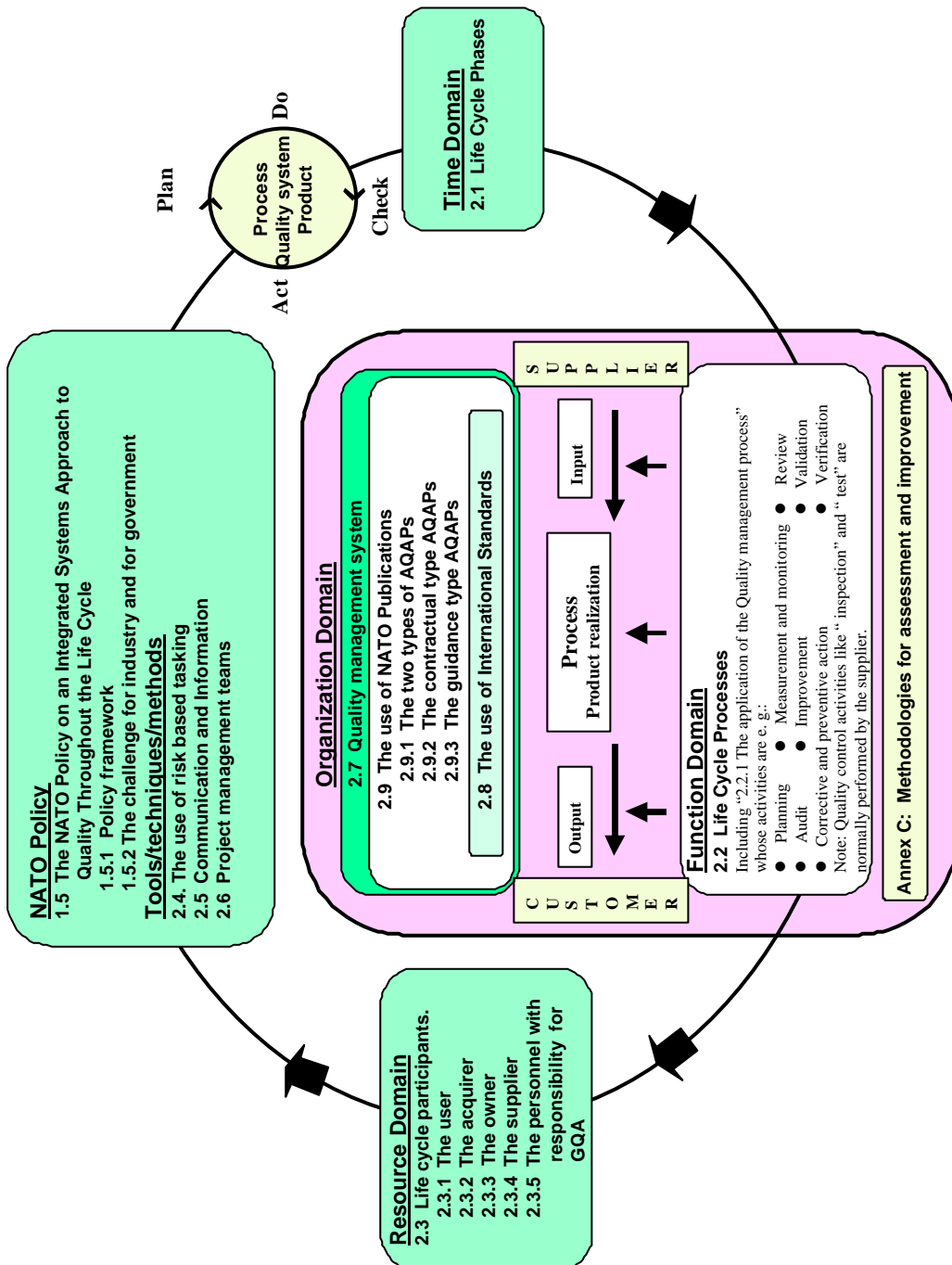
The use of contractual type AQAPs is supported by the following guidance type AQAPs. These guides will be of use to personnel responsible for contract preparation, accomplishment, surveillance and/or evaluating a supplier's quality management system for compliance to the AQAPs. They will also contribute to the commonality of interpretation of the requirements between suppliers and GQA personnel, and between NQAAs when GQA is to be performed within the provisions of STANAG 4107.

- a. AQAP-119 "NATO Guide to AQAPs -110, -120, -130" has been developed to supplement the guidance standard ISO 9000-2.
- b. AQAP-159 "NATO Guide for AQAP-150" has been developed to provide guidance to AQAP-150.
- c. AQAP-169 "NATO Guidance on the use of AQAP-160" has been developed to provide background information, interpretation guidance and application guidance on AQAP-160. The interpretation guidance explains the AQAP-160 model and the concept behind the standard. The application guidance primarily focuses on the tailoring of AQAP-160.
- d. AQAP-170 "NATO guide for the delegation of Government Quality Assurance", gives guidance for the conduct of Government Quality Assurance under the conditions of STANAG 4107 and supports the harmonisation of practices in GQA among NATO Nations, Agencies and Commands.



**THE NATO POLICY ON AN INTEGRATED SYSTEMS APPROACH TO QUALITY THROUGH THE LIFE CYCLE.**

The relationship among the domains and the related concepts.





**EXAMPLES OF LIFE CYCLE AND PROJECT MANAGEMENT PROCESSES.**

Table 1 shows examples from ISO 10006, “Quality management - Guidelines to quality in project management”. Table 2 shows examples from ISO/IEC CD2 15288, “Life Cycle Management—System Life Cycle Processes”. ISO/IEC15288 CD2 uses the term “stage” instead of “phase”.

**TABLE 1. Examples from ISO10006  
“Quality management – Guidelines to quality in project management”**

No.	System life cycle Phases.	Concept	Development	Production	Utilisation	Support	Retirement
	Project Management Processes.						
5.2	<b>STRATEGIC PROCESS<sup>20</sup>.</b>						
5.2	Strategic process.						
5.3	<b>INTERDEPENDENCY MANAGEMENT PROCESSES.</b> Projects consist of processes and an action in one of these usually affects others. The overall management of the interdependencies among the project processes is the responsibility of the project manager.						
5.3.1	Project initiation and project plan development						
5.3.2	Interaction management						
5.3.3	Change management						
5.3.4	Closure						
5.4	<b>SCOPE-RELATED PROCESSES.</b> For the purpose of this International Standard, “scope” includes a description of the project product, its characteristics and how they are to be measured or assessed.						
5.4.1	Concept development						
5.4.2	Scope development and control						
5.4.3	Activity definition						
5.4.4.	Activity control						

<sup>20</sup> The strategic project process is a direction-setting process that organizes and manages the realization of the project processes. In setting the direction for the project, the following concepts, which are important to the achievement of quality in project management, should be considered:

- satisfaction of customers and other stakeholders stated and implied needs is paramount;
- a project is carried out as a set of planned and interdependent processes;
- a focus on the quality of both process and product is necessary to meet the project objectives;
- management is responsible for creating an environment for quality;
- management is responsible for continual improvement.

No.	System life cycle Phases.	Concept	Development	Production	Utilisation	Support	Retirement
	Project Management Processes.						
<b>5.5</b>	<b>TIME-RELATED PROCESSES</b> These processes aim to determine dependencies and the duration of activities and to ensure timely completion of the project.						
5.5.1	Activities dependency planning						
5.5.2	Duration estimation						
5.5.3	Schedule development						
5.5.4	Schedule control						
<b>5.6</b>	<b>COST- RELATED PROCESSES.</b> These processes aim to forecast and manage the project costs and to ensure that the project is completed within budget constraints.						
5.6.1	Cost estimation						
5.6.2	Budgeting						
5.6.3	Cost control						
<b>5.7</b>	<b>RESOURCE-RELATED PROCESSES.</b> These processes aim to plan and control resources. They help to identify any possible problems with resources. Examples of resources include computer software, equipment, facilities, finance, information systems, materials, personnel, services and space.						
5.7.1	Resource planning						
5.7.2	Resource control						
<b>5.8</b>	<b>PERSONNEL-RELATED PROCESSES</b> People determine the quality and success of project. The personnel-related processes aim to create an environment in which people can contribute effectively and efficiently to the project.						
5.8.1	Definition of project organisational structure						
5.8.2	Staff allocation						
5.8.3	Team development						
<b>5.9</b>	<b>COMMUNICATION-RELATED OPERATIONAL PROCESSES</b> These processes aim to facilitate the exchange of information necessary for the project. They ensure timely and appropriate generation, collection, dissemination, storage and ultimate disposition of project information.						

No.	System life cycle Phases.	Concept	Development	Production	Utilisation	Support	Retirement
	Project Management Processes.						
5.9.1	Communication planning						
5.9.2	Information management						
5.9.3	Communication control						
<b>5.10</b>	<b>RISK-RELATED PROCESSES.</b> Management of project risks deals with uncertainties throughout the project and requires a structured approach. The aim of the risk related processes is to minimise the impact of potential negative events and to take full advantage of opportunities for improvement. In this International Standard, the term risk covers both aspects. Risks are related either to the project processes or to the compliance of the project product with project objectives.						
5.10.1	Risk identification						
5.10.2	Risk estimation						
5.10.3	Risk response development						
5.10.4	Risk control.						
<b>5.11</b>	<b>PURCHASING-RELATED PROCESSES.</b> These processes deal with the purchase, acquisition or procurement of products obtained for the project.						
5.11.1	Purchasing planning and control						
5.11.2	Documentation of requirements						
5.11.3	Evaluation of subcontractors						
5.11.4	Subcontracting						
5.11.5	Contract control						

**Table 2. Examples from ISO/IEC CD2 15288  
“Life Cycle Management—System Life Cycle Processes”**

No.	System life cycle Phases.	Concept	Development	Production	Utilization	Support	Retirement
	Life Cycle Processes.						
<b>6.1</b>	<b>ENTERPRISE<sup>21</sup> PROCESSES</b>						
6.1.1	Enterprise Management Process						
6.1.2	Investment Management Process						
6.1.3	System Life Cycle Processes Management Process						
6.1.4	Resource Management Process						
<b>6.2</b>	<b>AGREEMENT PROCESSES</b>						
6.2.1	Acquisition Process						
6.2.2	Supply Process						
<b>6.3</b>	<b>PROJECT MANAGEMENT PROCESSES</b>						
6.3.1	Planning Process						
6.3.2	Assessment Process						
6.3.3	Control Process						
6.3.4.	Decision Management Process						
6.3.4	Risk Management Process						
6.3.5	Configuration Management Process						
<b>6.4</b>	<b>TECHNICAL PROCESSES</b>						
6.4.1	Stakeholder Requirements Definition Process						
6.4.2	Requirements Analysis Process						
6.4.3	Architectural Design Process						
6.4.4	Implementation Process						
6.4.5	Integration Process						
6.4.6	Verification Process						
6.4.7	Transition Process						
6.4.8	Validation Process						
6.4.9	Operation and Maintenance Process						
6.4.10	Disposal Process						
<b>Matrix showing an example of life cycle processes (from ISO/IEC CD2 15288).</b>							

<sup>21</sup> In this AQAP the term “organisation” is used.

## METHODOLOGIES FOR ASSESSMENT AND IMPROVEMENT

1. The international community has developed some assessment tools and performance indicators. Examples are:

- a. The ISO 9000 series.

*Eight quality management principles have been identified to facilitate the achievement of quality objectives. These are:*

**Customer focused organisation** - organisations depend on their customers and therefore should understand current and future customer needs, meet customer requirements and strive to exceed customer expectations;

**Leadership** – leaders establish unity of purpose, direction, and the internal environment of the organisation. They create the environment in which people can become fully involved in achieving the organisation’s objectives;

**Involvement of people** – people at all levels are the essence of an organisation and their full involvement enables their abilities to be used for the organisation’s benefit;

**Process approach** – a desired result is achieved more efficiently when related resources and activities are managed as a process;

**System approach to management** – identifying, understanding and managing a system of interrelated processes for a given objective contributes to the effectiveness and efficiency of the organisation;

**Continual improvement** – continual improvement is a permanent objective of the organisation;

**Factual approach to decision making** – effective decisions are based on the logical and intuitive analysis of data and information;

**Mutually beneficial supplier relationships** – mutually beneficial relationships between the organisation and its suppliers enhance the ability of both organisations to create value.

- b. The Malcolm Baldrige National Quality Award.

*The award program promotes quality awareness, recognises quality achievements of organisations, and provides a vehicle for sharing successful strategies. The Baldrige Award criteria focus on results and continuous improvement. They provide a framework for designing, implementing, and assessing a process for managing all business operations. Seven categories make up the award criteria:*

**Leadership** - Examines how senior executives guide the organisation and how the organisation addresses its responsibilities to the public and practices good citizenship.

**Strategic planning** - Examines how the organisation sets strategic directions and how it determines key action plans.

**Customer and market focus** - Examines how the organisation determines requirements and expectations of customers and markets.

**Information and analysis** - Examines the management, effective use, and analysis of data and information to support key organisation processes and the organisation's performance management system.

**Human resource focus** - Examines how the organisation enables its workforce to develop its full potential and how the workforce is aligned with the organisation's objectives.

**Process management** - Examines aspects of how key production/delivery and support processes are designed, managed, and improved.

**Business results** - Examines the organisation's performance and improvement in its key business areas: customers satisfaction, financial and marketplace performance, human resources, supplier and partner performance, and operational performance. The category also examines how the organisation performs relative to competitors.

- c. EFQM-model (European Foundation for Quality Management) with guidelines on self-assessment (both for companies and public sector).

*Excellent results with respects to Performance, Customers, People and Society are achieved through Leadership driving Policy and Strategy, People, Partnerships and Resources, and Processes.*

**Leadership** - How leaders develop and facilitate the achievement of the mission and vision, develop values required for long term success and implement these via appropriate actions and behaviours, and are personally involved in ensuring that the organisation's management system is developed and implemented.

**Policy and Strategy** - How the organisation implements its mission and vision via a clear stakeholder focused strategy, supported by relevant policies, plans, objectives, targets and processes.

**People** - How the organisation manages, develops and releases the knowledge and full potential of its people at an individual, team-based and organisation-wide level, and plans these activities in order to support its policy and strategy and the effective operation of its processes.

**Partnerships and Resources** - How the organisation plans and manages its external partnerships and internal resources in order to support its policy and strategy and the effective operation of its processes.

**Processes** - How the organisation designs, manages and improves its processes in order to support its policy and strategy and fully satisfy, and generate increasing value for, its customers and other stakeholders.

**Customer Results** - What the organisation is achieving in relation to its external customers.

**People Results** - What the organisation is achieving in relation to its people.

**Society Results** - What the organisation is achieving in relation to local, national and international society as appropriate.

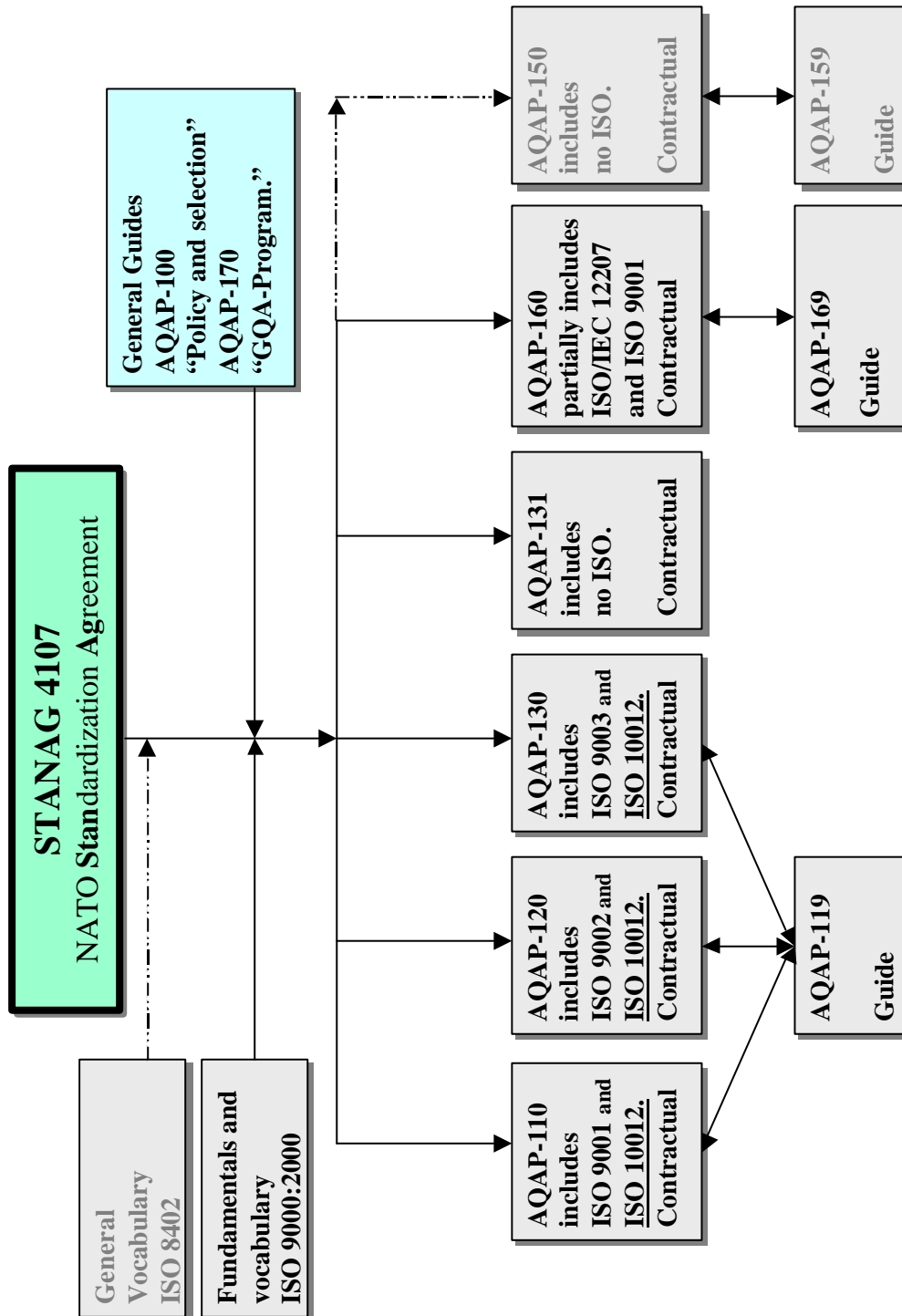
**Key Performance Results** - What the organisation is achieving in relation to its planned performance.

2. Assessment approaches have also been developed for specific processes. For example, software life cycle processes have assessment approaches such as the following:

- a. Capability Maturity Model (CMM)
- b. Software Process Assessment, ISO/IEC15504. (SPICE)
- c. Bootstrap.



**QUALITY MANAGEMENT DOCUMENTS USED BY NATO**



AQAP-150 is planned to be fully superseded by AQAP-160 after a period of transition.  
ISO 9000:2000 series is expected to be used for a future update of the AQAP-110 series.  
ISO 8402 is planned to be fully superseded by ISO 9000:2000 after a period of transition.



## TYPES OF ALLIED QUALITY ASSURANCE PUBLICATIONS (AQAPS)

### 1. Contractual Type

These AQAPs specify NATO requirements for quality management to be met by suppliers in fulfilling defence contracts in which the AQAPs are invoked:

AQAP-110 "NATO Quality Assurance Requirements for Design, Development and Production"

AQAP-120 "NATO Quality Assurance Requirements for Production"

AQAP-130 "NATO Quality Assurance Requirements for Inspection"

AQAP-131 "NATO Quality Assurance Requirements for Final Inspection"

AQAP-150 "NATO Quality Assurance Requirements for Software Development".

AQAP-160 "NATO integrated quality requirements for software throughout the life cycle".

### 2. Guidance Type

#### a. Policy document

AQAP-100 "The NATO Policy on an Integrated Systems Approach to Quality through the Life Cycle".

#### b. Guidance for contractual AQAPs

These AQAPs are complementary guides to AQAPs -110, -120, -130 and to AQAP-150, -160 respectively to aid in their interpretation and for use when undertaking the evaluation of suppliers' quality arrangements for compliance with these AQAPs:

AQAP-119 "NATO Guide to AQAPs -110, -120, -130"

AQAP-159 "NATO Guide to AQAP-150".

AQAP-169 "NATO Guidance on the use of AQAP-160".

#### c. Guidance for GQA activities

This AQAP specifies guidance for the National Quality Assurance Authorities (NQAA) for Government Quality Assurance (GQA):

AQAP-170 "NATO Guide for the delegation of Government Quality Assurance".



## **CRITERIA FOR THE APPLICATION OF CONTRACTUAL QUALITY MANAGEMENT REQUIREMENTS**

### **1. General**

- a. Allied Quality Assurance Publications AQAP-110, AQAP-120, AQAP-130, AQAP-131, AQAP-150 and AQAP-160 were prepared for the common purpose of prescribing contractual requirements for quality management to be provided to the acquirer by the supplier. They vary in scope and extent of requirements and are intended for use in differing situations of procurement of product.
- b. The applicability of any one of these AQAPs, or non-applicability as the case may be, depends on the type of the product being procured and its acquisition strategy (e. g. complexity of the supplier task). The level of requirements for quality management should be such as to avoid imposing either excessive or insufficient requirements on the supplier.
- c. The selection and application of the appropriate requirement for quality management should follow a "process of elimination" beginning with a decision regarding the need for an AQAP at all, and progressing, if necessary, to a decision whether AQAP-131 is adequate. If AQAP-131 is adequate and satisfactory to the acquirer it should be contractually specified.
- d. The same process of elimination must take place with respect to AQAP-130. If AQAP-130 is adequate, AQAP-120 must not be the selected requirement. AQAP-120 should be selected only when it is ascertained that AQAP-130 will not be effective. AQAP-110 should be selected only when the contract includes a requirement for design and development.
- e. When development of software forms a part of the requirements of a contract, AQAP-160 (AQAP-150) should be invoked alone or in conjunction with AQAP-110.
- f. It is recognised that the acquirer is responsible for laying down contractual requirements concerning the supplier's obligations as regards quality management. However, since the objective is to standardise, as far as possible, among NATO nations and organisations, the nature of the requirements stated in these AQAPs and the way in which they are applied, the criteria below are recommended for the application of AQAP-110, AQAP-120, AQAP-130, AQAP-131 and AQAP-160 (AQAP-150).

### **2. Selection of AQAP Conditions/Requirements**

- a. No AQAP Requirement:
  - Compliance with any of the AQAPs should not be specified contractually when:
    - There is no need to include specific requirements for quality management in the contract and to have Government Quality Assurance actions performed. Reliance is placed on the supplier's controls to obtain the product specified in the contract; or
    - the conformance to the contractual requirements are such that they can adequately be determined after receipt<sup>22</sup>.
- b. NATO Quality Assurance Requirements for Final Inspection (AQAP-131)
  - AQAP-131 provides the minimum inspection requirements to assure conformance of product to contract requirements. AQAP-131 should be made a requirement of the contract when conformance with the requirements can be demonstrated satisfactorily on receipt of the final product.

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<sup>22</sup> Considering also delivery schedule.

- c. NATO Quality Assurance Requirements for Inspection (AQAP-130)
  - AQAP-130 provides requirements for the supplier to demonstrate a documented inspection system capable of producing objective evidence that product conforms to contract requirements whether manufactured or processed by the supplier or by sub-contractors. AQAP-130 should be made a requirement of the contract when:
    - the design related to the product is established and is satisfactory to the Design Authority; and
    - conformance with requirements can only be demonstrated adequately on the basis of inspection, during the manufacturing and processing of materials, parts, components, sub-assemblies and the final product, as appropriate.
- d. NATO Quality Assurance Requirements for Production (AQAP-120)
  - AQAP-120 provides requirements for the supplier to demonstrate a documented quality management system capable of producing objective evidence that product conforms to contract requirements whether manufactured or processed by the supplier or sub-contractor. AQAP-120 should be made a requirement of the contract when:
    - the design related to the product is established and is satisfactory to the Design Authority;
    - the complexity of the product requires comprehensive quality control and the need for servicing may arise;
    - life, reliability and other quality characteristics can only be ensured by the supplier by use, throughout the manufacturing or processing phases, of materials and parts of proven quality and by means of detailed work instructions, process control and procedures whose purpose is to permit the earliest possible corrective action.
- e. NATO Quality Assurance Requirements for Design, Development and Production (AQAP-110)
  - AQAP-110 provides the most extensive contractual requirements for quality management. AQAP-110 should be made a requirement of the contract when requirements are basically specified in terms of functional and technical requirements and the supplier is, therefore, responsible for design and development.
- f. NATO Requirements for Software Acquisition. (AQAP-150 and 160)
  - AQAP-150 and -160 provide requirements for quality management in software acquisition.
  - Depending on the application, one of these AQAPs should be made a contractual requirement. In addition, AQAP-160 establishes a common framework for software life cycle processes, with well-defined terminology that can be referenced by industry. AQAP-160 is designed to be tailored for an individual organisation, project or application within a project. When tailored, it specifies the requirements to manage the quality of the software life cycle processes and their resulting products and services. For the supply (and related acquisition, development, production and deployment, operations and maintenance) of other system components (e.g., hardware), AQAP-160 has to be used in conjunction with other appropriate standards (e.g., AQAP-110).
  - AQAP-150 is planned to be fully superseded by AQAP-160 after a period of transition.

**ISO AND ISO/IEC STANDARDS, AS REFERENCED IN THE TEXT OF THIS AQAP**

<b>Standard</b>	<b>Title</b>	<b>Issue Date</b>
ISO 9000	Quality management systems – Fundamentals and vocabulary	2000
ISO 9001	Quality Systems - Model for Quality Assurance in Design/Development, Production, Installation and Servicing.	1994
ISO 9001	Quality management systems – Requirement	2000
ISO 9004	Quality management systems – Guidelines for performance improvements	2000
ISO 9000-2	Quality Management and Quality Assurance Standards - Part 2: Generic Guidelines for Application of ISO 9001, ISO 9002, ISO 9003.	1994
ISO/IEC 12207	Information technology - Software life cycle processes.	1995
ISO/IEC TR 15504	“Software Process Assessment”	1999
ISO/IEC 15288 CD2	Life Cycle Management – System Life Cycle Processes.	2000
ISO10006	Quality management – Guidelines to quality in project management	1997



## DEFINITIONS AND ACRONYMS

<b>AAP</b>	Allied Administrative Publication.
<b>AC/250</b>	Group of National Directors for Quality Assurance.
<b>AQAP</b>	Allied Quality Assurance Publication.
<b>CMM<sup>(SM)</sup></b>	Capability Maturity Model <sup>(SM)</sup> for Software.
<b>Disposal</b>	Disposal consolidates the activities required to remove the equipment or system, and the supporting materiel and facilities as necessary in the end of its life cycle. This final disposal may be accomplished by, but not limited to, any combination of: Depositing; Buming or Recycling.
<b>GQA</b>	Government Quality Assurance is the process by which the appropriate National Authorities establish confidence that the contractual requirements relating to quality are met.
<b>Interested Party</b> ISO 9000:2000	<b>2.3.7 interested party:</b> person or group having an interest in the performance or success of an organisation (2.3.1).
<b>ISO</b>	Intemational Organisation for Standardisation
<b>Management</b> ISO 9000:2000	<b>2.2.2 management system:</b> system (2.2.1) to establish policy and objectives and to achieve those objectives.  <b>Quality management system:</b> system (2.2.1) to establish a quality policy (2.2.4) and quality objectives (2.2.5) and to achieve those objectives. <b>2.2.6 management</b> (noun): co-ordinated activities to direct and control an organisation (2.3.1). <b>2.2.7 top management:</b> person or group of people who direct and control an organisation (2.3.1) at the highest level. <b>2.2.8 quality management:</b> co-ordinated activities to direct and control an organisation (2.3.1) with regard to quality (2.1.1).
<b>Natural environment</b>	From ISO 14001: 3.2 environment: surroundings in which an organisation operates, including air, water, land, natural resources, flora, fauna, humans, and their interrelation.
<b>NQAA</b>	National Quality Assurance Authority.
<b>PAPS</b>	Phased Armaments Programming Systems.
<b>Participants, life cycle</b>	In this AQAP, the word “participant” is to be understood as people directly involved in the activities through the life cycle phases. By this definition a user is a participant. (See figure 1.).
<b>PfP</b>	Partnership for Peace.
<b>NQAR</b>	National Quality Assurance Representative or personnel with responsibility for Government Quality Assurance (GQA).
<b>SPICE</b>	Software Process Improvement and Capability Evaluation.
<b>STANAG</b>	Standardisation Agreement

### **DEFINITIONS AND ACRONYMS**

<b>Team</b>	A small number of people with complementary skills who are committed to a common purpose, performance goals, and approach for which they hold themselves mutually accountable.
<b>User</b>	More than one, in all applicable organisational levels and in all the life cycle phases, e.g. staff, operators and maintainers.
<b>Defence System</b>	“Defence system” is in this document considered to be synonymous with “Product”.
<b>WBS</b>	Work Breakdown Structure.