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Geographic information — Quality assurance of data supply

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National foreword

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TECHNICAL SPECIFICATION

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Geographic information — Quality assurance of data supply

Information géographique — Assurance qualité relative à l'approvisionnement de données

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of document:

— an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;

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An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/TS 19158 was prepared by Technical Committee ISO/TC 211, *Geographic information/Geomatics*.

Introduction

This Technical Specification provides a quality assurance framework for the producer and customer in their production relationship. It identifies methods of managing the quality of production more efficiently and effectively. It enables innovation and continual improvement within the context of existing:

— geographic information quality principles and quality evaluation procedures, and

— quality management systems.

With ever increasing demands in value and quality in the Geographic Information (GI) market the framework facilitates the production of a product that meets requirements in terms of cost, quantity, quality and timeliness.

Through the application of the framework there are opportunities for:

— better understanding of requirements by all involved in production and update especially within multiple producer environments,

— reduced data throughput time,

— reduced rework,

— improved data quality, and

— increased confidence within a mutually beneficial relationship leading to lower costs for both supplier and organization.

ISO 19157 establishes the principles for the description of geographic data quality and specifies components for reporting quality information as well as procedures for the evaluation of geographic data quality.

The quality assessment procedure, as defined in this Technical Specification, is a second-party (customer) conformity assessment activity.

Geographic information — Quality assurance of data supply

1 Scope

This Technical Specification provides a framework for quality assurance specific to geographic information. It is based upon the quality principles and quality evaluation procedures of geographic information identified in ISO 19157 and the general quality management principles defined in ISO 9000 [2].

The framework defined in this Technical Specification enables a customer to satisfy itself that its suppliers, both internal and external, are capable of delivering geographic information to the required quality. Fundamental to the framework is the assurance of the supplier's ability to understand and meet the quality requirements. Through the quality assurance framework both the customer and the supplier are able to consider the quality required at the earliest opportunity in the production/update process.

Principles and responsibilities of the relationship between the customer and the supplier that facilitate the framework are provided. The responsibility for the quality assessment procedure is shared between the customer and the supplier.

This Technical Specification is applicable to customers and suppliers of all geographic information where the quality of the product may be impacted upon by the supplier's processes in any of the following scenarios:

— there is an agreement or legislation for the supply of data acquisition services,

— data acquisition services are being tendered for, and

— one or more suppliers exist in the supply chain.

This Technical Specification is not applicable for the supply of legacy datasets or 'off the shelf' products where there is no further data production or update activity to manage.

2 Conformance

Any organization claiming conformance with this specification shall pass all of the requirements described in the abstract test suite presented in Annex A.

3 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 19157:—[1)], *Geographic information — Data quality*

4 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

1) To be published.

4.1
customer
organization or person that receives a product (4.3)

[SOURCE: ISO 9000:2005, definition 3.3.5]

NOTE The customer can be internal or external to the supplier (4.11) organization.

4.2
process
set of interrelated or interacting activities which transforms inputs into outputs

[SOURCE: ISO 9000:2005, definition 3.4.1]

NOTE The process may be broken down further into elemental activities [sub-process (4.10)] as is deemed necessary to control the quality (4.4) of the process.

4.3
product
result of a process (4.2)

[SOURCE: ISO 9000:2005, definition 3.4.2]

4.4
quality
degree to which a set of inherent characteristics fulfils requirements

[SOURCE: ISO 9000:2005, definition 3.1.1]

NOTE For the purposes of this Technical Specification the quality characteristics of a product (4.3) include:

— data quality (the elements of which are described by ISO 19157),

— volume of delivery,

— schedule of delivery, and

— cost of production and/or update.

4.5
quality assessment procedure
procedure by which a customer (4.1) assures that its suppliers (4.11) are capable of consistently delivering the product (4.3) to the required quality (4.4)

NOTE The assessment procedure is a second-party (customer) conformity assessment activity.

4.6
quality assessment result
output of the quality assessment procedure (4.5)

4.7
quality assurance
part of quality (4.4) management focused on providing confidence that quality requirements will be fulfilled

[SOURCE: ISO 9000:2005, definition 3.2.11]

4.8
quality assurance level
assurance level achieved is an outcome of the quality assessment procedure (4.5)

NOTE Three quality assurance levels can be achieved as part of the quality assurance framework: basic, operational and full.

4.9
quality control
part of quality (4.4) management focused on fulfilling quality requirements

[SOURCE: ISO 9000:2005, definition 3.2.10]

4.10
sub-process
activity elements of a process (4.2)

NOTE Sub-processes can be broken down even further as is deemed necessary to control the quality (4.4) of the process.

EXAMPLE In the case of photogrammetric survey, aerial triangulation can be considered a sub-process.

4.11
supplier
organization or person that provides a product (4.3)

[SOURCE: ISO 9000:2005, definition 3.3.6]

NOTE 1 The supplier can be internal or external to the customer organization.

NOTE 2 In the context of this Technical Specification, the supplier has provided a product via a process that can have some impact on quality (4.4).

5 Abbreviated terms

AQL Acceptance Quality Limit (ISO 3534-2 [1]) sometimes referred to as Acceptable Quality Level

GI Geographic Information

KPI Key Performance Indicators

QC Quality Control

QA Quality Assurance

6 General principles

6.1 Quality assurance in production and update

Customers can provide data product specifications to suppliers expecting them to deliver data according to that specification with little or no input into the supplier's processes. Delivery is expected on time and to the volumes requested with data at the required quality level. This approach creates risks, as until the final product is delivered, there is limited confidence in the supplier's ability to achieve this. These risks are getting worse with the requirement for:

— more complex data,

— increased speed to market, and

— outsourced production and update (external to the customer).

Figure 1 identifies that a product is created from the culmination of several interrelated processes combining outputs to produce a final product. By introducing quality evaluation processes to the

data outputs from each process, sub-process, teams and individuals, according to the requirements of ISO 19157, it is possible to determine how the quality of the final product will be affected.

EXAMPLE A process is employed to correct numerous data defects. The output from this process is then passed to another process tasked with further data enhancements. Through measuring the quality of the output of both processes the error introduced into the product will be more accurately understood than by measuring the product alone. In complex production and/or update processes it is not always clear where an error has been created it is therefore not easy to resolve.

ISO 19157 identifies that data quality elements can be evaluated in various ways and at different stages of the lifecycle of a dataset. In this instance that stage is the production and update stage where the objective is to assure the customer that the product can be built and maintained to the required quality.

Figure 1 identifies that each individual, team, sub-process or process can be seen to be creating a dataset. It is this dataset that forms the scope for any testing. The scope will only include those data quality elements, based on ISO 19157, that can be affected by the individual, team, sub-process or process. In general all elements relevant to the final product will be considered. In all cases feedback on testing will be provided to ensure the required quality is achieved and maintained. This procedure may be managed within a framework provided by a quality management system.

NOTE In many cases the assurance of quality starts with the definition and design of a product. This aspect is covered in general terms in ISO 9001 [3] and more specifically with regard to GI in ISO 19131 [5].

6.2 Data quality evaluation

This Technical Specification differentiates between data testing undertaken by the supplier and the customer as quality control (QC) and data quality assurance (QA) respectively. With this differentiation, and specific supplier responsibilities, the product is built on the concept of quality.

QC data quality evaluation is built in to the production process, monitoring and controlling the output of individuals, sub-processes and processes. The sampling regime of QC is designed to take into consideration the knowledge and skill of the operators and the complexity of the tasks. QC data quality results will then provide strong indications of the likely quality of the product to be delivered to the customer. With quality assurance throughout the production process it is possible to check against customer requirements and to inform the product design process.

Once data is delivered to the customer it can be tested as product (data QA). In this instance the customer's sampling regime will take into consideration the experience of the supplier, the complexity of the task, the supplier's QC data quality results, quality plan and training records. The aim will be to reduce the requirement for data QA without creating further risk.

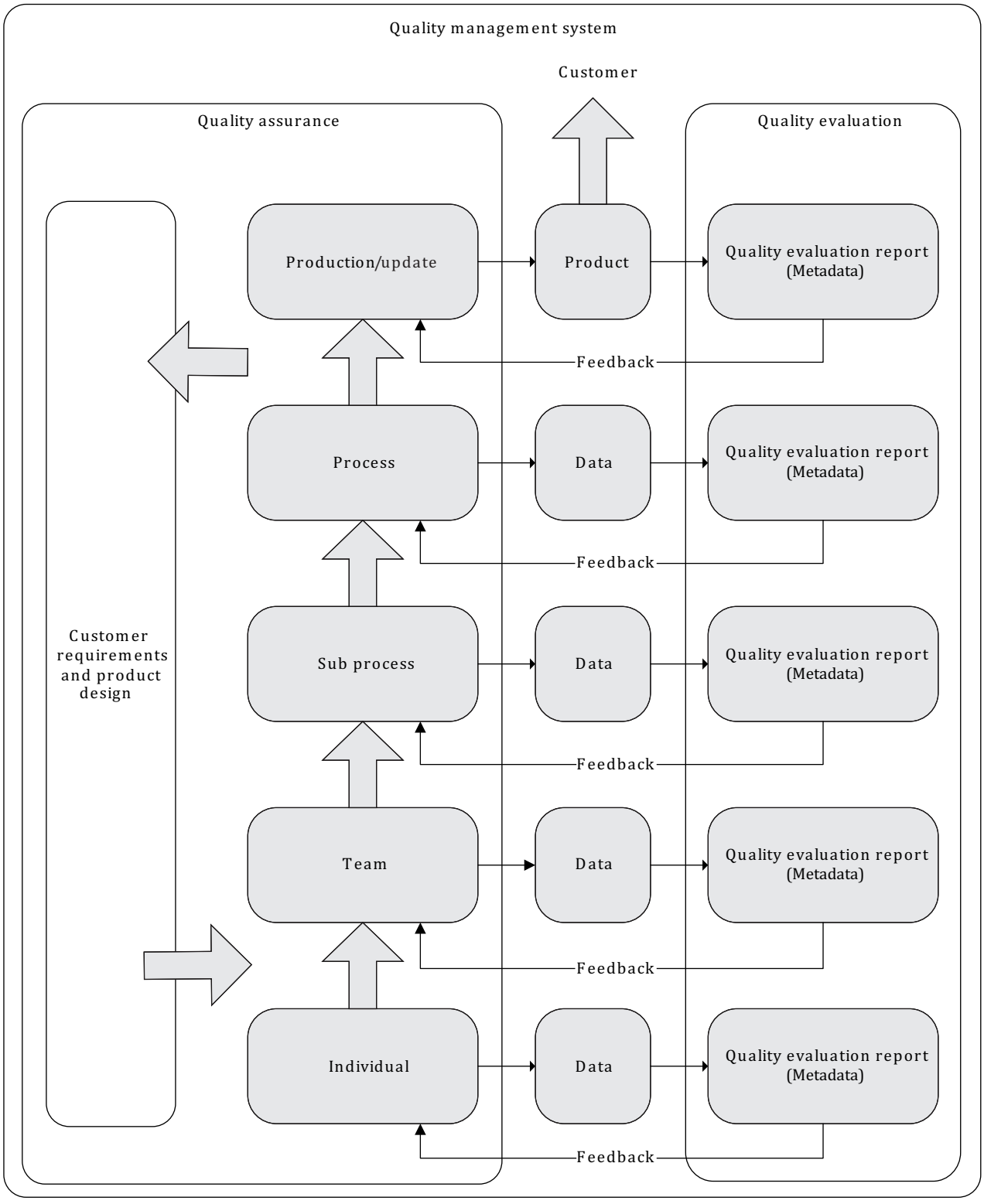

Figure 1 — Quality evaluation and quality assurance in production and update

6.3 Quality assurance framework

The quality assurance framework provides the opportunity for assuring quality at production points within the production and/or update environments as identified in 6.1.

Quality in this instance refers to the

— data quality as defined by ISO 19157,

— volume of delivery,

— schedule of delivery, and

— cost of production and/or update.

Three levels of quality assurance are described in this Technical Specification: basic, operational and full (Clause 8). With each increment there are greater opportunities for quality assurance, thereby mitigating risk to the quality of the product. For example, basic quality assurance may only assure a customer of supplier intent, whilst operational quality assurance will assure capability in the supplier's operating environment.

Assurance of quality is gained through this staged approach. This ensures that the quality of the product is well understood before it is even delivered. Clause 8 identifies the supplier responsibilities within the quality assessment procedure. Further guidance on supplier responsibilities is provided in Annex B.

Once quality assurance is gained the applicable levels of assurance within the supplier's data production or update process are considered to be quality assured. The aim then is to maintain this assurance for the life of the production process. The quality assessment procedure shall be designed to develop and improve supplier capabilities.

7 Requirements

7.1 Production and/or update quality assurance

All processes necessary for the creation of the product shall be identified (see 6.1). The quality requirement for each process and sub-process necessary for the creation of the product shall be identified. Quality in this instance refers to data quality according to the requirements of ISO 19157 as well as:

— volume of delivery,

— schedule of delivery, and

— cost of production and/or update

The quality evaluation procedure according to the requirements of ISO 19157 shall be applied to all relevant processes or sub-process outputs, where the process or sub-process can impact on data quality, as identified in 6.1.

All processes and sub-processes shall inform subsequent processes and sub-processes of input data quality.

NOTE If a price for services has already been agreed, which is recommended, it is not necessary to include the 'cost of production and/or update' as part of the quality assessment procedure.

7.2 Quality assurance levels

The appropriate level of quality assurance, as identified in Clause 8, shall be used to assess process, sub-process and individuals within the production and/or update element of the product cycle.

All supplier production processes, relevant to the delivery of product to the customer, shall have been assessed or shall be in the process of being assessed as identified in Clause 8.

8 Quality assessment procedures

8.1 Basic quality assessment

Basic quality assessment is the first level of quality assurance to be achieved in this quality assurance framework. As identified in Figure 1 it applies to the whole process that will deliver the product to the customer. Its objective is to rapidly reassure the customer that a supplier is capable of meeting the overall requirements for the delivery of the product/s. It is the customer that will confirm that the required level of quality assurance has been met. The quality assessment procedure can apply to existing processes, however a basic level of quality assurance is usually undertaken soon after the introduction of a new process that will deliver data. Exact timing of the quality assessment will depend on the complexity of the required product and/or processes.

NOTE In the case of services that are tendered for a basic level, quality assessment is undertaken as soon after contract award as is practical. This is demonstrated in the example of external supplier steps to quality assurance provided in C.2.

To gain assurance at this level the supplier shall be able to demonstrate to the customer that they have understood the product specification, the data AQLs, the delivery schedule, and have a process in place that will deliver the volumes and data quality necessary. Results of any initial data testing of the product and initial deliverables are analysed by the customer, together with the high level process documentation, change management and improvement plans. Once the customer has confirmed that quality assurance has been achieved at a basic level the next immediate aim is to achieve an operational level of quality assurance. See also the examples of assessment procedures provided in Annex C.

8.2 Operational quality assessment

8.2.1 General principles

Following basic quality assurance, operational quality assurance is the second level of assurance to be achieved. Figure 1 illustrates the individual parts of the processes that will deliver to the customer. The objective of operational quality assurance is to reassure the customer that the sub-processes, and the individuals that operate within them, are delivering the required quality in support of other processes and sub-processes. It is the customer that will confirm that the required level of assurance has been met.

The quality assessment procedure at the operational level shall start immediately after confirmation that the basic level of assurance has been achieved. The assessment shall be completed within an agreed period. Exact timing will depend on the complexity of the product and/or processes.

8.2.2 Sub-process quality assessment

Sub-process quality assessment is a subset of operational quality assessment. The division of processes into further sub-processes will depend on:

— availability of output data that can be tested within a data quality scope,

— process complexity, for example, if the process can be broken down further and/or if the process is prone to error,

— process criticality, with due consideration for the impact of process error, and

— process dependencies, with consideration for external influences on the process.

It is the customer that will confirm that the required level of assurance has been met. To achieve this, the supplier must be able to provide evidence of:

— the identification of each sub-process and how these fit together,

— relevant and appropriate process controls (for examples, see B.2.3),

— the delivery of geographic information which meets the quality requirement for the next process in terms of data quality,according to the requirements in ISO 19157, volume and schedule, and

— an acceptable proportion of the individuals (the team) working on any sub-process have been quality assessed and assured (as identified in 8.2.3) and those that have not are in the process of doing so.

8.2.3 Individual and team quality assessment

Individual quality assessment is a subset of operational quality assessment. The aim of individual quality assessment is to ensure that the workforce is adequately trained, coached, mentored and supported to be capable of delivering to the quality required.

It is the supplier's responsibility to undertake the quality assessment of individuals. To achieve an appropriate level of assurance for a sub-process the individual shall have completed all the necessary training for that sub-process.

The individual shall have demonstrated that they have the necessary knowledge and skills to be capable of constantly meeting the data production or update AQLs and output volumes and schedule required of the sub-process. Annex D provides an example of production AQLs for an individual.

The individual shall be able to demonstrate basic knowledge of how the process is managed, be able to point to monitors and metrics of performance, and be actively involved in continuous improvement.

The quality assessment procedure of an individual shall be used as an opportunity to develop and improve the knowledge and skills of that individual within the workforce.

Individuals may be grouped into teams. The quality assessment procedure may be applied to the team through aggregation of individuals' quality assessment results (see D.2).

8.3 Full quality assessment

Full quality assessment is the final level of quality assurance to be achieved within this quality assurance framework. It is considered achieved when an appropriate level of assurance at operational level has been sustained for a period, to be agreed between supplier and customer, for all sub-processes in the production or update process.

8.4 Quality assurance maintenance and monitors

To maintain any level of quality assurance it is important for the customer and supplier to continually monitor the production and/or update processes. This analysis shall be as detailed as is required to look for trends and manage the risk to quality. The aim is for the appropriate level of assurance to be maintained for the life of the production process.

The level of quality assurance achieved shall be continually supported and monitored through:

— quality audits, for example as defined by ISO 19011 [4]. In particular checking continued ability to meet the quality requirements as identified in the quality assessment procedure and to identify any possible process improvements;

— QA of data supplied to the customer;

— QC of data through sub-processes;

— schedule and volume adherence monitors; and

— supplier process reviews.

NOTE 1 Process reviews are particularly useful where there are risks around volume and cost or if a data quality issue arises.

NOTE 2 Process reviews may be undertaken independently or as part of a quality audit.

8.5 Failure to achieve required quality assurance level

In some instances a supplier might not achieve the required quality assurance level due to significant failings. Theses failings may have contractual implications.

Typical issues that may affect the required level quality assurance being achieved are:

— a major breakdown in the control of a process or sub-process,

— insufficient action within the agreed timescales on reported failings, and

— repeated failings of a similar type.

Any punitive action shall only occur after any agreed level of support is provided, by the customer to the supplier, to either prevent or rectify any issue(s).

Failure to achieve a specific quality assurance level does not automatically mean that a previously acquired level is reverted to. For example, if a supplier has failed to achieve operational quality assurance it may indicate a problem exists in the information gathered during the assessment procedure to achieve basic quality assurance level. In all cases it is for the customer to agree to the appropriate procedure with the supplier in the terms of a contract.

NOTE In cases where the supplier is external to the customer the mechanics of the support offered and any punitive action plan to follow significant failings shall be written into the terms of the contract.

Annex A
(normative)

Abstract test suite

A.1 Production and/or update quality assurance

A.1.1 Process management

a) Test purpose: to determine that the supplier is capable of identifying processes and sub-processes necessary for data production and/or update for the customer.

b) Check the supplier's capability in accordance with the production and/or update quality assurance requirements set out in this Technical Specification.

c) Reference: 7.1.

d) Test type: Capability.

A.1.2 Quality requirement

a) Test purpose: To determine that the supplier is capable of identifying the quality requirement for each process and sub-process necessary for data production and/or update for the customer.

b) Test method: Check the supplier's capability to identify the appropriate quality requirement for:

— data quality according to the requirements in ISO 19157,

— volume of delivery,

— schedule of delivery, and

— cost of production and/or update.

c) Reference: 7.1 and ISO 19157.

d) Test type: Capability.

A.1.3 Quality evaluation

a) Test purpose: To determine that the supplier is capable of identifying process, sub-process and an individual's output quality necessary for data production and/or update for the customer.

b) Test method: Check the supplier's capability in accordance with the requirements and applicable annexes in this Technical Specification and ISO 19157.

c) Reference: 7.1 and ISO 19157.

d) Test type: Capability.

A.2 Quality assessment procedure

a) Test purpose: To determine that the supplier is capable of implementing a quality assessment procedure to control and support its production and/or update processes, sub-processes and individuals.

b) Test method: Check the supplier's capability in accordance with the requirements for quality assessment and guidance set out in this Technical Specification.

c) Reference: 7.2 and Clause 8.

d) Test type: Capability.

Annex B
(informative)

Example of supplier responsibilities

B.1 Introduction

This annex provides the supplier responsibilities that are considered useful in fostering a mutually beneficial relationship (with a customer) in production. Whilst based on the fundamentals of a quality management system, this annex is not a quality management system. If a quality management system is required, the application of ISO 9001 is recommended.

NOTE There may be other responsibilities that are not included here.

B.2 Supplier responsibilities

B.2.1 Introduction

This clause identifies the key responsibilities of the supplier and how those responsibilities should support the production.

B.2.2 Understanding the requirement

The supplier should be responsible for ensuring they have the necessary understanding of the specification, data quality AQLs and delivery schedule to enable them to produce to the required quality and volume. Advice should be sought from the customer when uncertainty about the requirements is encountered.

B.2.3 Process controls

The supplier should be responsible for introducing process controls to the production environment. These controls should include:

— data quality controls, for example AQLs for individuals (see D.3),

— any automation that will reduce or remove the chance of error, for instance automated data validation and automated process,

— documented process procedures to be followed especially procedures where there is variance in the process,

— a documented process change management system, and

— a training plan for the workforce.

B.2.4 Quality control

The supplier should be responsible for monitoring all sub-process outputs in terms of data quality and volumes. Appropriate action should be taken as soon as any issues are identified. The customer should be kept informed of all issues.

AQL statements for supplier sub-processes and individuals should be produced to effectively control and monitor data quality within the process. The AQLs should be based on the quality elements and quality evaluation procedures identified in ISO 19157.

Validation software should be used to control data quality, limiting the need for manual effort.

NOTE 1 With regard to the sub-process or individual, AQLs are only required against those quality elements that may be affected by the sub-process or individual. The individual measures and AQLs that form part of customer validation software need not be repeated in a statement. If the validation software is utilized by the supplier there need only be one measure and associated AQL, that is, data must pass validation (100%).

NOTE 2 The AQLs at the sub-process and individual level may be different from that of the overall product produced. See D.3 for an example of AQLs used for individuals.

B.2.5 Quality plan

The supplier should be responsible for documenting all the necessary production processes, including management elements, to meet the requirements of the customer. The plan should identify the process controls that will be utilised and where they will be utilised in the process. Documentation should be version controlled and made available to the customer.

B.2.6 The workforce

The supplier should be responsible for ensuring they have the workforce with all the skills required to complete the task.

The workforce should be given appropriate training, coaching and mentoring on the required specification. Training should be validated to confirm understanding.

EXAMPLE Before commencing work in a live production environment, checks should be made to ensure that the individual is capable of meeting the AQLs and volumes required. This confirmation would form part of the quality assessment of individuals.

NOTE The process of quality assessing an individual should be designed to develop and improve the individual's capability.

B.2.7 Continual improvement

The supplier should constantly seek to improve quality and reduce costs. The supplier should respond and act quickly to incident and feedback reports. The supplier should also instigate process reviews and implement improvements based on those reviews. Process reviews and the improvements should be presented to the customer.

NOTE It should be possible for cost savings and/or production schedule improvement to be passed on to the customer.

B.2.8 Process change management

The supplier should be responsible for communicating any proposed changes to their process to the customer following their own assessment. This enables the customer to also assess for impact, either positive or negative, in terms of data quality, schedule or volume.

B.2.9 Quality assessment support

The supplier should be responsible for quality assessing individuals. This assures both the supplier and the individual that the individual is able to consistently meet the requirement of their part in the production process. Clause 8 provides detail on the quality assessment procedure.

The supplier should be responsible for ensuring that all the customer's requirements for other quality assessment levels are made available. For example, access to:

— documentation, for instance quality plan, QC monitors, training records, process mapping, and

— the workforce for process review assistance and confirmation of understanding of specification.

NOTE The process of quality assessing an individual should be designed to develop and improve the individual's capability.

Annex C
(informative)

Quality assurance in production and the steps to an appropriate level of quality assurance

C.1 Introduction

To realise any product the following phases are completed:

— the production requirements are managed, for example the requirement is understood and communicated,

— the production resources are managed, for example the process to deliver the product is built, and then

— the production work is completed and the process delivers the product.

The following workflow scenarios provide more detail for activities and steps from the identification of a new requirement, the delivery of data to the assurance of the production process. The external supplier scenario assumes a tendering exercise will be required. These workflow scenarios are applicable to the process, sub-process and teams. The quality assessment procedure for individuals is covered separately in Annex D.

NOTE 1 Some activities and/or steps may be irrelevant to a specific workflow whilst others may be necessary. The customer should identify what is appropriate for their needs.

NOTE 2 In many cases the assurance of quality starts with the definition and design of a product. This aspect is covered in greater detail in general terms in ISO 9001 and more specifically with regard to GI in ISO 19131. The internal supplier quality assessment procedure gives an example of how to take the design of a product into account.

C.2 Example of external supplier quality assessment procedure

Before any production can commence the production requirements are managed by the customer through the steps identified in Table C.1.

Table C.1 — Manage production requirements

Step	Activity
New production requirements for external resource identified	Budget and timescale identified.
Tender preparation	Requirements gathered and project plan created.
Prior information notice	High level information published in, for example, the Official Journal of the European Union (OJEU) and to known potential interested parties. Potential suppliers declare interest.
Pre-qualification questionnaire issued	Questionnaire designed to confirm supplier ability to, for example: - work with customer using quality assurance framework, - manage risks, - be flexible in work loading, ensuring business continuity, and - provide customer support.
Respondents assessed	Responses assessed against pre-qualification questionnaire.
Invitation To Tender (ITT) issued	Terms and conditions provided with requests for: quality plan, process maps, flowcharts, risk management plan and test data.
ITT responses evaluated	Responses assessed against criteria.
Preferred supplier(s) selection	Short list of potential suppliers for tender negotiations chosen. Supplier sites visited to confirm set-up facilities. Test data supplied and evaluated by the customer using ISO 19157.

With the production requirements managed, it is the production resources that are now managed as identified in Table C.2.

Table C.2 — Manage production resources

Step	Activity
Contract agreed with preferred supplier(s)	Agree to terms and conditions, service levels, schedules including costs, volumes, key performance indicators, data quality measures according to 19157 and audit programme. Agree start date and quality assessment procedure time frame.
Supplier(s) set-up processes	Where appropriate, suppliers provided with edit software and testing tools/software. Training on specifications, production process support provided.
Basic quality assurance level	Collection, presentation and evaluation of evidence. Assessment within the work area location, production and process support provided (see 8.1).

With a basic level of quality assurance achieved production can start. This will continue through to completion, as identified in Table C.3.

Table C.3 — Production work is completed

Step	Activity
Production starts	Production contract 'consumables' provided to supplier, production commences.
QC	Data supplier monitors production output
Individual quality assessment	Data supplier uses QC to assess individual data quality input (see 8.2.3).

Table C.3 *(continued)*

Step	Activity
1st data delivery	Data is received by the customer.
Data QA	The data is quality assured. This assurance may include full inspection tests, for example ensuring 100% domain consistency, and quality evaluation by sampling for other quality measures. See ISO 19157 for guidance.
Incident/acceptance report/feedback	Failures against agreed AQLs reported back to supplier with request for investigation and remedial action. Supplier provides report back to customer on reasons for error and actions taken to prevent further occurrence.
Quality requirement met	Consecutive deliveries of work confirm competency to agreed AQLs, volumes and schedule.
Operational quality assurance level	Collection, presentation and evaluation of evidence to the agreed quality assessment procedure timeframe (see 8.2).
Full quality assurance level	Collection, presentation and evaluation of evidence to the agreed quality assessment procedure timeframe (see 8.3).

Once in production the supplier will seek to continually improve through the repetitive cycle of the steps in Table C.4.

Table C.4 — Production improvement

Step	Activity
Review production quality	Review against data quality, costs, schedule and volume using monitors, feedback reports.
Introduce improvements to the production process	Agreement and notification of changes, including an impact assessment on data quality, delivery schedule, volume and cost.

C.3 Example of internal supplier quality assessment procedure

Similar to the external supplier, before any production can commence the internal production requirements are managed by the organization through the steps identified in Table C.5.

Table C.5 — Manage internal production requirements

Step	Activity
Identification of requirements	Production manager identifies the budget and timescale.
Design and set-up processes	Process design and development against evaluation of customer requirements. Quality plan and process maps are created. Training provided on hardware, software and specification identified and delivered to individuals. Trial process to determine the process capability, QC & data QA requirements.
Agree key performance indicators and AQLs	Data AQLs, volume and delivery schedule agreed. Monitors against these elements are in place. QC measures in place. QC data quality results ready to be used as evidence of individual quality assurance.

With the production requirements managed, it is the internal production resources that are now managed as identified in Table C.6.

Table C.6 — Manage internal production resources

Step	Activity
Schedule and allocate work	Work scheduled and allocated to specific resources to ensure delivery within the required timescales.
Basic quality assurance level	Collection, presentation and evaluation of evidence. Assessment of process in work area location (see 8.1).

With a basic level of quality assurance achieved, internal production can start. This will continue through to completion, as identified in Table C.7.

Table C.7 — Internal production work is completed

Step	Activity
Production starts	Production progress monitored.
In process QC	QC built into process ensuring quality delivered at source. Monitors in place to identify volume/rates, error trends, and individual quality assessment results.
1st delivery	Data is received.
Data QA	The data is quality assured. This assurance may include full inspection tests, for example ensuring 100% domain consistency, and quality evaluation by sampling for other quality measures. See ISO 19157 for guidance.
Incident/acceptance report/feedback	Failures against AQLs reported and fed back to source for correction. Actions taken to prevent further occurrence may include process review or change, further training, identification of best practise and/or individual performance management.
Quality requirement met	Consecutive deliveries of work confirm competency to agreed AQLs, volumes and schedule.
Operational quality assurance level	Collection, presentation and evaluation of evidence to the agreed quality assessment procedure timeframe (see 8.2).
Full quality assurance level	Collection, presentation and evaluation of evidence to the agreed quality assessment procedure timeframe (see 8.3).

Once in production the internal supplier will seek to continually improve through the repetitive cycle of the steps in Table C.8.

Table C.8 — Internal production improvement

Step	Activity
Review production quality	Review against data quality, costs, schedule and volume using monitors, feedback reports.
Introduce improvements to the production process	Agreement and notifications of changes including an impact assessment on data quality, delivery schedule, volume and cost.

Annex D
(informative)

Example of individual and team quality assessment procedure

D.1 Introduction

The following is an extract of a document in use by Ordnance Survey (Great Britain) [6]. Using that document the individual can identify the data quality required for their part in the process of maintaining geographic information. The principle for the development of that document was that if the operator can affect GI data quality it should be measured as part of the quality assessment procedure. Some data quality elements that are relevant to the dataset are not considered as these are effectively managed through validation software and the structure of the data.

EXAMPLE Validation software might ensure that 100% of data conforms to domain consistency rules.

At the individual level the descriptions used may be unique to the process, or the supplier. The descriptions are couched in a way that is relevant to the operation being performed. These may then be related back to quality elements as defined by ISO 19157.

As a single operator edits only a few features as part of an operation, the use of percentages has been avoided. Instead, the impact of any error is considered against the overall data quality requirement. It is then weighted accordingly.

D.2 Individual and team quality assessment procedure

Following the completion of any relevant training, an individual's work is assessed as part of the quality control process. The sampling rate is dependent on the individual's known level of knowledge and skill.

The aim is that the agreed level of data quality has been achieved, at an agreed rate of production and to an agreed schedule.

Once an individual achieves this level of assurance it is maintained through continued QC sampling and training, as appropriate. Team assurance is achieved through aggregation of the individual quality assessments, that is, the agreed number of individuals that have achieved the appropriate level of quality assurance within the team.

D.3 Individual quality assurance measurement

Individuals' completed production/update tasks is assessed against the measures identified in Table D.1. Every instance of an error against these measures is given an individual weighted value ranging from 0,5 to 5 according to the severity of error. At the end of testing the values are combined for each relevant dataset and if the total equals or exceeds 5 then the task has failed for that dataset.

The AQL for each dataset is **4**. A dataset is deemed to have passed with a total error value of **4** or less.

If a task fails, it is returned to the individual for rework. For every dataset tested, pass or fail, a feedback report is sent to the individual operator.

All results from quality control checks are entered into a database. The database is maintained and monitored by the quality checking team. This team will collect statistics, issue reports and monitor error trends which are in turn forwarded to line managers and senior managers at appropriate intervals.

The level of sampling, the minimum size and the maximum size of task to be checked, the data to be sampled and the threshold for team quality assessment is controlled independently of production.

Table D.1 — Individual error weighting against measures

Dataset	Quality element	Test description	Error value weighting (per error)
Address	Completeness (commission)	Incorrect addition of an address	5
	Completeness (commission)	Address retained in error	5
	Thematic accuracy (Classification correctness)	Address matched to incorrect feature	5
	Thematic accuracy (Classification correctness)	Alternative address attribution omitted or retained in error	2
	Completeness (omission)	Available address not matched to feature	1
Routing	Completeness (commission)	Off specification (unnecessary) addition of critical road routing information	5
	Completeness (commission)	Critical road routing information retained in error	5
	Completeness (omission)	Critical road routing information not captured	5
	Thematic accuracy (classification correctness)	Incorrect critical road routing information captured	5
	Completeness (commission)	Off specification (unnecessary) addition of non-critical road routing information	2
	Completeness (commission)	Non-critical road routing information retained in error	2
	Completeness (omission)	Non-critical road routing information not captured	2
	Thematic accuracy (classification correctness)	Incorrect non-critical road routing information captured	2
Road network	Completeness (commission)	Off specification (unnecessary) addition of a road network line or changes to an existing line	2
	Completeness (commission)	Road network line retained in error	2
	Completeness (omission)	Omission of a road network line	2
Land use	Completeness (commission)	Unnecessary land use classification entry	3
	Completeness (omission)	Land use classification entry missing	3
	Thematic accuracy (classification correctness)	Incorrect land use classification entry	3
Mean high or low water	Logical consistency (conceptual consistency)	Mean high or low water continuous line features interrupted	5
	Thematic accuracy (classification correctness)	Incorrect description or classification of the mean high or low water	5

Table D.1 *(continued)*

Dataset	Quality element	Test description	Error value weighting (per error)
Topography	Completeness (commission)	Topographic detail retained in error	5
	Completeness (omission)	Topographic detail omitted	5
	Completeness (commission)	Topographic detail retained in error	2
	Completeness (omission)	Topographic detail omitted	2
	Completeness (commission)	Off specification (unnecessary) changes to existing line, point or text feature	2
	Completeness (commission)	Off specification (unnecessary) topographic detail added	1
	Completeness (omission)	Names and numbers omitted	2
	Completeness (commission)	Off specification (unnecessary) changes or additions to names and numbers	2
	Completeness (commission)	Off specification (unnecessary) text association additions or changes	2
	Completeness (omission)	Text association omitted	2
	Logical consistency (conceptual consistency)	Topographic detail inconsistent over the edge of a plan	5
	Logical consistency (conceptual consistency)	Classification or coding inconsistent over the edge of a plan	5
	Thematic accuracy (classification correctness)	Feature captured with: incorrect labels, line, text type, point codes or physical levels (≥100 features added)	1
	Thematic accuracy (classification correctness)	Feature Level Attribution, incorrect labels, line, text type, point codes or physical levels (<100 features added)	2
	Thematic accuracy (classification correctness)	Incorrect names and numbers (text string)	2
	Thematic accuracy (classification correctness)	Incorrect text association (text string error)	2
	Positional accuracy (absolute accuracy)	Existing topographic features not moved when outside action limits identified in the specification	3
	Positional accuracy (absolute accuracy)	Existing topographic features moved when within action limits not moved when outside action limits identified in the specification	2
	Positional accuracy (relative accuracy)	Point pairs with errors exceeding values identified in the specification	5
	Positional accuracy (geometric fidelity)	Visible error in shape and alignment of topographic feature	5

Bibliography

[1] ISO 3534-2:2006, *Statistics — Vocabulary and symbols*

[2] ISO 9000:2005, *Quality management systems — Fundamentals and vocabulary*

[3] ISO 9001:2008, *Quality management systems — Requirements*

[4] ISO 19011:2002, *Guidelines for quality and/or environmental management systems auditing*

[5] ISO 19131:2007, *Geographic information — Data product specifications*

[6] *Guide to accreditation*, Ordnance Survey (Great Britain), 2009

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