WORKING GROUP ON THE GOVERNANCE OF QUALITY MANAGEMENT OF DATA AND ADVICE (WGQUALITY)

VOLUME 5 | ISSUE 34

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ICES Scientific Reports

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Recommended format for purpose of citation:

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i Executive summary

The Working Group on the Governance of Quality Management of Data and Advice (WGQuality) supports the ICES aim of creating an end-to-end quality assurance framework for advice production - from data management, data integration, data analysis, and data use, to the process of translating that data into ICES advice. In this report, WGQuality analyse existing ICES quality management processes within advice production in the context of an international quality standard (ISO 9001:2015). A draft of a quality manual that follows this standard is presented. Where it was found that a requirement of the standard could not be currently fulfilled, it is identified as a gap, and proposed procedures to fill these gaps are presented. Data quality tools proposed by the ICES Planning Group on Data Needs for Assessment and Advice (PGDATA) are also evaluated and, where possible, progressed towards an operational state. The next steps required to implement a quality management system are proposed.

ii Expert group information

Expert group name	Working Group on the Governance of Quality Management of Data and Advice (WGQuality)
Expert group cycle	Multiannual fixed term
Year cycle started	2021
Reporting year in cycle	3/3
Chair	David Currie, Ireland
Meeting venue(s) and dates	19–22 January 2021, online meeting, 16 participants
	18–20 January 2022, online meeting, 14 participants
	17–20 January 2023, Copenhagen, Denmark, hybrid meeting, 17 participants

1   Introduction

1.1   Background

In 2013, the ICES Planning Group on Commercial Catches, Discards and Biological sampling (PGCCDBS) recommended a shift of the practical work into two separate expert groups, one dealing with collection, interpretation and quality assurance of data on commercial catches (Working Group on Commercial Catches WGCATCH[1]) and the other on biological parameters (Working Group on Biological Parameters WGBIOP[2]). The remaining work was given to the Planning Group on Data Needs for Assessments and Advice (PGDATA) – this group was then tasked over the period of 2015–2017 to improve the effectiveness of the ICES benchmarking process and the quality of ICES advice, and to ensure the best use of available resources for data collection. During its second 3-year work cycle (2018–2020) PGDATA spent a large amount of time discussing and thinking about the quality assurance of data that is used for assessment and advice. However, the concept of "quality" is cross-cutting and should be managed throughout a process, so PGDATA proposed that a new group should be formed with a wider scope and mandate: The Working Group on the Governance of Quality Management of Data and Advice, WGQuality.

1.2   WGQuality 3-year programme

The ICES advisory plan highlights the first priority area for development is "Assuring Quality" - it states that quality assurance "*encompasses the entire process from data collection to the publication of objective and independent advice*"[3]. There is a recognition within ICES of the need for an end-to-end quality management system (QMS) to encompass best practice in data management, data integration, and translation into advice. A QMS can be defined as "…*a formalized system that documents processes, procedures, and responsibilities for achieving quality policies and objectives*"[4]. Typically, a QMS will follow a particular framework (such as ISO 9001:2015[5] or similar) that describes an approach to quality management.

Quality management systems should address an organisation's unique needs. However, common elements include[6]:

- The organisation's quality policy and quality objectives,
- Documented procedures,
- Data management,
- Measurements of customer satisfaction of output product quality,
- Identification of opportunities to improve.

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[1] https://www.ices.dk/community/groups/Pages/WGcatch.aspx

[2] https://www.ices.dk/community/groups/Pages/WGBIOP.aspx

[3] https://issuu.com/icesdk/docs/ices_advisory_plan

[4] https://asq.org/quality-resources/quality-management-system

[5] https://www.iso.org/standard/62085.html

[6] https://asq.org/quality-resources/quality-management-system

As part of its 3-year work plan WGQuality took on the task of evaluating the existing quality processes and procedures within the ICES advisory system, and specifying a fully operational quality management system that is in line with the scope and direction in the advice plan. Once a quality management system was developed and accepted WGQuality intended to use it to evaluate ICES activities.

In recent years there has been a large amount of activity in the ICES world dedicated to improving quality. One of the major benefits of having a large number of expert groups, organisations, and individuals participating in this process is the high level of innovation displayed. However, the downsides of this can include a lack of knowledge about what other work is being done by other people and a lack of coordination in harnessing this work. WGQuality aimed to communicate to other members of the ICES network about the quality management system.

PGDATA previously proposed a number of interesting tools and processes to improve the data and informing the assessment and advice process - to this end, WGQuality also aimed to ensure that these ideas are operationalised.

1.3   WGQuality Terms of Reference (ToRs)

a)   Analyse existing ICES quality management processes within advice production and evaluate their coherence with the objectives of the ICES advisory plan. In particular highlight any gaps and overlaps between different processes.
b)   Specify a fully operational ICES advisory quality management system that is in line with the scope and direction in the advice plan.
c)   Create and implement an internal communication plan to explain the quality management system, ensure effective feedback mechanisms to identify needed improvements and highlight existing good practice.
d)   Use the quality management system to evaluate current activities.
e)   Operationalise the quality tools and processes that were proposed during the previous 3-year cycle of PGDATA.

2   Quality Management Processes in ICES

This section highlights the work done to fulfil ToRs a and b:

a)   *"Analyse existing ICES quality management processes within advice production and evaluate their coherence with the objectives of the ICES advisory plan. In particular highlight any gaps and overlaps between different processes."*

b)   *"Specify a fully operational ICES advisory quality management system that is in line with the scope and direction in the advice plan."*

The deliverables for these ToRs are:

- an evaluation of the existing quality processes and procedures within ICES,
- a draft ICES quality manual which will describe the overall approach to assuring the quality of assessment and advice within ICES. This will cover the quality assurance process from data collection to advice publication.

2.1   Why Quality Assurance matters to ICES

ICES mission is to advance and share scientific understanding of marine ecosystems and the services they provide and to use this knowledge to generate state-of-the-art advice for meeting conservation, management, and sustainability goals.

For many years the importance of quality assurance within ICES has been recognized – for example, the 2002 Copenhagen declaration[7] required that ICES "apply a quality assurance scheme for its advisory function".

"Assuring Quality" is the first priority area in the ICES advisory plan[8], and the plan states "*The existing quality control and assurance processes are enhanced to form an end-to-end quality assurance framework that will encompass best practice in data management, data integration, and translation into advice."*

The Advisory Plan defines a number of tasks related to quality:

- As part of the quality assurance framework (QAF), map out process flows and critical control points and feedback loops in the advisory system and begin to address identified critical control points.
- Seek international quality accreditation for the ICES advisory system.
- Develop a comprehensive ICES quality management system for advice including implementing RDBES, TAF, etc.
- Where possible ensure that all advice products are based on data that adhere to the FAIR principles.
- Application and ongoing development of the ICES benchmark system, to ensure the advice is fit for the evolving advisory demands.

The work of WGQuality supports the ICES aim of creating an end-to-end quality assurance framework for advice production.

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[7] https://www.ices.dk/about-ICES/who-we-are/Documents/CPH_declaration_2002.pdf

[8] https://issuu.com/icesdk/docs/ices_advisory_plan

Recent and ongoing quality assurance initiatives within ICES include:

- Transparent assessment framework[9] (TAF) – this is an online resource for assuring quality, improving efficiency, and ensuring transparency of ICES advisory processes. Making the data, methods and results from ICES assessments easy to find, explore and re-run.
- Regional database & estimation system (RDBES)[10] (see also Regional Database (RDB) Fishframe[11]). The RDBES stores detailed commercial fisheries sampling data and aggregated effort and landings data. The aims of the RDBES include providing a regional estimation system such that statistical estimates of quantities of interest can be produced from sample data.
- Stock assessment graphs (SAG)[12] - ICES ecosystem advice is based on assessment results that are presented in stock assessment standard graphs and data tables. Data and plots are available in the ICES Stock Assessment Database.
- Stock information database (SID)[13] – provides meta-information about every stock that ICES provides management advice for.
- SID Issue Lists[14] - that stores in one place all the known issues for each of the stocks.
- Vulnerable marine ecosystem portal[15]
- Survey and data portals[16]
- Data policy[17] - by maximizing the availability of data to the community at large, ICES promotes the use of these data, thereby ensuring that their maximum value can be realized and thus contribute to an increased understanding of the marine environment.
- ICES Library[18] – updated online repository and discovery system for ICES publications

2.2 Existing ICES quality policies and procedures

The ICES Advisory Plan contains "Assuring Quality" as a priority area. The "Guide to ICES advisory framework and principles"[19] provides the overarching framework to ICES advice. Further details are provided in modules for advice on fishing opportunities[20] and advice on ecosystem services and effects[21].

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[9] https://www.ices.dk/marine-data/assessment-tools/Pages/transparent-assessment-framework.aspx

[10] https://imdis.seadatanet.org/files/IMDIS2021_25_abstract.pdf

[11] https://www.ices.dk/data/data-portals/Pages/RDB-FishFrame.aspx

[12] https://www.ices.dk/marine-data/assessment-tools/Pages/stock-assessment-graphs.aspx

[13] http://stockdatabase.ices.dk/Default.aspx

[14] http://stockdatabase.ices.dk/Manage/rollingissues.aspx

[15] https://www.ices.dk/marine-data/data-portals/Pages/vulnerable-marine-ecosystems.aspx

[16] https://www.ices.dk/marine-data/data-portals/Pages/default.aspx

[17] https://www.ices.dk/marine-data/guidelines-and-policy/Pages/ICES-data-policy.aspx

[18] https://ices-library.figshare.com/

[19] ICES. 2020. Guide to ICES advisory framework and principles. *In* Report of the ICES Advisory Committee, 2020. ICES Advice 2020, section 1.1. https://doi.org/10.17895/ices.advice.7648

[20] ICES. 2021. Advice on fishing opportunities. In Report of the ICES Advisory Committee, 2021. ICES Advice 2021, section 1.1.1. https://doi.org/10.17895/ices.advice.7720

[21] ICES. 2021. ICES ecosystem overviews. In Report of the ICES Advisory Committee, 2021. ICES Advice 2021, Section 16.2. https://doi.org/10.17895/ices.advice.7916

The ten principles applied to ICES advice production are:

Guidelines for advice

Principle 1

- The guidelines and procedures to produce ICES advice are documented, openly accessible, and up-to-date.

Request formulation

Principle 2

- Final request formulation is agreed through dialogue to clarify the requester's needs and expectations, the ICES process, likely resource implications, timelines, format of advice, and roles and responsibilities of the engaged parties.

Principle 3

- Where possible, existing policy goals, objectives, and the level of acceptable risk relevant to the advice request are identified. Where these objectives and descriptions of risk are unclear, ICES will identify these in the advice, and, where possible, provide options for management action and the consequences of the options and their trade-offs.

Knowledge production and review

Principle 4

- The deliberations of all relevant expert groups are published by the time the associated advice is published.

Principle 5

- The best-available science and quality-assured data are used. ICES selects and applies relevant methods for any analysis, including the development of new methods. The methods are peer reviewed by independent experts and clearly and openly documented.

Principle 6

- Data are findable, attributable, researchable, reusable, and conform to ICES data policy. Data flows are documented.

Principle 7

- To ensure that the best available, credible science has been used and to confirm that the analysis provides a sound basis for advice, all analyses and methods are peer reviewed by at least two independent reviewers. For recurrent advice, the review is conducted through a benchmark process; for special requests through one-off reviews.

Advice release

Principle 8

- Advice is comprehensive, unambiguous, and consistent with the synthesized knowledge, while taking the peer review into account. All advice follows existing advice frameworks and any deviation from the frameworks or related, previous advice is identified and justified.

Principle 9

- All ICES advice is adopted by the ICES Advisory Committee (ACOM), through consensus, prior to being made available to the requester and simultaneously published on ICES website.

Principle 10

- ICES provides advice as an impartial response to a request, and does not lobby the requester or any other party to implement its advice.

There are also a large number of technical guidelines documents[22] covering specific subjects in more detail – these include: "Advice on catches and landings", "Advice on fishing opportunities", "Criteria for the use of data in ICES advisory work", "Definitions of stock status", and "Technical Services".

Expert groups are groups of scientists who collaborate during scheduled meetings, and often intersessionally, to develop science and the basis for ICES advice. Expert groups follow the "Guidelines for ICES Groups"[23].

ICES Data Centre accreditation

In recent years there has been increasing interest from stakeholders and clients for ICES to look more systematically at the overall quality assurance of its outputs, with data governance and management being a keystone of this. This led the ICES Data Centre to consider accreditation.

Why seek Data Centre accreditation?

- External pressure from advice recipients,
- To audit the Data Centre processes and documentation,
- To identify gaps and areas for improvement,
- To follow best practice,
- Future proofing services,
- To receive an external and impartial review.

The ICES Data Centre, in discussion with the ICES Data and Information Group (DIG) decided that the "CoreTrustSeal"[24] data centre standard was the appropriate accreditation to aim for - this was achieved in 2021.

As part of this process data process flow schematics for data sets directly managed by the ICES Data Centre were drawn up and published (for an example see "Data Flow Schematic for Vessel Monitoring System (VMS) and Catch Data in the North East Atlantic Fisheries Commission (NEAFC) regulatory area"[25]).

Lessons learned

- Thanks to the ICES network the Data Centre was well prepared but even so the effort required was substantial, and it has touched all parts of ICES' work.
- Engagement from stakeholders involved in different parts of the chain is essential and has been positive.

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[22] https://www.ices.dk/advice/Pages/technical_guidelines.aspx

[23] https://www.ices.dk/about-ICES/Documents/Guidelines_for_ICES_Groups.pdf

[24] https://www.coretrustseal.org/

[25] https://doi.org/10.17895/ices.advice.6101

- All of the outputs that have been produced or enhanced for accreditation will also be used in other activities.

2.3   Quality Management Systems standards

There are a number of different quality management systems that are in common use – the PGDATA 2020 report[26] summarised a number of these that are relevant to ICES. These included the European Statistical System Quality Assurance Framework, IODE Accreditation for National Oceanographic Data Centres, CoreTrustSeal Certification for Data Centres, ISO 9001:2015 Quality Management Systems, and ISO/IEC 17025:2017 Accreditation for laboratories.

Whereas PGDATA discussions focussed on data management and statistical data processing, the aim of WGQuality was to look at the broader topic of quality management processes within ICES advice production. With this in mind, it was agreed that some of the more specific standards previously discussed would not be relevant and that we should focus on the ISO 9000 family of quality management standards since these provide a generic framework which can be used by different types of organisations operating in many different fields.

The ISO 9000 core standards include:

ISO 9000:2015. Quality management systems - Fundamentals and vocabulary[27]

- Describes the fundamental concepts and principles of quality management

- Specifies the terms and definitions that apply to all quality management and quality management system standards.

Three of these definitions are particularly useful and worth reproducing here:

"Quality"

- An organization focused on quality promotes a culture that results in the behaviour, attitudes, activities and processes that deliver value through fulfilling the needs and expectations of customers and other relevant interested parties.

- The quality of an organization's products and services is determined by the ability to satisfy customers and the intended and unintended impact on relevant interested parties.

- The quality of products and services includes not only their intended function and performance, but also their perceived value and benefit to the customer.

"Quality management system (QMS)"

- A QMS comprises activities by which the organization identifies its objectives and determines the processes and resources required to achieve desired results.

- The QMS manages the interacting processes and resources required to provide value and realize results for relevant interested parties.

- The QMS enables top management to optimize the use of resources considering the long- and short-term consequences of their decision.

- A QMS provides the means to identify actions to address intended and unintended consequences in providing products and services.

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[26] http://doi.org/10.17895/ices.pub.7571

[27] https://www.iso.org/standard/45481.html

"**Top management**"

• Person or group of people who directs and controls an organization at the highest level

The ISO requirements of a QMS are defined within:

ISO 9001:2015. Quality management systems - Requirements[28]

This specifies the requirements for a quality management system. All the requirements of ISO 9001:2015 are generic and are intended to be applicable to any organization, regardless of its type or size, or the products and services it provides.

This standard is based on the seven quality management principles[29]. These are:

Principle 1 – **Customer focus**.

• The primary focus of quality management is to meet customer requirements and to strive to exceed customer expectations.

Principle 2 – **Leadership**.

• Leaders establish unity of purpose and direction of the organization. They should create and maintain the internal environment in which people can become fully involved in achieving the organization's objectives.

Principle 3 – **Engagement of people**.

• Competent, empowered and engaged people at all levels throughout the organization are essential to enhance its capability to create and deliver value.

Principle 4 – **Process approach**.

• Consistent and predictable results are achieved more effectively and efficiently when activities and related resources are managed as a process.

Principle 5 – **Improvement**.

• Improvement of the organization's overall performance should be a permanent objective of the organization.

Principle 6 – **Evidence-based decision making**.

• Effective decisions are based on the analysis of data and information.

Principle 7 – **Relationship management**.

• For sustained success, an organization manages its relationships with interested parties.

WGQuality believe that these seven quality management principles fit well with ICES.

Certification/accreditation

The words "certification" and "accreditation" are often used interchangeably however within the ISO world they have different meanings[30]

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[28] https://www.iso.org/standard/62085.html

[29] https://www.iso.org/iso/pub100080.pdf

[30] https://www.iso.org/certification.html

- Certification – "the provision by an independent body of written assurance (a certificate) that the product, service or system in question meets specific requirements."
- Accreditation – "the formal recognition by an independent body, generally known as an accreditation body, that a certification body operates according to international standards."

ISO does not perform certification - they develop international standards, such as ISO 9001:2015 but are not involved in their certification, and do not issue certificates - this is performed by external certification bodies.

There is no obligation to be certified to the ISO 9001:2015 standard and many organizations benefit from using the standard without seeking certification.

2.4   Method

WGQuality analysed existing ICES quality policies and procedures and placed them in the framework of ISO 9001:2015 by writing a draft quality manual. During this process if any requirement of the framework could not be fulfilled then it was identified as a gap.

2.5   Draft Quality Manual

ICES has a large number of principles, procedures, and guidelines related to quality, but it is not always easy to find these documents, or understand how they relate to each other. A quality manual can provide an easy way to summarise and collate this information and provide a focal point for the QMS.
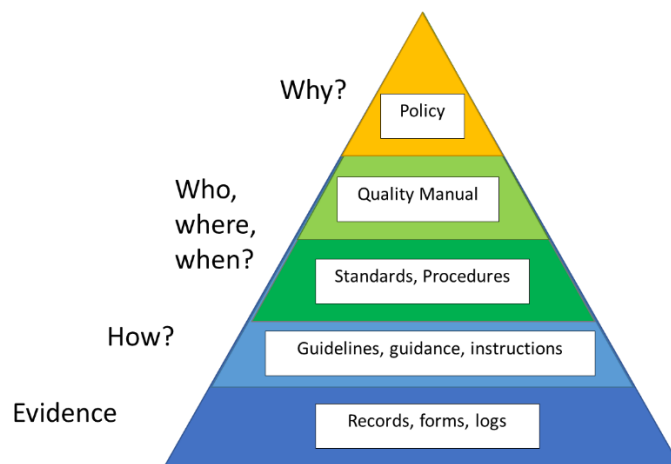
Figure 1 Documentation pyramid

WGQuality agreed that an ICES quality manual would be a useful tool and that it should be:

- Concise, and high level, with references to more detailed documents,
- A communication tool for external people (e.g. stake-holders) and internal people (e.g. new group chairs),
- Up-to-date,
- Publicly available,
- Based on the ISO 9001:2015 standard.

Conversely an ICES quality manual should not be overly verbose and complicated, or too detailed; out-of-date or left on a shelf; or secret.

Scope

The scope of the quality management system encompasses the current quality processes for data management, data and knowledge integration, data analysis, and the advice production.

- Data management is about data compilation, handling, storage, checking completeness, and quality control.
- Data and knowledge integration is about selection, estimation and interpretation of the available data and knowledge relevant to the advice being produced.
- Data analysis is about doing and documenting assessments.
- Advice production is about drafting, reviewing and finalising the content of the advice.

It should be noted that the collection of data is not within the scope of the system since ICES does not undertake this activity – however there are ICES expert groups who coordinate data collection activities, and create guidance and best practice on this topic.

Processes

ISO 9001:2015 follows a process-based approach. A process is a set of interrelated or interacting operations or activities carried out by people, using resources with a view to achieving a goal. A process is therefore oriented towards satisfying the needs and expectations of a customer (external or internal) and other relevant stakeholders. It enables the transformation of incoming elements into output elements, the expected final result of which is a service or a product, whether tangible or intangible.

During the creation of the draft quality manual 5 processes were identified:

- **Organisational Process**: provides overall management of the ICES QMS
- **Advisory Process**: generates scientific advice to support ecosystem-based management of human activities in our seas and oceans
- **Supporting Processes**
  - **Data Management Process**: ensures that data used within the Advisory Process are findable, attributable, researchable, reusable, and conform to ICES data policy
  - **Transparent Assessment Framework (TAF) Process**: assures quality, improves efficiency, and ensures transparency of data and analyses used in the Advisory process
  - **Advisory Support Process**: provides logistical, infrastructural, administrative, and scientific support to the Advisory Process
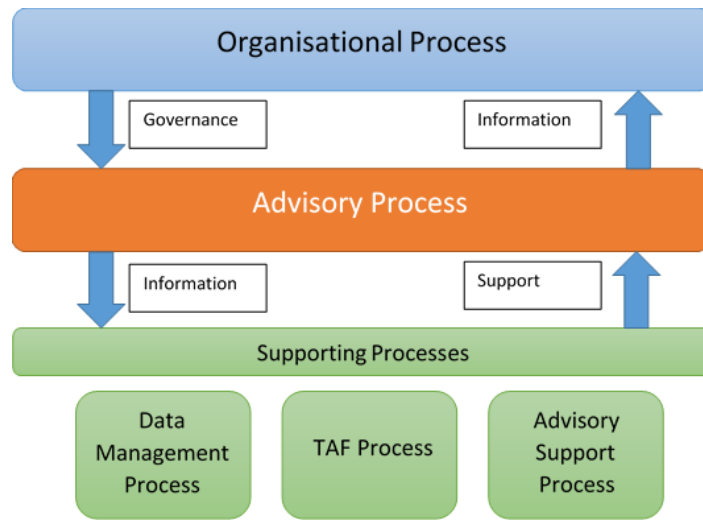
Each of these processes has a process owner proposed – a process owner takes responsibility for the running of the quality management system within that process, although they may delegate specific tasks to other people. These processes are mapped to ICES roles in the following way:
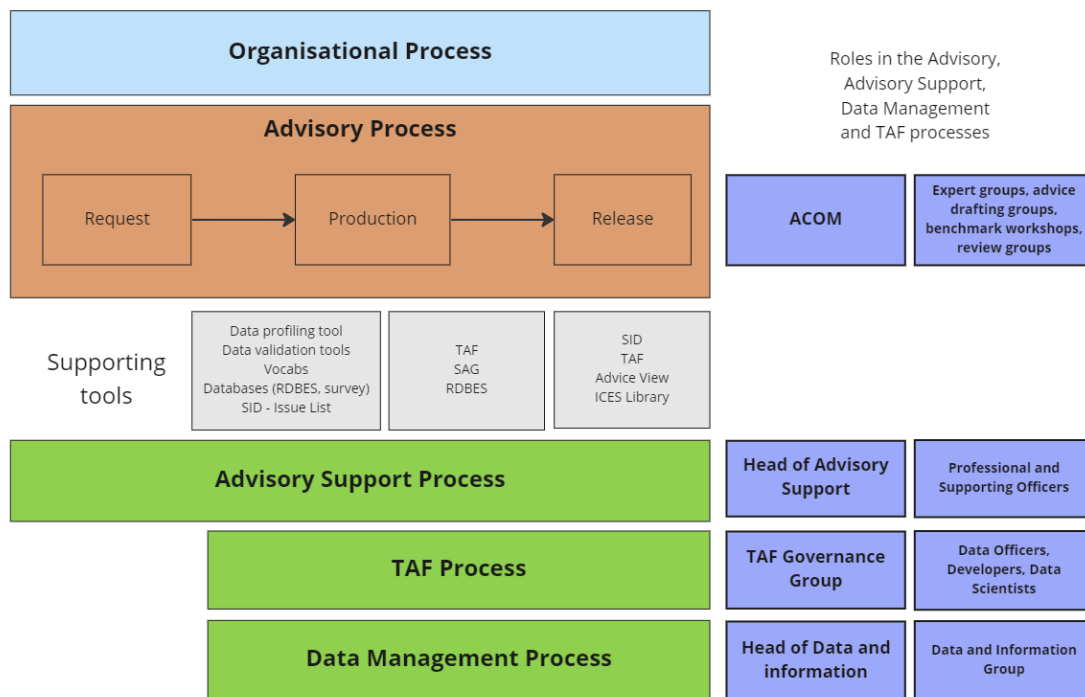
The draft manual is included in this report in Annex 5: "Draft Quality Manual". The section headings follow the structure defined by the ISO 9001:2015 requirements.

The draft manual describes the current policies and procedures - where a gap in the existing quality management system has been identified a note in bold font has been added to the draft manual to refer to Section 2.6 of this report.

2.6 Gaps Identified

The following gaps in the existing quality management policies and procedures were identified. Where appropriate, a solution to fill the gap has been proposed.

2.6.1 Quality Support Manager role in the secretariat

A large amount of the quality management work described in the draft quality manual is already performed within the secretariat. However, we believe it is necessary to have a named lead person for managing and supporting the ICES quality management system. We have called this role the "Quality Support Manager". It is important to note that **the quality of ICES advice outputs depend on all participants in the processes.** The responsibility for quality must not be delegated to this single role – they are simply there to support the quality management system.

The responsibilities of a Quality Support Manager should include:

- Support process owners in the implementation and day-to-day running of the QMS
- Ensure all QMS documentation is kept up-to-date according to its review cycle
- Collate quality objective indicators during the year
- Compile an annual report on the performance of the QMS in the previous year
- Support process owners to track risks and opportunities
- Track non-conformities, corrective actions, and improvements
- Coordinate self-assessments, internal audits and management reviews
- Work with process owners to develop a communication plan for the QMS
- Ownership of the Quality Manual and of the process for its review and updates.
- Report on implementation of the QMS

To ensure participation of the ICES community in the quality management system the Quality Support Manager should work in tandem with a Quality Management Governance expert group. The participants in this group should include:

- Representatives from the ACOM leadership team,
- The Head of the ICES Data Centre,
- The chair of DIG,
- The lead of the TAF secretariat team,
- The chair of WGTAFGOV,
- The Head of Advisory Support,
- The Quality Support manager,
- Relevant Steering Group chairs.

Other participants can be invited to attend the group as required. The ToRs for this group could include:

a) Provide guidance and feedback to the Quality Support Manager,
b) Evaluate, review and update as necessary the ICES Quality Management System, and the Quality Manual itself.
c) Advise on regulations and their impact on the ICES Quality Management System Strategy,
d) Facilitate best practice in quality management by providing guidance to expert groups and engaging in dialogue.

We also note that if ISO 9001:2015 certification is applied for in the future then extra work by the Quality Support Manager would be required to prepare for audits.

2.6.2   Quality Policy

The requirement in ISO 9001:2015 is that the leadership within an organisation will establish, implement, and maintain an appropriate quality policy which supports its strategic aims. This policy should provide a framework for setting quality objectives. It should also include a commitment to satisfy any applicable requirements, and a commitment to continual improvement of the QMS.

"Assuring Quality", is the first priority area in the ICES advisory plan, and Principle 5 of the advisory framework states that advisory products use "The best-available science and quality-assured data". However, at present ICES does not have a documented Quality Policy. A Quality Policy doesn't have to be a long document, but it needs to clearly state the commitment by leadership to the quality management system. A draft of a potential ICES Quality Policy is presented below:

"ICES Quality Policy (Draft)

ICES mission is to advance and share scientific understanding of marine ecosystems and the services they provide, and to use this knowledge to generate state-of-the-art advice for meeting conservation, management, and sustainability goals. ICES advice is produced through an advisory process - the ten principles of which form the foundation of this Quality Policy.

It is the policy of ICES to implement these principles using the ICES Quality Management System, with progress measured through regular monitoring and communication with ICES' advice recipients and stake-holders. ICES commits to continual improvement of this quality management system, and to maintaining its CoreTrustSeal accreditation.

Principles of ICES Advice

Guidelines for advice

Principle 1. The guidelines and procedures to produce ICES advice are documented, openly accessible, and up-to-date.

Request formulation

Principle 2. Final request formulation is agreed through dialogue to clarify the requester's needs and expectations, the ICES process, likely resource implications, timelines, format of advice, and roles and responsibilities of the engaged parties.

Principle 3. Where possible, existing policy goals, objectives, and the level of acceptable risk relevant to the advice request are identified. Where these objectives and descriptions of risk are unclear, ICES will identify these in the advice, and, where possible, provide options for management action and the consequences of the options and their trade-offs.

Knowledge production and review

Principle 4. The deliberations of all relevant expert groups are published by the time the associated advice is published.

Principle 5. The best-available science and quality-assured data are used. ICES selects and applies relevant methods for any analysis, including the development of new methods. The methods are peer reviewed by independent experts and clearly and openly documented.

Principle 6. Data are findable, attributable, researchable, reusable, and conform to ICES data policy. Data flows are documented.

Principle 7. To ensure that the best available, credible science has been used and to confirm that the analysis provides a sound basis for advice, all analyses and methods are peer reviewed by at least two independent reviewers. For recurrent advice, the review is conducted through a benchmark process; for special requests through one-off reviews.

<u>*Advice release*</u>

Principle 8. Advice is comprehensive, unambiguous, and consistent with the synthesized knowledge, while taking the peer review into account. All advice follows existing advice frameworks and any deviation from the frameworks or related, previous advice is identified and justified.

Principle 9. All ICES advice is adopted by the ICES Advisory Committee (ACOM), through consensus, prior to being made available to the requester and simultaneously published on ICES website.

Principle 10. ICES provides advice as an impartial response to a request, and does not lobby the requester or any other party to implement its advice."

2.6.3   Quality Objective Definition Procedure

ISO 9001:2015 requires that an organization shall establish quality objectives at relevant functions, levels and processes needed for the quality management system.

The quality objectives shall: be consistent with the quality policy; be measurable; take into account applicable requirements; be relevant to conformity of products and services and to enhancement of customer satisfaction; be monitored; be communicated; and be updated as appropriate. The organization shall maintain documented information on the quality objectives.

Currently formal Quality Objectives are not defined in ICES although measurements of indicators related to quality are made (e.g. the number of stocks within the Transparent Assessment Framework has been measured annually for a number of years).

WGQuality proposes the following process for defining Quality Objectives:

- In 2023

  - Process owners (as defined in the draft quality manual) define relevant Quality Objectives that are directly linked to the Quality Policy:
    - ACOM decide on the objectives relevant for the advisory process,
    - the ICES Data Centre and DIG propose data process objectives for the data management process,
    - the TAF secretariat team and WGTAFGOV propose TAF process objectives,
    - and the Head of Advisory Support proposes quality objectives for the Advisory Support process.
  - Quality Objectives should be specific and measureable and based on the quality policy – they should also have a set of indicators and targets defined.
  - ACOM should then review and approve all Quality Objectives.

- In 2024

  - Objectives are measured during year by the relevant people/groups
  - The Quality Support Manager monitors provisional figures during the year

- In 2025

  - The Quality Support Manager compiles an annual report using the Quality Objective figures/measurements compiled during 2024

- o The Quality Support Manager presents a report of the previous year's Quality Objectives to the first ACOM meeting (March)
  - ▪ Actions are presented and agreed by ACOM to improve performance
  - ▪ Recommendations are sent to relevant people and groups to improve performance
- o New Quality Objectives can be proposed to the Quality Manager and the quality governance group for discussion
  - ▪ Recommendations for new Quality Objectives will need to be approved by ACOM

To clarify what we mean by Quality Objectives we have created examples that are in line with the draft Quality Policy already presented. Targets for these indicators have not been proposed but in general they should also be defined – these target values can be multi-annual with the purpose of improving performance over a number of years.

Example Quality Objectives

Example Quality Objectives related to Principle 1 ("*The guidelines and procedures to produce ICES advice are documented, openly accessible, and up-to-date*"):

- ICES guidelines and procedures are publicly published using a DOI (digital object identifier)

  - o Proposed Indicator: number or percentage of guidelines and procedures published with a DOI

- A catalogue of ICES guidelines and procedures exists and is kept up-to-date

  - o Proposed Indicator: The number of guidelines/procedures that are not in the catalogue

- ICES guidelines and procedures should be reviewed every 3 years as a minimum

  - o Proposed Indicator: the number of guidelines and procedures that have exceeded this review period.

- ICES guidelines and procedures are appropriately categorized so they are easy to find in the ICES library system

  - o Proposed Indicator: the number of categorised guidelines/procedures

- Links within documents/webpages should work and be up-to-date

  - o Proposed Indicator: the number of broken links in guidelines and procedures

Example Quality Objectives related to Principle 5. ("*The best-available science and quality-assured data are used. ICES selects and applies relevant methods for any analysis, including the development of new methods. The methods are peer reviewed by independent experts and clearly and openly documented.*")

- Every 5 years all stocks should be evaluated to see whether a benchmark is required

  - o Proposed Indicator: the number of stocks not evaluated for a bench-mark within the last 5 years

- Expert groups should update the stock issue list on an annual basis.

- o Proposed Indicator: the number of stocks that have been updated in the issue list

- ICES expert group reports should be categorised/labelled so that end-users can find them

  - o Proposed Indicator: the number of categorised expert group reports

- ICES should notify the relevant groups listed in a group's resolution when an expert group report is published

  - o Proposed Indicator: the percentage of reports that have all relevant parties notified upon publication

- Data used in the production of advice should have associated meta-data

  - o Proposed Indicator: the percentage of relevant data sets that have meta-data

2.6.4 Risks and Opportunity Tracking Procedure

When planning for the quality management system, ICES needs to determine the risks and opportunities that need to be addressed to enhance desirable effects; prevent, or reduce, undesired effects; and achieve improvement. It also needs to plan actions to address these risks and opportunities.

Currently the ICES Bureau oversees a risk register that tracks and mitigates for organisational risk whilst within the other QMS processes risks and opportunities are tracked in different ways. We recommend the use of a standard format for risk and opportunity trackers for the Advisory, Data Management, TAF, and Advisory Support processes - this would allow detailed risks and opportunities to be recorded for each process in a consistent way. These risk/opportunity trackers should be reviewed and updated on an annual basis at least and the proposed Quality Support Manager should include them in their annual report, along with a summary of any new entries or updates, and actions taken. If a significant risk or opportunity which could have an organisational impact is identified within a QMS process then it can be raised with ICES Bureau.

When a risk or opportunity is initially identified a quick analysis of the Potential Impact and Likelihood should be performed and a decision can then be taken on whether it needs to be added to a tracker.

<div align="center">

Potential impact

Likelihood		1 Low	2 Medium	3 High
	1 Unlikely			
	2 Quite likely			
	3 Very likely			

</div>

Include in tracker - action needed

Include in tracker - monitor

Don't include in tracker

Examples of a standard format for risk and opportunity trackers, along with example entries to illustrate their use are shown below:

Risk Tracker

Title	Type	Potential impact	Likelihood	Challenges	Action required
Descriptive name	*Categorical description e.g. "Open data and code"*	*Low, Medium, High*	*Unlikely, Quite likely, Very likely*	*What risks does this bring for ICES?*	*What has been or should be put in place to mitigate the risks of disruption?*
Survey time	Data quality	High	Quite likely	A given country in a coordinated survey cannot fulfil all the planned stations. The quality of the data is not sufficient for the assessment.	Implement a feedback system within survey groups to monitor ship time use/availability in near real-time.
Documentation	Expert knowledge	High	Very likely	Undocumented procedures /workflow /code /estimates /modelling /methods get lost if experts leave the ICES system. This would affect consistency, accuracy, reproducibility, and timeliness of assessments	Move assessments to TAF. Provide training for experts. Plan who will take over when experts are leaving.
Tools aren't maintained/ updated	Systems	Medium	Very likely	Resources aren't provided to maintain and develop tools. The tools become obsolete or out-of-date, and are no longer used. Tools might also give incorrect results causing people to develop their own processes.	When a tool is developed resources that will be required for long-term maintenance and development should be identified.

Opportunity Tracker

Title	Type	Potential impact	Likelihood	Opportunities	Action required
Descriptive name	*Categorical description e.g. "Open data and code"*	*Low, Medium, High*	*Unlikely, Quite likely, Very likely*	*What opportunities does this bring for ICES?*	*What has been or should be put in place to gain benefits?*
Survey time	Data quality	High	Quite likely	A given country which has extra survey time available could do extra stations, or support other countries to achieve their number of stations. The quality of the data used in assessment is improved.	Implement a feedback system within survey groups to monitor ship time use/availability in near real-time.
Improving, developing, and storing documentation	Expert knowledge	High	Quite likely	Documenting procedures gives a chance to re-evaluate and improve processes. Easier to share knowledge with the ICES community and improve methods once it is documented.	Move assessments to TAF. Provide training for experts.

Any actions required should be linked to the system proposed in Section 2.6.6 so that they can be managed.

2.6.5   Procedure to change the QMS

A formal ICES QMS does not exist at the moment so there is no formal procedure for changing it – we recommend that the following draft procedure is considered.

The processes described in the draft manual are subject to changes stemming from the internal and external environment as well as to shifts in obligations to clients and updated quality standards. These changes may require an update to the QMS as these changes may have an impact on outputs, quality measurements and activities. Although changes to the QMS may be initiated for different reasons the process to change the system should be similar. Changing the QMS system should be part of the Organisational Process and only be done according to a predefined plan as established by the quality support manager, and only if the request to change the system is deemed appropriate.

The general procedure for changing the QMS should be:

- Initiation of the process by accepting the request to change the QMS
- Define the plan of action
    - The plan of action includes:
        - the purpose of the changes and their potential consequences;
        - the integrity of the quality management system;
        - the availability of resources;
        - the allocation or reallocation of responsibilities and authorities.
        - Time line

- ICES council approves the plan of action
- Quality support manager to execute the plan and report to Council on the outcomes
- Implement the change

All processes for quality improvement are based on the Plan-Do-Check-Act (PDCA) cycle:
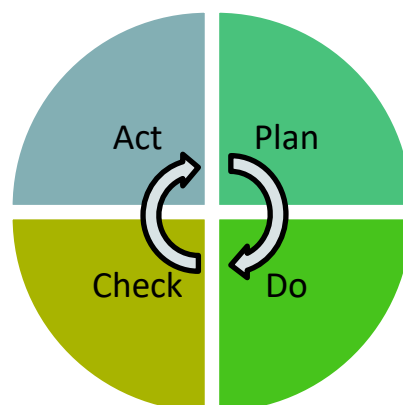

Figure 2 PDCA cycle

- Plan: define the goals of the process in a SMART[31] manner. Identify desired results and the prerequisites (resources, expertise, budget, etc.) and the interest of stakeholders
- Do: execute the process and define the results
- Check: compare the results against the goals and improve if not matching the goals
- Act: Implement results in the QMS

2.6.6   Non-conformities and corrective action procedure

A non-conformity is defined as the failure to meet one or more existing requirements of the QMS as certified under the ISO 9001:2015 standard. The ISO standard defines the requirements of the QMS to be implemented to ensure the services' output or product meets the client's needs. Failing to comply with the QMS may result from deviating from procedures, specifications, or other standards embedded in the QMS. Nonconformities, therefore, refer to infringements on the QMS procedures, e.g. by skipping a prescribed quality check or review procedure. A QMS will not prevent errors from happening. For example, even the incorrect selection of a time series is not considered a nonconformity if all appropriate procedures are applied correctly.

We recommend that the following procedure be considered for managing non-conformities within the QMS.

Nonconformities can be classified based on their (potential) impact and opportunities. Doing so helps to respond to the nonconformity correctly in terms of time and required actions. Apart from nonconformities, observations and recommendations for improvements may be defined. For example, the incorrect use of a time series can trigger an improvement to the system as the process for selecting the time series can be improved.

Type	Description
Major Nonconformity (category 1)	Potential show-stopper. The lack of effective implementation of one or more standard system requirements or a situation in which it is not or insufficiently guaranteed that the product or service will meet the requirements. Complaints are treated as severe. Severe nonconformities may result in a major decrease in customer/client satisfaction.
	Immediate remedial action is needed to eliminate the nonconformity as such (if applicable to the nonconformity). The process owner and/or the quality support manager will assess the corrective measures based on the evidence provided.
Minor Nonconformity (category 2)	The lack of monitoring or control of implementing the management system or other requirements does not affect the system's functioning or the fulfilment of the product or service requirements.
	Determine the root cause(s), eliminate the cause(s) so the nonconformity does not re-occur, and implement any corrective action necessary. Corrective actions are defined as an action undertaken to prevent the recurrence of a nonconformity.
	The process owner and/or the quality support manager will review the action plan for the corrective actions. During the next opportunity, the implemented corrective measures will be assessed. Therefore, minor nonconformities do not detrimentally affect the quality assurance of the outcomes.
Potential Nonconformity (Observation)	Observations are findings that lack a relationship with a standard requirement or a finding without clear evidence. Observations should be investigated, and no deadline for corrective action has been set. An observation may become a nonconformity if the finding has not been thoroughly investigated. However, the process owner and/or the quality support manager will assess the answer.

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[31] Specific, Measurable, Achievable, Relevant, and Time-Bound

Type	Description
Preventive measures and recommendations for improvements	A preventive measure or improvement can be issued if the process meets the minimum requirements, but the process could be improved. A point for improvement is usually system or process related.

Nonconformities need to be evaluated, and corrective measures shall be taken to avoid deviations in the future. Nonconformities are also an opportunity to improve the QMS, and any opportunity to improve the system should be addressed. Implementing corrective measures to avoid repetition of the nonconformities and available opportunities to improve the QMS and the results of the primary process should all follow the same path as the procedures are alike. Opportunities for improvement can also be identified through a review of operational procedures, overall objectives, audit results, corrective actions, management review, staff suggestions, risk assessment, analysis of data and proficiency testing results, and customer feedback.

An improvement process for the different types of nonconformities is proposed below – this includes a number of different steps and actions.

Phases	Action	Who	How
Phase 0: Identifying and recording any nonconformity, complaint, or proposal for improvement	Inform the quality support manager. The quality support manager collates all information required to validate the request.	Anyone can file a complaint, suspicion of nonconformity. (Internal) audits	Designated form (to be developed) for reporting. Audits will report through audit findings.
Accept the request	The quality support manager registers the request and informs the requestor that the request has been taken up.	Quality support manager	Enter the request into the registration system (to be developed). The system shall facilitate the registration of the nature of the nonconformities and any subsequent actions taken as well as the results of any corrective action.
Identify and inform the process owner	The quality support manager forwards the request to the responsible process owner for follow-up. (Define timing depending on severity)	Quality support manager	Designated form including all the following phases (to be developed) Complete section phase 0
Identify need for action and when applicable undertake action to eliminate the cause(s) of the nonconformity, in order that it does not recur or occur elsewhere	In an extreme case the process is immediately stopped and remedial action is taken.	Process owner	
Phase 1: Identify the request holder and prioritise.	The process owner responds to the quality manager on the allocation of the "request holder". The "request holder" is the person/people allocated to handle the request.	Process owner	Designated form (to be developed) Complete phase 1
Phase 2: Analysis of the request	Request holder completes phase 2 and informs quality support manager Deviations, nonconformities and complaints (corrective	Request holder	Designated form (to be developed) Complete phase 2

Phases	Action	Who	How
	measures): Register corrective measure and analyse complaints describing the origin, history, magnitude of the impact and frequency, solution and options for implementation		
	Improvements (preventive measure): Register the request and define proposal for improvement		
	Feedback to quality support manager		
Phase 3: Decision to implement the solution	Quality support manager informs the process owner of the proposed solution.	Quality support manager and process owner	Designated form (to be developed)
			Complete phase 3
	Process owner will take the decision whether or not the proposed solution is deemed acceptable and feasible. The process owner informs the quality support manager		
	If not acceptable or feasible, quality support manager communicates the decision to the requestor.		
Phase 4: Monitor progress implementation of the proposed solution	Implement corrective or preventive measure.	Request holder	Designated form (to be developed)
			Complete phase 4
	Inform requestor on progress	Quality support manager	Suitable method
Phase 5: Measure has been implemented, release updated procedures and	Process owner agrees the updated procedures and releases the procedures. Any stopped processes may be restarted.	Process owner	Designated form (to be developed)
			Complete phase 5
	Inform requestor on final implementation.	Quality support manager	Suitable method
	Request approval to close the issue.		
Phase 6: Check operability and effectiveness of the measure	When needed, operability is tested.	Quality support manager	Designated form (to be developed)
			Complete phase 6
Closure	Form is closed.	Quality support manager	Registration system
	Issue is closed in the registration system		

2.6.7   Standard for the Legitimacy of Data used in ICES advice

This originates from the workshop on Data Standards and Guidelines for Fisheries Dependent Data (WKDSG)[32] where a review of available standards and guidance did not uncover existing standards for addressing potential conflict-of-interest of data-collectors. During plenary discussions, conflict of interest was highlighted as an important potential threat to the integrity of advice, and perceived conflict of interest as an important potential threat to the legitimacy of advice.

WKDSG recommended that standards be developed for managing conflict of interest (perceived or actual) in the collection and application of data for use by ICES. The purpose of such standards should be to protect the legitimacy of advice when data-collectors with potential conflict of interests are involved. The workshop on developing guidance for ensuring the integrity of scientific information submitted to ICES by data providers (WKENSURE) is scheduled for February 2023[33] and aims to develop guidance on this topic.

2.6.8   Self-assessment and internal audits

Self-evaluation is an important tool within a continual improvement cycle. To aid this the ISO 9004:2018 standard "*Quality management — Quality of an organization — Guidance to achieve sustained success*"[34] provides a self-assessment tool which can help to measure the maturity of quality management processes, and highlight areas for improvement. It is recommended that the proposed quality support manager, along with the Process Owners, should make use of this tool.

Internal audits of the quality management system are a requirement of the ISO9001:2015 standard. We recommend that this procedure should be managed by the proposed Quality Support Manager with assistance from the Quality Governance Group. The internal audit of the QMS on should be performed on an annual basis with the results documented and presented to ACOM. Any issues or improvements identified should be recorded using the procedure described in section 2.6.6.

2.6.9   Management Review Procedure

It is a requirement of the ISO 9001:2015 standard that "t*op management shall review the organization's quality management system, at planned intervals, to ensure its continuing suitability, adequacy, effectiveness and alignment with the strategic direction of the organization.*"

We recommend the following approach to management reviews is considered.

Management reviews are planned and occur on an annual basis. At a minimum, these reviews are attended by the ACOM leadership team (Chair of ACOM, its Vice-Chairs, and the Head of Advice Support from ICES Secretariat). The Management Reviews are scheduled and a meeting agenda consisting of all required inputs is prepared. Outputs from Management Reviews include the actions and decisions relating to any opportunities for improvement, needed changes to the QMS and resource needs. The meeting minutes and outputs are retained on SharePoint.

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[32] https://doi.org/10.17895/ices.pub.8038

[33] https://www.ices.dk/community/groups/Pages/WKEnsure.aspx

[34] https://www.iso.org/standard/70397.html

2.7   Summary

A draft quality manual describing existing ICES quality management procedures was written - this follows the ISO 9001:2015 requirements. Where a requirement could not be fulfilled by current procedures this was identified as a gap and new policies and procedures to fill these gaps were proposed.

3   Communication

This section describes the work done to fulfil ToR c: "*Create and implement an internal communication plan to explain the quality management system, ensure effective feedback mechanisms to identify needed improvements and highlight existing good practice.*"

A list of stake-holders and the messages WGQuality wanted to communicate was created. An initial communication plan was created, focussing on activities required in the first half of 2021 and the plan was updated during the life-time of the group.

Key stakeholders
- Internal

    o   ICES Council
    o   Advisory Committee (ACOM) and Science Committee (SCICOM)
    o   Ecosystems Observations Steering Group (EOSG), Data Science and Technology steering group (DSTSG), Integrated Ecosystem Assessments Steering Group (IE-ASG), Fisheries Resources Steering Group (FRSG), Aquaculture Steering Group (ASG) chairs
    o   ICES expert groups that produce advisory products
    o   WGCHAIRS
    o   ICES Secretariat (roles related to advice and data management)

- External

    o   EU Regional Coordination Groups (RCGs) and DCF National Correspondents
    o   STECF
    o   Advice recipients and advice users (all communication via ACOM though)
    o   Current data submitters
    o   Future data submitters e.g. fishing industry/eNGOs

Key messages
- The key messages from the first meeting were:

    o   We exist!
    o   Our plans, and scope,
    o   The development of the commercial sampling summary template (for relevant groups).

- The key messages from our second meeting were:

    o   Plans, scope, benefits of quality management system, and gaps identified so far.

- The key messages from our third meeting were:

    o   The proposals for the future ICES Quality Management System (QMS) need to be discussed and reviewed by ACOM

Communication plan

Task	2021				2022				2023			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Short update for ICES science highlights	X											
ICES E-evaluation	X											
Inform SG chairs	X											
Set up ICES web page	X											
Inform RCGs of work and template		X										
Inform STECF of commercial sampling summary template	X											
Communication to ACOM March meeting						X						
Summary of progress to MIRIA/MIACO									X			
Communication to ACOM March meeting									X			
WGQuality final report									X			

The group's intent was to ask ACOM for an endorsement of our direction at their meeting in March 2022, however, this was not possible due to events in the wider world. As a result, it was not possible to start informing other members of the ICES network about the proposed QMS. The group will ask ACOM to discuss and review its proposals at the March 2023 meeting.

It was noted that the expertise of the WGQuality group members did not cover the entire scope of ICES advice production - an effort was made to attract participants from areas such as the production of ecosystem advice but this was not successful. Achieving effective communication with advice focused groups has been identified as a difficulty by previous working groups looking at similar topics (see PGDATA 2020[35]).

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[35] http://doi.org/10.17895/ices.pub.7571

4   Evaluate Activities

This section describes the work done to fulfil ToR d: "*Use the quality management system to evaluate current activities.*"

Limited work was done on this ToR since it depended on the output from ToR a and ToR b and these took longer than expected to complete.

4.1   Fisheries Independent Data Quality

In 2022, we recommended that the EOSG chair should begin the process to develop standard reports and overviews of fisheries independent data, similar to the work done in the EU Regional Coordination Groups (RCGs) on fisheries dependent data. The recommendation was also to start a process considering what standard information end-users of a survey data such as expert groups would find useful and who could develop these reports. This recommendation was discussed in the EOSG forum and with the ICES Data Centre and both showed willingness to follow-up on this recommendation. In 2023 ahead of the EOSG meeting we initiated a brainstorm on how best to initiate the work. The main points were:

- To evaluate end-user needs for survey data and to ensure that this data can be easily provided (e.g. ICES ecosystem overviews, STECF prioritisation of surveys, RCG overviews, ICES assessment WGs, benchmarks, EOSG coordination).
- The development of an overall mapping of what data is being collected during the fishery independent surveys with a focus on spatial and temporal perspectives, starting with the most recent developments of the ICES data portal (DATRAS and acoustic databases).
- Matching of the data collected with data actually being used for assessment, utilising the most recent developments of the ICES Stock Information Database (SID).
- To get an overview of how these fishery independent surveys are being stored, and create a system to track this information. This would enable us to see whether all relevant fishery independent surveys are being uploaded.
- Starting a process so that in the future some standard data quality evaluations of the fishery independent surveys can be included in survey reports.

The objectives of such a work would be to ensure the quality and accessibility of fisheries independent data used for ICES advice, and to assess any gaps or needs related to data integration in ICES databases. Another objective would be to develop a survey metadata database specification, and tool specifications so that is easy to identify which data is available in a given area and time period – this should be done in collaboration with the ICES Data Centre and Data and Information Group (DIG)

These identified points and objectives are clearly a good fit for a workshop which would start implementing a framework for fisheries independent data quality evaluation and draw a roadmap for future work. It could also be included in the future work plan of an expert group such as WGQuality. Our views on the work to be done will be given in the EOSG forum and the EOSG chair will ensure any follow-up needed.

4.2   Data Profiling Tool

The ICES Data Centre have a developed a Data Profiling Tool[36] to aid in evaluating the completeness of supporting information for a data product, data source or web application. This was developed in response to a growing need to document information relating to the use of new data sources in advice outputs. The Data and Information Group (DIG) are supporting this and have formed a sub-group to further develop the process, and review incoming submissions. Data flows and data products supporting the Ecosystem Overviews[37], a key advice product, provided an initial use case for the tool.

WGQuality believe this is an excellent development and clearly supports the advice principle of ensuring data used in the advisory process are FAIR[38].

4.3   Data call development and release procedure

In response to feedback from data submitters ICES have developed a new process for defining, aligning and publishing data calls. On average 15 data calls are initiated by ICES each year which puts a resource demand on the ICES member countries fulfilling them. The new process uses checklists on GitHub and should be more robust, and less prone to error. WGQuality believes this is a great example of continual improvement within the ICES system, particularly since it was initialised as a response to feedback from data submitters.

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[36] https://www.ices.dk/data/tools/Pages/Data-profiler.aspx

[37] https://www.ices.dk/advice/ESD/Pages/Ecosystem-overviews.aspx

[38] https://www.go-fair.org/fair-principles/

5   Operationalise quality tools and processes

This section describes the work done to fulfil ToR e: *"Operationalise the quality tools and processes that were proposed during the previous 3-year cycle of PGDATA."*

During the 2021 meeting of WGQuality the key outputs from PGDATA were enumerated and a decision was taken on if they should be progressed - if they were to be progressed then who should do this was identified.

5.1   Documentation template for commercial fisheries sampling schemes

WGQuality recognises that documentation of commercial sampling programmes that currently feed data into the ICES advisory process, or might do so in the future, is an important feature of a quality management system. To that end we recommended that the 2022 Workshop to Evaluate the Utility of Industry-derived data for enhancing scientific knowledge and providing data for stock assessments (WKEVUT) encouraged participants to try documenting their programmes using the commercial sampling summary template which was initially developed by PGDATA.

WKEVUT completed this activity and provided feedback via a number of recommendations. WGQuality agreed with the recommendations and the updated template is available in Annex 4: "Commercial Sampling Summary Template".

A question still remains on how completed templates should be shared – a central source such as a website or GitHub repository would seem preferable.

5.2   Re-organisation of ICES Data Quality Assurance repository

PGDATA considered accessibility to recommendations and good practices, in particular considering the organisation of the ICES Data Quality Assurance Repository[39]. Over a number of years this has accumulated more than 200 links to workshops and expert group reports that are not organised in a very intuitive way. This means that although there is a large amount of useful information (e.g. answers to issues, examples of good practices, recommendations for practical implementations) only a few experts in each of these fields are able to find it.

ICES have implemented a new library platform called FigShare that has a feature called "Collections" - this feature allows groups to curate a list of publications, give the list a DOI to make it citeable and trackable, and also allow people to "follow" the list so they are notified when a new entry is added. WGQuality believe that this will be an improvement on the current Data Quality Assurance web page.

WGBIOP have been made aware of this feature and have on their agenda to populate a Collection. WGCatch have also been made aware of this library feature.

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[39] https://www.ices.dk/community/pages/pgccdbs-doc-repository.aspx

5.3   ICES data mining tool

ICES developed a data mining tool that used text analysis to explore the content of ICES reports. Although it is not currently in a "production" state in the future it could possibly be used to tag reports and documents. This should be kept in mind during the migration of the ICES Data Quality Assurance repository to the new library platform.

5.4   Quality Assurance Framework based on European Statistical Standard

In 2018 from the different possibilities to structure a Quality Assurance Framework PGDATA proposed a general frame-work following the principles developed in the European Statistical Standard and its standard for Quality Reports Structure[40]. This thinking has been incorporated into the draft quality manual developed by WGQuality.

5.5   Communication and cooperation with end-users on the quality and consistency of the data

PGDATA noted in their 2020 report (pages 12-13) that a large number of different assessment working groups (WGs) have developed multiple ways of presenting similar information. This raises the question of duplication of work and a need for sharing and developing data analysis functions in a collaborative way. The current GitHub repos used by WGs mimic the WGs structure and thus cannot be used for collaborative work across WGs. The development of the RDBES presents an opportunity to develop common R functions and scripts which could be housed in a data exploratory analysis GitHub repo and used by many different WGs. WGQuality recommended to the EU Regional Coordination Groups (RCGs) and the ICES WGCATCH group that such a repo is created and that work is begun to develop RDBES data exploration scripts.

PGDATA noted in their 2020 report (pages 12-13) that stock assessors were often interested in the stability of a time series and how the latest year's data correlated with that time series. However, data submitters rarely perform these types of analyses and often concentrate on quality checks within a single year. WGQuality recommended to the EU Regional Coordination Groups (RCGs) and the ICES WGCATCH group that whenever data quality reports are developed consideration should be given to including information about how the data has varied over time.

Over recent years there has been good progress within the EU Regional Coordination Groups at developing standard reports that visualise commercial catch, effort, and sampling data from the RDB/RDBES. It would be useful if standard reports and overviews were also made available for fisheries independent data. Whilst there are ICES tools available for displaying and downloading survey data such as https://data.ices.dk/view-map it would be useful to make more specific outputs available that could better inform users of the data. There have been initiatives to develop such products which could potentially be adapted or expanded by ICES (e.g. the Irish Groundfish Survey app https://shiny.marine.ie/igfsexplorer/ and gridded abundance maps https://www.emodnet-biology.eu/trends-abundance-fish-species-north-sea). WGQuality recommended to the ICES Ecosystem Observation Steering Group (EOSG) chair that a process is started to consider what standard information users of a survey database such as DATRAS would find useful, and who could develop these reports.

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[40] https://ec.europa.eu/eurostat/web/quality/european-quality-standards/european-statistics-code-of-practice

5.6 Uninformed strata report

PGDATA noted in their 2020 report (page 13) that when exploring the data from InterCatch (IC), stock assessors have the ability to impute data for unsampled strata. Borrowing data from relevant and well informed strata suppose that the data are of sufficient quality to support a widening of their scope. In this situation, the stock assessors can use charts such as that on PGDATA 2020 page 14 which could be run from the output of IC to easily identify areas where the strata are not suitable to be used for imputation. Similar outputs to this have been used in the WGCSE and WGBIE assessment groups.

WGQuality recommended to the RCGs and WGCATCH that a graphical informed/uninformed strata report using the RDBES data format should be developed – this could then be used by stock coordinators to support any required imputation

5.7 Species identification app

PGDATA noted in their 2020 report (page 23) there is a need to improve the species recognition skills of on-board fisheries observers, and to allow for staff turn-over. The group recommended that an online facility to evaluate the species recognition of skills of observers could be developed – this could be both a training tool for new observers, and a refresher course for existing observers. There have been some related developments that could provide a starting point e.g. ILVO have co-developed the RayScan app https://rayscan.app/ to help fishers identify species of ray, and there is an online Marine Species Identification Portal http://species-identification.org/). WGQuality recommended to WGSMART, WGTIFD, and WGMLEARN to consider investigating whether ICES groups / national institutes could collaborate on a species identification evaluation tool which could then be used by ICES countries, and the wider community.

WGSMART commented: "*Currently, WGSMART is focusing on the development and maintenance of the SmartDots software, requiring a massive amount of time and resources. Therefore, we are not able at the moment to develop such species identification tool. However, the development of this tool seems a very interesting evolution. We could give input to any developments carried out by another group, if one was to be setup to develop such a tool, given that we now have experience in what is involved in developing such platforms.*"

5.8 Feedback on data calls

We gave annual feedback on the assessment and RDBES data calls. It was agreed that the assessment data call is at a mature stage so there is little room for improvement – this should be seen as very positive.

The RDBES data call is still being developed so more discussion and clarification with the ICES Data Centre was required.

5.9 Summary

A number of tools either developed or proposed by PGDATA were identified as suitable for being progressed and efforts were made to do so.

6 Discussion and Next Steps

6.1 Discussion

WGQuality made good progress on ToRs (a) and (b) – namely drafting a quality manual, and identifying gaps in the current quality management systems used within ICES. When we identified a gap in current processes we also drafted a policy or procedure to fill that gap. This work took the majority of the group's 3-year life-cycle. It is important to note that the quality management system proposals are only based on the view of this expert group so need to be discussed further by ACOM and the wider ICES community. Considering this it meant it was only possible to do a limited amount of work on ToR (c) "Create and implement an internal communication plan to explain the QMS" and ToR (d) "Use the QMS to evaluate current activities".

There is some further work required on the draft quality manual. Its current format strictly follows the structure defined by the ISO 9001:2015 requirements. Apart from the observed omissions described in Section 2.6, the draft manual provides a comprehensive overview of all the processes, steps, and information required under the standard. To slim the manual down to a more manageable document the detailed descriptions should be transferred to separate documents under the QMS. These documents or handbooks are still inseparable from the manual and subject to review. The manual would then form a high-level description of the QMS, and refer to the various documents which would provide more details.

Within ISO9001:2015 a "process" is a set of interrelated or interacting operations or activities carried out by people, using resources with a view to achieving a goal. The draft manual presents the QMS as having 5 processes:

- Organisational Process
- Advisory Process
- 3 Supporting Processes:
  - Data Management
  - Transparent Assessment Framework (TAF) Process
  - Advisory Support Process
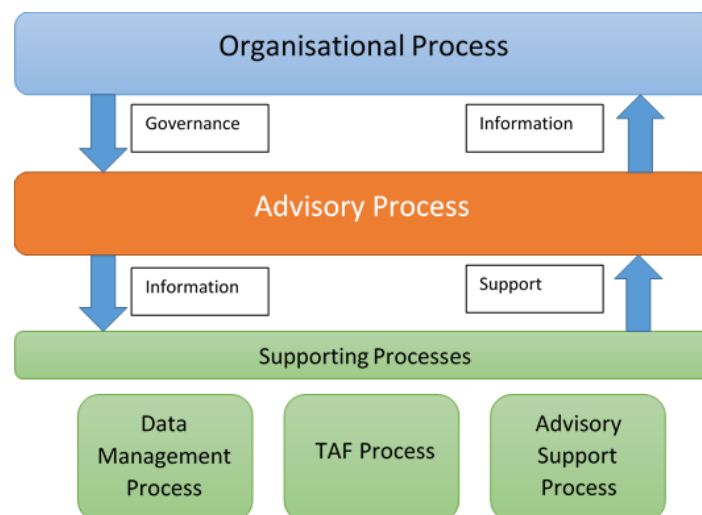
These processes are currently described in Section 4.4 of the draft quality manual. The details of the processes should be moved into separate "Process Description" documents, each of which uses a common format. A common structure for these documents based on a format used by Ifremer is proposed in Annex 3: "QMS Process Description Template". Respective process owners would then govern these documents in cooperation with the proposed quality support manager.

Various forms would also need to be developed to accommodate the needs of the QMS - these forms and associated guidance would have their own review cycle within the QMS. Having separate documents also allows for updates to be made to these documents without updating the quality manual itself. The need to update the quality manual should be limited as much as possible once it is finalised.

Within the draft quality manual funding is considered within the overall description of the resources available to ICES but not specifically in relation to the scope of the QMS. Funding should also be described within the context of the organisation since it's a key stakeholder involvement and part of the decision-making processes.

6.2   Next steps

We believe that the next steps involve ACOM reviewing and discussing the work presented in this report. At a later point it could also be useful to get external experts to review the proposed quality management system, ask difficult questions, and give feedback on where ICES can improve. This external expertise could also advise and help with any future certification process.

There is no obligation to be certified to the ISO 9001:2015 standard - WGQuality believes that whilst the pathway to certification should be kept open ICES should not pursue it until a later date.

Based on the 3-year work-plan that WGQuality have completed we recommend the following proposals for ACOM to review and discuss:

1.   ICES advice production follows the ISO 9001:2015 "Quality management systems — Requirements" standard.
2.   During 2023 ICES creates a "Quality Support Manager" role within the Secretariat to support work on quality management.
3.   During 2023 a quality management governance group is formed which includes the process leaders as defined within the Quality Management System.
4.   During 2023 the Quality Support Manager works with the quality management governance group to:

    a.   Finalise and publish an ICES Quality Manual (building on WGQuality's draft manual).
    b.   Implement the policies/processes/procedures that have been identified as gaps by WGQuality. The most important of these are:
        i.   Publish an ICES Quality Policy
        ii.   Finalise and implement the process for defining Quality Objectives
        iii.   Finalise and implement the process for dealing with non-conformities

5.   During 2024 the overall quality management system is piloted, and its implementation monitored throughout the year.
6.   During 2025 the results from the first full year of operating the quality management system are reported and analysed.
7.   ICES apply for certification against the ISO 9001:2015 standard at an appropriate future time.

6.3 WGQuality future

As discussed in Section 2.6 we believe that a quality management governance group should be formed in the future which consists of the process leaders as defined within the Quality Management System. These will be the correct people to guide the further development of an ICES Quality Management System.

We note that there are a large number of groups that consider quality within ICES. This can lead to a number of problems:

- It's difficult for groups to know what work is being done in other groups – useful results are not necessarily effectively communicated between groups, and work might be duplicated.
- Expertise is spread thinly between groups.
- There are increasing national limitations on physical group attendance – related to issues such as increased travel costs, and a desire to reduce carbon footprints.

Considering these issues we feel that whenever possible it would be advantageous to combine expertise within existing groups rather than creating new groups or workshops. We note that steering group chairs have a key role in rationalising groups and identifying overlapping ToRs and encourage this work.

We believe that there has been a large body of work looking at the quality of detailed data, but note that there has not been as much work looking at the quality of data through the assessment and advice process life-cycle.

The current members of WGQuality believe that an interim step is necessary to produce an informed plan of any future activities so we are not currently proposing a new 3 year work-cycle. Instead we intend to hold a workshop to be chaired by Joël Vigneau that will look at how data quality issues within the whole advice life-cycle should be approached. The proposed title is the ICES workshop on the Future of Advice Data Quality Assurance (WKFAQ). The key aims of this meeting will be to:

a)   Identify all groups that are dealing with data quality issues throughout the advice production lifecycle.
b)   Plan for a stream-lined, coherent approach to dealing with data quality issues throughout the advice production lifecycle within ICES.

The content of the workshop will be affected by the reception within ICES of our recommendations (summarised in section 6.2) so ToRs will not be drafted until after these have been reviewed and discussed. If a Quality Support Manager role is created then they should be included in the workshop, as well as process owners and other relevant parties.

Annex 1: List of participants

Name	Institute	Country (of institute)	Email
Rui Catarino	ICES Secretariat	Denmark	rui.catarino@ices.dk
Julie Olivia Coad Davies	DTU Aqua	Denmark	joco@aqua.dtu.dk
Jessica Craig	Marine Scotland Science	Scotland, UK	Jessica.Craig@gov.scot
David Currie (Chair)	Marine Institute	Ireland	David.Currie@Marine.ie
Edvin Fuglebakk	IMR	Norway	Edvin.Fuglebakk@hi.no
Dorleta Garcia	ICES	Denmark	Dorleta.Garcia@ices.dk
Neil Holdsworth	ICES Secretariat	Denmark	neilh@ices.dk
Henrik Kjems-Nielsen	ICES Secretariat	Denmark	henrikn@ices.dk
Colm Lordan	Marine Institute	Ireland	colm.lordan@marine.ie
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Kotaro Ono	IMR	Norway	Kotaro.Ono@hi.no
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Adrian Tait	Marine Scotland Science	Scotland, UK	Adrian.Tait@gov.scot
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Annex 2:   Resolutions

2020/FT/DSTSG03   A **Working Group on the Governance of Quality Management of Data and Advice** (WGQuality), chaired by David Currie, Ireland; will work on ToRs and generate deliverables as listed in the Table below.

	MEETING DATES	VENUE	REPORTING DETAILS	COMMENTS (CHANGE IN CHAIR, ETC.)
Year 2021	19-22 January	Online	E-evaluation 1st March 2021 to DSTSG	
Year 2022	18-20 January	Online	E-evaluation by 1st March to DSTSG	
Year 2023	17-20 January	ICES HQ, Denmark	Final report by 15th March to DSTSG	

ToR descriptors

ToR	Description	Background	Science Plan codes	Duration	Expected Deliverables
a	Analyse existing ICES quality management processes within advice production and evaluate their coherence with the objectives of the ICES advisory plan. In particular highlight any gaps and overlaps between different processes.	The concept of "quality" is cross-cutting and should be managed throughout a process. The ICES advisory plan highlights the first priority area for development is "Assuring Quality" - it states that quality assurance "encompasses the entire process from data collection to the publication of objective and independent advice". .	3.1, 3.2, 3.3	3 years	An evaluation of the existing quality processes and procedures within ICES.
b	Specify a fully operational ICES advisory quality management system that is in line with the scope and direction in the advice plan.	There is a recognition within ICES of the need for an end-to-end quality management system (QMS) to encompass best practice in data management, data integration, and translation into advice. A QMS is defined as "…a formalized system that documents processes, procedures, and responsibilities for achieving quality policies and objectives".	3.1, 3.2, 3.3	3 years	A draft ICES quality manual which will describe the overall approach to assuring the quality of assessment and advice within ICES. This will cover the quality assurance process from data collection to advice publication.
c	Create and implement an internal communication plan to explain the	There is a large amount of activity in the ICES world focussing on data needs for assessment and advice. One of the major benefits of having	3.1, 3.2, 3.3	3 years	Quality assurance communication plan for the ICES network.

ToR	Description	Background	Science Plan codes	Duration	Expected Deliverables
	quality management system, ensure effective feedback mechanisms to identify needed improvements and highlight existing good practice.	a large number of expert groups, organisations, and individuals participating in this process is the high level of innovation displayed. However, the downsides of this can include a lack of knowledge about what other work is being done by other people and a lack of coordination in harnessing this work.			
d	Use the quality management system to evaluate current activities.	Identify gaps and create a plan to fill them. Prioritise issues, identify unnecessary duplication of activities, and propose remedies.	3.1, 3.2, 3.3	3 years	
e	Operationalise the quality tools and processes that were proposed during the previous 3-year cycle of PGDATA.	PGDATA has previously proposed a number of interesting tools and processes to improve the data informing the assessment and advice process. With the new RDBES/TAF system becoming fully operational over this next work cycle, this is an ideal time to embed these within the workflow. To this end, the next 3-year cycle should also ensure that these ideas are operationalised.	3.1, 3.2, 3.3	3 years	The finalised "Series of ICES Sampling Protocols" template proposed by PGDATA for fisheries dependent data. Documents (based on the temple) describing commercial sampling programs have been created by countries. The process to link the completed documents to data submitted to the commercial fisheries Regional Database & Estimation System (RDBES) is agreed. The procedure to make these documents available to stock assessment groups via the RDBES and Transparent Assessment Framework (TAF) has been agreed and tested. Structure and maintenance of PGCCDBS repository is agreed RDBES/TAF script and tools repository

Summary of the Work Plan

YEAR 1	ToR a) and b)
	• Collate existing policies that relate to the quality of ICES advice and identify any gaps.
	• Agree on a format for the ICES quality manual and which ICES publication type it fits best
	• Create a first draft an ICES quality manual for the advisory process – the purpose of the manual is to document the overall approach to quality management of advice within ICES. The working group will not be looking to invent multiple new procedures but will instead concentrate on compiling and collating the existing procedures into a coherent whole.
	• Identify the types of generic processes within ICES that contribute to advice outputs.
	ToR c)
	• Outline a communication plan for the 3-year cycle of the working group.
	• Identify key stakeholders that should be prioritised
	• Identify the key messages that should be communicated
	ToR d)
	• Limited activity expected in year 1
	ToR e)
	• Identify if are all data collected and used for advice purposes are covered by an identified sampling protocol (e.g. the Series of ICES Sampling protocols used for surveys, and the PGDATA proposed "Series of ICES Sampling Protocols" for fisheries dependent data)
	• Finalise the "Series of ICES Sampling Protocols" template for fisheries dependent data and encourage countries to start using it.
	• Investigate the feasibility of a "species identification" app and other ideas produced by PGDATA
	• Review status of the PGCCDBS (Data Quality Assurance) repository and agree on the way forward.
	• Review draft ICES advice and RDBES data calls and give feedback
YEAR 2	ToR a) and b)
	• Revise draft ICES quality manual in line with feedback
	• Define what documentation is needed for the processes that contribute to ICES advice (such as process flows, standard operating procedures, guidelines, and manuals). Propose tools such as standard templates when required
	• Propose who will need to complete the documentation e.g. a benchmark assessment group.
	ToR c)
	• Review and refine communication plan
	• Identify key targets for year 2 and year 3, alongside the stakeholders identified for Year 1
	ToR d)
	• Use the quality management system described in the quality manual to identify gaps in processes
	• Begin identifying new or revised tools or processes that can fill the identified gaps. Tools could refer to code but might also could be "soft" items such as decision support flow-charts. The group would not intend to create all the identified tools ourselves.
	ToR e)
	• Start to create a collection of useful data quality, scripts, graphs and function that can be used within the RDBES/TAF. Design processes that will allow people to contribute to this work. Agree how this work fits with the PGCCDBS (Data Quality Assurance) repository and how it will be maintained.
	• Review draft ICES advice and RDBES data calls and give feedback

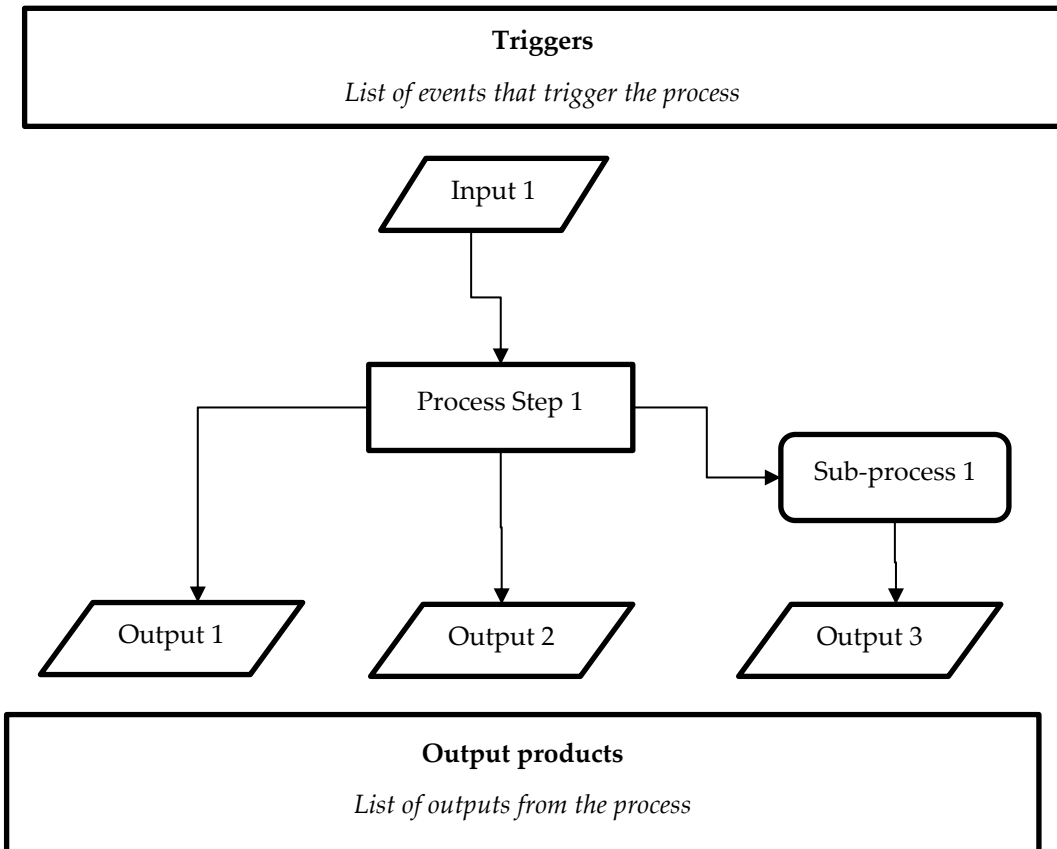| YEAR 3	ToR a) and b)
	• Revise draft ICES quality manual in line with feedback
	• Track and review the documentation.
	ToR c)
	• Refine year 3 of the communication plan and implement it
	ToR d)
	• Use the quality management system described in the quality manual to identify gaps in processes
	• Continue identifying new or revised tools or processes that can fill the identified gaps
	ToR e)
	• Promote the data quality and RDBES/TAF repository/ies.
	• Review draft ICES advice and RDBES data calls and give feedback

Supporting information

Priority	Improving quality assurance processes is a key priority for ICES and is a priority area of the ICES Advice Plan – the work of this group is thus considered as a high priority.
Resource requirements	The research programmes which provide the main input to this group are already underway, and resources are already committed. The additional resources required to undertake additional activities in the framework of this group is negligible. WGQuality builds extensively on experiences gained within PGDATA and PGCCDBS. Countries are encouraged to ensure that their national members have sufficient resources to conduct the necessary intersessional work to address the ToRs. For EU Member States, work within this WG can be funded under the Data Collection Framework (DCF)/European Maritime, Fisheries and Aquaculture Fund (EMFAF).
Participants	The Group is normally attended by some 20–25 members and guests. The participants at WGQuality should represent the entire process from data collection (fisheries dependent and independent data) to the publication of objective and independent advice.
Secretariat facilities	SharePoint and meeting room requirement.
Financial	No financial implications.
Linkages to ACOM and groups under ACOM	There will be strong linkage with ACOM
Linkages to other committees or groups	The work within this group is very relevant to the groups within the FRSG and forthcoming DSTSG (particularly WGCATCH, WGBIOP and WGRDBESGOV). This work will also be relevant to groups within the IEASG, in particular since a wide variety of data sources will be contributing to the outputs of those groups.
Linkages to other organizations	There is a natural link to similar issues of quality assurance in the EU Regional Coordination Groups.

Annex 3: QMS Process Description Template

Process Name	
Process Purpose	
Process Owner	
Version written on	
Approved by	

Relevant Stakeholders	Expectations of the process

Process Flow-Chart(s)

Triggers

List of events that trigger the process

Input 1

Process Step 1

Sub-process 1

Output 1

Output 2

Output 3

Output products

List of outputs from the process

Process Step Number	Actors	Step-by-step activities	Documented information
1	*Who is involved?*	*What happens?*	*Describe the inputs and outputs*
2			
….			

Sub-process Flow Chart(s)

…

(For each sub-process include a flow chart and table in the same format as above.

Annex 4: Commercial Sampling Summary Template

Commercial Catch Sampling Summary

Template v1.21 January 2023

The following information should be provided by the person completing this template.

Document created date:	
Most recent document review date:	
Contact name:	
Contact email:	

A glossary of relevant terminology can be found in Appendix 1.

1. Purpose and scope of this document

The purpose of the template is to increase transparency by allowing all countries to provide metadata on the purpose and design of their commercial catch sampling programmes in a standard way.

It is intended to be used as a high-level summary of a programmes and is aimed at users of the data who need to understand how it was collected. It is not intended that all details of a programme will be provided in this document - references and links should be provided to more detailed documentation as required e.g. detailed sampling protocols, or published guidelines and best practice.

Please note:

- *The meaning of the statistical terms used in this report follow ICES WKPICS1 REPORT 2011 https://doi.org/10.17895/ices.pub.21286752.v2*
- *Information relating to the ICES Regional Database & Estimation System (RDBES) can be found at https://github.com/ices-tools-dev/RDBES*
- *Where possible links have been provided to ICES vocabularies – using values from these lists in your answers will make it easier to compare different sampling programmes.*

2. Programme overview

2.1. Programme name

*[The name of this sampling programme. **It is very important to maintain consistent naming of the programme so please ensure this name matches other reference sources** such as data submitted to the RDBES, and EU national work-plans (where relevant)]*

2.2. The objective of this commercial catch sampling programme

[A brief description of the purpose of this programme - for example onshore-sampling to obtain data to estimate landed catch by species, length-composition, catch in numbers by age, and mean weight of fish by size/age; or at-sea sampling to estimate by-catch.]

2.3. Spatial coverage and temporal resolution

[Include a summary of the areas sampled (can include a map if desired) , and the time of year and frequency of the sampling. A map of ICES Ecoregions and statistical areas can be found here https://www.ices.dk/data/Documents/Maps/ICES-Ecoregions-hybrid-statistical-areas.png]

2.4. Stocks targeted

[If the sampling programme targets a small group (<10) of stocks list the ICES stock codes (http://vocab.ices.dk/?ref=260). For broader sampling programmes describe the target (e.g. all commercial fish)]

2.5. Known quality issues

[Highlight any known quality issues with the data e.g. discard data from 1995 − 2000 is not generally considered suitable for use in assessment or analyses.]

2.6. Time-series

[Include a brief summary of the existing time-series (first survey year, e.g. 1994–present), including some brief information about significant changes in the methods over time that might affect the consistency of the time-series (e.g. convenience sampling until 2015 thereafter probabilistic/random). Use a table for your answer if helpful. Sampling selection method codes can be taken from https://vocab.ices.dk/?ref=1637 e.g.

Time period	Description
1994 - 2015	*Convenience Sampling (NPCS)*
2016 – present	*Simple Random Sampling Without Replacement (SRSWOR)*

3. Sampling design

3.1. Organisations conducting the sampling

[List all organisations sampling data. Identify any bilateral/multi-lateral agreements – for sampling conducted under these agreements it is preferred if only one country fully completes this form and other countries then refer to it. Identify Regional Coordination Group (RCG) region when relevant. More information on RCG's can be found here https://www.fisheries-rcg.eu/). Use a table for your answer if helpful e.g.

Organisation	Country http://vo-cab.ices.dk/?ref=337	Bi-lateral / multi-lateral agreement part-ners	RCG region http://vo-cab.ices.dk/?ref=1640 (if relevant)

3.2. Sampling scheme type

Sampler affiliation	Y/N	Location	Y/N
Observer		At-sea	
Self-sampling		On-shore	
Control			

3.3. ICES Regional Database & Estimation System (RDBES) Upper Hierarchy

[Specify which ICES RDBES Upper Hierarchy is used for data submission, if known. More details available at https://github.com/ices-tools-dev/RDBES/tree/master/Documents

3.4. Target population

[Brief text description e.g., all demersal fish landed into England and Wales for which estimates of length or age composition is required]

3.5. Sampling frame

[Brief text description e.g., List of English and Welsh >=10m vessels predominantly using shrimp beam trawls]

3.6. Under coverage of the sampling frame

[Summarise any population components excluded from sampling e.g. vessels excluded for health & safety reasons; vessels below certain size; ports with few landings; landing sites where considerable effort would be required to sample very small amounts. (Please don't list vessel names)]

3.7. Sampling units

[Brief description of the primary sampling units (PSU) (e.g., vessel-trips, port-day) and lower level sampling units within PSUs (e.g., fishing operations within vessel-trips for at-sea sampling programmes, or vessel-trips in port-days, fish boxes for on-shore sampling programmes). Note that if data from this programme is being submitted to the RDBES then that should include full information on sampling units.]

3.8. Stratification of Primary Sampling Units (PSU)

[Describe the stratification of the sampling frame of primary sampling units (e.g., quarter, area, gear, vessel size etc.). Note that if data from this programme is being submitted to the RDBES then that data should include full information on stratification.]

3.9.   Effort allocation

[The coverage of the sampling frame of the target population and temporal resolution of the sampling of PSUs (time of year; frequency), and an explanation for the effort allocation.]

3.10.   Selection methods

[Describe how units are selected within a PSU (e.g., selection of fishing operations within a trip in at-sea sampling programmes ; selection of a vessel-trips within a port-day ; selection of boxes within market categories on a market-day visit). Use ICES vocabulary https://vocab.ices.dk/?ref=1637 Note that if data from this programme is being submitted to the RDBES then that data should include full information on selection methods.]

3.11.   Recording of non-responses and refusals

[Are non-responses and refusals recorded? How often do these occur? Are they random or is there a pattern?]

3.12.   Risks and mitigations

[Are there known problems with acquiring satisfactory data (e.g. samplers not having access to landings) if so briefly describe them, along with any mitigations put in place.]

3.13.   Further information on sampling design

[Insert references and links to any other publicly available documents related to the sampling plan (e.g. detailed sampling protocols published on an institute's web-site).]

4.   Biological sampling protocols

4.1.   Species selection strategy

[Describe the strategy used to select the species for this programme (e.g. all fish species, all demersal fish in the commercial landings are sampled for biological data, all pelagic, all benthic fauna included or a specific list). For self-sampling programmes include the requested sample size. Note that if data from this programme is being submitted to the RDBES then that data should include full information on species selection. Different species can be sampled for different biological parameters and this should be noted in the following sections. Different processes might be used for samples from different areas – again please note this in the sections below.]

4.2.   Sub-sampling procedure

[Is the weight of the whole catch or just a component of it being recorded. Are catch and/or box weights measured or estimated? Are conversion factors used? Are fish weighed either whole, gutted or by individual components https://vocab.ices.dk/?ref=1642. This information might vary by species.]

4.3.   Length sampling

[Specify if lengths are taken for every PSU or just for selected PSUs (provide details). Are the PSU's length stratified (e.g if a sample comes from market and has been size classified) or non-

stratified? Number of fish/boxes (or other units/methods) to be measured by PSU; description of how the lengths are measured for each species (e.g., fork-length, total length https://vocab.ices.dk/?ref=1606 and https://fishbase.mnhn.fr/Images/Glospic/G_Fig13a6181_FL.jpg for image descriptions) and if estimated provide details, and accuracy, (e.g. by 1 cm or 0.5 cm https://vocab.ices.dk/?ref=1608). This information might vary by species.]

4.4.   Fish weight sampling

[Specify if weight measurements of individual fish are taken for every PSU or selected PSU and provide details. Are the PSU's weight stratified (e.g if a sample comes from market fish are size classified) or non-stratified? Number of fish/boxes (or other units/methods) to be measured by PSU for weight-composition; description of how the weights are measured for each species (e.g. individual measurements recorded or average from subsample weight divided by number of fish in the subsample). This information might vary by species.]

4.5.   Age sampling

[Provide information on type and number of ageing structure (e.g otolith, scale) collected http://vocab.ices.dk/?ref=1507 (specify if more than one) and if these are taken from stratified or non-stratified samples. Provide details of any stratification e.g per length class. This information might vary by species.]

4.6.   Other biological parameters measured

[Include details of other biological parameters which are routinely collected (e.g sex, maturity, fat content, stomach content, parasites, DNA) and if these are taken from stratified or non-stratified samples. Provide details on number of samples and level of stratification. Include the same level of details for other biological parameters that are taken on an ad-hoc basis.]

4.7.   Further information on biological sampling protocols

[Insert references and links to any other publicly available documents related to the biological parameter sampling (e.g. detailed biological sampling protocols published on a web-site). Provide detailed information on any changes which have occurred in relation to biological sampling back in time e.g. improved species identification or selection methods. Where information is not publicly available, document who should be contacted.]

5.   Data storage

5.1.   Programme data storage

[How is data stored nationally e.g. database, spreadsheets. If detailed data is stored internationally specify the name of the international database and number of years' data is available.]

National data storage			
Database name	Location (e.g. host institute)	Format (database / spreadsheet)	Years of data stored

International data storage			
Database name	Location (e.g. host institute)	Format (database / spreadsheet)	Years of data stored

5.2. Further information on data storage

[Insert references and links to any other publicly available documents related to data storage and access policies (e.g. detailed information on an institute's database published on a website).]

6. Data quality checks and validation

6.1. National data checks

[Brief summary of data quality checks and validation performed at a national level. This could include those performed during or soon after data collection and those performed later (e.g. checks performed when combining data prior to submission to a data call). Provide a schematic if it is helpful.]

6.2. International data checks

[Brief summary of data quality checks and validation performed at an international level e.g. during or after data submission to an international database. Provide a schematic if it is helpful.]

6.3. National data flow

[Where there are multiple organisations involved in collecting and processing national data please show how the data flows between them. Provide a schematic if it is helpful.]

6.4. Further information on data checks and validation

[Insert references and links to any other publicly available documents or code repositories related to data quality checks (e.g. links to publicly available data checking source code or packages).]

7.   Estimation procedure

7.1.   Estimation procedures

[Briefly describe the estimation procedure for each parameter. Identify whether model-based, model-assisted, or design-based estimation is being done. Is missing data imputed? Include a description of the process for estimating variance where this is done.]

7.2.   Further information on estimation procedures

[Insert references and links to any other publicly available documents or code repositories related to estimation (e.g. links to publicly available source code or packages).]

8.   Feedback to fishing industry

[If applicable, include a summary of the feedback provided to the fishing industry using the table below]

Fishery / Stock	*e.g. herring*
Feedback type	*e.g. Report / Raw data / Metadata*
Scope / Vessels included	*e.g. Data from single vessel / data from all participating vessels*
Timing & frequency	*e.g. Annual after end of fishing season / quarterly*
Recipient(s) of feedback	*e.g. Single skipper / all skippers in fishery*
Contents	*e.g. Summary of recorded hauls / Summary of samples collected / Map of sample locations / Plots of length and weight distributions*

Appendix 1 Glossary

Definitions

FLEET: A physical group of vessels sharing similar characteristics in terms of technical features and/or major activity.

FISHERY: A group of vessel voyages targeting the same (assemblage of) species and/or stocks, using similar gear, during the same period of the year and within the same area.

FLEET SEGMENT: a group of vessels with the same length class (LOA) and predominant fishing gear during the year, e.g. according to the Appendix III of the EU-DCF. Vessels may have different fishing activities during the reference period, but are classified in only one fleet segment.

MÉTIER: A group of fishing operations targeting a similar (assemblage of) species, using similar gear, during the same period of the year and/or within the same area and which are characterised by a similar exploitation pattern. The catches for such a sub-population of fishing operations in a fishery (domain) cannot generally be sampled with known probability since a list of PSUs is not available in advance. Estimates of catch characteristic for a métier (domain) are therefore often based on stratification after selection of PSUs (post-stratification.) EU Commission Decision 2008/949/EC (DCF) provides detailed requirements for Member States to collect economic data by fleet segment, and biological data by fleet metier.

MULTI-STAGE SAMPLING: When conducting probability-based multi-stage sampling, a series of consecutive random selections is performed, and groups of the ultimate units being studied (for example specimens of fish) are united to form higher sampling units. An example of multi-stage sampling would be selection of vessels (PSUs), trips, and fishing operations which are ultimately sub-sampled to collect specimens of fish for age-determination.

PRIMARY SAMPLING UNIT (PSU): A sampling unit that is selected in the first stage in multi-stage sampling is called a primary sampling unit.

SAMPLE DESIGN: The totality of instructions, protocols, and rules that govern a sampling method.

SAMPLING FRAME: In statistics, a sampling frame is the list of sampling units or device from which a sample is drawn. The sampling frame comprises all the primary sampling units and any stratification of these, and may be based on a vessel registry or list of ports.

STRATIFICATION: The advance decomposition of a finite population of sampling units of size N into k non-overlapping subpopulations (strata) of size N_i .

STRATIFICATION AFTER SELECTION: If a simple random sample is taken from a finite population of sampling units of size N the sample may be treated as a stratified sample during the analysis if the post-strata sizes N_i are known. Stratification after selection (post-stratification) is usually applied if the strata to which the selected sampling units belong are only known after the sample is taken. This is often the case for métiers. Standard stratified estimators cannot generally be applied when métiers cuts across strata.

Sampling Activities

CO-SAMPLING: The process whereby fishers or fishing crew-members take samples from the catch, based on a sampling scheme as defined by a research institute. These samples are stored

or frozen for later analysis at a research institute. Upon return of the vessel, the samples are transferred to the research institute for analysis and measurements.

MARKET-SAMPLING: Factory-sampling: The process where catches are sampled once they have been landed in an auction or factory. The sampling is normally carried out by researchers from research institutes.

SELF SAMPLING: The process whereby fishers or fishing crew-members take samples from the catch and carry out measurements on those samples. Self-sampling programmes may be carried out by industry organizations alone or joint efforts of industry organizations and research organizations.

Sampling roles

FISHER/SKIPPER: The operator of a fishing vessel and responsible for the daily operations on the vessel.

FISHING CREW MEMBER: People on board of fishing vessels with tasks related to the fishing operations and potentially also related to sampling activities

INDUSTRY SCIENTIST: Similar to above, but employed by a fishery organization

OBSERVER (SCIENTIFIC): A person who goes out to sea with a commercial fishing vessel to carry out sampling activities and observe the composition of the catches, discards and bycatch. An observer is normally employed by a research institute although observers may also be employed by fishery organizations

RESEARCHER/SCIENTIST: A person with a scientific training who is carrying out research activities in the context of sampling commercial catches. A researcher is normally employed by a research institute.

VESSEL OWNER/OPERATOR: The owner and/or operator of a fishing vessel.

Annex 5:   Draft Quality Manual

This document has been produced under the auspices of an ICES Expert Group or Committee. The contents therein do not necessarily represent the view of the Council.

1. Scope

The scope of this manual is the quality management system concerning the production of ICES advice - from data management, data and knowledge integration, data analysis, and the process of translating that data for use in ICES advice.

2. Normative references

- *ISO 9000:2015, Quality management systems — Fundamentals and vocabulary*

- *ISO 9001:2015 Quality management systems — Requirements*

3. Definitions and acronyms

Definitions

- Advice. Advice can be broadly defined as "guidance, options, recommendations or assessments developed following a scientific method to address a specified question" but within ICES, the term "advice" is only applied when the advice has been formulated through ICES advisory processes (expert groups, advice drafting group, peer-review, and approval by the ACOM).[41]
- Expert group. Expert groups are groups of scientists who collaborate during scheduled meetings, and often intersessionally, to develop scientific analyses used as the basis for ICES advice.
- Quality. The quality of ICES advice is determined by its ability to satisfy the recipients of the advice, and the intended and unintended impact on other stakeholders. The quality of advice includes not only its intended function and performance, but also its perceived value and benefit.
- Quality management system (QMS): The QMS comprises activities by which ICES identifies its objectives and determines the processes and resources required to achieve desired results. The QMS manages the interacting processes and resources required to provide value and realize results for relevant stakeholders.

Acronyms

- ICES: International Council for the Exploration of the Sea
- CIEM: Conseil International pour l'Exploration de la Mer
- QMS: Quality Management System
- ACOM: ICES Advisory Committee
- SCICOM: ICES Science Committee

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[41] https://www.ices.dk/about-ICES/Documents/Guidelines_for_ICES_Groups.pdf

- DIG: The Data and Information Group
- ISO: International Standards Organisation
- NGO: Non-governmental organization
- ToR: Term of Reference

4. Context of the organization

4.1 Understanding the organization and its context

The International Council for the Exploration of the Sea (ICES) is an intergovernmental science organization that develops science and advice to support the sustainable use of the seas and oceans, specifically in the North Atlantic and its adjacent seas. ICES unites a community of more than 6000 marine scientists from over 700 institutes in 20 member countries and beyond [42].

The mission of ICES is "to advance and share scientific understanding of marine ecosystems and the services they provide and use this knowledge to generate state-of-the-art advice for meeting conservation, management and sustainability goals". The ICES Science Plan[43] and the ICES Advisory Plan[44] describe the current scientific and advisory priorities and pathways to achieve them.

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[42] https://issuu.com/icesdk/docs/ices_stategic_plan_2019_web

[43] https://issuu.com/icesdk/docs/ices_science_plan_2019_web

[44] https://issuu.com/icesdk/docs/ices_advisory_plan

The principal decision and policy-making body of ICES is the Council[45], which comprises a President and two delegates appointed by each of the 20 member countries[46]. The Bureau acts as the Executive Committee of the Council, and the Finance Committee[47] is responsible for overseeing the organization's financial matters. The work of the Council is carried out through the Advisory Committee (ACOM)[48], Science Committee (SCICOM)[49], Data and Information Group (DIG)[50], Science Impact and Publication Group (SIPG)[51], Training Group (TG)[52], and the Secretariat[53]. The ICES secretariat provides logistical, administrative, and data handling support to the ICES community, and is led by the General Secretary.

The core of ICES work is accomplished through Expert Groups (EG) and workshops[54], while Steering Groups (SG)[55] manage the expert groups and workshops portfolio. Expert groups are groups of scientists who collaborate during scheduled meetings to develop, gather and analyse information relating to marine ecosystems, identify new avenues of research, fill gaps in existing knowledge and develop analyses that underpin advice on the state and sustainable use of the oceans. Their work is facilitated and informed by outputs from ICES co-sponsored science symposia and an Annual Science Conference (ASC). Over 2500 different scientists participate in over 150 ICES expert groups every year, many attending two or more groups.

All ICES expert groups are established, dissolved, and guided by SCICOM and ACOM. SCICOM oversees all aspects of ICES scientific work while ACOM is responsible for advice and relationships with the recipients of advice. Advice recipients include national governments, European Union, Directorate Generals (DGs), Regional Sea Conventions, Regional Fisheries Bodies and other international organizations.

The overall aim is that advice is based on the best available science that is characterized by quality assurance and developed through a transparent process that is unbiased, independent, and is recognized by all relevant parties as applicable to management[56].

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[45] https://www.ices.dk/community/groups/Pages/COUNCIL.aspx

[46] https://www.ices.dk/about-ICES/who-we-are/Pages/Member-Countries.aspx

[47] https://www.ices.dk/about-ICES/who-we-are/Pages/Finance-Committee.aspx

[48] https://www.ices.dk/community/groups/Pages/ACOM.aspx

[49] https://www.ices.dk/community/groups/Pages/SCICOM.aspx

[50] https://www.ices.dk/community/groups/Pages/DIG.aspx

[51] https://www.ices.dk/community/groups/Pages/SIPG.aspx

[52] https://www.ices.dk/community/groups/Pages/TG.aspx

[53] https://www.ices.dk/about-ICES/who-we-are/Pages/Secretariat.aspx

[54] https://www.ices.dk/community/groups/Pages/default.aspx

[55] https://www.ices.dk/community/groups/Pages/Committees%20and%20steering%20groups.aspx

[56] https://www.ices.dk/about-ICES/Documents/Guidelines_for_ICES_Groups.pdf

4.2 Understanding the needs and expectations of interested parties

ICES has a Stakeholder Engagement Strategy[57] which guides its interactions with interested parties. ICES stakeholders are defined as those who affect or are affected by a decision, process, or action of ICES. Four stakeholder roles have been identified at ICES:

- An **expert** has a formal role that is part of a process that integrates experience-based and scientific knowledge to produce robust evidence. Experts are selected on an individual basis according to their expertise at the discretion of the Chair or ICES member country.
- As an **observer,** stakeholders gain access to the advice process before it is delivered to decision-makers. They can provide input and observe how the advice is produced. Observers can be organizations or individuals that are invited based on democratic and transparency principles.
- As a **contributor** stakeholder involvement is designed to address a given research question or policy issue. Contributors may be invited on an individual or representative basis.
- Being a **partner**, stakeholders can be engaged in committed and continued relationships with the ICES system. Their interaction is recurrent and integrated into ICES planning. Engagement with partners facilitates deliberative dialogue for contested science and policy issues, ranging from corrections to advice after errors have occurred, quality control and quality assurance, to understanding and informing stakeholders' strategies or policy objectives.

Stakeholder groups currently engaged in ICES include the following categories: the fishing and aquaculture industry/sector; environmental NGOs and associations; other NGOs and associations (including consumers' associations); scientific organizations; international agencies, government bodies, decision- makers, as well as fisheries and ecosystem managers.

ICES has established annual meetings to keep engagement with the requesters of the advice (MIRIA) and with the Advisory Councils and observers to the advisory process (MIACO). Members of MIRIA include regional fisheries and environmental commissions and competent authorities of ICES member countries. MIACO participants are organizations and individuals which hold observer status at ICES, including representatives from EU Advisory Councils, fishing organizations and environmental NGOs.

4.3 Determining the scope of the quality management system

The scope of the quality management system encompasses the current quality processes for data management, data and knowledge integration, data analysis, and the process of translating that data for use in ICES advice. It should be noted that the collection of data is not within the scope of the system since ICES does not undertake this activity – however there are ICES
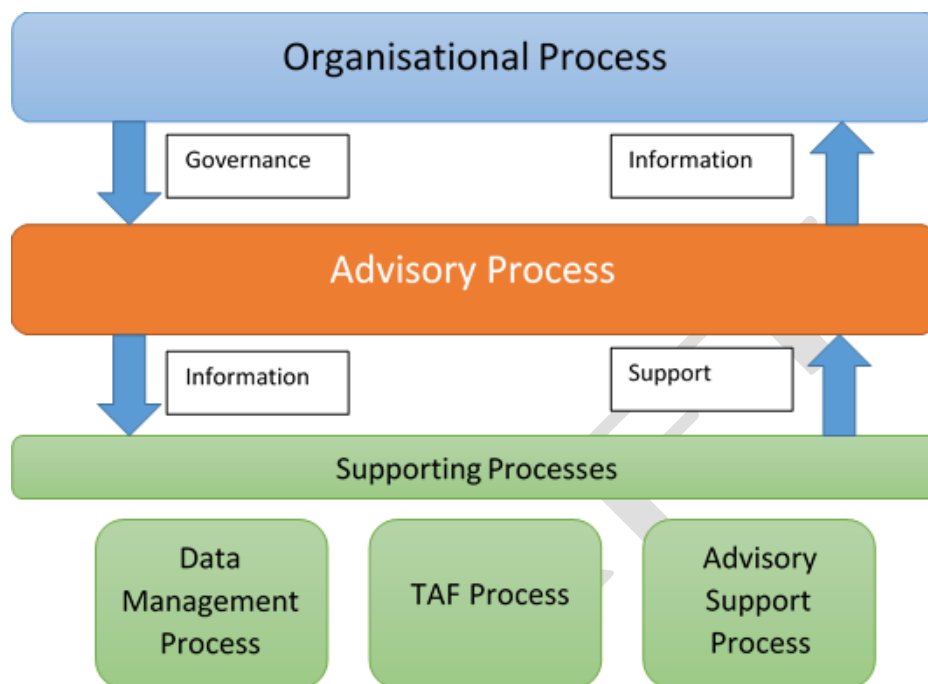
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[57] https://doi.org/10.17895/ices.pub.21815106.v1

expert groups who coordinate data collection activities, and create guidance and best practice on this topic.

4.4 Quality management system and its processes

There are 5 processes within the Quality Management System (QMS) which can be represented in a simple diagram:

- Organisational Process: provides overall management of the ICES QMS
- Advisory Process: generating scientific advice to support ecosystem-based management of human activities in our seas and oceans
- Supporting Processes
  - Data Management: ensures that data used within the Advisory Process are findable, attributable, researchable, reusable, and conform to ICES data policy
  - Transparent Assessment Framework (TAF) Process: assures quality, improves efficiency, and ensures transparency of data and analyses used in the Advisory processes
  - Advisory Support Process: provides logistical, infrastructural, administrative, and scientific support to the Advisory Process

These 5 processes are discussed in the proceeding sections.

Organisational process

Process purpose	Provide overall management of ICES QMS
Process owner	ICES Council

(Note that a "Quality Support Manager" role to support the day-to-day QMS tasks has been identified as a need by WGQuality – see section 2 of the WGQuality 2023 report for more details.)

The organisational process encapsulates the overall management of the quality management system, including ownership of the QMS. Operational tasks and activities may be delegated to relevant committees, groups, or the Secretariat.

Advisory Process

| Process purpose	Generating scientific advice to support ecosystem-based management of human activities in our seas and oceans
Process owner	ACOM

The Advisory Process is the process of generating scientific advice to support ecosystem-based management of human activities in our seas and oceans. The "Guide to ICES advisory framework and principles"[58] provides the overarching framework to ICES advice – shown below. Further details are provided in modules for advice on fishing opportunities[59] and advice on ecosystem services and effects[60].

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[58] ICES. 2020. Guide to ICES advisory framework and principles. *In* Report of the ICES Advisory Committee, 2020. ICES Advice 2020, section 1.1. https://doi.org/10.17895/ices.advice.7648

[59] ICES. 2021. Advice on fishing opportunities. In Report of the ICES Advisory Committee, 2021. ICES Advice 2021, section 1.1.1. https://doi.org/10.17895/ices.advice.7720

[60] : ICES. 2021. ICES ecosystem overviews. In Report of the ICES Advisory Committee, 2021. ICES Advice 2021, Section 16.2. https://doi.org/10.17895/ices.advice.7916

ICES advisory framework
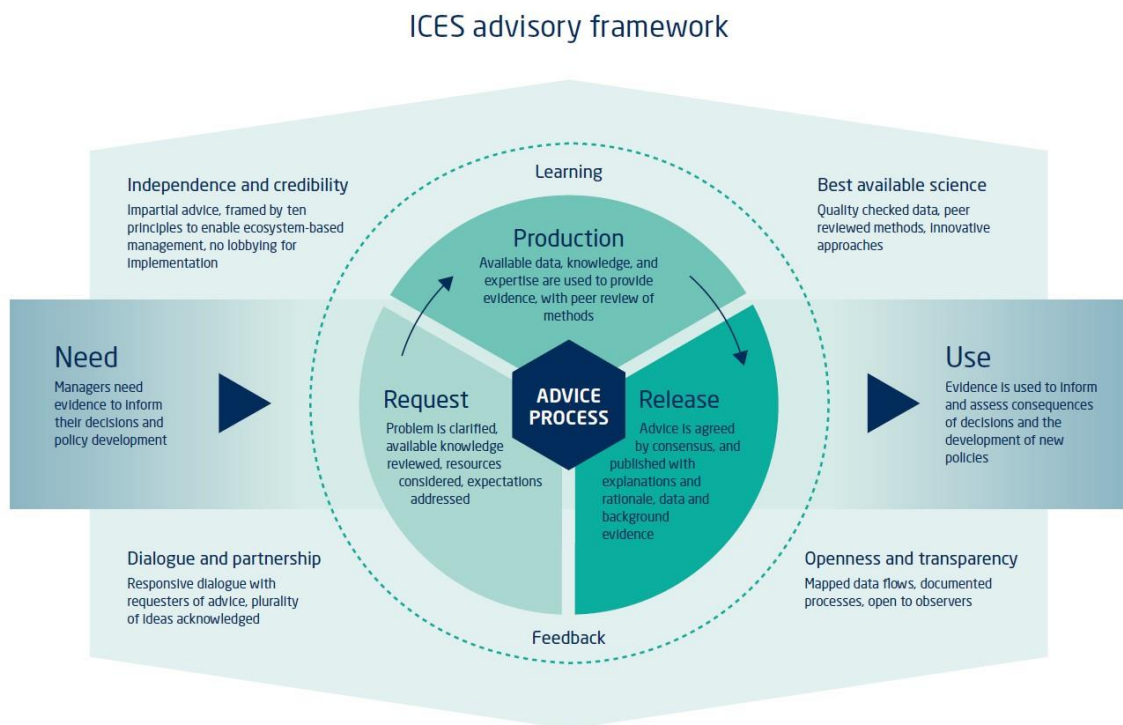
The advisory framework and principles apply to the production of all ICES advisory products:

- ICES advice, consisting of recurrent and one-off special requests, Ecosystem and Fisheries Overviews, and Viewpoints; and
- Requests for services.

ICES advice is produced through a three-stage framework of "Request", "Production", and "Release". There are ten principles applied across these stages, which vary slightly based on the advice type or product.

1. The guidelines and procedures to produce ICES advice are documented, openly accessible, and up-to-date.
2. Final request formulation is agreed through dialogue to clarify the requester's needs and expectations, the ICES process, likely resource implications, timelines, format of advice, and roles and responsibilities of the engaged parties.
3. Where possible, existing policy goals, objectives, and the level of acceptable risk relevant to the advice request are identified. Where these objectives and descriptions of risk are unclear, ICES will identify these in the advice, and, where possible, provide options for management action and the consequences of the options and their trade-offs.
4. The deliberations of all relevant expert groups are published by the time the associated advice is published.
5. The best-available science and quality-assured data are used. ICES selects and applies relevant methods for any analysis, including the development of new methods. The methods are peer reviewed by independent experts and clearly and openly documented.

6. Data are findable, attributable, researchable, reusable, and conform to ICES data policy. Data flows are documented.
7. To ensure that the best available, credible science has been used and to confirm that the analysis provides a sound basis for advice, all analyses and methods are peer reviewed by at least two independent reviewers. For recurrent advice, the review is conducted through a benchmark process; for special requests through one-off reviews.
8. Advice is comprehensive, unambiguous, and consistent with the synthesized knowledge, while taking the peer review into account. All advice follows existing advice frameworks and any deviation from the frameworks or related, previous advice is identified and justified.
9. All ICES advice is adopted by the ICES Advisory Committee (ACOM), through consensus, prior to being made available to the requester and simultaneously published on ICES website.
10. ICES provides advice as an impartial response to a request, and does not lobby the requester or any other party to implement its advice.

ICES advice is based on peer-reviewed expert group reports, prepared in an advice drafting group, and approved by the ICES Advisory Committee (ACOM)[61]. A generic description of the ICES advisory process is shown below:

- A request for advice is received from a competent authority (the "client").
- The scope of the advice request is clarified with the client, including the deadline for the advice delivery.
- ICES Advisory Committee decides whether the request can be addressed and, if so, the process to be followed to respond to the request. It also identifies the experts to be involved – either the expertise from one or several existing ICES expert groups or through a workshop that includes experts with interest in the subject matter.
- The costs associated with the advice is approved by the client before the advisory process is initiated.
- Expert group and workshop reports are peer-reviewed by independent experts. For the recurrent advice (for example single fish stock advice provided frequently, usually annually), where approaches and methods have been reviewed in a benchmark process, no review group is established as the peer-review process already took place in the benchmark. In these cases, the expert group performs an "audit", which consists in determining whether previously agreed methodologies from the benchmarks or other prior peer review processes have been conducted appropriately (see "Guidance for audits in ICES expert groups"[62]).
- The expert group report, together with the review, is used as a basis by the advice drafting group to produce a draft of the advice.
- The draft advice prepared by the advice drafting group is discussed and finally approved by the ICES Advisory Committee (ACOM).
- The advice is delivered to the client.

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[61] https://www.ices.dk/sites/pub/Publication%20Reports/Guidelines%20and%20Policies/12.01_Advisory_process.pdf

[62] https://community.ices.dk/admin/icesguidelines/Guidelines/Guidelines%20for%20EG%20audit%20process.pdf

There have been a number of different types of groups mentioned in the advisory process – a description of these is below.

Expert Group

Expert groups are groups of scientists who collaborate during scheduled meetings, and often intersessionally, to develop science and the basis for ICES advice. Expert groups are at the heart of ICES and play a critical role generating the science and analyses that further understanding of marine ecosystems and support advice on the state and sustainable use of our seas and oceans. Expert groups welcome members from all ICES Member Countries, with scientists from other countries welcomed by invitation. ICES Secretariat provides each expert group with logistical and technical support to facilitate effective meeting planning, reporting, and external communication.

Expert groups address a series of pre-agreed tasks known as Terms of Reference (ToR) that are listed in a Resolution[63]. The work of many expert groups provides the basis of ICES advice. Professional officers from the Advisory Support department in the Secretariat will liaise with expert groups to support their work. All ICES expert groups are established, dissolved, and guided by the Science Committee (SCICOM) and the Advisory Committee (ACOM). Expert groups follow the "Guidelines for ICES Groups"[64].

The term expert group is a generic term for working groups and workshops. Advice-focused working groups run for many years - they have annual ToR reflecting annual advisory requests and publish an ICES Scientific Report every year. Workshops are usually single events, to tackle a particular science or advisory issue.

Benchmark Workshop

The goal of a benchmark is consensus agreement on an assessment methodology that is to be used in future assessments. This assessment methodology can be an analytical assessment, but can also be non-analytical, for instance based on trends in an assessment or in a selected

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[63] https://www.ices.dk/about-ICES/how-we-work/Pages/resolutions.aspx

[64] https://www.ices.dk/about-ICES/Documents/Guidelines_for_ICES_Groups.pdf

set of (survey) indicators, with or without forecasts. The result will be the 'best available' method that ICES advice will be based on. Typically, a stock will be benchmarked every 3–5 years to keep pace with changing situations. In order to be flexible to changing situations an Intermediate Benchmark Protocol was set up to deal with short term adaptations in assessment methodology. Guidelines for benchmark workshops have been specified[65].

The workshops are tasked to:

1. Review all available data for use in the assessment with the aim to improve integration of environmental information into the assessment;
2. Review the assessments of stocks or regions listed in the ToRs;
3. Produce "Stock Annexes" in which the revised assessment methodology (analytical or trends based) is described. (A Stock Annex describes the methodology agreed by the benchmark workshop and the assumptions on which this is based);
4. Complete a report that describes the reasoning behind choices made concerning the assessment methodology; and planning of future work needed to improve assessments;
5. Document the peer review process.

A benchmark meeting is open to experts and stakeholders, and is reviewed by external experts throughout the process. A benchmark process takes about five to seven months of preparation and includes a data evaluation workshop and a final benchmark meeting.

Review Group

A key part of ICES advice process is peer review. The review is generally of an ICES Scientific Report– the output of an expert group – which provides the knowledge and evidence base for the advice. A review shall ensure that the analyses and assessments used are of suitable quality to form the basis of the given advice. It must evaluate both the application of the best available science and whether the knowledge, either synthesized or new, is appropriate to provide the advice.

A review group shall consist of two or three nominated independent experts, either from within or external to ICES. In addition, a chair may be appointed to lead the group. ACOM, supported by the ICES Secretariat, selects the reviewers and the Chair. Reviewers are supported in their role by the Secretariat. The Review Group follows the "Guidelines for review processes"[66]

Advice Drafting Group (ADG)

ADGs follow "Guidelines for Advice Drafting Groups"[67]. The ADG will work from draft texts of the advice - the ADG should ascertain that the advice:

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[65]https://community.ices.dk/admin/icesguidelines/Guidelines/Guidelines%20for%20Benchmark%20and%20Data%20Compilation%20Workshops.pdf

[66] https://www.ices.dk/sites/pub/Publication%20Reports/Guidelines%20and%20Policies/16.05.05_Guidelines_for_Review_Groups.pdf

[67] https://www.ices.dk/sites/pub/Publication%20Reports/Guidelines%20and%20Policies/16.01.03.Guidelines_for_Advice_Drafting_Groups.pdf

- is consistent with the scientific results and, where applicable, takes into account relevant comments by the peer review;
- is consistent in interpretation, meaning that the same or similar approaches and frameworks should be used to address similar issues;
- is consistent in presentation, meaning that the same or similar language should be used to describe similar situations;
- is clear and presented in a manner that is appropriate to the client, avoiding as much as possible technical terms or jargon;
- answers the request fully; and
- considers the full range of relevant issues.

For recurrent fisheries advice the ADG should also ensure the following points are covered:

1. That the assessment on which the advice will rest:
   a) meets the standard of quality for stock assessments,
   b) has been audited and quality checked by the EG,
   c) is conducted according to the specifications of the benchmark, and
   d) is unbiased in interpretation;
2. That unless significant issues are identified, the single-stock advice should be based on the assessment as accepted by the EG, following methods described in the stock annex;
3. That if a significant issue is identified that cannot easily be rectified, the ADG will inform ACOM as soon as possible with a suggestion for a potential course of action. This may result in advice being postponed;
4. That the provision of advice on fishing opportunities is based on the appropriate basis (management plan, MSY, or precautionary approach), agreed with the clients and consistent with the procedures outlined in "Advice basis" (ICES, 2018).

Technical guidelines

There are a large number of technical guideline documents[68] which support the advisory process and cover specific subjects in detail – these include: "Advice on catches and landings", "Advice on fishing opportunities", "Criteria for the use of data in ICES advisory work", "Definitions of stock status", and "Technical Services".

Supporting Processes

The Data Management, Transparent Assessment Framework, and Advisory Support processes all support the Advisory process:

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[68] https://www.ices.dk/advice/Pages/technical_guidelines.aspx

Transparent Assessment Framework (TAF) Process

Process purpose	Manage the Transparent Assessment Framework in order to assure quality, improve efficiency, and ensure transparency of data and analyses used in the ICES advisory processes
Process owner	TAF Secretariat team

The Transparent Assessment Framework (TAF)[69] is an online open resource of ICES stock assessments for each assessment year. All data input and output are fully traceable and versioned. The open framework enables anyone to easily find, reference, download, and run the assessment from any stage in the process leading to the published ICES advice for a given stock. TAF is a framework developed by ICES to organize data, methods, and results used in fish stock assessments, so they are easy to reference and re-run with new data or methods.
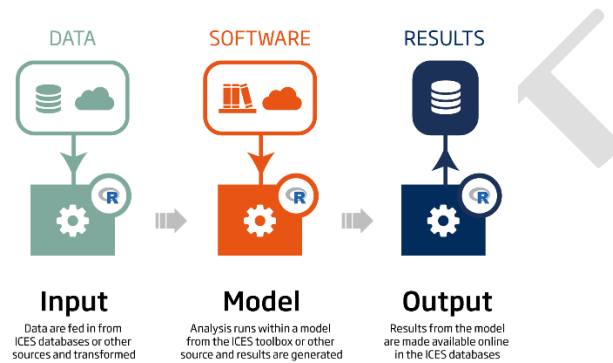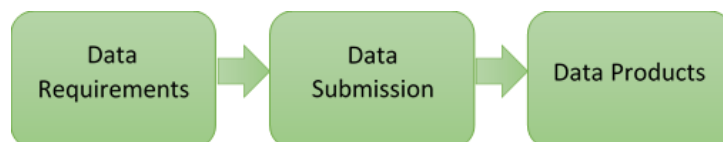

TAF assessments are stored and made visible on GitHub (https://github.com/ices-taf) and through the online application at: https://taf.ices.dk

The Working Group on the Transparent Assessment Framework Governance (WGTAFGOV) [70] has developed a governance framework for TAF. The group provides a channel for user feedback to TAF, as well as oversee and advises on the interpretation and prioritisation of recommendations and requests for TAF. The group is also responsible for overseeing the development of user guidance and training for TAF.

Data Management Process

Process purpose	Ensure that data used within the Advisory Process are findable, attributable, inter-operable, reusable, and conform to ICES data policy
Process owner	Head of ICES Data Centre

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[69] https://www.ices.dk/data/assessment-tools/Pages/transparent-assessment-framework.aspx

[70] https://www.ices.dk/community/groups/Pages/WGTAFGOV.aspx

ICES has a well-established Data Centre, which manages over 30 large dataset collections related to the marine environment. The majority of data – covering the Northeast Atlantic, Baltic Sea, Greenland Sea, and Norwegian Sea – originate from national institutes that are part of the ICES network. Access to, and the provision of, high quality data is a cornerstone of how ICES operates as an inter-governmental organization. Furthermore, ICES makes every effort to ensure that data received are handled and stored in a way that preserves the integrity of the data as it was submitted. The ICES Data Centre has achieved CoreTrustSeal certification[71].

The ICES Data policy[72] governs overall provision, access and use rights to data that are managed through ICES. The ICES Data policy is reviewed by ICES Data and Information Group (DIG) on a 4-year cycle. Updates or changes are then ratified by the governing body (ICES Council). The specific licences regarding commercially sensitive or biologically sensitive data, are reviewed by the thematic governance groups for that topic, DIG and ratified by the ICES Science Committee (SCICOM).

The Data and Information Group (DIG), is the cross-themed operational group that deals with all aspects of data governance at a general level i.e. data policy, strategy, quality assurance etc. DIG is linked to a number of data governance groups that deal with specific systems/data types that perform more specific quality assurance and prioritisation. Feedback is gathered from expert groups directly working with the data; through web portal usage; and from regular meetings with the advice recipients (clients). Feedback can flow between governance groups, and the ICES Data Centre, and outwards to other partners – such as other international conventions. Quality control and quality assurance procedures are undertaken by the ICES expert groups at various stages in the life cycle of data: at data collation, groups of experts will evaluate the latest data against the entire dataset and document variations in working group reports for the specific survey/data collection available in the ICES publications library. When the data are used in assessment, the assessment report, and the associated management advice, comment on the quality of the data, which is fed back to the data submitter and the ICES Data Centre.

Data flows are documented according to a standard schema - the schema includes information on roles, ownership, who provides data, which data policies apply to incoming/outgoing data, the data quality approach, target audience, links to metadata and governance groups, and the process for ingestion of data. Changes to the dataflow and associated metadata and reference vocabularies are documented. The process for the updating of a dataflow is managed through the relevant governance group and follows a standard 'master change' process. The proposed change is first assessed in terms of impact on existing datasets and processes - data providers and users are then consulted via their working group structures (or external client committees). The change is communicated and agreed via this process and is usually documented within the system as a recommendation with a proposed timeline.

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[71] https://www.coretrustseal.org/

[72] https://www.ices.dk/data/guidelines-and-policy/Pages/ICES-data-policy.aspx

Schematics of the data flows actively managed by the ICES Data Centre are being drawn and will be published by ICES[73]. Each data stream, through its relevant governance group, have specified the necessary attributes of data and metadata in accordance with the intended use of the data. Data collection and data processing standards are based on community best practice guidelines, either published directly on the ICES publications repository (for example fish trawl survey protocols), or via other international best practice repositories (for example Ocean Best Practices https://www.oceanbestpractices.org/).

Advisory Support Process

Process purpose	Provide logistical, infrastructural, administrative, and scientific support to the Advisory Process
Process owner	Head of Advisory Support

The Advisory Support Process encompasses the range of support processes provide by the ICES Secretariat's Advice team to the advisory process - this includes logistical, infrastructural, administrative, and scientific supports.

5. Leadership

5.1 Leadership and commitment

The Council is the principal decision and policy-making body of ICES – Bureau acts as the Executive Committee of the Council. The work of the Council is carried out through bodies including the Advisory Committee (ACOM), Science Committee (SCICOM), Data and Information Group (DIG), and the Secretariat.

The Advisory Committee (ACOM) approves all ICES advice and has overall responsibility for all advisory products and for the ongoing development and improvement of the advisory process. The ACOM Leadership consists of the Chair of ACOM, its Vice-Chairs, and the Head of Advice Support from ICES Secretariat. ACOM commitments to quality assurance are communicated in the advisory framework and principles which apply to the production of all ICES advisory products and in the Advisory Plan.

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[73] For example, see ICES. 2021. Vessel Monitoring System (VMS) and Logbook data in the North East Atlantic (FAO Major Fishing Area 27). ICES Data Flow Schematics Vol. 2: Ed. 1. 10 pp. https://doi.org/10.17895/ices.advice.7670

5.2 Policy

(Note that the lack of an explicit ICES Quality Policy has been identified as a gap by WGQuality – see section 2 of the WGQuality 2023 report for more details.)

Quality assurance is the cornerstone of ICES advisory products. Principle 5 of the advisory framework states that advisory products use "The best-available science and quality-assured data". Principle 6 states that "Data are findable, attributable, researchable, reusable, and conform to ICES data policy. Data flows are documented." Principle 7 seeks "To ensure that the best available, credible science has been used and to confirm that the analysis provides a sound basis for advice, all analyses and methods are peer reviewed by at least two independent reviewers. For recurrent advice, the review is conducted through a benchmark process; for special requests through one-off reviews."

Furthermore, "Assuring Quality", is the first priority area in the ICES advisory plan (ICES, 2020). This strategic plan states that "*The existing quality control and assurance processes are enhanced to form an end-to-end quality assurance framework that will encompass best practice in data management, data integration, and translation into advice. Quality assurance should meet international standards, adhere to the FAIR principles, and include independent peer review for all areas of advice.*"

5.3 Organizational roles, responsibilities and authorities

ICES is a relatively complex network organisation, it relies on a range of individuals working for member country institutes to fulfil decision making roles within the structure. Generally speaking, the ICES Council[74], which represents the member country delegations, is the body that makes decisions. Decisions are then acted upon by the executive board of Council, the Bureau in the diagram above. Issues that need a decision are brought to Council (via Bureau) from the Committees of the Council (Advisory Committee - ACOM, Science Committee - SCICOM and Finance Committee) or the Secretariat represented by the General Secretary. Operational implementation of decisions is then carried out by the Committees, through the Steering Groups and Expert groups and through the Secretariat.

Taking this model of decision making and implementation into account, the table below outlines the expected responsibilities of each part of the organisation to the Quality Manual.

(WGQuality note that the "Quality Support Manager" and "Quality Governance Group" discussed in section 2 of the WGQuality 2023 report should take over the task of defining the content of the quality manual.)

	Role	Responsibility
Establishment	WGQuality	**Define** the content of the manual.
	Science Committee (SCICOM)	**Review** this manual.
	Advisory Committee (ACOM)	**Review** this manual.
Ownership	ICES Council	**Adopt** this manual.
	ICES Bureau	**Accountable** for the implementation of the manual.
Implementation	Steering Group Chairs	**Ensure** the manual is clearly understood and followed within the working groups.
	ICES Secretariat	**Support** the application of this manual.
	ICES Data Centre	**Apply** the manual to the data management under their care.
	ICES working group Chairs	**Adhere** to this manual.
	ICES working group members	**Follow** this manual.

The processes within the QMS which were defined earlier can be mapped to roles:

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[74] ICES (1964): Convention for The International Council for the Exploration of the Sea. ICES Convention, policies, and strategy. Report. https://doi.org/10.17895/ices.pub.7533
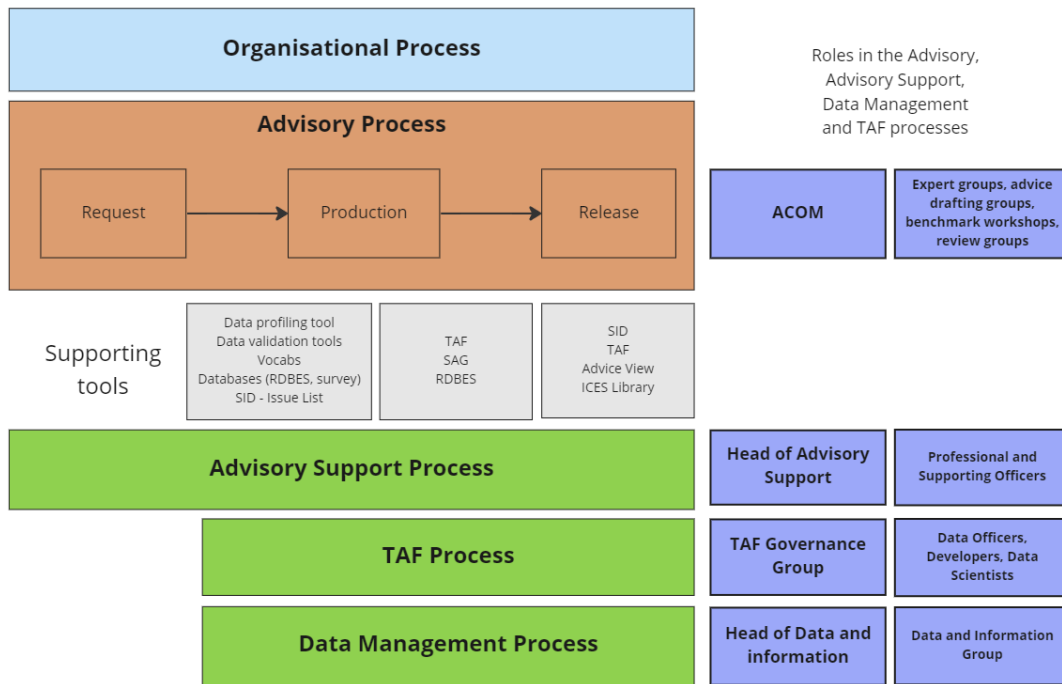
6. Planning

6.1 Actions to address risks and opportunities

(Note that consistent tracking of risks and opportunities has been identified as a gap by WGQuality – see section 2 of the WGQuality 2023 report for more details.)

Properly addressing risks and opportunities based on the QMS is the basis for the successful implementation of the system and is key to improving the outcomes and products.

- The ICES Bureau oversees a risk register that tracks and mitigates for organisational risk and is reviewed and updated annually.
- Within the Advisory process ACOM identify, track and discuss risks and opportunities at their regular meetings.
- Within the Transparent Assessment Framework (TAF) Process the governance group WGTAFGOV identify, track and discuss risks and opportunities at their regular meetings.
- Within the Data Management process the ICES Data Information Group (DIG) maintain a "Challenges and Opportunities Tracker"[75] which is updated on an annual basis - this allows risks and opportunities to be identified and actions to address them identified.
- Within the Advisory Support process, the Head of Advisory Support monitors risks and opportunities.

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[75]https://community.ices.dk/Committees/DIG/_layouts/15/start.aspx#/Lists/DIG%20future%20challenges%20and%20opportunities/AllItems.aspx (restricted access)

6.2 Quality objectives and planning to achieve them

(Note that formal "Quality Objectives" do not exist at the moment and have been identified as a gap by WGQuality – see section 2 of the WGQuality 2023 report for more details.)

ICES defines Quality Objectives within the Advisory, Data Management, TAF, and Advisory Support Processes – measurable indicators are also defined and monitored where appropriate.

6.3 Planning of changes

(Note that a formal ICES QMS does exist at the moment so there is not a formal procedure for changing it. This has been identified as a gap by WGQuality – see section 2 of the WGQuality 2023 report for more details.)

The processes described in this manual are subject to changes stemming from the internal and external environment as well as to shifts in obligations to clients and updated quality standards. These changes may require an update to the QMS as these changes may have an impact on outputs, quality measurements, and activities. Changing the QMS system is part of the Organisational Process and is only done according to a predefined plan.

7. Support

7.1 Resources

General

As previously discussed in ICES is an intergovernmental science organization consisting of 20 member countries – the majority of resources used by ICES are provided directly by the member countries. This includes direct financial contributions (total national contributions of 23.435 million DKK in 2020), and the time of scientists and other experts (23,462 expert days in 2020).

People

ICES unites a community of more than 6000 marine scientists from over 700 institutes in its 20 member countries and beyond.

Infrastructure

ICES Secretariat has been based in Copenhagen, Denmark, since the organization's inception in 1902. The ICES secretariat provides secretarial, administrative, and data handling support to the ICES community.

Environment for the operation of processes

The ICES Secretariat provides each expert group with logistical and technical support to facilitate effective meeting planning, reporting, and external communication.

ICES seeks to cultivate a welcoming, resourceful, diverse, inclusive, gender balanced, and respectful working environment. The ICES Code of Ethics and Professional Conduct[76] applies to anyone partaking in any ICES activity. ICES activity participants treat each other with respect and this means that when dealing with others everybody is expected to:

- Embrace diversity,
- Include equally,
- Communicate thoughtfully,
- Avoid harassment,
- Promote wellbeing.

Given ICES role as a knowledge provider, it is essential that experts contributing to science and advice maintain scientific independence, integrity and impartiality. It is also essential that their behaviours and actions minimise any risk of actual, potential or perceived Conflicts of Interest.

The ICES Code of Conduct provides guidance on identifying and handling actual, potential, or perceived Conflicts of Interest, defines the standard for behaviours of experts contributing to ICES science and advice and sets the responsibilities of those contributing to ICES' work.

Monitoring and measuring resources

The General Secretary is responsible for the resourcing of the Secretariat. Using the management team, appropriate infrastructure, skills and resource gaps are identified and resolved in line with the agreed forecast budgets proposed by the finance committee.

The ICES Council delegates are responsible for ensuring appropriate and sufficient resources are available to the advice and science processes. This is managed through a nomination process, and the Secretariat provides a tool for this and a dashboard of all the ongoing processes and resources required. Operational measurement is the responsibility of ACOM and SCICOM.

Organisational knowledge

Expert group reporting

The main publication series used by expert groups to share details of their work with the international marine science community is "ICES Scientific Reports". A small number of expert groups focusing on ICES internal processes, co-ordinating the work of groups in the ICES system or proposing changes and developments for ICES working procedures and structures publish their work in the "ICES Business Reports" series rather than the ICES Scientific Reports series.

All groups need to provide either a scientific or business report, at the end of their three-year cycle.

The purpose of the "ICES Scientific Reports" series is to make scientific outputs from ICES expert groups available to marine scientists and others with an interest in obtaining information on the state and sustainable use of our seas and oceans. The "ICES Scientific Reports" are

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[76] https://doi.org/10.17895/ices.pub.21647825.v2

published with an ISSN, DOI and a specified citation format. All reports in this series must include significant science and analytical content and not just descriptions of expert group process.

The effectiveness of ICES internal processes influences our capability to generate public facing science (as shared using the "ICES Scientific Reports" series). Thus a small number of expert groups in the ICES community undertake important activities that strive to improve the effectiveness of our internal process and the ways we generate science or advice. The audience for the work of these groups is predominantly engaged individuals in a small number of groups and committees within the ICES community. Business Reports are formatted in a standard way and made widely available through the ICES website and library. Reports of the main ICES bodies such as Council and the Science Committee are also published as "Business Reports".

ICES Journal of Marine Science

The ICES Journal of Marine Science[77] is a peer-reviewed scientific journal publishing articles that contribute to the understanding of marine ecosystems and the impact of human activities on them.

Other publications

ICES also produces a variety of other publications[78] including Cooperative Research Reports (CRR), Techniques in Marine Science (TIMES), ID Leaflets for Plankton, ID Leaflets for Diseases and Parasites in Fish and Shellfish, and ICES User Handbooks.

Annual Science Conference (ASC)

The ASC[79] provides opportunities for marine scientists to present and discuss the latest marine science, develop new ideas, and establish partnerships. The scientific programme provides opportunities for everyone, from students and early career scientists to senior scientists and leaders of research institutes, to engage and to contribute.

Symposia

ICES organize and provide support for scientific symposia in order to develop and share knowledge and expertise related to marine science[80].

7.2 Competence

Updating and expanding skills and competencies of scientists is critical to maintaining relevant, quality science. Given the requirements of the quality system, it is important that those involved are competent in the relevant areas covered by this documentation. Whilst ICES is not directly responsible for the competence of scientists in member countries, it does provide

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[77] https://www.ices.dk/Science/publications/ijms/Pages/default.aspx

[78] https://www.ices.dk/Science/publications/Pages/Home.aspx

[79] https://www.ices.dk/events/asc/ASC2022/Pages/default.aspx

[80] https://www.ices.dk/events/symposia/Pages/default.aspx

a number of development facilities that can be utilised. These include the ICES Annual Science Conference, ICES science symposia, ICES Webinars[81], and ICES Publications which includes the Journal Of Marine Science. ICES Publications is a valuable resource with publications by past and present experts that can help form the basis of, and build on, scientific competencies.

In addition to the above there is an ICES Training Group[82]. This group oversees the ICES training programme which, through a series of training courses[83], aims to help build the resources to support scientific advice on interactions between human activities and marine ecosystems.

The ICES working groups[84] also provide a forum for sharing and developing techniques and procedures. These groups, as well as the workshops that are proposed by the groups, contribute to the continued knowledge building of attendees from a range of institutes, as well as strengthening harmonisation of practice between member states.

7.3 Awareness

Chairs of ICES working groups become members of the ICES WGCHAIRS group[85]. Participants share experiences and ideas, co-ordinate work, meet with their steering group, advisory committee and science committee chairs, and highlight any support they need from the ICES network. The group also provides participants with updates on developments in the network and their implications, as well as opportunities to identify future science priorities and plans for advisory products.

The activities of the working group are tailored to meet the needs of both new and existing chairs and to help all chairs increase the scope, scale and impact of their work. WGCHAIRS also hosts events for working group chairs at the Annual Science Conference (ASC) and provides a forum to address topics intersessionally.

WGCHAIRS provides the key platform to ensure chairs are aware of the quality management system and explain how it relates to their group's work.

7.4 Communication

(Note that the "Quality Support Manager" role proposed by WGQuality could assist in developing and implementing a QMS communication plan – see section 2 of the WGQuality 2023 report.)

ACOM take the lead in communication related to the quality of advice. This includes internal communication to ICES expert groups, and external communication to the recipients of advice and other stakeholders.

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[81] https://www.ices.dk/events/webinars/Pages/default.aspx

[82] https://www.ices.dk/community/groups/Pages/TG.aspx

[83] https://www.ices.dk/events/Training/Pages/default.aspx

[84] https://www.ices.dk/community/groups/Pages/default.aspx

[85] https://www.ices.dk/community/groups/Pages/WGCHAIRS.aspx

7.5 Documented information

ICES use Microsoft SharePoint to manage documents within Expert Groups – this also provides a version control function. Expert group reports and other externally available documents are published via the ICES library[86] - in recent years a Digital Object Identifier (DOI) is also "minted" for new publications to aid long-term traceability.

The Science Impact and Publication Group (SIPG) monitors ICES publication outputs and provides advice to the organisation on increasing the reach and impact of ICES publications and science, including expert group reports.

Code and data

GitHub is a web based code repository management system that expert groups can use to store analytical scripts. It is an open system that version tracks changes, bugs and developments and invites collaboration – it is ideal for scripts and source code that expert groups use in their analysis.

TAF[87] makes ICES stock assessments open and reproducible - it uses the Git version control system to track changes made to source code.

ICES makes every effort to ensure that data received are handled and stored in a way that preserves the integrity of the data as it was submitted. The ICES Data Centre has achieved CoreTrustSeal certification[88].

8. Operation

8.1 Operational planning and control

ICES implements a number of key tools to support operational planning and control:

- An annual work plan for advice production is developed, taking into account the annually agreed tasks and other requirements specified under the framework agreements (MoU's, Service contracts and specific agreements[89]) of the recipients of advice. The annual workplan also anticipates additional advice requests and services that are budgeted for, but not specified at the outset of the annual agreement.
- The ICES Resolution system is used to create and resource expert groups and agree their work-plan. The ICES Recommendation system allows expert groups to communicate priorities to each other.

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[86] https://www.ices.dk/publications/library/Pages/default.aspx

[87] https://taf.ices.dk

[88] https://www.coretrustseal.org/wp-content/uploads/2021/03/International-Council-for-the-Exploration-of-the-Sea.pdf

[89] https://www.ices.dk/about-ICES/global-cooperation/Pages/Cooperation-agreements.aspx

- The Resource coordination tool (RCT) is the ICES customer relationship management system, which underpins the other networking tools listed here, and ensures consistent information about the experts, their institutes and their memberships to processes and working groups is available to the community.
- ACOM and SCICOM convene throughout the year to check progress on the operation of the implementation of workplans; in addition, they operate 'forum' message boards to ensure timely decision making and consensus agreement on planning and execution of work.
- A Coordination Group (CG) consisting of the chairs of ACOM, SCICOM, Heads of Departments and the General Secretary meets on a regular basis to monitor ongoing work, discuss any issues, and agree on solutions.
- Community.ices.dk is the ICES Extranet content management system. All expert groups and organizational processes have document repositories housed on this resource, which is used for the meeting cycles of the expert groups, advice production, data calls, advice request development and meetings and minutes from advice drafting groups, benchmark groups, ACOM, SCICOM, Bureau and ICES Council.

8.2 Requirements for products and services

"Request" is the first step in the framework of ICES advice production:

- A request for advice is received from a competent authority (the "client").
- The scope of the advice request is clarified with the client, including the deadline for the advice delivery.
- ICES Advisory Committee (ACOM) decides whether the request can be addressed and, if so, the process to be followed to respond to the request.
- The ICES Secretariat identifies the experts to be involved – either the expertise from one or several existing ICES expert groups or through a workshop that includes experts with interest in the subject matter.
  The costs associated with the advice is approved by the client before the advisory process is initiated.

8.3 Design and development of products and services

General

Design and development of ICES products and services is divided in two pathways. The first is the development of products and services required to meet requests formulated by ICES clients and this falls within the scope of this manual.

The second pathway refers to the development of scientific products and services that serve to advance scientific knowledge about the marine environment and interactions with resource users. It is principally concerned with the development of scientific knowledge and expertise. Though it is not directly within the scope of this manual it does have relevance because it influences the development of the ICES Science and Advice Plans led by SCICOM and ACOM correspondingly. It includes networking activities that facilitate knowledge transfer and training of the ICES community and aims to benefit the international scientific community - these

activities include workshops, symposia, strategic initiatives, network events, committees and training actions.

Five steps of design and development of ICES advice exist: planning, inputs, controls, outputs, and changes.

Planning

ICES develop plans for advice products and services in line with objectives specified in the Advisory Plan and following requests formulated by ICES clients, for which the Advice Framework documents the planning process. ICES advisory committee decides whether the advice request can be addressed, then seeks approval for the cost associated with the request.

Specific advice products and services include Recurrent advice, Non-recurrent advice, Special requests or Technical service and are developed by experts from the ICES community who are nominated (by member countries) or invited (by Chairs) to contribute based on their specialist skills and knowledge. A member of the expert group chairs the process.

Inputs

The scope of an advice request is clarified with the client, including the deadline for the advice delivery. The formulation of inputs required to service requests are determined by the experts according to the scope of the request, and may involve further dialogue with clients during the process.

Controls

Advice products document the scientific process and findings developed by experts in servicing a request. This documentation serves as evidence of the controls applied. It includes a description of the specific request – which is necessary to verify if outputs meet requirements, explanations of the methods used to address the request, analyses and results, assumptions used and, if applicable, reasons it may not have been possible to fully address the request. The entire workflow is overseen by a Science Officer and Support Officer from the ICES Secretariat who are dedicated to assisting both the technical and practical implementation of the process.

A peer review process is used to control the development of ICES advice products.

Outputs

ICES Advice documents[90] serve as the product from the advisory process. Technical services and associated documentation are used to support the development of advisory products. Other services, including training, symposia and expert groups focussed on advancing scientific knowledge about the marine environment and interactions with resource users, are also products from the advisory process, albeit indirectly.

Reviews/validation/changes

An independent peer review process is used to assess whether the scientific methods, processes and products for advice are sound. Following peer-review, additional review is undertaken by ACOM to decide whether draft advice products are fit-for-purpose. At either evaluation stage, reviewers may request expert groups to make changes.

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[90] https://www.ices.dk/advice/Pages/Latest-Advice.aspx

8.4 Control of externally provided processes, products and services

General

Data will only be used as a basis for ICES advice if they have been collected under a framework which ensures unbiased access to and use of the full data set for analysis in support of scientific advice. 'Full data set' means in this context that access and use is to the complete data set at a resolution and with associated information which has been agreed prior to the collection of the data or the principles of which have been written in law.[91] This means that the data must either have been collected through a public programme subject to public regulation (legislation or directives), through studies or research projects where data are made available by the data collectors, or through projects or cooperative projects with the industry where a written agreement has been made prior to data collection that the complete data set will be available for analysis on support of scientific advice.

ICES uses appropriate methods to ensure that externally provided data and knowledge products and/or services relevant to the production of ICES advice meet requirements. For recurrent advice this is performed and documented during the Benchmark workshop. Specification of technical details such as required data formats is typically the responsibility of ICES data governance groups. In addition, the Data Profiling Tool[92] enables an advice process to document and check that data inputs and products meet the necessary criteria outlined in the Advisory plan on quality assurance and transparency[93].

Type and extent of control

The methods used to evaluate, select and monitor suppliers, depend on whether the supplier is a member of ICES, or a third-party. For Members of ICES, there is no selection process, but they are required to demonstrate their capability to meet requirements for quality and delivery of data and knowledge products, by responding to specified Data Calls[94]. This applies whether data and knowledge products are provided directly by themselves, or in collaboration with third-parties. For third-parties directly providing data and knowledge products relevant to ICES advice, evaluation and selection is based on documented evidence submitted to ICES Benchmark Workshops[95], and where applicable, prior track record, of their capability to meet requirements for quality and delivery of data and knowledge products required by specified Data Calls. Expert Groups also play a key role in evaluating the quality of the submitted data they are working with against relevant quality metrics that they may specify in accordance with its intended use.

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[91]https://www.ices.dk/sites/pub/Publication%20Reports/Guidelines%20and%20Policies/12.05.03_Criteria_for_use_of_data_in_ICES_advisory_work.pdf

[92] https://www.ices.dk/data/tools/Pages/Data-profiler.aspx

[93] https://www.ices.dk/data/tools/Pages/Data-profiler.aspx

[94] Data Calls. https://www.ices.dk/data/tools/Pages/Data-calls.aspx [note: all current and past data calls can be found in the ICES publications library]

[95] Introduction to Benchmarks at ICES. https://www.ices.dk/community/Documents/Advice/Introduction%20to%20Benchmarks%20at%20ICES.pdf

Complementary evidence for assessing the suitability of suppliers processes, and data and knowledge products relevant to ICES advisory processes include:

- Documentation of quality control processes and procedures that is publicly accessible.

- Evidence of peer /independent review. Peer review may include established scientific peer review processes or specific evaluation by experts in the ICES community. Independent review includes evidence of independent audit or certification of a quality assurance system.

- Assessment of the risk to production of ICES advice in terms of any issues regarding the quality or continuity of information. For example, issues such as the completeness of information, its representativity and accuracy, legal obligations for data collection, any agreements with ICES on data provision, access and sharing.

Ongoing monitoring of quality and service/product delivery is the responsibility of ICES data governance and expert working groups that use any data and knowledge products.

Information for external providers

ICES Data Calls are used to provide all suppliers with information on the specified requirements, such as standards for information, technical details such as required data formats, and any timelines, which relate to provision of data and knowledge products and services relevant to the production of ICES advice.

(Note that the "Standard for the Legitimacy of Data used in ICES advice" does not exist yet but has been identified as a need by WGQuality – see section 2 of the WGQuality 2023 report for more details.)

Third-party data suppliers to ICES will be required to address any Conflict of Interests as outlined in the Standard for the Legitimacy of Data used in ICES advice.

8.5 Production and service provision

ICES advice is based on peer-reviewed expert group reports. Expert group and workshop reports are peer-reviewed by independent experts. For the recurrent advice, where approaches and methods have been reviewed in a benchmark process, no review group is established as the peer-review process already took place in the benchmark. In these cases, the expert group performs an "audit", which consists in determining whether previously agreed methodologies from the benchmarks or other prior peer review processes have been conducted. The expert group report, together with the review, is used as a basis by the advice drafting group to produce a draft of the advice.

8.6 Release of products and services

ICES advice is based on peer-reviewed expert group reports, prepared in an advice drafting group, and approved by the ICES Advisory Committee (ACOM) – the advice is then delivered to the client.

8.7 Control of nonconforming outputs

Any changes to advice within a given year are tracked by the ICES secretariat and passed on to the clients; the most important being the changes to headline advice, which are based on customer needs. New versions of advice are version controlled and published with an incremented persistent identifier (Digital Object Identifier – DOI) that relates the original advice to the updated version.

9. Performance evaluation

9.1 Monitoring, measurement, analysis and evaluation

The data required to measure progress against the defined quality objectives is specified by ACOM and then collected with the support of the Secretariat - appropriate analyses are then performed.

Customer Satisfaction

Annual reviews of advisory services take place in the form of a formal meeting between ICES, Advisory Councils and other Observers (MIACO) and between ICES and Requesters of Advice (MIRIA). At these meetings, all parties are invited to review the advice and advice processes carried out in the previous year, feedback on action points from the previous year's meeting are also discussed, along with future advice needs. These meetings are documented. The meetings ensure the advice provided by ICES is appropriate to the needs of the requesters.

9.2 Internal audit

(Note that a formal ICES QMS does exist at the moment so there is not a formal internal audit. This has been identified as a gap by WGQuality – see section 2 of the WGQuality 2023 report for more details.)

An internal audit of the QMS is performed on an annual basis and the results are documented in the group's report. Any improvements identified are notified to the relevant people using the ICES Recommendation system.

9.3 Management review

(Note that a formal ICES QMS does exist at the moment so there is not a formal procedure for management review. This has been identified as a gap by WGQuality – see section 2 of the WGQuality 2023 report for more details.)

ACOM review the quality management system, at planned intervals, to ensure its continuing suitability, adequacy, effectiveness and alignment with the strategic direction of the organization.

10.   Improvements

10.1 General

Improvement is inherent in each of the priority areas of the ICES Advisory Plan and thus demonstrates how ICES continuously strives to improve their services and products so that they meet the requirement of ensuring the delivery of high quality advice.

The ICES resolution and recommendation systems are key components of the ICES improvement cycle. Resolutions lay the foundation for ICES work. In particular, resolutions are used to form working groups and workshops and define their work plans, including Terms of Reference (ToRs) – these are often defined in response to a potential improvement that has been identified. The recommendation system allows expert groups to identify areas and opportunities for improvements and highlight these to other groups - the progress of these recommendations is then monitored.

Requests for advice are answered following a set of frameworks and guidelines. ACOM and Advisory Support are responsible for advice related guidelines, which are updated following the appropriate cycle (annually to every 4-5 years). All updated documents are version controlled with older versions archived.

ICES advice is based on the best available science and data at the time of its preparation. The advisory products will frequently provide suggestions on how the science and data flows can be further utilised, developed and improved. The recommendations system facilitates this feedback, expert groups and advice drafting groups are requested to formulate recommendations, the purpose being to ensure that other expert groups, steering group chairs, ICES Secretariat, ICES Data Centre, ACOM, and SCICOM are aware of information that influences work in other parts of the network. An online database of recommendations exists where comments, actions and version history is tracked and maintained. The recommendation system can be seen as a list of future improvements that stimulates work within the ICES community.

Annual reviews of advisory services take place in the form of a formal meeting between ICES, Advisory Councils and other Observers (MIACO) and between ICES and Requesters of Advice (MIRIA). Review cycles thus ensure that the existing quality control and assurance cycles are maintained and reviewed, that they address and incorporate future needs and expectations, prevent and/or reduce the undesired effects that would require corrections and identify where nonconformity exists. The overall aim is to improve the effectiveness of the quality management system and its performance.

10.2 Nonconformity and corrective action

(Note that a formal ICES QMS does exist at the moment so there is not a formal procedure for managing non-conformities within it. This has been identified as a gap by WGQuality – see section 2 of the WGQuality 2023 report for more details.)

Nonconformity is defined as the failure to meet one or more existing requirements of the QMS. Nonconformities, therefore, refer to infringements on the QMS procedures, e.g. by skipping a prescribed quality check or review procedure. Corrective actions shall be appropriate to

the effects of the non-conformities encountered - individual Process Owners shall ascertain the best corrective action most suitable for their given process flows.

10.3 Continual improvement

(Note that the "Quality Support Manager" role proposed by WGQuality would have a key role in coordinating improvements to the QMS– see section 2 of the WGQuality 2023 report for more details.)

ICES is committed to the continual improvement of the QMS with respect to its suitability, adequacy and effectiveness for the production of ICES advice. This process of continuous improvement will be as a result of evidence-based decision making at the appropriate level, in particular the Management Review.

Further, the ICES Data Centre holds the CoreTrustSeal accreditation for data centres and is committed to a continuous improvement cycle.