

# Mathmet Data Quality Assurance Plan Guidance

For use with PDF Data Quality Assurance Plan Generator Issued Version 1.0.0

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## Official language

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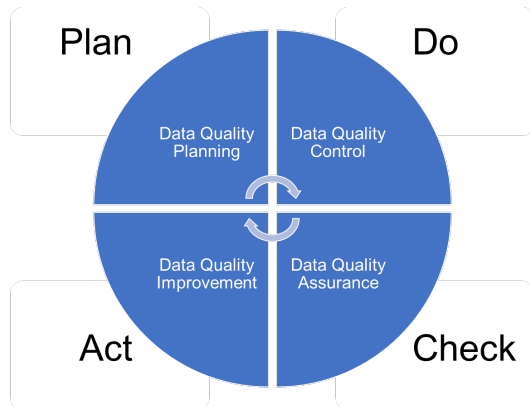
## GLOSSARY

Term	Definition	Source
<b>Audit</b>	Systematic, independent, and documented process for obtaining objective evidence and evaluating it objectively to determine the extent to which the audit criteria are fulfilled.	[1]
<b>Business impact analysis</b>	Process of analysing the impact over time of a disruption on the organisation.	[2]
<b>Customer</b>	Person or organisation that could or does receive a product or a service that is intended for or required by this person or organisation. A customer can be internal or external to the organisation.	[1]
<b>Data</b>	Reinterpretable representation of information in a formalized manner suitable for communication, interpretation, or processing.	[3]
<b>Data administrator</b>	Person who controls and coordinates the work of data technicians by defining criteria needed to maintain data quality, by designing data schemata, and by analysing the causes of errors to prevent their recurrence.	[3]
<b>Data dictionary</b>	Collection of data dictionary entries that allows lookup by entity identifier.	[3]
<b>Data Integrity Level (DIL)</b>	A risk assessment metric that accounts for complexity and criticality levels.	
<b>Data life cycle</b>	All stages in the process of data usage from initial establishment to its discontinuation.	[4]
<b>Data manager</b>	Person who establishes plans for data quality improvement in an organisation, grants data administrators the authority to trace and correct data over the information systems or organisation and maintains data consistency in individual information systems through the organisation-wide data architecture (ISO 8000-2:2020).	[3]

Term	Definition	Source
<b>Data processing</b>	Systematic performance of operations upon data. Examples: Arithmetic or logic operations upon data, merging or sorting of data, assembling or compiling of programs, or operations on text, such as editing, sorting, merging, storing, retrieving, displaying, or printing.	[5]
<b>Data quality</b>	Degree to which a set of inherent characteristics of data fulfils requirements.	[3]
<b>Data quality management</b>	Coordinated activities to direct and control an organisation with regard to data quality.	[3]
<b>Data set (or dataset)</b>	Logically meaningful grouping of data.	[3]
<b>Data specification</b>	Set of requirements covering the characteristics of data being fit for one or more particular purposes.	[3]
<b>Data steward</b>	Person or organisation delegated the responsibility for managing a specific set of data resources.	[3]
<b>Data technician</b>	Person who creates, reads, modifies, and deletes data in accordance with the guidelines for data quality management, and measures data quality and corrects data errors found as a result of measuring data quality.	[3]
<b>Management system</b>	A management system is a set of interrelated or interacting elements of an organisation to establish: <ul style="list-style-type: none"> <li>• policies, intentions and direction of an organisation as formally expressed by its top management,</li> <li>• and objectives, results to be achieved,</li> <li>• and processes, sets of interrelated or interacting activities that use inputs to deliver an intended result, to achieve those objectives.</li> </ul>	[1]
<b>Measurement uncertainty</b>	Parameter, associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand	[6]
<b>Non-conformity</b>	Non-fulfilment of a requirement.	[7]
<b>Quality</b>	The degree to which a set of inherent characteristics of an object fulfils requirements.	[1]
<b>Quality control</b>	Part of quality management focused on fulfilling quality requirements.	[1]

Term	Definition	Source
<b>Quality management system realisation</b>	Process of establishing, documenting, implementing, maintaining, and continually improving a quality management system.	[1]
<b>Quality planning</b>	Part of quality management focused on setting quality objectives and specifying necessary operational processes, and related resources to achieve the quality objectives.	[1]
<b>Quality requirement</b>	Need or expectation that is stated, generally implied or obligatory, related to data.	[1]
<b>Repeatability condition of measurement</b>	Condition of measurement, out of a set of conditions that includes the same measurement procedure, same operators, same measuring system, same operating conditions and same location, and replicate measurements on the same or similar objects over a short period of time.	[8]
<b>Reproducibility condition of measurement</b>	Condition of measurement, out of a set of conditions that includes different locations, operators, measuring systems, and replicate measurements on the same or similar objects.	[8]
<b>Risk analysis</b>	Systematic use of available information to identify hazards and to estimate the risk.	[9]
<b>Risk assessment</b>	Overall process comprising a risk analysis and a risk evaluation.	[9]
<b>Risk evaluation</b>	Procedure based on the risk analysis to determine whether tolerable risk has been exceeded.	[9]
<b>Uncertainty budget</b>	Statement of a measurement uncertainty, of the components of that measurement uncertainty, and of their calculation and combination.	[8]

## 1. INTRODUCTION



This document provides information to assist with completing a Mathmet Data Quality Assurance Plan (DQP). The associated interactive PDF supports the documentation of the people, procedures and activities performed to fulfil predefined quality objectives during the development and maintenance of a specific dataset or meaningful group of datasets, within the metrology community and wider scientific domains, in which quality and trustworthiness are essential... A completed data quality assurance plan facilitates the auditing of datasets, particularly with respect to the ISO 8000 [1] series of standards.

Figure 1 : Plan/Do/Check/Act pattern for data quality (source: ISO 8000)

## 2. DATASET DETAILS

### Q01 Dataset label

Provide a meaningful name for the dataset(s). The name will also serve as a title for the **Data Quality Assurance Plan**.

### Q02 Brief description

Give general information about the project. Describe what the dataset is, what its purpose is, where it is stored (e.g., link to a **data dictionary**), where the project's documentation is stored etc.

### Q03-Q06 Responsibilities

A **Data Quality Assurance Plan** is established by the dataset development team. Team members may have different roles: **data manager(s)**, **data administrator(s)**, **data technician(s)** and **data steward(s)**. These roles are defined by the ISO 8000 series of standards. The most essential roles are **data technician** and **data steward**. Smaller development teams might be composed of a small number of **data technicians** and/or **data stewards**. For example, a team might have a single member, who creates (as **data technician**) and manages (as **data steward**) the dataset.

### Q07 DQM plan status / Q08a DQM plan date / Q08b DQM plan version

Provide information about the **Data Quality Assurance Plan** itself: the current status of the plan, still a draft or issued, the latest date when the plan underwent significant changes, and an identifier for the current version of the plan.



### 3. DATA INTEGRITY LEVEL

A **risk analysis** results in the calculation of a **Data Integrity Level** (DIL). The DIL is a numeric scale, between 1 and 4, that reflects the potential impact of quality on the overall dataset development project.

#### **Q09 Dataset level of complexity**

Evaluate the anticipated complexity of the dataset(s). Dataset complexity (CP) can be defined considering one or more of: (a) size of the dataset(s), (b) amount of effort needed for dataset consolidation, and (c) dataset understandability.

**Table 1:** Data complexity levels, typical features, and examples.

CP	Complexity of data	Typical features	Example
1	Very simple	Commonly used datatypes (e.g. numeric).	Hourly time series of a single room temperature sensor readings over one month.
		Few datatypes.	
		Small amount of data.	
		Simple/unexpensive capture/generation/processing/storage infrastructure.	
		Simple uncertainty budget.	
2	Simple	Easy to represent visually (e.g. numeric matrix).	Hourly time series of room temperature, relative humidity and CO2 concentration sensor readings of a large building over one year.
		Moderate number of datatypes.	
		Moderate amount of data.	
		Intermediate capture/generation/processing/storage infrastructure.	
		Intermediate uncertainty budget	
3	Moderate	Non-trivial datatypes.	Combined thermographic, photogrammetric and 3D point cloud data of a large building.
		Fair number of datatypes.	
		Large or very large datasets.	
		Complex/expensive capture/generation/processing/storage infrastructure.	
		Complicated uncertainty budget.	
4	Complex	Non-trivial datatypes.	Multi-spectral satellite imagery of a continent.
		Combination of many datatypes.	
		Very complex/expensive capture/generation/processing/storage infrastructure.	
		Very complicated uncertainty budget.	

### Q10 Dataset level of criticality

Evaluate the expected criticality of usage (CU) the product dataset(s), i.e. the consequences of customers using data of inappropriate quality, particularly on business/reputation.

**Table 2:** Data criticality levels, explanations, and examples.

CU	Criticality of usage	Explanation	Example
1	Not critical	No danger of loss of income or reputation.	Prototype dataset for internal use.
		Short life, will not require maintenance in future.	
2	Significant	Potential for loss of income or reputation.	Dataset used for scientific research.
3	Substantial	Likely to lead to loss of income or reputation if faulty.	Dataset used for commercial applications.
4	Life critical	May result in personal injury or loss of life.	Avionics reference standards.

### Q11 Does the calculated DIL seem suitable?

After risk has been analysed, the interactive PDF tool will compute a DIL value according to the rules from Table 3. This recommended DIL can be accepted, or it could be revised by the team. For example, if inexperienced **data technicians** are involved, the team can decide to increase the DIL. If the DIL value is revised, then the project-specific factors that justify increasing or decreasing the recommended DIL value must be documented.

Once the DIL value is set, the interactive PDF tool provides an appropriate list of recommended or compulsory questions explained in the following sections. The mapping between recommended questions and DIL values is given in Appendix.

**Table 3:** Calculating Data Integrity Level.

	CP1	CP2	CP3	CP4
CU1	1	1	1	1
CU2	2	2	3	4
CU3	3	3	3	4
CU4	4	4	4	4

## 4. FITNESS FOR PURPOSE

### Q12 How will the dataset user requirements be documented?

Document user requirements (**data specification**) in any case, regardless of the DIL value. However, it is expected that higher DIL levels have more detailed user requirements. For example, datasets with higher levels of complexity might have longer mathematical specifications.

From Q12, all answer fields support rich and long text, however good practice is to provide a short explanation and a link to a working document (stored in a persistent accessible location).

### Q13 How will the data life cycle be documented?

Document the **data life cycle**: from creation to long-term preservation. For example, provide a short explanation and link to a flow diagram, or for a more complex project, link a Gantt chart, a task board etc. **Data life cycle** processes can include how data is captured (how it is discovered, acquired, recombined from static or dynamic sources), how it is created (data pipeline, if it is synthetic data), how it is formatted (and what format conversions have been applied), how it is annotated (are there metadata?), how it is validated (detection/mitigation of abnormalities is also covered by the data quality monitoring section of the plan), how it is anonymised (for privacy purposes), how the data will be preserved (e.g., is there a retention period?) etc.

**Q14 How will the project team approve the dataset user requirements internally?**

Describe the procedure for approval of the user requirements within the development team. Who oversees collating user requirements? Who approves them within the team? How is the approval traced (email thread, merge request if using a version control system, digital signature, meeting minutes...)?

**Q15 How will the customer or customer proxy approve the dataset user requirements?**

Who is the **customer**? Who is the **customer** proxy, if any? Describe the procedure for approval by the **customer**. How is user requirement documentation communicated to **customer**? How is the approval traced (email thread, merge request, digital signature, meeting minutes...)? If the **customer** is not involved in this procedure, which team members act as a proxy?

**Q16 How will the objectivity of the dataset user requirements review be ensured?**

Describe how an independent person/organisation will review the user requirements. Depending on the criticality of usage of the dataset, it could be someone in the same organisation with expertise but not directly involved in the development, or an external assessor with an accepted level of authoritativeness/accreditation.

## **5. DATA QUALITY PLANNING**

**Q17 Describe how the roadmap of data quality procedures will be documented.**

Detail the roadmap for the implementation of the data quality interventions, for example by providing a link to a document: a flow diagram (for example, a sub-diagram of the data life cycle diagram) or for more complex projects: Gantt chart, task board... It could also be a link to an external platform, e.g., a project tracker.

**Q18 Describe how the implementation progress against the roadmap for data quality procedures will be tracked.**

Describe the procedure that will be implemented to track progress against the roadmap. For example, progress review meetings with minutes, or approval procedure in a project tracker.

### Q19 How will the risks associated to developing the dataset be assessed and mitigated?

Document the risk assessment associated to the development of the dataset. What could go wrong and how to mitigate? For examples, having redundant instruments, setting up data backup procedures.

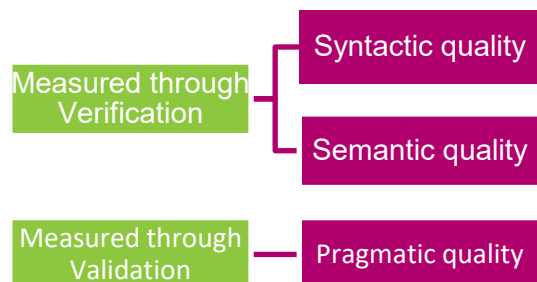
### Q20 How will the potential negative impact on business/reputation of non-conformities in the dataset be assessed and mitigated?

For higher DIL values, provide a more detailed criticality assessment and mitigation plan, e.g., a **business impact analysis**.

## 6. QUALITY MONITORING, CONTROL, AND IMPROVEMENT

### Q21 How will non-conformities in the dataset be reported?

Describe how non-conformities are identified and documented. Internal reporting and customer reporting could have different channels. For example, the development team can set up a procedure to assign priority levels to non-conformities. ISO 8000 standards characterise data quality according to its consistency with its format (syntactic quality), its meaning (semantic quality), and its usefulness (pragmatic quality).



### Q22 How will corrective actions on non-conformities in the dataset be logged?

Provide a short description and/or a link to an external document, or a link to an interactive platform such as an issue tracker.

### Q23 How will non-conformities in the dataset be prevented?

Describe the procedures that will be implemented to prevent non-conformities. For example, provide a link to a testing/verification plan or to a comparison dataset.

### Q24 Who will oversee dealing with non-conformities in the dataset?

Assign team members or organisational units to the management of non-conformities in the dataset(s).

## **7. QUALITY ASSURANCE**

### **Q25 How will data quality be documented and made available for review?**

Provide a link to a document (for example, a shared Word document in review mode), or a link to a dedicated platform (for example, an issue tracker).

### **Q26 How will the project team review data quality issues?**

Provide, for example, a link to an agenda for review meetings with minutes, or a link to a chat history that is private to the team.

### **Q27 How will the customer or customer proxy review data quality issues?**

Describe how data quality issues will be communicated to the customer (through email, in meetings with minutes, via an access to an issue tracker...).

### **Q28 How will the objectivity of the data quality issue review be ensured?**

Describe how the processes for review and mitigation of data quality issues will be reviewed independently. Depending on the criticality level, the independent reviewer can be someone in the same organisation who is not involved in the development of the dataset, or an external expert.

## 8. DATA UNDERSTANDABILITY

### Q29 How will the meaning of the data be formalised?

Provide a link to a **data specification** document. A machine-interpretable format specification must be provided if compliance with the [FAIR principles](#) is desired, e.g., the dataset is intended to be shared in an open science data repository.

### Q30 How will the structure of the dataset be documented?

Provide a link to a data model document/diagram (e.g., a UML diagram), or a database schema with metadata (e.g., the dataset is kept in a relational database). A machine-interpretable format specification needs to be provided to comply with the [FAIR principles](#).

### Q31 How will the metadata be documented?

Provide a link to metadata database schema, a controlled vocabulary, a taxonomy... In simpler cases, a README file that explains the headers, if the data is shared in a tabular format. A machine-interpretable format specification needs to be provided to comply with the [FAIR principles](#).

### Q32 How will the customer know how to exploit the dataset?

Detail how customers will learn about the dataset usage. For example, provide a link to a user manual in PDF format, or a link to a documentation wiki/web site. For more complex datasets/intended usage, describe how training will be provided, e.g., online or via in-person workshops/classes...



## 9. METROLOGICAL SOUNDNESS

### **Q33 Will the dataset contain measurement data or data derived from measurements?**

Measurements here refer to collections of values obtained experimentally by comparison of quantities or counting of entities, as well as the values derived from experimental results using models and calculations.

### **Q34 How will the main operations applied to the dataset be logged?**

If the dataset contains measurement data, describe the logging procedure for the main operation, e.g., by providing a link to a document/diagram. Note that this question is superseded by Q35 for DILs 3 and 4,

### **Q35 How will the operations applied to the dataset be logged?**

For higher levels of criticality/complexity, describe all operations performed on or in relation to the dataset, e.g., provide a processing pipeline specification.

### **Q36 Is the dataset generation intended to be repeatable?**

Repeatability is defined as “Condition of measurement, out of a set of conditions that includes the same measurement procedure, same operators, same measuring system, same operating conditions and same location, and replicate measurements on the same or similar objects over a short period of time.” (VIM: International Vocabulary of Metrology [2])

### **Q37 How will the dataset's repeatability conditions be documented?**

Detail how repeatability conditions are documented. For example, provide a link to a document which details how to find the persons, locations, artifacts, instruments, and procedures involved in any repeated experiment.

**Q38 Is the dataset generation intended to be reproducible?**

Reproducibility is defined as “Condition of measurement, out of a set of conditions that includes different locations, operators, measuring systems, and replicate measurements on the same or similar objects.” (VIM: International Vocabulary of Metrology [2])

**Q39 How will the dataset’s reproducibility conditions be documented?**

Detail how reproducibility conditions are documented. For example, provide a link to a document that describes the persons, locations, artifacts, instruments, and procedures involved in the original experiment and the degree of similitude expected from any reproduction.

**Q40 How will measurement uncertainty be expressed and evaluated?**

Document how **measurement uncertainty** is expressed/evaluated. Refer to the Guide to the expression of uncertainty in measurement (GUM) [3] when possible, or provide links to explanatory documents (reports, papers) when the uncertainty evaluation is not traceable to the GUM. If there is an uncertainty budget, provide a link and explain how it is traceable to the GUM, if not, justify why there is not one.

If the evaluation is performed using commercial software: specify the tools and version used. If it is performed using in-house software, specify tools and version used, and link to the source code and/or a software quality plan.

**Q41 How will confidence in the dataset generation process be demonstrated?**

For higher levels of criticality of usage, this could be a link to a recent ISO 17025 accreditation certificate.

## APPENDIX

The quality requirements for each Data Integrity Level (DIL) are listed as a series of tables. These tables use the following keys:

**Table 4:** Key for following tables

X	Not required
R	Recommended
M	Mandatory

**Table 5:** Fitness for purpose

Quality requirement	DIL 1	DIL 2	DIL 3	DIL 4
Documented user requirements (Q12)	M	M	M	M
Documented data life cycle (Q13)	X	R	M	M
Review by team (Q14)	R	M	M	M
Review by customer or proxy (Q15)	X	R	M	M
Objectivity of user requirements (Q16)	X	X	M	M

**Table 6:** Data quality planning

Quality requirement	DIL 1	DIL 2	DIL 3	DIL 4
Roadmap of data quality processes (Q17)	X	R	M	M
Document progress and updates against initial implementation roadmap (Q18)	X	R	M	M
Risk assessment report (Q19)	X	X	R	M
Business impact report (Q20)	X	R	R	M

**Table 7:** Metrological soundness and traceability

Quality requirement	DIL 1	DIL 2	DIL 3	DIL 4
Log main operations applied to the dataset (Q34)	R	M	X	X
Log all operations applied to the dataset (Q35)	X	R	M	M

Document repeatability conditions (Q37)	R	M	M	M
Statement of reproducibility (Q39)	R	R	M	M
Measurement uncertainty evaluation (Q40)	R	R	R	R
Ensure confidence in dataset generation process (Q41)	R	R	R	R

**Table 8: Data quality monitoring, control and improvement**

Quality requirement	DIL 1	DIL 2	DIL 3	DIL 4
Data non-conformity report (Q21)	R	M	M	M
Log of data non-conformity corrections (Q22)	X	R	M	M
Document procedures to prevent data non-conformities (Q23)	X	R	M	M
Data quality committee/team (Q24)	X	R	M	M

**Table 9: Data quality assurance**

Quality requirement	DIL 1	DIL 2	DIL 3	DIL 4
Data Quality Report (Q25)	X	R	M	M
Review of data quality issues by team (Q26)	R	M	M	M
Review of data quality issues by customer or proxy (Q27)	X	M	M	M
Ensure objectivity of data quality issue review (Q28)	X	R	M	M

**Table 10:** Data understandability

Quality requirement	DIL 1	DIL 2	DIL 3	DIL 4
Existence of data model (Q29)	R	R	M	M
Existence of data dictionary (Q30)	R	R	R	R
Documented metadata (Q31)	R	R	R	M
Provision of guidance for data usage (Q32)	R	R	R	M

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## DOCUMENT HISTORY

Version	Date	Revised by	Change(s)	Approved by
1.0.0	May 2025	JLH, KL, IG	Initial live release.	NPL
1.0.0	July 2025	JLH, KL	Corrected tables, added corresponding question numbers.	NPL