



The Structure of Whole Quality

From the Defined Quality Object to a Responsible Quality Determination

Foundational Article 1 — Third Edition

Whole-Quality Institute

Quality is often discussed as though it begins with measurements, checklists, available data, or performance scores. Whole Quality begins earlier.

It begins with the defined Quality Object whose Quality is to be determined. From that starting point, the methodology establishes what the object is required or intended to do, how that function is realized, the relevant Scale, Boundaries, Interfaces and Context, what applies to the object, what should be examined, what state or result is expected, what Evidence supports the Findings, and what Quality State and Quality Claim can responsibly be established.

The Authoritative Definitions of the Root Concepts used in this article are established in the Whole Quality Root Vocabulary Standard (WQI_VOC1), Revision 2.0. This Foundational Article does not redefine those concepts. It explains the overall methodological architecture and how its principal elements relate.

Whole Quality does not create the quality-relevant structure of the defined Quality Object. It progressively reveals that structure at a Methodological Resolution adequate for the intended Quality Determination.

1. The Starting Point: The Defined Quality Object

The first methodological question is:

What is the subject whose Quality is being determined?

A Quality Object may be an infrastructure system, a support-service arrangement, a Management System, a biological object, a health-related object, a process, an activity, an Interface, or another appropriately defined subject.

Different Quality Objects require different applied Quality Factors, Quality Indicators, Quality Outcome Criteria, Evidence, and Reference Layer sources. The Whole Quality methodology remains stable, but its application must arise from the nature of the Quality Object, its Intended Functions and Intended Results, Function Realization, Scale, Boundaries, Interfaces, Context, and Applicable Basis.

Without a sufficiently clear definition of the Quality Object, the determination may become ambiguous: it may be unclear what was examined, what was excluded, and what the resulting Quality Claim actually means.

2. Quality Object Description and Methodological Resolution

Definition of the Quality Object is the starting point, but the object must also be described at the level needed for the intended Quality Determination.

The Quality Object Description may address relevant characteristics, composition, constituent parts, relationships, Lifecycle position, operating or service conditions, users or affected persons, environment, dependencies, and other quality-relevant conditions.

The level of detail should be adequate for the intended determination. Methodological Resolution refers to the degree of quality-relevant detail used to examine the defined Quality Object. Finer resolution may reveal additional detail, but more detail is not automatically better. The appropriate resolution depends on what the determination is intended to establish.

Before interpretation proceeds, the description should therefore be checked for sufficient clarity and completeness. This is a practical methodological check, not a separate Quality Factor and not a separate determination of Quality.

3. Scale, Boundaries, Interfaces, and Context

3.1 Scale

Scale identifies the level of aggregation or extent at which the Quality Object is defined and its Quality is considered. A component, facility, network, organization, population, or system-of-systems may each be a legitimate Quality Object, but a Quality State established at one Scale does not automatically transfer to another.

3.2 Boundaries

Boundaries establish the relevant limits of the Quality Object for the intended determination. They clarify what is included, what is excluded, and where the subject of the determination ends.

A Boundary may be physical, functional, organizational, informational, responsibility-based, temporal in application, or otherwise relevant. It need not coincide with ownership, property, jurisdiction, or an organizational chart.

3.3 Interfaces

Interfaces identify the relevant interactions through which parts of a Quality Object, or the Quality Object and something outside it, interact in Function Realization.

They may involve matter, energy, information, control, authority, responsibility, services, resources, decisions, or other interactions. Systems engineering likewise treats interfaces and relationships among system elements as central to understanding how a system works as a whole [1].

A Boundary establishes the relevant limit. An Interface identifies the interaction across or within that limit. Both must be sufficiently clear because Function Realization may be affected not only by individual constituents but also by the relationships among them.

3.4 Context

Context consists of the relevant surrounding conditions and circumstances that affect the Quality Object, Function Realization, or the intended Quality Determination. Context may affect which requirements or criteria apply, what Evidence is needed, and how observations should be interpreted.

4. Intended Functions, Intended Results, and Function Realization

4.1 Intended Functions

An Intended Function states what the Quality Object is required or intended to do.

A Quality Object may have one or more Intended Functions. The applicable functions must be established for the Quality Object and Context being considered. Where several functions exist, their relationships, dependencies, shared Intended Results, and any applicable priorities may also need to be understood.

4.2 Intended Results

An Intended Result is a result required or intended to arise from realization of an Intended Function.

An Intended Function may be associated with one or more Intended Results. An Intended Result may also be associated with more than one Intended Function where that relationship is justified.

The Intended Function and Intended Results are related but not interchangeable. The Intended Function states what the Quality Object is required or intended to do; the Intended Results identify results required or intended to arise from realization of that function.

4.3 Function Realization

Function Realization describes the manner and degree to which the Quality Object realizes an Intended Function and its associated Intended Results.

It may depend on relevant conditions, capabilities, relationships, resources, controls, protections, adaptations, Boundaries, Interfaces, and external dependencies. For conditional, intermittent, standby, or demand-dependent functions, demonstrated capability may form part of Function Realization.

Systems engineering also uses functional analysis and functional decomposition to identify what a system must do and how functions, relationships, dependencies, and interfaces contribute to higher-level objectives [1]. Whole Quality uses this established systems perspective within a different methodological purpose: to determine and communicate the Quality State of a defined Quality Object.

Function Realization comes before the derivation of Quality Factors. Whole Quality first seeks to understand how the Quality Object realizes its Intended Functions and only then organizes that understanding into principal methodological dimensions.

5. Applicable Basis and Failure-Mode Families

5.1 Applicable Basis

Understanding Function Realization requires understanding what applies to the Quality Object and to the intended Quality Determination.

The Applicable Basis is the set of requirements, knowledge, and other justified bases used to establish what applies. It may include laws, regulations, contracts, specifications, design bases, scientific knowledge, professional knowledge, technical requirements, functional dependencies, or other justified sources.

This distinction is important because Whole Quality does not allow the analyst to invent requirements, priorities, or critical conditions from preference. Where several Intended Functions or requirements interact, their applicability or precedence must be justified through the Applicable Basis.

5.2 Failure-Mode Families

Failure-Mode Families provide a methodological completeness check. They help test whether the proposed Quality architecture can reveal important ways in which an Intended Function or Intended Result may fail to be realized as required or may become degraded.

Established failure-analysis methods similarly examine how items or processes may fail to perform their functions and the effects of those failures. IEC 60812:2018 describes FMEA and FMECA as systematic methods for identifying modes of failure and their effects, applicable to hardware, software, processes involving human action, and interfaces [2].

Whole Quality uses Failure-Mode Families more narrowly as a completeness test. They do not automatically become Quality Factors or Quality Indicators, and they do not by themselves generate the Quality Factor architecture.

6. Quality Factors, Quality Indicators, and Quality Outcome Criteria

6.1 Quality Factors

A Quality Factor is a principal dimension of Function Realization that must be understood to determine the Quality State of a defined Quality Object.

Quality Factors are derived from the Quality Object, its Intended Functions and Intended Results, Function Realization, Boundaries, Interfaces, relevant conditions, and applicable requirements or knowledge. Failure-Mode Families may then be used to test whether important dimensions have been overlooked.

6.2 Quality Indicators

A Quality Indicator identifies what should be examined to understand a Quality Factor.

A Quality Indicator does not itself specify the examination method, the expected state, the Evidence, or the resulting Finding. Examination may be quantitative or qualitative, direct or indirect.

A Quality Factor may be examined through multiple Quality Indicators.

6.3 Quality Outcome Criteria

A Quality Outcome Criterion establishes the expected state or result against which observations associated with a Quality Indicator are interpreted.

A Quality Indicator may be interpreted through one or more applicable Quality Outcome Criteria. Multiple complementary criteria may be needed where the aspect represented by the Indicator is multidimensional.

The criterion must have a justified substantive basis. Context may affect whether a criterion applies, but Context does not itself create the expected state.

7. Evidence, Findings, Interpretation, and Quality Determination

7.1 Evidence

Evidence is the information or observations used to support a Finding about the actual condition of a Quality Object. It may include observations, measurements, inspection results, records, professional evaluations, scientific information, testimony, images, samples, operating information, or other information appropriate to the Quality Object and Context.

The existence of Evidence is not enough by itself. Its dependability for the use being made of it must be considered, and the available Evidence must provide enough appropriate support for the intended Finding and Quality Determination.

7.2 Evidence Quality, Evidence Sufficiency, and Uncertainty

Evidence Quality concerns whether Evidence is dependable for the use made of it. Evidence Sufficiency concerns whether enough appropriate Evidence is available to support the intended determination.

Where relevant conditions, relationships, or conclusions remain unknown or are not established with sufficient confidence, the result is Uncertainty. Uncertainty should remain visible rather than being converted into an unsupported favorable or unfavorable conclusion.

Insufficient Evidence limits what can responsibly be concluded; it does not by itself prove poor Quality.

7.3 Evidence-Supported Findings and Quality Factor Interpretation

Evidence supports Findings about the actual condition of the Quality Object. Those Findings are then interpreted to determine what they establish about the condition of each Quality Factor.

Interpretation is not automatically a count, average, weight, or score. Relevant relationships, Evidence Quality, Evidence Sufficiency, Uncertainty, Critical Conditions, and Non-Compensability may all affect what can responsibly be concluded.

7.4 Quality Determination

A Quality Determination is the structured application of Whole Quality to establish the Quality State of a defined Quality Object.

The determination must remain bounded by the Quality Object, Scale, Boundaries, Context, Methodological Resolution, Applicable Basis, Evidence, temporal basis, and relevant limitations. It establishes the conclusion; it does not create the underlying condition of the Quality Object.

8. Applicable Basis, Reference Layer, and Evidence

Applicable Basis, Reference Layer, and Evidence perform different methodological roles.

Applicable Basis establishes what applies. Reference Layer supports what is expected. Evidence supports what is actually found.

The Reference Layer is the body of sources used to establish or justify the Quality Outcome Criteria applicable to the Quality Object. It may include laws, regulations, standards, contracts, specifications, design bases, scientific literature, professional guidance, validated data, and other justified sources.

A source may contribute to both the Applicable Basis and the Reference Layer, but the roles remain distinct. Inclusion of a source also does not make every part of that source applicable.

This separation helps preserve traceability from the basis of the determination, through the expected criteria, to the Evidence and Findings about actual condition.

9. Critical Conditions, Non-Compensability, Quality State, and Quality Claim

9.1 Critical Conditions and Non-Compensability

Some conditions may be so important to Function Realization that their absence, failure, violation, or unresolved status prevents a responsible positive Quality State determination or Quality Claim. Whole Quality identifies such a condition as a Critical Condition.

Non-Compensability means that specified unfavorable or unresolved conditions cannot be offset by favorable Findings elsewhere. Neither Critical status nor Non-Compensability should be assigned merely by analyst preference; they require a justified basis.

9.2 Quality State

The Quality State is the interpreted condition of the Quality of the defined Quality Object established through a bounded, evidence-supported determination.

A Quality State may be favorable, unfavorable, mixed, qualified, or unresolved. It applies only to the defined Quality Object, scope, conditions, Context, and temporal basis of the determination.

9.3 Quality Claim

A Quality Claim communicates a statement about the Quality State supported by the Quality Determination. It should not exceed the scope, certainty, or support of that determination.

A broader or stronger Quality Claim generally requires a correspondingly broader and stronger methodological basis. A satisfactory component, Indicator, document, activity, or certification should not automatically be generalized to the Quality State of the whole Quality Object.

10. The Whole Quality Conceptual Pathway

The principal conceptual pathway may be summarized as follows:

- Defined Quality Object
- Intended Function(s) and Intended Result(s)
- Function Realization
- Quality Factors
- Quality Indicators
- Quality Outcome Criteria
- Evidence-Supported Findings
- Quality Factor Interpretation
- Quality State
- Quality Claim

This is a conceptual dependency, not a rigid one-pass workflow. Scale, Boundaries, Interfaces, Context, Methodological Resolution, Applicable Basis, Reference Layer, Evidence Quality, Evidence Sufficiency, Uncertainty, Failure-Mode Families, Critical Conditions, Non-Compensability, and Traceability support or constrain the principal pathway.

Application may be iterative. Additional understanding may require refinement of the Quality Object Description, Methodological Resolution, Boundaries, Interfaces, Applicable Basis, Quality Factors, Quality Indicators, Quality Outcome Criteria, Evidence needs, or other elements. Material changes should remain traceable, and the final Quality Determination should be internally consistent.

11. Applied Whole Quality Initiatives

The Infrastructure Quality Initiative applies Whole Quality to infrastructure Quality Objects. The American Support Standards Initiative applies it to support-service Quality Objects. Other Whole Quality platforms may develop Applied Vocabularies, Core Standards, and Context Guides for additional classes of Quality Objects.

These applications differ because their Quality Objects and substantive bases differ. The Root Concepts of the methodology remain stable.

Universality belongs to the methodology. Specificity belongs to the defined Quality Object and its application Context.

12. Methodological Sources and Related Work

Whole Quality draws on an intellectual environment that includes systems engineering, failure analysis, measurement and evidence practices, and terminology science. These established bodies of work provide useful background for several concepts used in this article.

NASA systems engineering guidance describes functional analysis, functional decomposition, system architecture, and interface management as means of understanding what a system must do and how system elements, relationships, dependencies, and interfaces contribute to higher-level requirements [1]. IEC 60812 provides a systematic failure-analysis framework for identifying how items or processes may fail to perform their functions and the effects of those failures [2]. ISO 704 and ISO 1087 provide established principles and vocabulary for terminology work, including disciplined relationships among objects, concepts, definitions, and designations [3,4].

Whole Quality does not reproduce any one of these established methods. Its distinct methodological synthesis is the use of a defined Quality Object and Function Realization as the basis for deriving Quality Factors and Quality Indicators; the separation of Quality Indicators from Quality Outcome Criteria; the separation of Applicable Basis, Reference Layer, and Evidence; the use of Failure-Mode Families as a completeness test; and the bounded progression from Evidence-Supported Findings and Quality Factor Interpretation to Quality State and Quality Claim.

The references below are methodological context, not sources of the WQI Authoritative Definitions. Those definitions are controlled by WQI_VOC1.

[1] National Aeronautics and Space Administration (NASA). NASA Systems Engineering Handbook. NASA/SP-2016-6105 Rev. 2. Washington, DC: NASA, 2016/2017.

[2] International Electrotechnical Commission (IEC). IEC 60812:2018, Failure modes and effects analysis (FMEA and FMECA). Geneva: IEC, 2018.

[3] International Organization for Standardization (ISO). ISO 704:2022, Terminology work — Principles and methods. Geneva: ISO, 2022.

[4] International Organization for Standardization (ISO). ISO 1087:2019, Terminology work and terminology science — Vocabulary. Geneva: ISO, 2019.

Conclusion

Whole Quality begins with the defined Quality Object, not with available Indicators, measurements, checklists, or documents.

The Quality Object is described at an adequate Methodological Resolution. Its Intended Functions and Intended Results are established, and Function Realization is examined within relevant Scale, Boundaries, Interfaces, Context, and Applicable Basis. Quality Factors organize the principal dimensions that must be understood. Quality Indicators identify what should be examined. Quality Outcome Criteria establish what is expected. Evidence supports Findings about what is actually found.

Evidence Quality, Evidence Sufficiency, and Uncertainty constrain what can responsibly be concluded. Evidence-Supported Findings are interpreted at the Quality Factor level. Critical Conditions and Non-Compensability are considered where applicable. The resulting Quality Determination establishes a bounded Quality State from which a responsible Quality Claim may be made.

Whole Quality does not create complexity. It provides a structured way to reveal and interpret the quality-relevant structure that already exists within the defined Quality Object.

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Whole-Quality Institute, “The Structure of Whole Quality: From the Defined Quality Object to a Responsible Quality Determination,” Foundational Article 1, Third Edition, September 2026.

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