



Boundaries in Whole Quality

Scale, Object Nature, Interfaces, and Quality Claims

Foundational Article 7 — Third Edition

Whole-Quality Institute

Quality cannot be determined responsibly if the Boundaries of the determination are unclear.

A Quality Claim may state that an infrastructure system is reliable, a support service is effective, or the health state of the human body is satisfactory. Without clearly established Boundaries, however, the claim remains incomplete.

Whole Quality therefore asks:

- What is the defined Quality Object?
- What Intended Function or Intended Functions are being considered?
- Which Intended Results are expected?
- Within what Boundaries are those Intended Results expected to be realized?
- Across which Interfaces does Function Realization occur?
- To what object, period, population, Lifecycle stage, operating condition, or circumstance does the Quality Determination apply?

FTA6 established that one Intended Function is realized through multiple Intended Results. FTA7 explains that those Intended Results cannot be interpreted responsibly unless their applicable Boundaries and relevant Interfaces are established.

Boundaries establish the scope within which the Intended Function or Intended Functions are interpreted, Function Realization is examined, Evidence is evaluated, the Quality State is determined, and the resulting Quality Claim remains valid.

The authoritative definitions of Boundary, Interface, and related Root Concepts are established in the Whole Quality Root Vocabulary Standard (WQI VOC1). This Foundational Article does not redefine those concepts. It explains their methodological role within Whole Quality.

WQI_VOC1 Revision 2.0 distinguishes four related questions: what the Quality Object is; at what Scale or extent it is defined; where its relevant Boundaries lie; and what Methodological Resolution is adequate for the intended Quality Determination. This article focuses on the third question while preserving those distinctions.

The recurring example introduced in FTA6 continues throughout this article. Assume that the defined Quality Object is:

Human Body Health

Within what Boundaries should its Intended Results be examined so that the resulting Quality Determination remains responsible and appropriately bounded?

FTA4 introduced Methodological Resolution. FTA7 continues that progression by showing that a Methodological Resolution adequate for the intended Quality Determination may establish more specific

Boundaries and reveal additional Interfaces while the defined Quality Object and the methodology remain unchanged.

1. Why Boundaries Matter

Whole Quality begins with the definition of the Quality Object. Once the Intended Function and Intended Results have been identified, a further question must be answered:

Within what Boundaries are the Intended Function and Intended Results expected to be realized and determined?

Boundaries do more than separate what is inside from what is outside. They establish the scope of methodological responsibility. Two determinations may examine the same defined Quality Object and reach different conclusions because they apply to different Boundaries. Neither conclusion is necessarily incorrect; each may address a different scope.

For example, one infrastructure determination may examine the whole Lifecycle, while another examines only operation. One health determination may concern the whole human body, while another concerns recovery following a specific injury. One support-service determination may concern the entire support arrangement, while another concerns one defined support period.

Accordingly, Boundaries shall be established before Quality Determination proceeds. As the intended Quality Determination requires, Boundaries may be established at a more specific level. The Quality Object remains unchanged; the scope of interpretation becomes more precisely defined.

1.1 Recurring Example — Human Body Health

For Human Body Health, possible Boundaries may include:

- the whole human body;
- one physiological system;
- one organ or tissue;
- one defined period of recovery;
- one stage of life;
- one medical episode.

These examples may represent different Boundaries of one determination or, where separately defined, different Quality Objects. A subsystem, organ, tissue, period, or episode does not automatically become a separate Quality Object merely because it is examined in detail. The distinction must be explicit in the intended Quality Determination.

2. Boundary Differences by Object Nature

The character and visibility of Boundaries depend partly upon the nature of the defined Quality Object. Whole Quality applies one methodology across different object types, but it does not assume that all Boundaries can be identified in the same way.

2.1 Human-Created and Technical Quality Objects

For human-created infrastructure, equipment, documents, or organizational systems, Boundaries may be intentionally designed, contractually assigned, physically marked, or defined through ownership and responsibility. Even so, functional and operational Boundaries may differ from physical ones.

2.2 Natural, Subsurface, and Environmental Quality Objects

For natural or subsurface objects, Boundaries may be gradual, uncertain, changing, or known only through indirect Evidence. The methodology must therefore distinguish the real object from the bounded representation used for determination and make remaining Uncertainty explicit.

2.3 Biological Quality Objects

Biological Boundaries may be physically identifiable at some levels, such as an organ or tissue, while remaining dynamic and highly interconnected at others. A boundary around one body system does not eliminate its dependence upon other systems or the surrounding environment.

2.4 Social, Relational, and Support-Service Quality Objects

For support services and other relational Quality Objects, Boundaries may be defined through persons, roles, responsibilities, settings, time periods, activities, and service relationships rather than through a physical enclosure. The supported person and the real conditions of Function Realization remain central to the determination.

Object nature therefore influences how Boundaries are identified, evidenced, and interpreted. It does not change the methodological requirement that every Quality Determination and Quality Claim remain appropriately bounded.

3. Boundaries and Interfaces

A Boundary establishes separation and scope. An Interface identifies a quality-relevant interaction at, across, or within that Boundary. The concepts are distinct but complementary.

An Interface may involve the exchange of matter, energy, information, people, services, responsibilities, influence, or another interaction relevant to Function Realization. Interfaces may be external, connecting the Quality Object with its surroundings, or internal, connecting constituent parts within the defined Quality Object.

3.1 External and Internal Interfaces

A natural gas pipeline transportation system has external Interfaces with production facilities, distribution systems, regulators, emergency responders, communities, and the natural environment. It also has internal Interfaces among pipeline segments, compressor stations, valves, monitoring systems, maintenance activities, and operating personnel.

Human Body Health has external Interfaces with the environment through respiration, nutrition, physical activity, microorganisms, medical interventions, and social conditions. It also has internal Interfaces among organs, body systems, tissues, cells, biochemical processes, and regulatory mechanisms.

3.2 Interfaces and Intended Results

Intended Results are rarely realized independently. Effective circulation of blood, for example, depends upon coordinated Interfaces among the heart, blood vessels, lungs, nervous system, endocrine regulation, kidneys, and other biological structures. Support-service Intended Results similarly depend upon interactions among the person receiving support, support professionals, family members, healthcare providers, employers, and community resources.

At a finer Methodological Resolution, additional Interfaces may become visible where relevant to the intended Quality Determination. The methodology does not create these interactions; it progressively reveals the interaction structure through which the Intended Function is realized, maintained, weakened, interrupted, or restored.

4. Boundaries, Quality State Determination, and Quality Claims

Whole Quality does not determine quality in the abstract. It determines the Quality State of a defined Quality Object within explicitly established Boundaries. Consequently, every Quality Determination is bounded, and the resulting Quality Claim is bounded as well.

4.1 Scope of Interpretation

A Quality Claim is valid only within the Boundaries in which the Quality Object, Intended Function, Intended Results, Function Realization, and Evidence were examined. Extending the claim beyond those Boundaries requires additional justification, additional Evidence, or a new Quality Determination.

4.2 Recurring Example — Human Body Health

A determination that a person's health state is satisfactory during a defined rehabilitation period does not automatically apply before the injury, after a later illness, throughout the person's lifetime, or under substantially different physiological conditions. A determination concerning one body system also does not automatically establish the Quality State of the whole human body.

4.3 Responsible Quality Claims

A responsible Quality Claim should remain consistent with:

- the defined Quality Object;
- the established Boundaries;
- the applicable Interfaces;
- the Methodological Resolution applied;
- the available Evidence;
- the purpose of the determination;
- the remaining Uncertainty and limitations.

Clearly established Boundaries make visible what has and has not been examined. They do not guarantee correctness, but they increase transparency and protect the methodology from unsupported generalization. A broader or stronger claim requires a correspondingly broader or stronger methodological basis.

4.4 Preparing for Quality Factors

After the Quality Object, Intended Function, Intended Results, Boundaries, and Interfaces have been established, Whole Quality can ask which principal dimensions of Function Realization should be examined. Those principal dimensions become the Quality Factors.

5. Methodological Sources and Related Work

Whole Quality is developed as a distinct cross-domain methodology. Established systems-engineering guidance provides relevant context for defining system boundaries, identifying internal and external Interfaces, and maintaining traceability between system elements and their interactions [1].

The WQI contribution in this article is the cross-domain treatment of Boundary and Interface as distinct controlled concepts within a Quality Determination, together with the requirement that the resulting Quality State and Quality Claim remain bounded by what was actually defined and examined. WQI_VOC1 remains authoritative for the controlled definitions.

References

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

Conclusion

Boundaries are a methodological foundation of responsible Quality Determination. They establish the scope within which the defined Quality Object, its Intended Function, Intended Results, Function Realization, Evidence, determined Quality State, and resulting Quality Claim remain valid.

Object nature influences how Boundaries are identified and evidenced. Interfaces identify the quality-relevant interactions occurring at, across, or within those Boundaries. As the intended Quality Determination requires, both may be represented more specifically while the defined Quality Object and the Whole Quality methodology remain unchanged.

Every Quality Claim must therefore remain bounded by the defined Quality Object, the completed determination, the applicable Evidence, and the Uncertainty and limitations that remain.

A Quality Object may have one or more Intended Functions. An Intended Function may be associated with one or more Intended Results.

A Quality Factor may be examined through multiple Quality Indicators.

A Quality Indicator may be interpreted through one or more applicable Quality Outcome Criteria.

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