

Online Resource 1

Article: When the record cannot decide: a framework for functional inference in archaeology, with an application to moai transport

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Caption: Gate 0 Archaeological Functional-Inference Audit — reusable field sheet, with the moai case worked through as an example and the prospective decision rules for each still-open component.

Supplementary material

Gate 0 — Archaeological Functional-Inference Audit (Field Sheet)

A reusable checklist for auditing any claim that a morphological attribute reflects task-specific function. Work through the questions in order; a 'no' at a Layer-1 stage (1–6) stops the inference at that stage with the stated reason, rather than treating it as a disconfirmed claim. Question 7 is the Layer-2 diagnostic; question 8 is prospective. The right-hand column shows the moai transport case worked through as an example.

#	Question	Stage / State	Worked example: moai
0	What is the observed attribute, and what construct does it claim?	—	Shoulder-to-base width ratio, claimed to show a base built wider for transport
1	Construct validity: does the attribute isolate the functional part?	Gate 0, stage 1 → S1	No — a ratio does not identify which part changed; the contrast is on the shoulder (A1a → S1)
2	Scale validity: is the contrast robust to body-size allometry?	Gate 0, stage 2 → S2	Yes — the ratio contrast survives size adjustment
3	Observability: is the variable recorded in all compared contexts?	Gate 0, stage 3 → S3	Ratio: yes. D-shaped outline: partially observed in road and platform contexts, which is what allows identification bounds to be computed; the continuous base angle is available for road statues only, with no comparison class (Component C → S3)
4	Identifiability: can absence be confused with non-observation?	Gate 0, stage 4 → S4	Yes — complete-case D-shaped frequencies do not identify population prevalence: road [8.1%, 71.0%] and platform [11.0%, 88.6%] bounds overlap (Component B → S4). Basal observability rises after detachment in absolute terms and becomes selectively elevated relative to matched non-basal descriptors in the road context, so the missingness is stage-structured
5	Precision: is the estimate	Gate 0, stage 5 → S5	Direct base width: CI excludes

	precise enough to matter?		widening beyond ~4%, but does not resolve small effects
6	Applicability: does the engineering hypothesis actually entail the tested pattern?	Gate 0, stage 6 → not applicable	Yes for the base-width prediction; recorded, not assumed
7	Functional specificity: does the contrast exceed negative controls / background?	Layer 2 → S6 / S7 / S8	Not demonstrated — candidate-minus-control d difference ~0 with a wide CI (residual contrast → S6); direct base evidence weighs against substantial absolute widening (>~4%), smaller effects unresolved (→ S8, directional)
8	What new data would change the state, and in which direction?	Prospective rescue	Component B: near-complete observation of road-stage bases (38 of 39, all non-D) would identify the ordering; a modest scan would not

How to use this sheet

Layer 1 (admissibility, questions 1–6): each stage asks whether the datum can bear the test, independently of the result. A failure here means the evidence is inadmissible for the specific claim — not that the claim is false. Record the stage of failure and its state (S1–S5), or proceed to Layer 2.

Layer 2 (diagnosis, question 7): reached only by components that clear admissibility. Functional specificity asks whether the contrast exceeds what tradition, style, selection, or record-formation would produce. Outcomes: S6 (admissible, non-specific), S7 (diagnostically supportive), or S8 (admissible evidence weighing against the prediction).

Prospective rescue (question 8): for any component that is non-identified under missingness (S4), the same worst-case bounds that establish non-identification also define the minimum future observation that would change the state. Record what data, at which stage, and in which direction each new observation would move the verdict. This converts ‘the record cannot decide’ into a quantified, falsifiable research design.

Prospective decision rules for the moai case

The following rules are stated prospectively: they specify, for each still-open component, which future observations would change its state and in which direction. They are decision rules we would apply to new data, not a pre-registration — the analysis here is retrospective, and we mark them as such honestly. Their purpose is to make the framework’s conclusions falsifiable by future fieldwork rather than adjustable after it.

Component / current state	Observation that would change the state	Adverse frontier: identifies ordering against the prediction	Supportive frontier: identifies ordering for the prediction
A2 base width (S8, directional)	Larger size-adjusted road sample; independent base-width measurement	Continued null or negative road effect within the current interval	A road-stage base wider than platform beyond ~4%, size-adjusted
B D-shaped outline (S4, non-identified)	Observation of currently unobserved road-stage and platform bases	Observe ≥38 of the 39 missing road bases, all non-D: road upper bound (~9.7%) drops below the platform lower bound (~11.0%), identifying road < platform	Road alone cannot identify road > platform: even all 39 road bases D gives a road lower bound of ~71.0% against a platform upper bound of ~88.6%. A supportive ordering needs a joint campaign—

			all 39 road bases D and ≈85 platform bases non-D (≈124 targeted observations)
A1 shoulder localization (S1/S6)	Independent chronological or workshop attribution	Contrast remains carried by shoulder / attributable to tradition	Base-specific change tied to transport context, separable from style
C base angle (S3, partly unobservable)	Base angle in degrees for platform and quarry statues, not only road	No measurable cross-stage angle difference	A stage-ordered angle gradient consistent with transport

These rows are the constructive output of the rescue frontier (Section 3.10): each names the data, the stage, and the direction that would move the verdict.

States: S0 not decomposed · S1 construct-invalid · S2 scale-confounded · S3 unobservable · S4 non-identified under missingness · S5 imprecise · S6 admissible but non-specific · S7 diagnostically supportive · S8 admissible evidence against the prediction.