

# Not Artefact, but Standard:

## Harappan Weight Metrology as Tiered Administrative Infrastructure

**GemsOfINDOLOGY**

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### Abstract

The Harappan weight system is not an archaeological curiosity. It is a tiered metrological architecture — binary-octal scaling for precision commodities, decimal scaling for bulk goods — that solved distinct administrative problems with distinct mathematical tools, deployed across a civilisation spanning over a million square kilometres, standardised to a base unit of 0.89 grams (Masha = 8 Ratti), and held stable across 500 or more excavated specimens with a mean deviation below 4%. That base unit was still in use in Mauryan coinage (Satamana: 100 Ratti; Karshapana: 32 Ratti), is recoverable from a cuneiform tablet recording Dilmun-Ur trade conversion rates (UET V, 796; Bibby 1970), and is still used by jewellers in Bharat today.

The Griffith-Müller tradition, which reads Harappan material culture as the remnant of a lost civilisation with no functional descendants, cannot account for this. A weight standard that persists for 5000 years in continuous operational use is not a relic. It is infrastructure. The colonial framing that called it archaeology, and the postcolonial state that legislated it out of official existence with the Standards of Weights and Measures Act (1956), are two moments in the same epistemological operation: the refusal to recognise functional knowledge as knowledge when it appears in South Asian sources.

### 1. The Problem with 'Artefact'

The colonial scholarly and archaeological tradition has a default label for Harappan material culture: artefact. The label performs a specific operation. It acknowledges the object while refusing to ask what it functionally means. A weight is an artefact. A weight system is infrastructure. A weight system that is still operational is a living administrative tradition. The distinction is not semantic — it determines whether the evidence is read as data about a dead civilisation or data about a functioning one. We read it as the latter.

Max Müller's interpretive framework, which read Indian material and textual culture as mythological and symbolic, set the template that Indological scholarship inherited and reproduced. Applied to Harappan material culture, this framework produces a specific blindness: it can describe the weights, catalogue them, and analyse their ratios, while remaining

constitutionally unable to ask whether the system they instantiate is still running. The 'lost civilisation' framing is not a neutral description. It is a conclusion built into the method.

The Harappan weight system was not lost. It was documented by British colonial administrators in their own unit conversion tables, where the Ratti appears as a known quantity requiring conversion to imperial units. It persisted through the Mauryan imperial system, the medieval period, the Mughal administrative apparatus, and 200 years of British colonial rule without interruption. The Indian Parliament abolished it in 1956. The word 'lost' belongs to the colonial framework, not the historical record.

## 2. The Architecture: A Designed Tiered System

The Harappan weight system is not one system. It is two systems, integrated into a single administrative framework. The first: binary-octal scaling, with weights doubling from the base unit upward — 1, 2, 4, 8, 16, 32, 64 Ratti. The second: decimal scaling, with weights at decimal multiples — 100, 200, 300, 1600, 3000 Ratti. A. S. Hemmy, analysing the weights recovered from the first excavations at Mohenjo-daro and Harappa, identified this dual structure in 1931. The smaller weights increased by a factor of two; the larger were decimal multiples of the smaller series. This observation has been confirmed by every subsequent analysis of the corpus.

The dual structure is not an accident of accumulation. It is the metrologist's solution to two genuinely different problems. The binary problem: given an indivisible object — a gold ornament, a gemstone, a pharmacological compound — how do you measure it precisely on a balance scale using the minimum number of counter-weights? Binary scaling solves this. With weights at 1, 2, 4, 8, 16, 32 Ratti, any value in that range is expressible as a unique combination. No fractional remainders. No ambiguity. The decimal problem: given a large bulk quantity — grain, copper, textile fibre — how do you count and aggregate it rapidly? Decimal scaling solves this. Multiples of ten are countable on fingers and combinable without specialist knowledge.

The Harappan metrologist who designed this system knew the difference between a jeweller's problem and a grain merchant's problem and built two tools. The Egyptian decimal system solves only the second problem, and less accurately. The Mesopotamian sexagesimal system is computationally elegant but requires specialist knowledge to operate at speed. The Harappan system is the most operationally efficient metrological design in the ancient connected world.

The binary logic is not historically confined to the ancient Indus. The carat system — still the global standard for gemstone and gold measurement — operates on binary subdivision. Modern digital computation is built entirely on binary logic. These are not coincidences. They are convergent solutions to the same mathematical problem: how to represent any value within a range using the minimum number of discrete units. The Harappan metrologist reached this solution for precious commodity measurement approximately 5000 years ago. The jewellers of Bharat who use the Ratti today are operating the same solution.

**Table 1: Harappan Weight Series — Binary-Octal and Decimal Registers with Gram Values**

Ratio	Ratti	Masha	Grams (approx.)	Series	Common Name / Use
1	1	1/8	0.11	Binary	Ratti — base unit; jewellery
2	2	1/4	0.22	Binary	Small gem weight
4	4	1/2	0.44	Binary	Half-masha
8	8	1	0.89	Binary	Masha — standard unit
16	16	2	1.76	Binary	Double masha
32	32	4	3.52	Binary	Karshapana base / Mauryan coin
64	64	8	5.63	Binary	Upper binary range
—	—	—	—	—	—
100	100	12.5	11.15	Decimal	Satamana coin (Gandharan)
200	200	25	22.30	Decimal	Bulk small commodity
300	300	37.5	33.45	Decimal	—
1600	1600	200	178.5	Decimal	Large bulk measure
3000	3000	375	334.5	Decimal	Largest standard unit

### 3. The Base Unit: Ratti, Masha, and the Stability Proof

The base unit of the Harappan system is the Ratti — the seed of *Abrus precatorius*, the Indian liquorice plant. Each seed weighs approximately 0.11 grams. Eight Ratti constitute one Masha (0.89 grams). The choice of a biological entity as the base unit is itself an administrative decision of precision. The mass of the *Abrus precatorius* seed is biologically stable across geography and season: the seed self-calibrates. Any trader, at any node of the network, can verify the standard against the seed without reference to a central calibration authority. The standard is distributed, self-certifying, and portable. This is not primitive — it is elegant.

The stability of the system across the full excavated corpus is the proof of its administrative rigour. Hemmy's analysis of weights from Mohenjo-daro, Harappa, and Chanhudaro — over 500 specimens spanning the full geographic range of the Harappan urban system — found that weights held to within 4% of their expected values across the entire series. This is not the variation profile of an approximate tradition. This is the variation profile of a manufactured system operating under real-world conditions of use, transport, and wear. The statistical analysis of the Marshall

(1934) dataset confirms that standardisation was not merely intended but achieved and maintained.

Mainkar (1984) established the continuity of the Harappan metrological tradition with later Indian weight systems, tracing the unit series through post-Harappan and Vedic period evidence. The Arthashastra of Kautilya (c. 300 BCE) contains detailed tables of weight standards for administrative purposes — the same administrative logic as the Harappan system, two millennia later. The unit is continuous. The logic is continuous. What changed is the political superstructure above the standard, not the standard itself.

#### 4. Continuity Through the Mauryan Period

The Ratti does not stop at the Harappan horizon. The Satamana coin — issued in Gandharan and pre-Mauryan contexts — averages 100 Ratti (11 to 12 grams). The Mauryan Karshapana averages 32 Ratti (3.5 grams). The ratio 32:100 is directly recoverable from the binary and decimal weight tables. The Ratti is the unit. The coin weights are denominated in it. This is not philological speculation — it is numismatic fact, confirmed by mass analysis of excavated coin specimens from Mauryan-period contexts.

The Karshapana at 32 Ratti is particularly significant. Thirty-two is 2 to the power of 5 — a pure binary value. The Mauryan state, administering the largest polity in South Asian history, chose a coin weight that sits precisely on the binary branch of the Harappan weight series. This is not coincidence. The Mauryan monetary system was designed to be compatible with the metrological infrastructure already in place. The Harappan standard was the foundation. The Mauryan currency was built on top of it.

The continuity argument is not romantic nationalism. It is a structural claim: that administrative systems are conservative, that metrological standards are especially conservative because their value depends on universal recognition and trust, and that the Ratti survived every political transition from the Harappan urban horizon to the Mauryan imperial system because it worked, was trusted, and was embedded in every level of commercial and administrative practice from the jeweller's shop to the state treasury.

**Table 2: Mauryan Coin Weights Denominated in Ratti**

Coin	Ratti Value	Gram Value (approx.)	Notes
Satamana (Gandharan)	100 Ratti	11–12 g	Pre-Mauryan and Mauryan; silver
Karshapana (Mauryan)	32 Ratti	3.5 g	Standard Mauryan silver punch-marked coin
Half Karshapana	16 Ratti	1.75 g	Binary subdivision confirmed

Coin	Ratti Value	Gram Value (approx.)	Notes
Masha (unit, not coin)	8 Ratti	0.89 g	Harappan base unit; persists as jewellery standard

5. The International Dimension: Dilmun, Ur, and the Trade Network Standard

The Harappan weight system was not parochial. Weights calibrated to the Harappan standard have been recovered at Dilmun (modern Bahrain), Ur (Mesopotamia), and Magan (modern Oman) — the three principal nodes of the ancient Gulf trade network. The Indus system was the anchor standard for a connected commercial zone that extended from the Indus delta to the rivers of Mesopotamia.

The critical evidence is the Ur cuneiform tablet UET V, 796. T. G. Bibby, in his 1970 analysis published in Kuml, demonstrated that the Dilmun weight standard — recoverable from weights excavated at Qalat al-Bahrain — mapped almost exactly onto the Indus weight scale. The Dilmun mina value in grams corresponds to the weight of the largest specimen found at Qalat al-Bahrain to within 0.5%, and aligns directly with the Indus series. Subsequent Cambridge Iraq scholarship has confirmed and refined this finding, establishing that the standard of Dilmun was the standard of Harappa.

The Ur tablet records a large copper consignment received at Dilmun in Dilmun weights and redistributed in Ur weights. The conversion ratio — recoverable from the tablet's arithmetic — is consistent with the Harappan-Dilmun equivalence. Slight discrepancies in the arithmetic are explained by brokerage: a commission charged by the agent, representing a deliberate 2% variance around the true exchange rate. The Indus system was not a peripheral participant in this network. It was the reference standard against which other systems were converted.

The comparative picture reinforces this. Egypt ran decimal weights at lower accuracy than the Harappan standard. Ur ran sexagesimal weights — computationally sophisticated but operationally complex. The Harappan system ran both binary-octal and decimal simultaneously, at higher accuracy than either comparator. The Indus was generating the metrological benchmark, not receiving influence from contemporary systems.

Table 3: Comparative Metrological Systems — Harappan, Egyptian, Mesopotamian, Dilmun

System	Base Unit (approx.)	Scaling Logic	Accuracy (deviation)	Comparative Assessment
Harappan (Indus)	0.89 g (Masha)	Binary-octal + decimal (dual)	<4% across 500+ specimens	Dual-system architecture; highest accuracy in the connected ancient world

System	Base Unit (approx.)	Scaling Logic	Accuracy (deviation)	Comparative Assessment
Egyptian	Qedet (~9.1 g)	Decimal (10:20:40:50:100:200)	Moderate	Single-system decimal; less accurate than Harappan standard
Mesopotamian — Ur	Shekel (~8.4 g)	Sexagesimal (base-60)	Moderate	Computationally rich; operationally complex; requires specialist knowledge
Dilmun (Bahrain)	Dilmun mina (~485 g)	Follows Indus scale	Confirmed by Bibby (1970) / Cambridge Iraq studies	Conversion rate recoverable from UET V, 796 cuneiform tablet

## 6. Continuity to the Present: Still in Use

Jewellers in Bharat use the Ratti today. This is not metaphor or historical analogy. The unit is in active use for gold and gemstone measurement — the precise commodity category for which the binary branch of the Harappan weight system was designed. Specimens of the *Abrus precatorius* seed are held at the National Museum, Delhi. The unit they define has been in continuous operational use for approximately 5000 years.

This single fact falsifies the 'lost civilisation' framing directly. A civilisation whose base unit of precious-commodity measurement is still in daily use by its descendant culture is not lost. Its administrative infrastructure is continuous. The framing of the Harappan as a lost civilisation — convenient to the colonial and diffusionist scholarly tradition, which required a clean break between the Indus and later South Asian culture to sustain the Aryan Migration framework — is contradicted by the evidence of living practice.

The continuity of the Ratti is not unique in this series. The continuity of water governance vocabulary from Kautilya's *Arthashastra* to contemporary village hydrology practice (Paper 5), the continuity of textile production systems from Harappan spindle whorl standardisation to medieval Indian cotton export (Paper 6), the continuity of domestic material knowledge from Vedic antimicrobial injunctions to contemporary practice (Paper 1) — all point in the same direction. Pre-modern South Asian knowledge systems were not interrupted by the end of the Harappan urban horizon. They were continuous. The colonial scholarly tradition required them to be interrupted, and manufactured the interruption through its interpretive choices.

## 7. The 1956 Act: Postcolonial Hardening in Its Metrological Form

The Indian Parliament passed the Standards of Weights and Measures Act in December 1956, effective 1 October 1958, adopting the International System of Units and formally replacing the indigenous weight standard with the metric system. This is postcolonial hardening in its clearest metrological form, and it requires being named as such.

The Ratti had survived 5000 years of administrative change without legislative abolition: the transition from Harappan urbanism to post-urban polities, the Mauryan imperial system, the medieval period, the Mughal administrative apparatus, and 200 years of British colonial rule. The British, characteristically, documented the Ratti in their own official unit conversion tables. They did not abolish it. They could not — it was embedded in every commercial practice they depended on. The Ratti persisted through empire because empire depended on it.

The postcolonial state abolished it. Independence transferred the colonial epistemological framework — the assumption that indigenous standards require replacement by European-derived systems — without interrogating its foundations, and then legislated it. The 1956 Act is not modernisation. It is the administrative completion of a project that began with Griffith reading Vedic domestic injunctions as religious prescription rather than functional knowledge. The logic is identical: an indigenous system that has demonstrated its functional superiority and operational longevity is displaced, not because it fails, but because the interpretive tradition cannot recognise it as knowledge.

The parallel with Book Chapter 7 of this series is direct. The Forest Acts (1865, 1878) were not repealed at independence — they were inherited and in some cases extended. The Five Year Plans replaced colonial canal irrigation policy with state-directed large dam construction following the same hydraulic logic that dismantled indigenous water governance. The 1956 Weights and Measures Act replaced the Ratti with the metric system following the same logic that dismantled indigenous metrology. The mechanism is identical across domains: colonial epistemology does not require colonial administrators. It requires only institutional investment in a narrative that cannot see functional South Asian knowledge as knowledge.

**Table 4: Continuity of the Ratti — From Harappan Horizon to the 1956 Act and Beyond**

Period	Date	Evidence	Unit
Harappan urban	c. 2800–1900 BCE	500+ chert cube weights; Hemmy (1931, 1938) analysis; sites include Mohenjo-daro, Harappa, Chanhudaro, Lothal, Dholavira	Masha / Ratti
Harappan trade network	c. 2100–1800 BCE	Weights calibrated to Harappan standard found at Dilmun (Bahrain) and Ur (Mesopotamia); Bibby (1970); Cambridge Iraq studies	Masha / Ratti
Pre-Mauryan	c. 600–300 BCE	Satamana coinage (Gandharan): avg. 100 Ratti (11–12 g); Mainkar (1984)	Ratti
Mauryan imperial	c. 300–185 BCE	Karshapana: 32 Ratti (3.5 g); Arthashastra references to weight standards; Kautilya's metrological tables	Ratti



Period	Date	Evidence	Unit
Medieval / Mughal	c. 600–1800 CE	Ratti recorded in British colonial unit tables; operational in jewellery and pharmacy trades throughout	Ratti
Colonial period	1757–1947	British document the Ratti in official unit conversion tables; do not abolish it	Ratti (recorded)
Postcolonial	1956 / 1958	Standards of Weights and Measures Act (December 1956, effective October 1958): metric system adopted; Ratti officially displaced from state administrative use	Ratti (displaced)
Present	2026	Ratti in active use among jewellers in Bharat for gold and gemstone measurement; National Museum, Delhi holds specimens	Ratti (operational)

## 8. Conclusion: What a Standard Is

A standard is not an artefact. An artefact is what a standard becomes when the interpretive tradition refuses to ask what it was for. The Ratti was a precision instrument, a trade protocol, a distributed calibration system, and an administrative technology. It solved the jeweller's problem and the grain merchant's problem simultaneously, using binary-octal and decimal scaling as two branches of a single integrated framework. It anchored a trade network that extended from the Indus delta to Mesopotamia. It denominated the coinage of the Mauryan empire. It is still in the hands of jewellers today.

The Griffith-Müller tradition called it archaeology. The postcolonial state called it obsolete. Both judgements belong to the same epistemological operation: the refusal to recognise functional knowledge as knowledge when it appears in South Asian sources. The evidence does not support either judgement. It supports a different conclusion: that the Harappan metrological system was one of the most sophisticated administrative technologies produced by any ancient civilisation, that it solved problems that other contemporary systems did not solve, that it was operationally continuous for five millennia, and that its displacement was not a natural consequence of progress but a specific act of colonial and postcolonial epistemological violence.

We name it as such.

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