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Competition Between Organizational Modes and Performance in Morocco's Water Sector: Turning Rivalry into Results

Compétition entre les modes d'organisation et performance dans le secteur de l'eau au Maroc : transformer la rivalité en résultats

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Abstract

Using a cross sectional survey of Moroccan water professionals (n=90) and a user module (n=120), this study quantifies how four faces of competition between organizational modes shape performance. Partial least squares structural equation modeling, mirrored by robust OLS, shows: internal competition improves operational efficiency; external competition elevates service quality; award stage competition strengthens financial viability; and institutional diversity/rivalry increases innovation and environmental performance. Effects are medium in size with out of sample predictive relevance. Findings translate into an actionable roadmap: public benchmarking, pro contestability incentives for quality, value for money procurement design, and green innovation clauses. Together, these levers convert rivalry into durable results for utilities and users.

Keywords: Organizational mode competition; Water sector (Morocco); Public–private partnerships; PLS SEM; Performance outcomes.

Résumé

À partir d'une enquête transversale menée auprès de 90 professionnels marocains du secteur de l'eau et d'un échantillon d'usagers (n=120), cette étude quantifie l'influence de quatre dimensions de la concurrence entre les différents modes d'organisation sur la performance. La modélisation par équations structurelles aux moindres carrés partiels (PLS-SEM), corroborée par une analyse robuste aux moindres carrés ordinaires (OLS), révèle que : la concurrence interne améliore l'efficacité opérationnelle ; la concurrence externe rehausse la qualité du service ; la concurrence lors de l'attribution des marchés renforce la viabilité financière ; et la diversité/rivalité institutionnelle stimule l'innovation et améliore la performance environnementale. Les effets observés sont d'une ampleur moyenne et présentent une pertinence prédictive hors échantillon. Ces résultats se traduisent par une feuille de route concrète : analyse comparative publique, incitations à la concurrence pour une meilleure qualité, conception des marchés publics optimisée et clauses d'innovation verte. Ensemble, ces leviers permettent de transformer la rivalité en résultats durables pour les services publics et les usagers.

Mots-clés : Concurrence entre les modes d'organisation ; Secteur de l'eau (Maroc) ; Partenariats public-privé ; PLS-SEM ; Performance.

1. Introduction

Although potable water services are natural monopolies at the point of delivery, policymakers increasingly engineer competition by design—through benchmarking, credible entry threats, competitive tendering, and institutional pluralism—to discipline costs, lift service quality, secure value-for-money, and accelerate green innovation. Morocco is no exception: a diversified governance landscape (direct public management, delegated management, concessions, and BOT-style PPPs for desalination and wastewater) sits alongside a modern PPP law (Law 86-12), while scarcity pressures sharpen the demand for efficient, resilient service models. Consequently, the sector offers an ideal empirical setting to test how distinct organizational competition modes map onto multi-dimensional performance in water PPPs. (Ministry of Finance, Morocco, 2014; Kettani, 2018).

Yet the literature remains fragmented across silos. One stream, rooted in yardstick competition, shows that relative performance comparisons among "monopoly" providers can mimic pressure from markets and reduce X-inefficiency; another emphasizes contestable markets, arguing that credible threats of entry and international comparison move operators toward higher quality; a third demonstrates that auction/procurement design determines whether competitive tendering yields durable value-for-money; a fourth—polycentric governance—posits that institutional diversity catalyzes experimentation and environmental innovation. Bringing these strands together, and translating them into testable propositions for Morocco's water PPPs, is both theoretically meaningful and practically urgent given fiscal constraints and climate risks. (Shleifer, 1985; Ofwat, 2019; Estache & Iimi, 2008; Ostrom, 2010).

Consistent with the survey-based framework summarized in the companion chapter on empirical results, we interrogate four competition constructs—Internal Competition (CI; benchmarking/yardstick), External Competition (CE; entry/substitution pressure and international comparison), Procurement Competition (CP; intensity and design at award), and Diversity/Rivalry across Modes (DR; institutional pluralism)—and four performance constructs—Operational Efficiency (EO), Service Quality (QS), Financial Viability (VF), and Innovation & Environmental Performance (IPE). These dimensions align with recognized utility KPIs (e.g., NRW, outage frequency, compliance with water quality standards) and with contemporary regulatory scorecards (e.g., C-MeX/D-MeX). (IBNET, 2014; Ofwat, 2021).

Research problem. Despite abundant case evidence, we lack an integrated, construct-level test of which form of competition most strongly predicts which facet of performance when all channels operate simultaneously. Our problem statement is therefore: *In Morocco's water*

PPPs, which competition levers—internal yardstick rivalry, external contestability, award-stage competition, or institutional diversity—most powerfully explain variance in efficiency, quality, financial viability, and eco-innovation once context is controlled? (Marin, 2009; OECD, 2015).

Hypotheses. Guided by theory and sector practice, we articulate four directional hypotheses:

- **H1 (CI → EO).** Internal yardstick competition (public benchmarking, transparent KPIs, credible mode switching) improves operational efficiency (NRW, repair times, unit OPEX). (Shleifer, 1985; Berg & Marques, 2011).
- **H2 (CE → QS).** External competition (credible entry/substitution, international yardsticks) raises service quality (compliance, continuity, user experience). (Baumol, Panzar, & Willig, 1982; Ofwat, 2019).
- **H3 (CP → VF).** Strong, well-designed procurement competition (effective number of bidders, MEAT/value-for-money criteria, anti-collusion, re-tendering options) enhances financial viability (cash-flow coverage, VfM adherence, predictable indexation). (Estache & Iimi, 2008; Decarolis, 2014; EPEC/EIB, 2015; NAO, 2023).
- **H4 (DR → IPE).** Greater diversity/rivalry among organizational modes fosters innovation and environmental performance (smart metering, leakage analytics, reuse, quantified CO_2 targets) via polycentric learning and dynamic competition. (Ostrom, 2010; Aghion et al., 2005; Ambec et al., 2013; Cheng et al., 2023).

We proceed by situating these hypotheses in the literature and by clarifying how we operationalize constructs for empirical testing.

Table 1. Hypotheses matrix and expected signs (summary)

Hypothesis	Competition driver (X)	Performance outcome (Y)	Expected sign	Rationale (abridged)
H1	Internal competition (CI)	Operational efficiency (EO)	+	Yardstick/benchmarking disciplines costs and routines
H2	External competition (CE)	Service quality (QS)	+	Contestability and reputational yardsticks push quality up
H3	Procurement competition (CP)	Financial viability (VF)	+	Depth and design of tendering secure VfM over lifecycle
H4	Diversity/rivalry (DR)	Innovation & environmental performance (IPE)	+	Polycentric rivalry spurs experimentation and diffusion

Source: Author synthesis based on Shleifer (1985); Baumol et al. (1982); Estache & Iimi (2008); Decarolis (2014); EPEC/EIB (2015); Ostrom (2010); Aghion et al. (2005); Ambec et al. (2013); Ofwat (2019).

2. Literature review

2.1. From yardstick competition to external contestability in network utilities

First, the yardstick competition tradition argues that even when markets are local monopolies, relative comparisons among peer operators can recover part of the discipline of competitive markets. In Shleifer's canonical model, regulated firms' payoffs depend on how they perform vis-à-vis a reference group, which induces effort and curbs slack; empirical applications to water utilities show that robust benchmarking systems are associated with reductions in operating costs and non-revenue water when data are audited and the incentive consequences are credible. (Shleifer, 1985; Berg & Marques, 2011).

Second, yardstick mechanisms have migrated into modern regulatory toolkits. The UK's water regulator Ofwat embedded comparative outcomes into PR19 via C-MeX/D-MeX and broader Outcomes Delivery Incentives (ODIs), operationalizing reputational and financial consequences around service quality and customer experience. The policy logic is simple: if customers perceive lagging performance relative to a public league table—and if part of allowed revenues depends on that score—operators re-optimize toward higher quality even absent head-to-head product market rivalry. (Ofwat, 2019; Ofwat, 2024; Ofwat, 2021).

Third, the contestable markets lens complements yardstick logic: when credible entry or substitution threats exist (e.g., alternative technical systems, re-tendering windows, or benchmarking against international peers), incumbents behave competitively "as if" rivals were present. In water, credible re-tendering and cross-jurisdictional comparisons have been linked to improved service continuity and compliance—particularly where regulators publish transparent quality scorecards and trigger review if performance slides. (Baumol, Panzar, & Willig, 1982; Marin, 2009; OECD, 2015).

Fourth, cross-country evidence underscores the service-quality channel: in Argentina, the privatization of water services was associated with statistically significant reductions in child mortality, plausibly mediated by water quality and continuity improvements; in Chile, the combination of private participation with a strong sector regulator (SISS) consolidated high compliance and 24/7 continuity in urban areas. While ownership per se is not the focus here, these studies illustrate that external pressure plus credible governance can lift service results—our H2 mechanism. (Galiani, Gertler, & Schargrodsky, 2005; Bitrán & Valenzuela, 2003).

When internal yardsticks are visible and external contestability is credible, we expect higher EO (through disciplined operations) and higher QS (through reputational and regulatory

pressure), provided metrics are well-designed and audited to deter gaming. (Shleifer, 1985; Ofwat, 2019; Berg & Marques, 2011).

Table 2. Construct map—competition and performance constructs (with typical indicators)

Construct	Short label	Typical indicators used in water utilities
Internal competition	CI	Publication of KPIs by mode/area; intra-jurisdiction benchmarking; credible options to switch mode
External competition	CE	Number/quality of potential entrants; exposure to alternative technical solutions; international benchmarking
Procurement competition	CP	Effective number of bidders; tender design (MEAT vs price-only); transparency/anti-collusion; re-tendering clauses
Diversity/rivalry of modes	DR	Coexistence of public/direct, DSP, concession, BOT/PPP; presence of "learning-by-comparison" forums
Operational efficiency	EO	NRW, mean repair time, OPEX/m^3
Service quality	QS	Compliance with WHO/ISO standards; outage frequency; complaint resolution; customer experience indices (e.g., C-MeX)
Financial viability	VF	Cash-flow coverage of debt/capital; adherence to VfM case; tariff indexation predictability
Innovation & environmental performance	IPE	Smart metering/telemetry; leakage analytics; reuse/valorization; quantified CO_2 targets/bonus–malus

Source: Author from IBNET Blue Book (2014), Ofwat (2019; 2021), OECD (2015).

2.2. Why procurement competition shapes financial viability in PPPs

To begin with, competition at the point of award is often the single strongest predictor of long-run value-for-money in infrastructure contracts. Using multi-country procurement data, Estache and Iimi (2008) showed that prices fall and allocative efficiency rises with the effective number of bidders, with diminishing returns beyond a threshold; critically, the gain depends on auction design, information disclosure, and barriers to entry. In water/roads markets, shallow competition (few bids) systematically erodes efficiency. (Estache & Iimi, 2008).

Moreover, not all "competition" is created equal: when tenders are awarded on price alone, the apparent savings at t_0 are frequently clawed back via renegotiations and change orders, undermining VfM. Decarolis (2014) quantified this effect in Italian public works, finding that price-only awards lost up to half of ex-ante savings ex-post. This insight generalizes to PPPs: MEAT/value-for-money criteria that weight life-cycle performance and quality, combined with credible enforcement, dominate price-only rules for complex services like water. (Decarolis, 2014).

In the same vein, guidance from the European PPP Expertise Centre (EPEC/EIB) codifies VfM analysis across project pipelines, emphasizing: (i) well-prepared business cases; (ii) transparent

and competitive procurement; (iii) optimal risk allocation; and (iv) ex-post performance monitoring. These principles mirror the mechanisms we capture under CP and anticipate a positive CP → VF linkage. (EPEC/EIB, 2015).

Furthermore, public audit bodies warn that single-bidder awards and limited bidder pools are persistent risks. The UK National Audit Office (2023) documents opportunities to save billions by reducing "single bidding," improving pipelines, and standardizing documentation; the European Court of Auditors reaches similar conclusions for EU funds, flagging weak competition as a recurrent source of poor outcomes. These reports reinforce why intensity and quality of tendering matter for financial viability. (NAO, 2023; European Court of Auditors, 2023).

Finally, Moroccan statute Law 86-12 provides a supportive legal foundation—equal access, transparency, and the possibility of competitive dialogue—for award processes that internalize quality and life-cycle costs. In desalination PPPs and complex wastewater schemes, this framework enables "competition for the market" to secure sustainable VfM if implemented with deep bidder pools and MEAT-style evaluation. (Kingdom of Morocco, 2014; Kettani, 2018).

The depth (enough serious bidders) and design (MEAT, transparency, re-tendering) of procurement competition should be positively associated with VF, net of context—precisely the mechanism we test under H3. (Estache & Iimi, 2008; Decarolis, 2014; EPEC/EIB, 2015; NAO, 2023).

Table 3. Award-stage design levers—micro-mechanisms and expected financial effects

Design lever	Micro-mechanism	Expected effect on VF
Sufficient bidder pool (≥ 5–7 bids in complex markets)	Reduces market power/collusion; sharper price–quality trade-offs	Lower whole-life cost; stronger cash-flow margins
MEAT/value-for-money criteria	Selects on life-cycle cost & quality, deters "race-to-the-bottom" bids	Fewer renegotiations; VfM case holds over time
Standardized docs & early data	Lowers bid costs; attracts entrants; improves comparability	More bids; tighter spreads; better bankability
Anti-collusion & transparency	Raises expected penalty for cartel behavior	Sustainable pricing; reduced rent capture
Re-tendering/termination options	Maintains credible threat of replacement	Enforces discipline; protects downside for grantor

Source: Author from Estache & Iimi (2008); Decarolis (2014); EPEC/EIB (2015); NAO (2023); European Court of Auditors (2023).

2.3. Diversity of organizational modes, innovation, and environmental performance

At root, the proposition that institutional diversity boosts innovation draws on polycentric governance: multiple, partially autonomous centers of decision-making experiment, learn, and

emulate, producing higher aggregate performance than monocentric systems when problems are complex and contexts heterogeneous. In water, plural regimes (direct public, DSP, concession, PPP/BOT) create comparative "windows"—operators observe peers' solutions (e.g., leakage analytics, smart meters, effluent reuse) and update. (Ostrom, 2010; Jordan et al., 2018).

Additionally, the innovation literature predicts an inverted-U between competitive pressure and innovation intensity: rivalry spurs innovation among "neck-and-neck" firms up to a point; beyond that, excess pressure discourages laggards. Translated to governance rivalry, diversity/rivalry (DR) should foster eco-innovation if rivalry is sufficient but not crushing, and if incentives recognize green outcomes (e.g., carbon targets, reuse metrics). (Aghion et al., 2005; Ambec, Cohen, Elgie, & Lanoie, 2013).

Recent empirical studies in wastewater PPPs support this channel. Using quasi-experimental designs in China, researchers find that PPP adoption and competitive award are associated with higher environmental efficiency (UWTE), and lower pollutant discharges, especially where contracts embed explicit performance incentives. While contexts differ, the mechanism—competition plus credible environmental clauses—is portable to other polycentric settings. (Cheng et al., 2023; Hou, Wei, & Fan, 2022; Wen, Wang, & Li, 2024).

In practice, policy instruments can steer rivalry toward green outcomes. The European Commission's Green Public Procurement (GPP) and innovation-oriented procurement guidelines encourage contracting authorities to embed environmental criteria and life-cycle costing, thereby creating demand-pull for eco-innovation. Combining GPP with comparative disclosure (e.g., leak rates, energy intensity, CO_2 per m^3) converts institutional rivalry into measurable environmental performance. (European Commission, 2016; OECD, 2024).

For Morocco, the coexistence of governance modes and the roll-out of capital-intensive desalination (often via PPP) open a natural laboratory for DR → IPE: pilots in smart distribution, renewable-powered plants, and reuse can scale faster when learning loops operate across modes under comparable metrics. To keep rivalry productive, environmental goals must be audited and incentivized (e.g., bonus–malus on CO_2 or leakage reduction), consistent with H4's design logic. (Kettani, 2018; Kingdom of Morocco, 2014).

Diversity/rivalry among modes should associate positively with IPE when (i) outcomes are measured and published; (ii) incentives target green results; and (iii) procurement remains competitive to prevent lock-in. (Ostrom, 2010; Aghion et al., 2005; Cheng et al., 2023).

3. Positioning and contributions

Contribution 1. We synthesize four literatures—yardstick competition, contestability, procurement/tender design, and polycentric innovation—into a construct-level, multi-outcome map for water PPPs. This integrated lens clarifies which lever is theoretically most aligned to which performance dimension and motivates the focused hypotheses H1–H4. (Shleifer, 1985; Estache & Iimi, 2008; Ofwat, 2019; Ostrom, 2010).

Contribution 2. By aligning CI/CE/CP/DR with EO/QS/VF/IPE and mapping to standard KPIs (IBNET; C-MeX), we ensure that theoretical mechanisms are measurable with sector-credible indicators, facilitating replication beyond Morocco. (IBNET, 2014; Ofwat, 2021).

Contribution 3. Each hypothesized linkage corresponds to actionable levers (benchmarking design, market contestability, procurement design, green clauses) that authorities can pull within existing legal frameworks (e.g., Law 86-12). Thus, the empirical tests directly inform the targeting of reforms. (Kingdom of Morocco, 2014; NAO, 2023; EPEC/EIB, 2015).

4. Hypotheses restated for empirical testing

- H1 (CI → EO): Jurisdictions with stronger internal benchmarking and credible intra-mode comparison will report lower NRW, shorter repair times, and lower OPEX/m³. (Shleifer, 1985; Berg & Marques, 2011).
- H2 (CE → QS): Jurisdictions with higher external contestability and international comparison will report higher compliance, fewer unplanned interruptions, and better customer experience. (Baumol et al., 1982; Ofwat, 2019; Marin, 2009).
- H3 (CP → VF): Projects awarded under deeper, MEAT-based competition will exhibit stronger cash-flow coverage and fewer renegotiations relative to price-only awards. (Estache & Iimi, 2008; Decarolis, 2014; EPEC/EIB, 2015; NAO, 2023).
- H4 (DR → IPE): Systems with greater institutional diversity/rivalry will report higher adoption of green technologies and more frequent contractual climate targets. (Ostrom, 2010; Aghion et al., 2005; Ambec et al., 2013; Cheng et al., 2023).

5. Methodological anchors for constructs (pre-analysis scaffolding)

To ensure clarity for readers of results, **Table 4** summarizes how constructs appear in sector practice and where reference indicators originate.

Table 4. Indicators and data anchors for each construct (for transparency before results)

Construct	Examples of item content (abridged)	External anchor
CI	"Regular benchmarking between modes"; "Public diffusion of internal indicators"; "Credible option to switch mode"	Yardstick competition theory; regulator scorecards
CE	"Threat of new entrants"; "Pressure from alternative technologies (e.g., desal, decentralized systems)"; "International comparison in use"	Contestable markets; cross-jurisdiction league tables
CP	"Number of effective bidders"; "MEAT/value-for-money criteria over price-only"; "Transparent, re-tenderable arrangements"	EPEC/EIB VfM guidance; NAO/ECA audit criteria
DR	"Coexistence of multiple organizational forms"; "Tools for comparative analysis across modes"; "Contractual encouragement of experimentation"	Polycentric governance; innovation procurement/GPP
EO	NRW; mean time to repair (MTR); OPEX/m^3	IBNET Blue Book KPI set
QS	Compliance with WHO/ISO standards; unplanned outages; C-MeX customer experience	Ofwat ODIs, C-MeX/D-MeX
VF	Debt-service coverage; adherence to VfM business case; indexation predictability	EPEC/EIB VfM and affordability tests
IPE	Smart meters/telemetry; analytics; reuse; explicit CO_2 clauses	GPP/innovation procurement playbooks

Source: Author from IBNET (2014); Ofwat (2019, 2021); EPEC/EIB (2015); European Commission (2016); OECD (2015).

6. Methodology

6.1. Research design and positioning (quantitative approach)

Building directly on Part I, we adopt a quantitative, cross-sectional design to test the directional hypotheses H1–H4 linking four forms of competition between organizational modes (internal, external, at award, and institutional diversity/rivalry) to four performance dimensions (operational efficiency, service quality, financial viability, and innovation & environmental performance). This choice is consistent with current guidance for testing theoretically grounded models with multiple latent constructs measured by short Likert scales, while balancing explanatory and predictive goals (Hair, Hult, Ringle, & Sarstedt, 2017; Hair & Alamer, 2022). Methodologically, we combine (i) partial least squares structural equation modeling (PLS-EM) to estimate the measurement and structural models under realistic distributional assumptions and modest sample sizes, with (ii) robust multiple regressions (OLS-HC3) as a transparent robustness mirror, thereby cross-checking the stability of signs, magnitudes and inferences (Hair et al., 2017; MacKinnon & White, 1985).

6.2. Population, frame, sample and power

The target population comprises professionals engaged in the Moroccan water sector across the four families described (operators, granting authorities/municipalities, central administration/basin agencies, external experts/controllers), plus a complementary user panel for service-quality cross-checks. The sampling frame was constructed from: (a) operator and

supervisory rosters, (b) lists of municipal concession units, and (c) professional networks of controllers/consultants. We implemented proportionate stratification by family and region (North/Centre/South), then invited 145 professionals; 90 complete responses were retained after quality screens (validity checks, straight-lining, and attention items), yielding a response rate of 62.1 %. Parallelly, the optional user module for Quality of Service gathered 120 household responses (see Part I §1.3 for descriptive statistics).

Given four endogenous constructs and paths of medium size, the achieved sample ($n = 90$) meets typical power thresholds for PLS-SEM with 4–6 predictors per equation (min. 68–80 for 80 % power under medium effects), while still warranting cautious interpretation and extensive robustness checks (Hair et al., 2017).

6.3. Instrument and measures

The instrument is a structured questionnaire organized in three blocks: (A) respondent profile; (B) competition constructs; (C) performance constructs. All multi-item scales use 5-point Likert response formats (1 = "strongly disagree" to 5 = "strongly agree") and were drafted from the conceptual definitions and item families developed in Part I, then refined by expert review and a pilot ($n = 18$). Internal consistency is gauged by Cronbach's α (target ≥ 0.70), complemented by composite reliability and rho_A (≥ 0.70), average variance extracted (AVE) (≥ 0.50), and indicator loadings (≥ 0.70) (Cronbach, 1951; Fornell & Larcker, 1981; Henseler, Ringle, & Sarstedt, 2015; Hair et al., 2017).

Discriminant validity is assessed by the Fornell-Larcker criterion and HTMT ratios (threshold < 0.85), which remain the recommended pair in reflective models; multicollinearity is monitored through VIF values, interpreted conservatively in line with O'Brien's caution against mechanical rules-of-thumb (Henseler et al., 2015; O'Brien, 2007).

To mitigate and diagnose common method bias (CMB), we (i) separated blocks B and C, (ii) used mixed item keying, (iii) guaranteed anonymity and non-evaluation, and (iv) inserted attention checks. Diagnostics include Harman's single-factor test, a single-factor CFA comparison, and a marker-variable approach; interpretation follows Podsakoff, MacKenzie, Lee & Podsakoff (2003).

6.4. Data collection, distribution and fieldwork window

Data were collected between March and May 2025 through a dual-mode distribution:

- **Targeted e-mailings** embedding a personalized link and unique token (three follow-up waves at days 7/14/28).

- **On-site distribution** (paper-pencil with subsequent digital capture) during two sectoral meetings (Rabat/Casablanca), supervised by trained research assistants.

The professional module logged 90 valid completes (out of 145 invitations), while the user module reached 120 completes (door-to-door in three communes, quota-balanced for income and gender). Missingness on item-level never exceeded 3 % per scale; we used listwise deletion for scale composites (given MCAR patterns from Little's test, not shown) and pairwise for descriptive tables. This pragmatic handling is standard in organizational surveys when missingness is low and random (Hair et al., 2017).

7. Results

7.1. Fieldwork outcomes and response structure

Table 5 summarizes fieldwork outcomes; by design, the realized sample mirrors sectoral strata and macro-regions used as controls in Part I, enabling multi-group and sensitivity checks.

Table 5 — Fieldwork outcomes and response rates (professionals, March–May 2025)

Stratum	Invited (N)	Completes (n)	Response rate (%)
Operators (ONEE / Delegates)	60	38	63.3
Grantors / Municipalities	36	22	61.1
Central administration / Basin agencies	19	12	63.2
External experts / Controllers	30	18	60.0
Total	145	90	62.1

***Source: Author's survey, 2025; field logs. ***

Strata balances and regional dispersion support both **descriptive readability** and **model-based inference** (Hair et al., 2017).

7.2. Measurement model: reliability, convergent and discriminant validity

All reflective blocks meet (and often exceed) minimum reliability and convergence standards. Cronbach's α and CR are ≥ 0.79 across constructs; AVE is ≥ 0.60, indicating that a majority of indicator variance loads on its intended latent factor (Cronbach, 1951; Fornell & Larcker, 1981; Hair et al., 2017).

Table 6 — Reliability and convergent validity (reflective blocks; professionals, n = 90)

Construct	k	α	rho_A	CR	AVE
Internal competition (CI)	4	0.83	0.84	0.88	0.64
External competition (CE)	4	0.82	0.83	0.87	0.60
Award competition (CP)	4	0.85	0.86	0.89	0.67
Diversity/rivalry of modes (DR)	4	0.80	0.81	0.86	0.60
Operational efficiency (EO)	3	0.79	0.80	0.87	0.69
Service quality (QS, managers)	4	0.84	0.85	0.89	0.67
Financial viability (VF)	3	0.81	0.82	0.88	0.71
Innovation & env. performance (IPE)	4	0.86	0.87	0.90	0.69

Source: Author's calculations (SmartPLS 4), 2025. Criteria per Cronbach (1951), Fornell & Larcker (1981), Hair et al. (2017).

Discriminant validity holds: on the Fornell-Larcker matrix, √AVE on the diagonal exceeds all off-diagonal correlations; on HTMT, all ratios are < 0.85. These complementary diagnostics reduce the risk of construct conflation in the structural model (Fornell & Larcker, 1981; Henseler et al., 2015).

Table 7— Discriminant validity (Fornell–Larcker, diagonal = √AVE)

	CI	CE	CP	DR	EO	QS	VF	IPE
CI	0.80	0.32	0.29	0.35	0.45	0.28	0.26	0.33
CE		0.77	0.31	0.30	0.22	0.41	0.24	0.27
CP			0.82	0.34	0.25	0.23	0.49	0.26
DR				0.77	0.27	0.26	0.28	0.43
EO					0.83	0.38	0.36	0.31
QS						0.82	0.33	0.29
VF							0.84	0.30
IPE								0.83

Source: Author's calculations (SmartPLS 4), 2025. Thresholds: √AVE > correlations (Fornell & Larcker, 1981).

Table 8 — Discriminant validity (HTMT ratios)

Pair (example)	HTMT
CI–CP	0.44
CI–DR	0.52
CE–QS	0.61
CP–VF	0.67
DR–IPE	0.63
HTMT_max	0.67

*__Source__: Author's calculations (SmartPLS 4), 2025. Criterion: HTMT < 0.85 (Henseler et al., 2015). *

Common method bias checks are reassuring: the first unrotated factor in Harman's test explains < 30 % of variance; a single-factor CFA fits substantially worse than the blocked model; and including a marker variable barely changes path estimates, exactly as recommended (Podsakoff et al., 2003).

7.3. Structural model (PLS-SEM): main paths, collinearity, and predictive metrics

Before turning to coefficients, we verified collinearity: all inner VIF values ranged 1.36–1.93, comfortably below conservative caution ranges (O'Brien, 2007).

Table 9— Collinearity diagnostics (inner VIF by endogenous)

Endogenous	CI	CE	CP	DR
EO	1.72	1.38	1.41	1.55
QS	1.36	1.81	1.42	1.50
VF	1.40	1.39	1.93	1.47
IPE	1.51	1.44	1.46	1.88

*__Source__: Author's calculations (SmartPLS 4), 2025. Interpretation per O'Brien (2007). *

Table 10 — Structural paths (standardized), bootstrap (5,000 resamples)

Hypothesized path	β	t	p	Result
H1: CI → EO	0.31	3.02	0.003	**Supported**
H2: CE → QS	0.27	2.76	0.006	**Supported**
H3: CP → VF	0.35	3.46	0.001	**Supported**
H4: DR → IPE	0.29	2.99	0.003	**Supported**
Non-target spillovers (e.g., CE → EO)	0.07	0.89	0.375	n.s.

Source: Author's calculations (SmartPLS 4), 2025. Bootstrap percentile CIs (not shown) exclude 0 for supported paths. Method references: Hair et al. (2017); Henseler et al. (2015).

Endogenous R^2 (adjusted) are EO = 0.41, QS = 0.36, VF = 0.43, IPE = 0.38; Stone-Geisser Q^2 are all > 0, indicating in-sample predictive relevance; PLSpredict outperforms linear baselines on MAE for each endogenous, consistent with the model's predictive intent (Stone, 1974; Geisser, 1975; Shmueli et al., 2019).

Table 11 — Model fit and predictive relevance (PLS-SEM)

Metric	EO	QS	VF	IPE
R^2 (adjusted)	0.41	0.36	0.43	0.38
Q^2 (blindfolding)	0.22	0.19	0.24	0.20
PLSpredict (MAE, PLS < LM)	✓	✓	✓	✓

Source: Author's calculations (SmartPLS 4), 2025. Q^2 per Stone (1974) & Geisser (1975); PLSpredict per Shmueli et al. (2019).

7.4. Robustness mirror: OLS with HC3 robust errors

To verify that substantive conclusions do not hinge on PLS-SEM only, we estimated four OLS equations (one per performance construct), with standardized predictors, HC3 robust errors, and the same conditioning set. The pattern replicates PLS-SEM: CI predicts EO (β = 0.33; p = 0.002), CE predicts QS (β = 0.38; p < 0.001), CP predicts VF (β = 0.41; p < 0.001), and DR predicts IPE (β = 0.45; p < 0.001). This convergence increases confidence that the effects are not model-artefacts (MacKinnon & White, 1985).

Table 12 — OLS (HC3) robustness: standardized betas and p-values

DV	Key predictor	β	p	R^2_adj
EO	CI	0.33	0.002	0.31
QS	CE	0.38	< 0.001	0.35
VF	CP	0.41	< 0.001	0.36
IPE	DR	0.45	< 0.001	0.38

Source: Author's calculations (R 4.3.2), 2025. Robust errors HC3 per MacKinnon & White (1985).

7.5. Substantive reading and hypothesis validation

In substance, results partition the channels of competitive pressure as theorized in Part I and documented internationally:

- H1 (CI → EO). Internal yardstick-style comparison—public KPIs, intra-mode benchmarking, and credible mode-switch options—disciplines routines (losses, repair

times, unit cost), hence better operational efficiency. This is consistent with the yardstick competition mechanism (Shleifer, 1985) and benchmarking evidence in water utilities (IBNET guidance). (Shleifer, 1985; World Bank/IBNET, 2014).

- H2 (CE → QS). Market contestability and external rivalry (threat of entry, international comparisons, alternative technological solutions) mainly lift service quality—the visible, reputation-sensitive dimension—mirroring regulatory experiences where quality is publicly compared and financially incentivized (e.g., C-MeX/D-MeX in PR19). (Ofwat, 2019; 2021; 2024).
- H3 (CP → VF). The competitiveness of award (number and diversity of bids, MEAT/value-for-money criteria, transparency, credible re-tendering) is the dominant determinant of financial viability, aligning with procurement economics: deeper competition and sound design lower lifecycle costs and curb renegotiations (Estache & Iimi, 2008; NAO, 2023; Decarolis, 2014; EPEC/EIB, 2015).
- H4 (DR → IPE). Diversity/rivalry of modes—a polycentric governance setting—most strongly fosters innovation & environmental performance, by enabling experimentation, comparison and diffusion under credible incentives; this coheres with dynamic competition insights and recent empirical findings in wastewater PPPs (Aghion et al., 2005; Cheng et al., 2023).

Across models, all four hypotheses are supported, with medium effects and R^2 in the 0.36–0.43 range; out-of-sample predictive checks reinforce practical usefulness (Shmueli et al., 2019).

We probed five sensitivities: (i) no-control vs with-controls; (ii) winsorization (5 %); (iii) exclusion of high-influence points; (iv) alternative algorithm (centroid weighting); (v) multi-group splits by contract family. The sign and significance of target paths remained stable; award-competition effects were slightly stronger on capital-intensive PPP/BOT strata—an expected pattern in infrastructure procurement (Estache & Iimi, 2008).

Table 13 — Sensitivity checks summary (significance of target paths)

Sensitivity	CI→EO	CE→QS	CP→VF	DR→IPE
Base (PLS)	✓	✓	✓	✓
No controls	✓	✓	✓	✓
Winsorized tails	✓	✓	✓	✓
Excl. high-influence	✓	✓	✓	✓
Multi-group: BOT/PPP	✓	✓	**✓ (stronger)**	✓

Source: Author's calculations (SmartPLS 4 / R 4.3.2), 2025. Procurement sensitivity informed by Estache & Iimi (2008).

8. Discussion

First, internal competition emerges as the primary lever of day-to-day efficiency (H1). This dovetails with the theory that relative performance information can discipline local monopolies and aligns with cross-utility benchmarking practice (Shleifer, 1985; IBNET, 2014). Consequently, authorities should institutionalize transparent, apples-to-apples KPI dashboards—clustered by climate/size to ensure fairness—to drive non-price rivalry on losses, repair times and OPEX per m³ (Fornell & Larcker, 1981; O'Brien, 2007).

Second, external competition—through contestability and public comparisons—is the natural engine of quality upgrades (H2). PR19's customer-experience incentives offer a blueprint: publish comparative scores and tie money to user-facing quality indicators, ensuring independent audits to deter gaming (Ofwat, 2019; 2021; 2024; Podsakoff et al., 2003).

Third, award-stage competition governs financial trajectories (H3): more (and more diverse) bids plus value-for-money (MEAT) criteria and anti-collusion controls translate into sturdier cash-flow coverage and fewer opportunistic renegotiations—exactly what large audits and micro-studies document (NAO, 2023; Decarolis, 2014; EPEC/EIB, 2015).

Finally, institutional diversity/rivalry (polycentricity) accelerates green innovation (H4) when paired with clear result targets and innovation funds; recent wastewater PPP evidence and innovation-competition theory point in this direction (Cheng et al., 2023; Aghion et al., 2005).

Accordingly, we recommend a sequenced mix of levers:

- Benchmarking made public: quarterly dashboards for NRW, response times, cost/m³ and compliance (IBNET-aligned indicators); comply-or-explain for outliers. (IBNET, 2014).
- Pro-contestability regime for quality: periodic APMIs and open calls even off-cycle; publish league tables à la PR19 (C-MeX-style composite) with bonus/malus. (Ofwat, 2019; 2021).
- Procurement depth & design: require MEAT with lifecycle costing; lotting to attract fringe bidders; publish single-bid rate; codify re-tendering triggers. (NAO, 2023; Estache & Iimi, 2008; EPEC/EIB, 2015).
- Green-innovation clauses: measurable IPE outcomes (reuse %, CO_2 targets, energy-specific consumption), gain-sharing and innovation funds, with third-party verification. (Cheng et al., 2023).

Conclusion

Taken together, this study contributes to a clearer understanding of how different forms of competition shape the performance of Morocco's water PPPs. The empirical results reveal four distinct yet complementary channels—CI → EO, CE → QS, CP → VF, and DR → IPE, highlighting that each organizational mode of rivalry aligns with a specific facet of performance. This mapping is theoretically coherent, statistically robust across PLS-SEM and robust OLS, and predictively valid out-of-sample. In other words, different faces of competition align with different facets of performance, which is both analytically clarifying and policy-relevant (Hair et al., 2017; Shmueli et al., 2019).

Naturally, limits remain. First, cross-sectional data restrict causal claims; stronger identification could combine policy shocks (e.g., re-tendering waves) with panel outcomes. Second, reliance on self-reports raises CMB risks, mitigated but never eliminated (Podsakoff et al., 2003). Third, $n = 90$—adequate but modest—caps the granularity of multi-group tests; scaled replication would help. Fourth, IPE—and environmental outcomes generally—materialize slowly; following project cohorts over 24–36 months would better capture trajectories.

These limitations point to several promising research perspectives. (i) A quasi-experimental design exploiting newly codified re-tendering rules or award-design reforms could more precisely establish the CP → VF link (NAO, 2023). (ii) A data-fusion strategy integrating operator KPIs (NRW, outage frequency, laboratory measures) with managerial and user-perception scales would enrich the multidimensional assessment of performance, especially within IBNET- data structures (IBNET, 2014). (iii) Policy pilots inspired by C-MeX-like incentive schemes could be tested in selected cities to evaluate both their direct effects on EO and VF and their potential spillover effects across organizational modes (Ofwat, 2019; 2021).

Overall, the study advances both theory and practice by demonstrating that competition in PPPs is not a monolithic force but a set of differentiated mechanisms that can be deliberately shaped to improve service outcomes. By refining these channels and improving the evidence base, future work can contribute to more effective, accountable, and citizen-oriented water governance in Morocco and beyond.

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