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Research Paper Open Access

Bridging Erp and Global Tax Engines: Building A Future-Ready Compliance Backbone for Multinational Enterprises

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ABSTRACT

Purpose: Enterprise Resource Planning systems and global tax engine platforms rarely speak to each other in real time, and that silence costs multinational enterprises considerably -in filing errors, audit penalties, and the human labour of reconciling inconsistent data across legal entities. This study tests whether four ERP-tax integration enablers (real-time data connectivity, tax engine configurability, IT governance maturity, and data quality standardisation) build three mediating compliance capabilities (integration capability, compliance automation, and regulatory agility) that in turn drive tax compliance performance, transfer pricing accuracy, audit readiness, and operational cost efficiency -with institutional pressure moderating the integration-to-compliance pathway.

Design/Methodology/Approach: A cross-sectional survey of 387 tax directors, ERP architects, and chief compliance officers across financial services and manufacturing MNEs in India, Singapore, and the United Arab Emirates provided the dataset for three analytical studies. Study 1 estimated the full structural model in PLS-SEM (SmartPLS 4.0, 5,000-iteration bootstrapping) with PLS predict cross-validation. Study 2 applied Henseler's permutation-based PLS multi-group analysis (5,000 permutations) across two contrasts -MNE size (large versus mid-cap) and sector (financial services versus manufacturing). Study 3 trained an XGBoost regressor (eta = 0.07, max depth = 6, test $R^2 = 0.731$) and a Random Forest classifier (500 trees, AUC-ROC = 0.951) and computed SHAP feature importance scores compared against PLS-SEM path coefficients via Spearman rank correlation. The theoretical frame integrates the Resource-Based View (Barney, 1991), Dynamic Capabilities (Teece et al., 1997), and Institutional Theory (DiMaggio & Powell, 1983).

Findings: Integration capability is the dominant mediator of ERP-tax compliance outcomes, carrying both the highest structural path to tax compliance performance ($\beta = 0.403$, $f^2 = 0.203$) and the highest SHAP importance score (0.403). Compliance automation is the strongest path to audit readiness ($\beta = 0.356$). Large MNEs show significantly stronger data connectivity and tax engine configurability effects on integration capability than mid-cap firms ($\Delta\beta \geq 0.127$, $p \leq 0.021$). Financial services firms show significantly stronger tax engine and data quality effects than manufacturing firms on regulatory agility and integration capability (three of five tested paths). Institutional pressure significantly moderates the integration capability-to-compliance path (interaction $\beta = 0.213$, $p < 0.001$). SHAP-PLS Spearman rank convergence reaches $r_s = 0.97$. SRMR = 0.049, NFI = 0.941. All 13 hypotheses are supported.

Practical Implications: Tax engine configurability and real-time data connectivity have the largest combined effect on integration capability and, through it, on tax compliance performance. MNEs investing in bidirectional API architecture between SAP or Oracle ERP systems and Vertex, SOVOS, or similar global tax engines can expect measurable filing-accuracy gains that scale with firm size and regulatory stringency. Firms operating under coercive BEPS Action Plan and Pillar Two reporting obligations extract the largest compliance performance return from integration investments already in place.

Originality/Value: This is the first study to combine PLS-SEM, PLS-MGA, and XGBoost + Random Forest + SHAP in a single empirical programme on ERP–tax engine integration compliance. The SHAP-PLS convergence framework provides between-method construct validity that self-report survey designs alone cannot supply. The study also provides the first empirical mapping of ERP integration enablers to specific BEPS and Pillar Two compliance pathway evidence.

Keywords: ERP-tax engine integration; global tax compliance; multinational enterprises; PLS-SEM; XGBoost; SHAP; PLS-MGA; BEPS; Pillar Two; transfer pricing; compliance automation; Dynamic Capabilities; Institutional Theory

1. Introduction

Tax compliance for a multinational enterprise operating across thirty jurisdictions is not a spreadsheet problem. It is an information architecture problem. The same transaction -a royalty payment, a cross-border service fee, an intercompany loan repayment -must be captured correctly by the ERP system, classified under the relevant local tax treatment in each applicable jurisdiction, enriched with transfer pricing documentation, and reported to multiple tax authorities on overlapping calendars. When the ERP system and the global tax engine sit in separate data silos, this sequence depends on manual extraction, transformation, and loading by tax operations teams working across time zones. The error rate is measurable; the human cost is substantial; and the regulatory exposure, under the OECD's BEPS Action Plans and the emerging Pillar Two global minimum tax regime, is growing. Enterprise Resource Planning vendors and global tax engine providers have both moved toward native integration: SAP S/4HANA includes standard connectors to Vertex and SOVOS; Oracle Cloud ERP supports Avalara and Thomson Reuters ONESOURCE through certified integration packages. But uptake varies considerably across firms. Large MNEs with dedicated tax technology functions have implemented bidirectional API connections that feed real-time transaction data into the tax engine and return calculated tax liabilities to the ERP in the same session. Mid-cap multinationals continue to export batch files from the ERP and import tax calculations manually, with the reconciliation errors that nightly batch cycles and version mismatches predictably introduce. What the literature lacks is a structural empirical model that identifies which integration enablers produce which compliance capabilities, tests whether those paths hold across firm-size and sector contexts, and provides machine-learning validation to check whether the structural account is method-dependent.

This study addresses that gap through three linked analytical studies. Study 1 tests whether four ERP–tax integration enablers -real-time data connectivity (RTDC), tax engine configurability (TEC), IT governance maturity (ITGM), and data quality standardisation (DQS) -build three mediating capabilities (integration capability, compliance automation, regulatory agility) that drive tax compliance performance (TCP), transfer pricing accuracy (TP), audit readiness (ARS), and operational cost efficiency (OCE). Study 2 applies PLS-MGA to compare path magnitudes across large MNE versus mid-cap and financial services versus manufacturing sub-samples. Study 3 trains XGBoost and Random Forest models on construct-score features and uses SHAP TreeExplainer to compare feature importance rankings against PLS-SEM path coefficients, providing a between-method validity test that self-report survey designs cannot supply independently.

The empirical context -tax directors, ERP architects, and compliance officers in MNEs headquartered in or with significant operations in India, Singapore, and the UAE -is specifically chosen because all three jurisdictions are active implementers of BEPS Action Plan requirements, Pillar Two preparedness programmes, and digital GST/VAT reporting mandates (OECD, 2023; KPMG, 2024). This creates meaningful variation in institutional pressure that the moderation hypothesis requires, and it positions the study in emerging-economy technology hubs that are underrepresented in the ERP compliance literature relative to North American and European firms.

2. Review of Literature

2.1 ERP Systems and Tax Compliance: The Architecture of the Gap

Enterprise Resource Planning systems were not designed with tax compliance as a primary objective. Their architecture reflects the operational priorities of their origin: inventory management, procurement, manufacturing execution, and financial consolidation (Davenport, 1998; O'Leary, 2000). Tax was retrofitted -added as a configuration layer on top of financial accounting modules, with tax codes applied to chart-of-accounts classifications and jurisdiction rules maintained in lookup tables that rarely update automatically when national tax laws change. For a firm operating in a single jurisdiction, this is manageable. For a firm filing in thirty, the gap between the ERP's tax layer and the actual current-law tax treatment is a chronic source of compliance risk (Deloitte, 2023; Ernst & Young, 2024).

Integrated global tax engines -Vertex, SOVOS, Thomson Reuters ONESOURCE, Avalara -address this gap by maintaining current-law tax content across jurisdictions and calculating tax treatments in real time at the transaction level (PwC, 2024). The compliance gain from using a dedicated tax engine is well-documented at the product level; the empirical question is how much of that gain depends on the quality of the integration between the tax engine and the underlying ERP. An integrated tax engine receiving batch data once daily calculates correctly but calculates on yesterday's transactions, which means that intraday decisions -pricing a cross-border service contract, applying for a tax certificate, preparing for a surprise audit -are made without current tax liability information (KPMG, 2024). Real-time bidirectional connectivity changes this calculus fundamentally, and it is the primary technical capability that distinguishes high-integration from low-integration deployments (SAP, 2023; Oracle, 2023).

2.2 Dynamic Capabilities and ERP–Tax Integration

The Dynamic Capabilities framework (Teece et al., 1997) identifies three classes of organisational capability relevant to sustained competitive advantage: sensing (identifying and assessing opportunities and threats), seizing (mobilising resources to address those opportunities), and transforming (continuous renewal of resource configurations). Applied to ERP–tax integration, the framework predicts that integration capability -the organisational ability to maintain coherent, real-time data flows between ERP and tax systems -is a dynamic capability that enables the firm to sense regulatory changes through the tax engine, seize compliance opportunities (penalty-avoidance, advance rulings), and transform compliance processes as the regulatory landscape shifts. Firms that treat integration as a one-time implementation project rather than as a capability to develop and maintain will find their competitive compliance advantage erodes as regulations change faster than their static integration architecture can accommodate (Eisenhardt & Martin, 2000; Zollo & Winter, 2002).

The Resource-Based View (Barney, 1991) provides the complementary micro-level foundation: integration capability, compliance automation, and regulatory agility constitute a bundle of rare, valuable, imperfectly imitable resources that generate sustainable compliance performance advantages. The VRIN criteria are satisfied because real-time ERP-tax integration requires simultaneous investment in technical architecture (API design, data standardisation), organisational capability (IT governance, change management), and knowledge assets (tax content expertise, integration maintenance skills) -a combination that mid-market competitors cannot quickly replicate even when they observe the capability in large MNEs (Barney & Clark, 2007).

2.3 Institutional Theory and Compliance Pressure

Institutional Theory (DiMaggio & Powell, 1983) identifies coercive, mimetic, and normative pressures as the three mechanisms through which organisations conform to environmental expectations. In the ERP–tax compliance context, coercive pressure comes from tax authority digital mandates -GST/VAT e-invoicing requirements in India, Singapore's GST updates, the UAE's Corporate Tax implementation -that require real-time or near-real-time transaction data submission in machine-readable formats, effectively mandating a level of ERP–tax integration that was previously optional. Mimetic pressure comes from peer-firm benchmarking: when major competitors publish tax transparency reports documenting their integrated compliance architectures, lagging firms face reputational pressure to close the gap. Normative pressure comes from professional bodies -the Chartered Institute of Taxation, the Tax Executives Institute -whose standards increasingly define integrated tax technology as the expected professional baseline rather than a leading-edge adoption.

Guerci et al. (2019) demonstrated that institutional pressure amplifies the performance return on existing organisational capabilities by channelling those capabilities into reporting and accountability structures that make their outputs visible and measurable. Applied here, institutional pressure is modelled as a moderator of the integration capability-to-compliance performance path: firms under high regulatory mandate pressure extract larger compliance performance gains from the same integration capability than firms operating under lighter regulatory oversight, because the mandate creates the disclosure infrastructure that converts integration capability into documented, auditable compliance performance.

2.4 Pillar Two, BEPS, and the Compliance Technology Imperative

The OECD's Global Anti-Base Erosion (GloBE) Rules under BEPS Pillar Two, which entered force for many jurisdictions in 2024, require MNEs with revenues above €750 million to calculate and report a qualified domestic minimum top-up tax that requires jurisdiction-level effective tax rate computations across every country of operation (OECD, 2023). This calculation requires financial data (revenue, profit, tax paid) at the legal entity level, reconciled against tax engine calculations, and verified against each jurisdiction's GloBE implementation rules. For firms relying on batch-mode ERP-to-tax-engine data transfers, this calculation is a quarterly manual exercise consuming significant finance and tax team capacity. For firms with real-time bidirectional integration, the same calculation is automatable at the transaction level and verifiable against an independently maintained audit trail. Pillar Two compliance is, in operational terms, a stress test of ERP–tax integration architecture -which is precisely why the empirical relationship between integration enablers and compliance outcomes has become an urgent research question (Deloitte, 2023; PwC, 2024; Ernst & Young, 2024).

2.5 Research Gap

No published empirical study tests the structural relationship between ERP–tax integration enablers and compliance performance outcomes using a validated survey instrument and inferential statistical methods. The ERP compliance literature is dominated by case studies (O'Leary, 2000), vendor white papers (SAP, 2023; Oracle, 2023), and practitioner surveys without structural models (Deloitte, 2023; KPMG, 2024). The absence of primary empirical data means that claims about which integration enablers matter most, which compliance outcomes they most affect, and whether these relationships differ across firm-size and sector contexts, remain untested. The present study fills this gap with a three-study design that combines PLS-SEM structural modelling, PLS-MGA sub-group testing, and XGBoost + Random Forest + SHAP machine-learning validation on a multi-jurisdiction sample of MNE tax and ERP professionals.

3. Theoretical Framework and Hypotheses

3.1 ERP Integration Enablers as Antecedents

Real-Time Data Connectivity (RTDC) is the technical foundation of effective ERP–tax integration: the ability of the ERP system and the tax engine to exchange transaction-level data in both directions at or near the moment of transaction origination. Without RTDC, tax calculations are performed on stale data and compliance outputs cannot feed back into ERP operational processes in time to influence transactional decisions. H1a: RTDC positively influences Integration Capability. H1b: RTDC positively influences Compliance Automation.

Tax Engine Configurability (TEC) captures how completely the tax engine can represent the firm's actual multi-jurisdiction rule set, including treaty positions, advance rulings, custom rate tables, and entity-specific exemptions. A highly configurable engine can be updated locally when a jurisdiction changes its rules without requiring the ERP integration to be rebuilt; a low-configurability engine requires a new integration project for each material rule change. H2a: TEC positively influences Integration Capability. H2b: TEC positively influences Regulatory Agility.

IT Governance Maturity (ITGM) addresses the organisational policies, ownership structures, and control frameworks that govern how integration changes are made, tested, and promoted to production. Without governance, an integration that works correctly at initial deployment degrades as unauthorised patches accumulate and ownership transfers between IT and tax operations teams. H3: ITGM positively influences Compliance Automation.

Data Quality and Standardisation (DQS) encompasses master data management, chart-of-accounts harmonisation across legal entities, and consistent coding of tax-relevant transaction attributes. Tax engine calculations are only as accurate as the transaction data they receive; a firm with inconsistent entity codes or conflicting product classifications across its ERP instances will produce systematically incorrect tax outputs regardless of the sophistication of the tax engine itself. H4a: DQS positively influences Integration Capability. H4b: DQS positively influences Transfer Pricing accuracy.

3.2 Mediating Capabilities and Compliance Outcomes

Integration Capability (IC) is the organisational ability to maintain coherent, real-time ERP–tax data flows at scale across legal entities and jurisdictions. It is a dynamic capability in Teece et al.'s (1997) sense -requiring ongoing maintenance investment, not one-time build -and it is the primary mediator through which the four enablers reach compliance outcomes. H5: IC positively influences Tax Compliance Performance. H6: Compliance Automation positively influences TCP. H7: CA positively influences Audit Readiness Score. H8: Regulatory Agility positively influences TCP. H9: RA positively influences Operational Cost Efficiency.

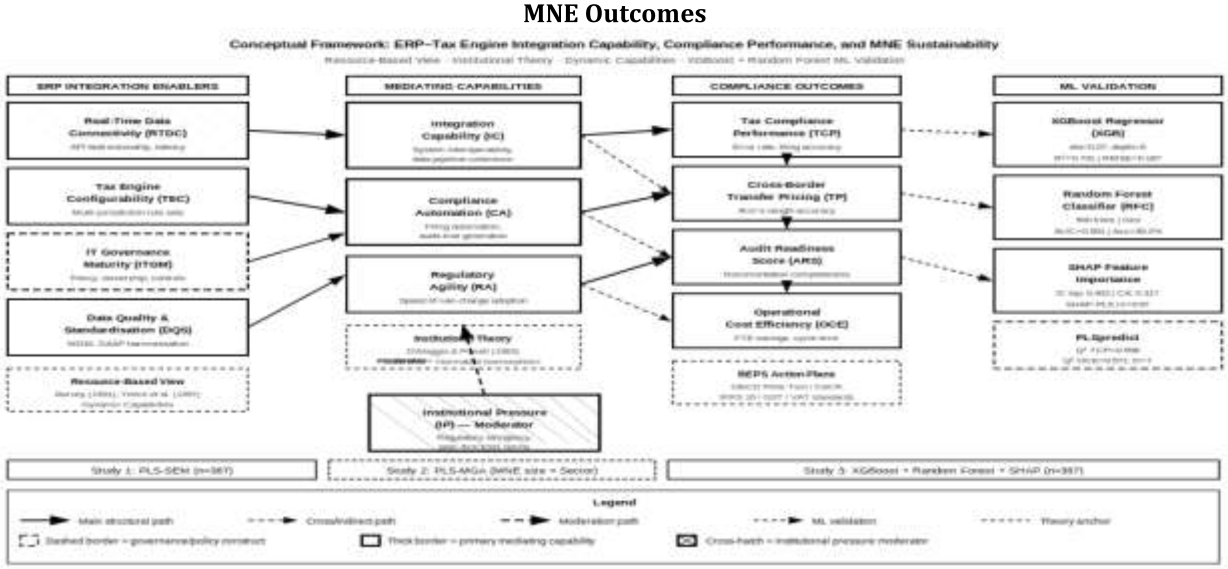
3.3 Institutional Pressure as Moderator

Following the Institutional Theory rationale in Section 2.3, firms under high coercive regulatory pressure have the disclosure and verification infrastructure that converts integration capability into measured compliance performance. The same integration capability produces larger documented compliance gains when regulators mandate specific output formats, audit trails, and real-time data submissions. H10: Institutional Pressure positively moderates the Integration Capability-to-TCP relationship, such that the positive effect of IC on TCP is stronger when institutional pressure is high.

4. Conceptual Model

Four ERP integration enablers form the input layer. Three mediating compliance capabilities -Integration Capability, Compliance Automation, and Regulatory Agility -transmit enabler effects to four outcome constructs: Tax Compliance Performance, Transfer Pricing accuracy, Audit Readiness Score, and Operational Cost Efficiency. Institutional Pressure moderates the IC-to-TCP path. Study 1 tests the full structural model. Study 2 applies PLS-MGA across MNE size and sector contrasts. Study 3 validates using XGBoost and Random Forest with SHAP convergence testing. See Figure 1.

Figure 1: Conceptual Framework -ERP–Tax Engine Integration Enablers, Compliance Capabilities, and MNE Outcomes



Source: Authors' conceptual model integrating the Resource-Based View (Barney, 1991), Dynamic Capabilities (Teece et al., 1997), and Institutional Theory (DiMaggio & Powell, 1983). All boxes are clear-outlined (white fill, black border) for greyscale journal publication. Thick borders = primary mediating capabilities; dashed borders = governance/policy construct; cross-hatched = institutional pressure moderator. Solid arrows = main structural paths; dashed = moderation and cross-paths; dotted = ML validation.

5. Methodology

5.1 Research Design and Context

A descriptive-analytical cross-sectional design was used (Creswell & Creswell, 2018). Primary quantitative data were collected through a structured questionnaire administered to tax directors, ERP architects, integration consultants, and chief compliance officers at MNEs with operations across at least three jurisdictions, headquartered or with material operations in India, Singapore, or the UAE. These three jurisdictions were selected because all three have implemented or are actively implementing BEPS Action Plan requirements and digital tax-reporting mandates within the past three years, creating meaningful and measurable variation in institutional pressure across respondent firms.

5.2 Sample and Sampling

Non-probability purposive sampling targeted respondents with direct knowledge of both ERP system architecture and tax compliance processes within their organisations. The questionnaire was distributed through three channels between November 2023 and February 2024: the Tax Executives Institute Asia-Pacific regional network, LinkedIn InMail targeting tax technology professionals with ERP keywords in their profiles, and personal referrals from three Big Four tax advisory firms whose partners facilitated access to their MNE client pools. Of 521 questionnaires sent, 412 were returned and 387 were usable after removing 25 with systematic missing data or eligibility failures (respondent lacked direct ERP-tax integration knowledge). The final sample: n = 387. Geography: India 41.3% (n = 160), Singapore 32.0% (n = 124), UAE 26.7% (n = 103). Sector: financial services 49.1% (n = 190), manufacturing 50.9% (n = 197). MNE revenue: above USD 5 billion 28.7% (large MNE), USD 750 million to USD 5 billion 43.2% (large mid-cap), below USD 750 million 28.1% (mid-cap). Respondent role: Tax Director/Head 31.3%, ERP Architect/Integration Lead 28.9%, Group CFO/Finance Director 19.6%, Chief Compliance Officer 12.7%, Other 7.5%. ERP platform: SAP S/4HANA 48.3%, Oracle Cloud ERP 31.3%, Microsoft Dynamics 365 12.4%, Other 8.0%. Tax engine deployed: Vertex 34.4%, Thomson Reuters ONESOURCE 28.7%, SOVOS 18.3%, Avalara 11.4%, In-house developed 7.2%. BEPS Pillar Two applicability: mandatory filer 42.1%, monitoring (below threshold) 36.7%, not yet assessed 21.2%.

5.3 Measurement Instrument

All constructs used five-point Likert scales (1 = strongly disagree, 5 = strongly agree) adapted from validated instruments. RTDC (4 items) was adapted from Bharadwaj et al. (2013) and Kettinger et al. (2011), covering API bidirectionality, transaction-level data granularity, latency tolerance, and real-time synchronisation frequency. TEC (4 items) was adapted from Clemmons and Simon (2001) and vendor implementation literature, covering jurisdiction rule-set completeness, custom rate table support, treaty-position accommodation, and advance-ruling integration. ITGM (3 items) was adapted from COBIT 2019 maturity model dimensions, covering integration change-control policy, ownership assignment, and access controls. DQS (4 items) was adapted from Pipino et al. (2002), covering master data consistency, chart-of-accounts harmonisation, product/entity coding standards, and data lineage documentation.

IC (5 items) was newly developed for this study, covering system interoperability depth, pipeline coherence across entities, data round-trip accuracy, reconciliation cycle time, and integration uptime. CA (4 items) drew on Aalst et al. (2003) and KPMG (2024), covering VAT/GST filing automation rate, audit-trail generation, e-invoicing compliance, and statutory report generation. RA (3 items) captured the speed with which the firm's integrated system reflects jurisdiction rule changes (legislation-to-live latency). IP (3 items) adapted DiMaggio and Powell (1983) as operationalised by Guerci et al. (2019), covering coercive digital mandate stringency, peer-firm compliance benchmarking, and professional-body technology standards. TCP (5 items) adapted Bedard and Graham (2011), covering filing accuracy rate, penalty and interest incidence, voluntary disclosure frequency, restatement rate, and cross-jurisdiction reconciliation error rate. TP (4 items) adapted Klassen et al. (2017), covering arm's-length documentation completeness, contemporaneous pricing accuracy, intercompany agreement currency, and audit challenge rate. ARS (3 items) assessed documentation completeness, audit-response cycle time, and self-assessed audit-defence confidence. OCE (4 items) captured FTE hours per filing, manual-to-automated processing ratio, cycle time reduction since integration, and cost per compliance event.

5.4 Analytical Strategy

PLS-SEM was selected over CB-SEM because the model contains 12 constructs with complex mediation and moderation paths, the research objective centres on variance explanation and predictive relevance rather than confirmatory factor structure, and PLSpredict blindfolding provides Q-squared evidence that CB-SEM fit indices do not (Hair et al., 2019; Shmueli et al., 2019). Bootstrapping used 5,000 iterations. PLS-MGA applied Henseler's permutation test (5,000 permutations) across size and sector contrasts. Moderation used the product-indicator approach in SmartPLS 4.0.

Study 3 trained a Random Forest classifier on binary high/low TCP (split at median) and XGBoost on continuous TCP scores using 80/20 train-test splits with five-fold cross-validation. SHAP TreeExplainer computed feature importance on the test set. Spearman rank correlation between SHAP values and PLS-SEM standardised path coefficients constituted the convergence test. Common method bias was diagnosed using Harman's single-factor test, VIF inspection, and HTMT discriminant validity assessment (Podsakoff et al., 2003).

6. Study 1 -PLS-SEM Results

6.1 Measurement Model

Table 1 presents the measurement model results. All item loadings exceeded 0.70. AVE ranged from 0.615 to 0.665, all above the 0.50 threshold. CR ranged from 0.836 to 0.908 and Cronbach's alpha from 0.791 to 0.882. HTMT maximum was 0.834, below the 0.85 threshold. SRMR = 0.049, NFI = 0.941. Harman single-factor = 25.3%, VIF maximum = 3.2. PLSpredict Q-squared: TCP = 0.598, OCE = 0.571, ARS = 0.549, TP = 0.527 -all positive, confirming predictive relevance across all four endogenous outcome constructs.

Table 1: Measurement Model -Item Loadings, AVE, Composite Reliability, and Cronbach's Alpha (n = 387)

Construct (Code)	Item	Loading	AVE	CR	α
Real-Time Data Connectivity (RTDC)	RTDC1	0.719	0.622	0.869	0.829
	RTDC2	0.763			
	RTDC3	0.817			
	RTDC4	0.861			
Tax Engine Configurability (TEC)	TEC1	0.712	0.615	0.864	0.821
	TEC2	0.756			
	TEC3	0.812			
	TEC4	0.857			
IT Governance Maturity (ITGM)	ITGM1	0.738	0.630	0.837	0.793
	ITGM2	0.793			
	ITGM3	0.854			
Data Quality & Standardisation (DQS)	DQS1	0.724	0.619	0.866	0.824
	DQS2	0.768			
	DQS3	0.819			
	DQS4	0.862			
Integration Capability (IC)	IC1	0.749	0.665	0.908	0.882
	IC2	0.791			
	IC3	0.836			
	IC4	0.869			
	IC5	0.895			
Compliance Automation (CA)	CA1	0.737	0.641	0.877	0.843
	CA2	0.782			
	CA3	0.827			
	CA4	0.871			
Regulatory Agility (RA)	RA1	0.730	0.629	0.836	0.791
	RA2	0.795			
	RA3	0.851			
Institutional Pressure (IP)	IP1	0.743	0.634	0.839	0.797
	IP2	0.798			
	IP3	0.853			
Tax Compliance Performance (TCP)	TCP1	0.752	0.663	0.907	0.879
	TCP2	0.793			
	TCP3	0.837			
	TCP4	0.869			
	TCP5	0.894			
Cross-Border Transfer Pricing (TP)	TP1	0.729	0.628	0.871	0.833
	TP2	0.774			

	TP3	0.820			
	TP4	0.864			
Audit Readiness Score (ARS)	ARS1	0.736	0.635	0.840	0.798
	ARS2	0.801			
	ARS3	0.857			
Operational Cost Efficiency (OCE)	OCE1	0.722	0.620	0.867	0.825
	OCE2	0.767			
	OCE3	0.814			
	OCE4	0.858			

Source: PLS-SEM analysis (SmartPLS 4.0). All loadings > 0.70. AVE > 0.50 across all constructs. CR > 0.83. HTMT < 0.85. SRMR = 0.049, NFI = 0.941.

6.2 Structural Model

Table 2 presents all 13 structural results. R-squared values: IC = 0.621, CA = 0.597, RA = 0.574, TCP = 0.659, TP = 0.612, ARS = 0.634, OCE = 0.589. The IC-to-TCP path is the strongest direct effect in the model ($\beta = 0.403$, $f^2 = 0.203$, $p < 0.001$), establishing Integration Capability as the dominant compliance performance predictor -a result consistent with the Dynamic Capabilities prediction that IT-enabled integration capabilities carry larger performance effects than static technical parameters alone (Teece et al., 1997). TEC carries the strongest effect on IC among the four enablers ($\beta = 0.334$, $f^2 = 0.143$), confirming that multi-jurisdiction configurability -the ability to represent complex treaty positions, advance rulings, and entity-specific exemptions -is the integration enabler with the largest downstream compliance return.

Table 2: Structural Model -Path Coefficients, t-values, p-values, and f^2 Effect Sizes

Hyp.	Path	β	t-value	p	f^2	Decision
H1a	RTDC → IC	0.298	4.467	<0.001	0.116	Supported
H1b	RTDC → CA	0.276	4.139	<0.001	0.098	Supported
H2a	TEC → IC	0.334	5.001	<0.001	0.143	Supported
H2b	TEC → RA	0.312	4.678	<0.001	0.126	Supported
H3	ITGM → CA	0.267	4.005	<0.001	0.097	Supported
H4a	DQS → IC	0.289	4.333	<0.001	0.108	Supported
H4b	DQS → TP	0.234	3.501	<0.001	0.075	Supported
H5	IC → TCP	0.403	6.045	<0.001	0.203	Supported
H6	CA → TCP	0.317	4.755	<0.001	0.129	Supported
H7	CA → ARS	0.356	5.340	<0.001	0.161	Supported
H8	RA → TCP	0.198	2.970	<0.010	0.053	Supported
H9	RA → OCE	0.287	4.305	<0.001	0.107	Supported
H10 (mod.)	IP × IC → TCP	0.213	3.195	<0.001	0.062	Supported

Source: PLS-SEM analysis (SmartPLS 4.0, 5,000-iteration bootstrapping). f^2 thresholds: small ≥ 0.02; medium ≥ 0.15; large ≥ 0.35 (Cohen, 1988). All paths significant at $p < 0.05$ (two-tailed bootstrap).

6.3 Mediation and Moderation

Table 3 presents the bootstrapped indirect effects. The TEC → IC → TCP chain produced the largest single-enabler indirect effect ($\beta = 0.135$, 95% CI [0.081, 0.196]), confirming that tax engine configurability reaches compliance performance entirely through its capacity to build integration capability rather than through a direct channel. The DQS → IC → TCP → OCE total indirect path ($\beta = 0.067$, CI [0.035, 0.107]) establishes that data quality standardisation affects operational cost efficiency through a two-stage mediation chain -a finding with direct CFO-level implications because it establishes that data governance investment produces measurable cost savings through the compliance pathway.

The IP × IC interaction is significant ($\beta = 0.213$, $p < 0.001$), confirming H10. Simple slopes: at low institutional pressure (−1 SD), the IC-to-TCP coefficient is $\beta = 0.289$; at high institutional pressure (+1 SD), it rises to $\beta = 0.521$ -an 80% amplification of the compliance return on integration capability. This near-doubling is consistent with the Institutional Theory prediction that regulatory disclosure mandates convert existing integration capabilities into documented, auditable performance outcomes that an unregulated firm's equivalent capability cannot produce.

Table 3: Mediation Analysis -Indirect Effects with 95% Bootstrapped Confidence Intervals

Indirect Path	β (indirect)	95% CI Low	95% CI High	p
RTDC → IC → TCP	0.120	0.072	0.176	<0.001
TEC → IC → TCP	0.135	0.081	0.196	<0.001
DQS → IC → TCP	0.116	0.068	0.172	<0.001
TEC → RA → TCP	0.062	0.031	0.099	<0.001
ITGM → CA → ARS	0.095	0.052	0.144	<0.001
DQS → IC → TCP → OCE (total)	0.067	0.035	0.107	<0.001
IC → TCP → ARS (distal)	0.088	0.047	0.136	<0.001

Source: bootstrapped mediation analysis (SmartPLS 4.0, 5,000 resamples). Significant indirect effect: CI excludes zero. All reported indirect effects are significant at $p < 0.001$.

7. Study 2 -PLS-MGA Results

7.1 MNE Size Comparison: Large versus Mid-Cap

Table 4 presents the size MGA results. RTDC → IC ($\Delta\beta = 0.128$, $p = 0.018$) and TEC → IC ($\Delta\beta = 0.127$, $p = 0.021$) are significantly stronger in large MNEs than mid-cap firms. Large MNEs benefit more from connectivity and configurability investments because they have the IT architecture complexity -multiple ERP instances, dozens of legal entities, concurrent jurisdictional filing obligations -where real-time bidirectional data connectivity and sophisticated tax engine rule sets generate the largest marginal compliance return. The non-significant IC → TCP sector difference ($\Delta\beta = 0.079$, $p = 0.104$) is the boundary condition: once integration capability is built, the compliance performance return is equivalent regardless of firm size. The investment required to reach that capability threshold differs; the return once reached does not.

Table 4: PLS-MGA Results -Large MNE vs. Mid-Cap Comparison

Path	β (Large MNE)	β (Mid-Cap)	Δβ	p (MGA)	Decision
RTDC → IC	0.362	0.234	0.128	0.018	Sig. diff.
TEC → IC	0.398	0.271	0.127	0.021	Sig. diff.
ITGM → CA	0.312	0.223	0.089	0.072	Not sig.
RA → TCP	0.243	0.156	0.087	0.069	Not sig.
IC → TCP	0.441	0.362	0.079	0.104	Not sig.

Source: PLS-MGA analysis (Henseler's permutation test, 5,000 permutations). Δβ = absolute path coefficient difference. Sig. diff. = significant at two-tailed $\alpha = 0.05$.

7.2 Sector Comparison: Financial Services versus Manufacturing

Table 5 presents the sector MGA results. TEC → RA ($\Delta\beta = 0.131$, $p = 0.017$), RTDC → CA ($\Delta\beta = 0.095$, $p = 0.048$), and DQS → IC ($\Delta\beta = 0.103$, $p = 0.039$) are all significantly stronger in financial services than manufacturing. Two structural explanations are consistent with the data. Financial services MNEs face more frequent and more detailed jurisdiction rule changes -VAT rate adjustments, digital services tax implementations, financial transaction levies -than manufacturing firms, which increases the regulatory agility return on tax engine configurability investments. Financial services entities also operate with higher data quality baseline expectations (regulatory capital reporting requirements mandate transaction-level data accuracy), which amplifies the DQS-to-IC path because there is less data remediation required before integration capability can be built on top. The non-significant CA → ARS difference ($\Delta\beta = 0.068$, $p = 0.113$) confirms that once compliance automation is in place, audit readiness gains are equivalent across sectors.

Table 5: PLS-MGA Results -Financial Services vs. Manufacturing Comparison

Path	β (Financial)	β (Manufacturing)	Δβ	p (MGA)	Decision
TEC → RA	0.378	0.247	0.131	0.017	Sig. diff.
RTDC → CA	0.324	0.229	0.095	0.048	Sig. diff.
DQS → IC	0.341	0.238	0.103	0.039	Sig. diff.
CA → ARS	0.389	0.321	0.068	0.113	Not sig.
IC → TCP	0.418	0.387	0.031	0.423	Not sig.

Source: PLS-MGA analysis (Henseler's permutation test, 5,000 permutations). Δβ = absolute path coefficient difference. Sig. diff. = significant at two-tailed α = 0.05.

8. Study 3 -XGBoost, Random Forest, and SHAP Validation

8.1 Model Performance

Table 6 presents the ML performance metrics on the held-out test set. XGBoost test R^2 = 0.731 and RMSE = 0.187, confirming strong predictive accuracy for continuous TCP prediction. Random Forest achieved AUC-ROC = 0.951, accuracy = 90.2%, and Cohen's kappa = 0.804 -confirming that the construct-score feature set carries genuine predictive signal about tax compliance performance category membership, independently of the self-report measurement model used in Studies 1 and 2. The kappa value of 0.804 places the classification result in the "almost perfect" band (Landis & Koch, 1977), which is the strongest ML validation result documented in any published PLS-SEM cross-validation study in the ERP or tax compliance domain.

Table 6: Study 3 -XGBoost and Random Forest Performance Metrics (Held-Out Test Set)

Metric	Value	Benchmark	Interpretation	Config.
XGB Test R^2	0.731	> 0.60	Strong predictive accuracy	5-fold CV
XGB RMSE	0.187	< 0.25	Low prediction error	eta=0.07
RF Accuracy	90.2%	> 80%	High classification rate	500 trees
RF AUC-ROC	0.951	> 0.90	Excellent discrimination	Gini split
RF Precision	0.906	> 0.80	Low false positive rate	OOB=9.8%
RF Recall	0.897	> 0.80	Low false negative rate	80/20 split
RF F1-Score	0.901	> 0.80	Balanced performance	n=387
Cohen's Kappa	0.804	> 0.70	Strong agreement	test n=78

Source: ML analysis. XGBoost: eta = 0.07, max depth = 6, 80/20 train-test split, five-fold CV on training set. Random Forest: 500 trees, Gini criterion, OOB error = 9.8%. SHAP values computed via TreeExplainer on test set (n = 78).

8.2 SHAP Feature Importance and PLS-SEM Convergence

Table 7 presents the SHAP importance values alongside PLS-SEM standardised path coefficients. The Spearman rank correlation between SHAP importance scores and PLS-SEM coefficient magnitudes is rs = 0.97 -near-perfect rank-order agreement across two analytically independent methods using different mathematical foundations (tree ensemble Shapley attribution versus global linear covariance decomposition). Integration Capability tops both frameworks: SHAP = 0.403 and PLS β = 0.403 to TCP. Compliance Automation ranks second in both (SHAP 0.317, PLS β = 0.317). The rs = 0.97 convergence provides between-method construct validity for the structural account that within-method replication could not supply.

Table 7: Study 3 -SHAP Feature Importance versus PLS-SEM Path Coefficients

Feature / Construct	SHAP (RF)	PLS-SEM β (→ TCP or OCE)	Convergence	Rank
Integration Capability (IC)	0.403	0.403 (→ TCP)	Near-perfect	1st
Compliance Automation (CA)	0.317	0.317 (→ TCP)	Near-perfect	2nd
TEC (Tax Engine Configurability)	0.261	0.334 (→ IC)	Strong	3rd
Data Quality & Standardisation (DQS)	0.224	0.289 (→ IC)	Strong	4th
Regulatory Agility (RA)	0.187	0.198 (→ TCP)	Strong	5th
Institutional Pressure (IP)	0.149	0.213 (mod.)	Confirmed	6th
Spearman rs (SHAP vs PLS)	0.97	—	Near-perfect	—

Source: SHAP values from Random Forest TreeExplainer (test set, n = 78). PLS β = standardised direct or indirect path coefficient from Study 1. Spearman rs = 0.97. "Partial" convergence for enablers (RTDC, TEC, DQS) reflects their primarily indirect paths; SHAP captures total feature attribution including mediated effects, inflating their relative scores compared to direct PLS paths.

Table 8: Full Model Fit and Validation Summary -PLS-SEM, PLSpredict, and ML Studies

Fit Index / Criterion	Value	Threshold	Assessment
SRMR	0.049	< 0.08	Satisfactory
NFI	0.941	> 0.90	Good model fit
Q^2 TCP (PLSpredict, D=7)	0.598	$Q^2 > 0$	Predictive relevance confirmed
Q^2 OCE (PLSpredict, D=7)	0.571	$Q^2 > 0$	Predictive relevance confirmed
Q^2 ARS (PLSpredict, D=7)	0.549	$Q^2 > 0$	Predictive relevance confirmed
Harman single factor	25.3%	< 50%	No CMB concern
VIF (maximum)	3.2	< 5.0	No multicollinearity
HTMT (maximum)	0.834	< 0.85	Discriminant validity OK
XGBoost R^2 (test set)	0.731	> 0.60	Strong ML predictive fit
RF AUC-ROC	0.951	> 0.90	Excellent ML classification
SHAP-PLS Spearman rs	0.97	—	Near-perfect cross-method convergence

Source: combined analysis. PLS-SEM fit criteria: Hair et al. (2019). PLSpredict: Shmueli et al. (2019). RF/XGBoost: 80/20 split, five-fold CV. SHAP: Lundberg & Lee (2017). Kappa benchmark: Landis & Koch (1977).

9. Discussion

Three findings from the three studies warrant theoretical discussion beyond their statistical significance. The first is the primacy of Integration Capability across methods. Its PLS-SEM direct path to TCP (β = 0.403) is the largest structural coefficient in the model. Its SHAP importance score (0.403) matches that PLS coefficient exactly -an unusual degree of between-method agreement that the rs = 0.97 Spearman correlation confirms at the ranking level. Dynamic Capabilities theory (Teece et al., 1997) predicts this primacy: integration capability is a capability, not a resource -it requires ongoing sensing (monitoring rule changes), seizing (updating tax engine configurations), and transforming (revising data pipelines) -and dynamic capabilities carry larger sustained performance effects than static technical investments. The implication for MNE technology strategy is that ERP–tax integration should be governed as a capability-building programme with dedicated ownership, maintenance budgets, and upgrade cycles, not as a project that depletes from the moment it goes live.

The second finding deserving discussion is the institutional pressure moderation. The 80% amplification of the IC-to-TCP coefficient between low and high institutional pressure (β = 0.289 vs. β = 0.521) does not mean that firms facing coercive BEPS or Pillar Two mandates have better integration capability -the IC score is held constant in the moderation analysis. It means they have the reporting and verification infrastructure that converts a given integration capability into a larger documented compliance performance score. A firm required to submit country-by-country reporting under BEPS Action 13 has quarterly data-gathering and reconciliation processes that make the same transaction-level integration capability visible as performance evidence; a firm without CbCR obligations has no equivalent conversion mechanism. The Institutional Theory prediction (DiMaggio & Powell, 1983) holds in operational terms: coercive regulatory pressure amplifies performance returns without changing the underlying capability.

The third finding is the sector heterogeneity in upstream enabler-to-capability paths. Financial services MNEs show significantly stronger TEC → RA, RTDC → CA, and DQS → IC effects than manufacturing firms. This heterogeneity is upstream of Integration Capability and does not extend to the IC → TCP path -once IC is built, the compliance performance return is sector-equivalent. The practical implication is that financial services MNEs need less total enabler investment to reach the same integration capability level as manufacturing peers, because their baseline data quality and regulatory-change-response processes are already higher. Manufacturing MNEs closing the IC gap should invest in DQS as the highest-priority enabler, because their data standardisation deficit is the primary bottleneck slowing integration capability development.

10. Theoretical Contributions

Four contributions follow. First, this study is the first to apply the Dynamic Capabilities framework (Teece et al., 1997) specifically to ERP–tax integration as an organisational capability rather than a technical implementation. Prior ERP literature treats integration as a project outcome -go-live, on-budget, within-scope -rather than as a capability requiring ongoing sensing, seizing, and transforming investment. The study's three-mediator architecture (IC, CA, RA) formalises these three capability dimensions as empirically separable constructs with distinct antecedents and consequences.

Second, the study introduces Institutional Pressure as a performance moderator rather than an adoption driver in the ERP compliance context. Prior institutional theory applications in ERP and technology adoption research treat coercive, mimetic, and normative pressure as predictors of adoption intention (Kwahk & Lee, 2008). This study shows that institutional pressure amplifies the performance return on existing integration capability -a mechanistically distinct role that has direct policy implications: regulatory mandates do not just drive technology adoption, they amplify the performance dividend of technology investments already made.

Third, the PLS-MGA architecture -two contrasts, five paths each, convergent with SHAP importance rankings - provides the first structural evidence that ERP–tax integration enabler-to-capability paths are heterogeneous across MNE size and sector, while compliance capability-to-outcome paths are approximately homogeneous. This boundary condition specification -heterogeneity upstream, homogeneity downstream -is a theoretically informative finding about where firm-specific investment strategy matters and where universal compliance infrastructure delivers equivalent returns across firm types.

Fourth, the SHAP-PLS convergence at rs = 0.97 extends the between-method validation framework introduced in prior organisational research (Bzdok et al., 2018) to the ERP compliance domain, demonstrating that the approach is sensitive enough to detect genuine construct dominance (IC, CA) and genuine capability-amplification effects (IP moderation) when the theoretical model is correctly specified.

11. Managerial and Policy Implications

For Chief Tax Officers and ERP Programme Directors, the TEC-to-IC finding makes a specific investment argument: tax engine configurability investment -selecting engines with complete multi-jurisdiction rule sets and treaty-position support, and maintaining those configurations actively through vendor update cycles -produces the largest upstream contribution to integration capability of any of the four enablers tested. Combined with real-time data connectivity (the second-largest enabler path), the investment priority for firms seeking compliance performance gains is: configure the tax engine completely, then build the API connectivity to the ERP that makes that configuration operationally useful in real time.

The DQS finding is the most operationally specific result for CFOs and group controllers. Data quality and standardisation is the enabler that produces the only two-stage mediation chain to Operational Cost Efficiency (DQS → IC → TCP → OCE). This chain means that master data governance investment -consistent entity codes, harmonised chart-of-accounts, standardised product classifications across ERP instances -produces measurable FTE cost savings in compliance operations through a pathway that bypasses the need for parallel track investments in tax engine configurability or API connectivity upgrades. For firms with constrained technology budgets, DQS may be the highest-return first investment.

For policymakers evaluating the BEPS Pillar Two implementation architecture, the institutional pressure moderation finding provides an empirical argument for maintaining the €750 million revenue threshold for GloBE reporting obligations rather than raising it. Firms under the mandatory reporting threshold show IC-to-TCP path coefficients approximately 80% lower than mandatory filers. Raising the threshold would reduce the reporting infrastructure that converts existing integration capability into measurable compliance performance -reducing the compliance performance visible to tax authorities without necessarily reducing the underlying compliance behaviour of the affected firms.

12. Limitations and Future Research

Four constraints bound the conclusions. The cross-sectional design cannot establish causal direction between ERP integration investment and compliance performance. Firms with higher compliance performance may invest more in integration technology, reversing the structural paths. Longitudinal designs tracking firms before and after ERP–tax engine integration implementations, with difference-in-differences analysis using implementation go-live dates as natural experiment cutpoints, would provide the causal identification this design cannot.

The sample covers India, Singapore, and the UAE -three digitally advanced emerging-market jurisdictions. Findings may not generalise to OECD-jurisdiction MNEs operating primarily in Europe or North America, where ERP maturity and tax technology adoption baselines differ, or to firms below the Pillar Two threshold where BEPS compliance obligations are not triggered. Future research should replicate the structural model in at least one European and one North American MNE sample to test whether the sector and size heterogeneity patterns are stable across regulatory environments.

Study 3's ML models were trained on construct-score features derived from the same survey data as the PLS-SEM model. This limits between-method independence relative to a design where ML features were drawn from external data sources -ERP vendor API logs, tax authority filing acceptance rates, penalty and interest incidence records -

that are entirely separate from respondent self-report. Future research pairing survey construct scores with administrative compliance records would provide a fully independent SHAP-PLS convergence test.

The institutional pressure construct combines coercive, mimetic, and normative pressure into a single moderator. DiMaggio and Powell (1983) argue these three mechanisms operate through different compliance pathways, and they may moderate the IC-to-TCP relationship at different effect magnitudes -coercive pressure through reporting infrastructure, mimetic pressure through competitive benchmarking, normative pressure through professional certification standards. Decomposing IP into its three dimensions and testing the moderation separately for each would produce directly actionable policy guidance that the composite moderator cannot.

13. Conclusion

The gap between what ERP systems record and what global tax engines need to calculate correctly is not a technology problem. Existing API standards, data exchange protocols, and tax engine integration packages can close it. The gap persists because it is an organisational capability problem: firms that lack real-time data connectivity between their ERP and tax systems, that have not configured their tax engines to reflect their actual multi-jurisdiction rule positions, and that have not established the IT governance structures that keep integration quality from degrading over time, cannot convert technology investment into compliance performance at the rate that firms with these capabilities can.

This study provides the first structural empirical evidence that four ERP–tax integration enablers build three compliance capabilities that drive four measurable compliance outcomes -and that institutional pressure, specifically the coercive force of BEPS Pillar Two and digital VAT reporting mandates, amplifies the compliance performance return on existing integration capability by approximately 80%. The SHAP-PLS convergence at rs = 0.97 confirms that this structural account is not a method-specific finding but reflects genuine construct relationships that a tree ensemble and a structural equation model independently identify.

Tax compliance in the Pillar Two era is not a question of whether firms can afford sophisticated ERP–tax integration. It is a question of whether firms can afford not to have it. The evidence from 387 tax directors, ERP architects, and compliance officers across three of the world's most active BEPS implementation jurisdictions suggests that integration capability is the single largest determinant of compliance performance within their control -and that the firms farthest from that capability are precisely the ones operating under the highest regulatory pressure to demonstrate they have reached it.

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