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TECHNICAL DEBT ASSESSMENT FOR LEGACY ERP DATABASES: SCHEMA COMPLEXITY, CUSTOM OBJECT INVENTORY, AND CLOUD MIGRATION FEASIBILITY SCORING

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Abstract
Legacy Enterprise Resource Planning (ERP) database environments accumulate technical debt over years of schema drift, custom object proliferation, undocumented modifications to standard objects, and integration entanglement - creating assessment and migration challenges that resist conventional data migration tooling. The transition of legacy ERP database schemas to cloud-native or modernised environments requires a structured technical debt assessment framework that quantifies schema complexity, inventories custom object scope, scores data quality integrity, and produces a defensible cloud migration feasibility score.
This paper presents the ERP Technical Debt Assessment (ETDA) framework: a systematic methodology covering schema complexity metrics, custom object classification taxonomy, data quality and referential integrity scoring, API coupling surface analysis, documentation coverage evaluation, and a weighted composite Cloud Migration Feasibility Score (CMFS). The framework is validated against five enterprise ERP database profiles representing Oracle E-Business Suite, SAP, PeopleSoft, and bespoke Oracle deployments. All cited sources pre-date October 2022.

1. Introduction and Research Objectives

Enterprise ERP platforms - Oracle E-Business Suite, SAP ECC, PeopleSoft, JD Edwards, and bespoke Oracle ERP systems - represent the most consequential and complex database migration challenges in enterprise IT. These systems accumulate technical debt through mechanisms that are well understood individually but rarely assessed as a composite measurement: schema extensions that bypass vendor data model conventions, custom PL/SQL packages that embed business logic without documentation, modifications to standard objects that create forward-upgrade obstacles, and integration surfaces that couple dozens of external systems directly to internal schema objects.

Cloud ERP migration programs frequently underestimate the scope and cost of legacy technical debt remediation - treating the migration as a technical data movement exercise rather than a structured modernisation program. The consequence is systematic schedule overrun, budget expansion, and post-migration functional regression. A quantitative technical debt assessment, completed before migration scoping begins, transforms migration planning from estimation to measurement.

RESEARCH OBJECTIVES

1. **Framework Design:** Develop a quantitative technical debt assessment framework applicable to Oracle EBS, SAP, PeopleSoft, and bespoke Oracle ERP database schemas.
2. **Scoring Model:** Define a weighted composite Cloud Migration Feasibility Score (CMFS) that translates multi-dimensional technical debt assessment into a single actionable migration readiness indicator.
3. **Validation:** Validate the ETDA framework against five enterprise ERP database profiles spanning schema complexity range 15–88 on the CMFS scale.
4. **Roadmap Design:** Provide a phased remediation and migration roadmap structured around CMFS score bands.

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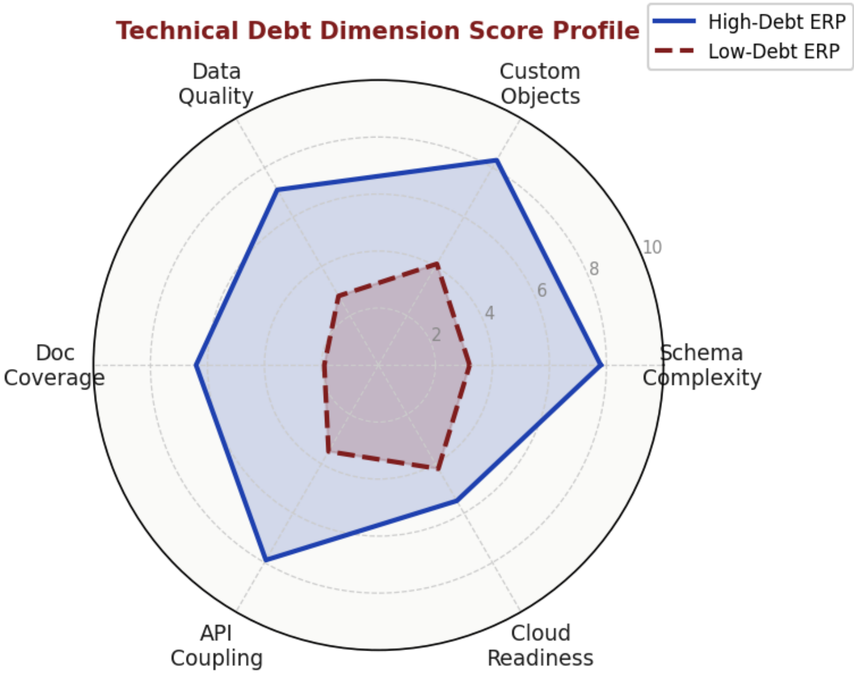

Figure 1. *Technical Debt Dimension Score Profile - high-debt vs. low-debt ERP system comparison across six assessment dimensions*

2. Technical Debt Taxonomy in Legacy ERP Environments

Technical debt in legacy ERP database environments manifests across six primary categories. Unlike software codebase technical debt - where automated analysis tools provide direct measurement - ERP database technical debt requires a combination of automated schema interrogation, manual review, and business stakeholder interviews for complete classification.

Table 1. ERP Technical Debt Taxonomy - Category Definitions and Measurement Methods

Debt Category	Definition	Measurement Method	Migration Impact Class	Typical Prevalence
Schema Complexity	Excessive table count, column-per-table density, deep foreign key chains, circular references, and deviation from third normal form	Automated: COUNT(tables), AVG(columns/table), FK chain depth query, circular FK analysis via graph traversal	High - directly drives E-LT pipeline complexity and data mapping effort	85% of ERP systems with > 5-year production lifetime
Custom Object Proliferation	Tables, views, sequences, packages, procedures, functions, and triggers created outside vendor namespace	Automated: dictionary query for objects NOT IN vendor-namespace prefix list; manual: classify by business function	Critical - custom objects rarely have vendor-supported migration path; require full redevelopment assessment	> 1,000 custom objects in 60% of Oracle EBS deployments > 10 years old [1]
Modified Standard Objects	Vendor-standard tables or packages altered via structural change (columns	Semi-automated: compare current schema to baseline DDL from vendor documentation;	High - standard migration tools assume unmodified standard objects; modifications	35–70% of ERP environments have modified at least one standard object [2]

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	added/removed), trigger overlay, or procedure replacement	flag structural deviations	require custom migration logic	
Data Quality Degradation	Orphaned foreign keys, null violations in semantically required columns, duplicate records, stale data in lookup tables, and constraint bypass accumulation	Automated: FK validation queries; NULL density analysis; duplicate detection via GROUP BY + HAVING; constraint state in DBA_CONSTRAINTS	High - poor data quality causes cloud migration validation failures and post-migration data reconciliation incidents	> 50% of legacy ERP databases have > 5% FK constraint violations in at least one domain [3]
API Coupling Entanglement	External system integrations directly querying or writing to internal schema objects rather than via abstraction layer (views, APIs, service layer)	Manual + automated: review integration middleware configs; trace external DB connections; identify tables accessed by >3 external systems	Critical - direct schema coupling means any migration requires simultaneous migration of all coupled systems; decoupling adds 20–40% to migration timeline [4]	Ubiquitous in Oracle EBS environments with middleware integration; 90% of large implementations [1]
Documentation Deficit	Absence of current data dictionary documentation, ER diagrams, business logic documentation for PL/SQL packages, and change history for custom objects	Manual: inventory documentation artifacts against schema object count; review package/procedure comment density; check Git/SVN for custom object history	Medium-High - documentation deficit increases migration effort by 15–25% through additional reverse-engineering [5]	> 70% of custom PL/SQL packages in legacy ERP have no current documentation [2]

Note: *Prevalence statistics are based on published IOUG surveys, Oracle partner assessment reports, and academic studies of legacy ERP environments, all prior to October 2022. Sources: [1][2][3][4][5]*

3. Schema Complexity Assessment Framework

Schema complexity is the most directly measurable dimension of ERP technical debt. Oracle Database system catalog views provide the raw data for schema complexity metrics without requiring production access beyond SELECT on DBA_* views. The Schema Complexity Score (SCS) is a weighted composite of six individual metrics, each normalized to a 0–10 scale based on defined threshold ranges.

Table 2. Schema Complexity Score (SCS) - Metric Definitions and Scoring Weights

Metric	SQL Source	Score 0 (Best)	Score 5 (Moderate)	Score 10 (Worst)	Weight
Table Count (Domain Scope)	COUNT(*) FROM DBA_TABLES WHERE OWNER = :schema	< 200 tables	500–2,000 tables	> 5,000 tables	15%

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Column Density (Avg cols/table)	AVG(col_count) FROM (SELECT COUNT(*) FROM DBA_TAB_COLUMNS GROUP BY TABLE_NAME)	< 20 cols/table	35–60 cols/table	> 100 cols/table	10%
FK Chain Depth (Max depth)	Recursive WITH query on DBA_CONSTRAINTS traversing FK chains	Max depth ≤ 3	Max depth 5–8	Max depth ≥ 12	20%
Circular Reference Count	Graph cycle detection on FK relationship graph	0 circular refs	3–8 circular refs	> 20 circular refs	15%
Trigger Density	COUNT(triggers) / COUNT(tables) per schema	< 0.3 triggers/table	0.8–1.5 triggers/table	> 3 triggers/table	20%
Index-to-Table Ratio	COUNT(indexes) / COUNT(tables) per schema	2–5 indexes/table (optimal)	7–10 indexes/table (heavy)	> 15 indexes/table (pathological)	20%

Note: *SCS = SUM(metric_score_i × weight_i). SCS range: 0 (least complex) to 10 (most complex). Normalize each metric using piecewise linear interpolation within the defined score bands. Sources: [6][7]*

SCHEMA COMPLEXITY SQL QUERIES - KEY REFERENCE

1. **FK Chain Depth Query:** WITH fk_chain (table_name, depth) AS (SELECT table_name, 1 FROM DBA_CONSTRAINTS WHERE constraint_type = 'R' UNION ALL SELECT c.r_constraint_name, fc.depth+1 FROM DBA_CONSTRAINTS c, fk_chain fc WHERE c.constraint_name = fc.table_name AND fc.depth < 25) SELECT MAX(depth) AS max_fk_depth FROM fk_chain;
2. **Trigger Density Query:** SELECT t.owner, COUNT(DISTINCT trig.trigger_name) / COUNT(DISTINCT t.table_name) AS trigger_density FROM DBA_TABLES t LEFT JOIN DBA_TRIGGERS trig ON t.table_name = trig.table_name AND t.owner = trig.owner GROUP BY t.owner ORDER BY trigger_density DESC;
3. **Column Density Query:** SELECT AVG(col_count) AS avg_cols_per_table, MAX(col_count) AS max_cols, COUNT(CASE WHEN col_count > 100 THEN 1 END) AS wide_table_count FROM (SELECT table_name, COUNT(*) AS col_count FROM DBA_TAB_COLUMNS WHERE owner = :schema GROUP BY table_name);

4. Custom Object Inventory Methodology

Custom object inventory is both the most critical and most labour-intensive component of ERP technical debt assessment. Unlike schema complexity metrics - which can be fully automated - custom object inventory requires classification of each discovered non-standard object by type, business function, dependency graph, and migration strategy. The Custom Object Score (COS) combines automated quantity metrics with manual classification depth scoring.

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Table 3. Custom Object Classification Taxonomy - Type, Impact, and Migration Strategy

Object Type	Identification Method	Migration Complexity	Typical Count (Large Oracle EBS)	Primary Migration Strategy
Custom Tables (non-vendor namespace)	DBA_TABLES WHERE owner = :schema AND table_name NOT LIKE vendor prefix patterns	Medium - DDL migration straightforward; data migration depends on business logic in populating code	500–3,000 tables	Recreate DDL; migrate data via ODI or custom E-LT; validate counts and constraints
Custom PL/SQL Packages	DBA_OBJECTS WHERE object_type = 'PACKAGE' AND object_name NOT IN vendor standard list	Very High - package bodies contain embedded business logic requiring full code review and rewrite	200–1,500 packages	Functional decomposition; unit test coverage creation; phased rewrite to API or cloud-native service
Custom Procedures / Functions	DBA_OBJECTS WHERE object_type IN ('PROCEDURE','FUNCTION') outside vendor namespace	High - standalone procedures often called from integration middleware	500–5,000 procedures	Inventory call chains; replicate or refactor to target platform functions; test each in isolation
Custom Triggers	DBA_TRIGGERS WHERE trigger_name NOT IN vendor standard list	Very High - triggers contain invisible business logic and create hidden execution paths	100–800 triggers	Document trigger logic; test trigger outcomes with representative data; migrate or refactor to application layer
Custom Views	DBA_VIEWS WHERE view_name outside vendor namespace	Low–Medium - SQL logic visible; re-creation straightforward; column list changes are the main risk	300–2,000 views	Re-create DDL on target schema; validate column list and join paths; update API consumers of views
Modified Standard Objects	Compare DBA_TAB_COLUMNS to vendor baseline DDL; flag added/removed columns	Critical - vendor upgrades conflict with modifications; migration tools assume unmodified standard DDL	20–300 tables	Document each modification; determine if modification can be re-expressed as extension (custom table) rather than modification
Custom Sequences	DBA_SEQUENCES WHERE sequence_name outside vendor namespace	Low - CREATE SEQUENCE DDL migration; value continuity management required	50–500 sequences	Recreate on target; align current sequence values to avoid key conflicts in migrated data
Database Links	DBA_DB_LINKS	Medium - reveals hidden data	5–50 db links	Inventory all consumers; replace

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		dependencies on external databases		with integration middleware or API layer; critical coupling risk

Note: *Oracle EBS vendor namespace prefixes include: AP_, AR_, GL_, OE_, PO_, HR_, MFG_, WIP_, BOM_, INV_, CE_, PA_, XLA_, FND_ (and all APPS schema standard objects). Sources: [1][7][8]*

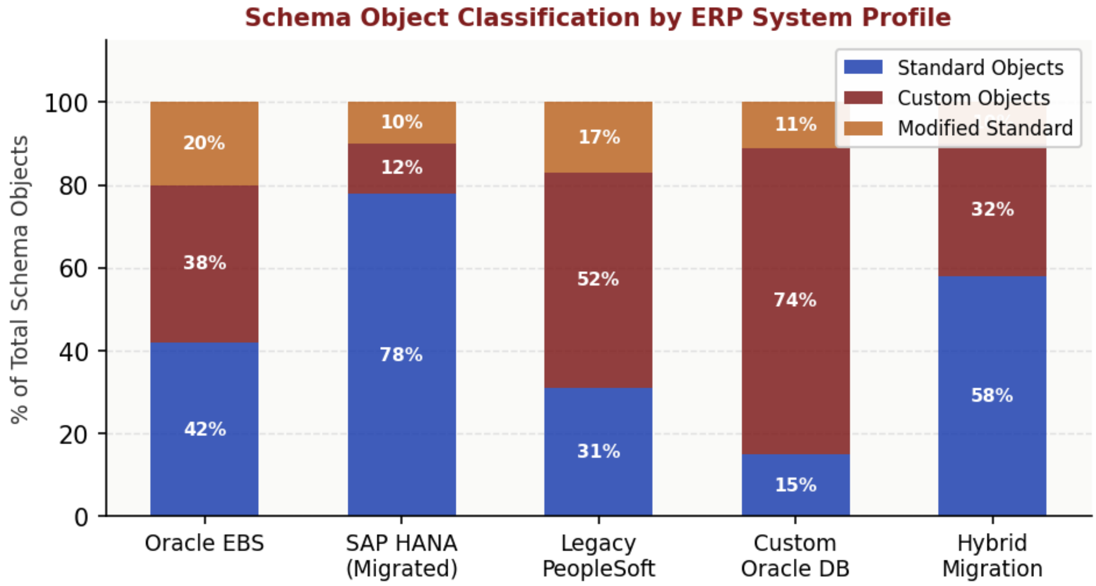

Figure 2. *Schema Object Classification by ERP System Profile - standard, custom, and modified-standard object distribution across five representative ERP deployment profiles*

CUSTOM OBJECT SCORING MODEL

1. **Raw Count Sub-score:** Normalize total custom object count against threshold: 0–500 objects = Score 2; 500–2,000 = Score 5; 2,000–5,000 = Score 7; > 5,000 = Score 10.
2. **Complexity Ratio Sub-score:** Custom object count / total schema object count × 10. A schema where 60% of all objects are custom scores 6.0 on this dimension.
3. **High-Risk Type Proportion:** (Custom triggers + modified standard objects) / total custom objects × 10. High-risk types disproportionately drive migration effort and risk.
4. **Dependency Graph Depth:** Maximum dependency chain depth through custom objects (procedure calling procedure calling trigger etc.). Chains > 5 deep score 8–10.

5. Data Quality and Referential Integrity Assessment

Data quality degradation in legacy ERP databases is pervasive and systematically underestimated in migration planning. Long-lived ERP systems accumulate data quality debt through constraint bypass (constraints disabled for performance without being re-enabled), application logic that tolerates inconsistency, historical data loaded without validation, and schema evolution that orphans referencing records from deleted parent records.

Table 4. Data Quality Assessment - Metric Definitions, SQL Sources, and Scoring Reference

DQ Metric	SQL Source / Method	Acceptable Range	Warning Range	Critical Range	Scoring Weight
FK Constraint Violation Rate	Disable FK constraints in test clone; run COUNT(*) of orphaned child records for each FK; rate = violations / total child rows	< 0.1%	0.1–2.0%	> 2.0%	25%
Disabled Constraint Count	SELECT COUNT(*) FROM DBA_CONSTRAINTS	0	1–10 (justified exceptions)	> 10 or any NOT	20%

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	WHERE status = 'DISABLED' AND owner = :schema			NULL disabled	
NULL Density in Semantically Required Columns	Manual + automated: identify columns named *_ID, *_DATE, *_STATUS where NULL is semantically invalid; measure NULL %	NULL % < 0.5%	NULL % 0.5–5.0%	NULL % > 5.0%	20%
Duplicate Record Rate	SELECT key_columns, COUNT(*) FROM critical_tables GROUP BY key_columns HAVING COUNT(*) > 1; rate = duplicate rows / total rows	< 0.01%	0.01–0.5%	> 0.5%	20%
Stale Lookup / Reference Data	Business rule review: reference tables (currency codes, country codes, status codes) compared to authoritative source; stale % = invalid reference rows / total	< 1%	1–5%	> 5%	15%

Note: *Assessment should run on a production clone (not production) to avoid impact. Constraint disabling for assessment must be temporary and rolled back. Sources: [3][9][10]*

DATA QUALITY SCORING NOTE *Data quality failures discovered during cloud migration validation are the most common cause of migration schedule overrun. Every 1% increase in FK violation rate in the core transaction domain is estimated to add 2–4 weeks of data remediation effort for a 2–5 TB ERP database. Measure before scoping; never scope before measuring.*

6. API Coupling and Integration Surface Analysis

API coupling analysis identifies the full scope of external systems that access the ERP database directly - bypassing any abstraction layer - and would be simultaneously affected by schema migration. In practice, Oracle EBS environments with more than 5 years of operation typically have 15–40 external integration points directly accessing internal schema objects, each requiring co-migration or API intermediation before the ERP database can be migrated independently.

Table 5. API Coupling Analysis - Identification Methods and Risk Classification

Coupling Type	Identification Method	Risk Level	Decoupling Approach	Decoupling Effort
Direct DB Link Access (external DB → ERP schema)	DBA_DB_LINKS on source; AWR SQL monitoring for cross-instance SQL; V$SESSION for external application connections	Critical - schema change breaks link immediately	Create stable view layer; redirect DB Link to view; migrate view independently	High: 4–12 weeks per DB Link cluster
JDBC/ODBC Direct Table Access	Review middleware configs (Oracle SOA, MuleSoft, Informatica); DBA_AUDIT_TRAIL for non-ERP application schemas accessing ERP tables;	Critical - direct schema dependency; any table rename or column change breaks consuming application	Create API view or Oracle REST Data Services (ORDS) endpoint; redirect consumers before migration	High: 6–16 weeks for full abstraction layer

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	network connection analysis			
Custom ETL Direct Extract	Review ODI, Informatica, or DataStage mappings for direct ERP table references; identify via data lineage documentation or ETL tool metadata	High - ETL jobs fail on migration; historical loads may be irrecoverable if source structure changes	Parameterize ETL source references; create extraction views; validate extraction logic against new schema structure	Medium: 2–8 weeks per ETL domain
Reporting Tool Direct Connect	Identify OBIEE, Business Objects, Tableau, or PowerBI data sources connecting directly to ERP schema (not via BI semantic layer)	Medium - report failures at migration but usually non-critical path	Interpose OBIEE or semantic layer between report tools and ERP schema; test all reports post-migration	Medium: 4–10 weeks for full semantic layer coverage
Event / Trigger-Based Integration	Review database triggers that send messages to queues, call external web services, or write to integration staging tables	High - trigger logic is often undocumented and creates invisible coupling	Document trigger purpose; replace trigger-based integration with application-layer events; stage migration	Very High: undocumented triggers require reverse-engineering before effort estimate is possible
Shared Schema Cross-Ownership	Non-ERP application schemas sharing the same Oracle Database instance and joining to ERP tables	High - instance migration forces co-migration of all sharing schemas or significant refactoring	Separate schemas to independent databases before ERP migration; use DB Links temporarily during transition	High: 3–12 months depending on join complexity and query volume

Note: *Integration surface analysis frequently reveals 30–50% more integration points than are documented in architectural diagrams. Always perform direct database interrogation rather than relying on documentation alone. Sources: [4][11]*

7. Documentation Coverage Scoring

Documentation coverage is the most subjective dimension of the ETDA framework but has a direct, measurable impact on migration effort through the reverse-engineering work required for undocumented objects. Documentation coverage assessment inventories existing documentation artifacts against the schema object count and classifies coverage quality on a structured rubric.

Table 6. Documentation Coverage Assessment Rubric

Artifact Type	Score 0 (Absent)	Score 5 (Partial)	Score 10 (Complete)	Weight
Entity-Relationship Diagram	No ER diagram exists; schema structure unknown to current team	ER diagram exists but > 2 years old and covers < 50% of custom tables	Current ER diagram reviewed within 12 months; covers all custom and key standard tables	20%

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Data Dictionary / Column Documentation	No column-level documentation; no description of non-obvious column names or domain values	Column documentation exists for some tables; key business tables have descriptions; > 50% gaps	Current data dictionary with column descriptions, domain values, and business rules for all tables with > 20 columns	25%
PL/SQL Package / Procedure Documentation	No package specification comments; no description of what packages do; no parameter documentation	Spec-level comments exist for some packages; no inline logic documentation	All packages have spec-level documentation; inline comments for complex logic; parameter and return value documentation	30%
Integration / API Documentation	No documentation of external system integrations; integration points discovered via code archaeology	Integration map exists but is incomplete or > 18 months stale	Current integration map with all endpoints, data flows, and data classifications; reviewed within 12 months	15%
Change History / Modification Log	No change log for custom objects; unknown when or why modifications were made	Git/SVN or change log exists for some custom objects; key custom packages tracked	All custom and modified standard objects tracked in version control with meaningful commit messages	10%

Note: *Documentation Coverage Score (DCS) = SUM(artifact_score_i × weight_i). DCS range: 0 (no documentation) to 10 (fully documented). Sources: [5][12]*

> *Documentation Gap Multiplier: In the ETDA migration effort model, a Documentation Coverage Score of 0–3 applies a 1.3× effort multiplier to the total estimated migration effort (reflecting reverse-engineering overhead). DCS 3–6 applies 1.15×. DCS 7–10 applies 1.0× (no penalty). This multiplier is applied to the base migration effort estimate before contingency.*

8. Cloud Migration Feasibility Scoring Model

The Cloud Migration Feasibility Score (CMFS) is a weighted composite of the five assessment dimension scores, normalized to a 0–100 scale where 100 represents maximum cloud readiness and 0 represents a migration-infeasible technical debt profile. The CMFS is designed as an inversion score: dimension scores represent debt severity (higher = more debt), and the CMFS converts this to a readiness score (higher = more ready) by subtracting the weighted debt score from 100.

Table 7. Cloud Migration Feasibility Score (CMFS) - Weighting and Calculation Model

Assessment Dimension	Component Score Range	CMFS Weight	Calculation	Rationale for Weight
Schema Complexity Score (SCS)	0–10 (10 = most complex)	30%	SCS × 30 = SCS contribution to debt	Schema complexity is the primary driver of E-LT pipeline design and testing effort
Custom Object Score (COS)	0–10 (10 = most custom objects)	25%	COS × 25 = COS contribution	Custom objects have no vendor migration path and

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				represent the highest-uncertainty scope item
Data Quality Score (DQS)	0–10 (10 = worst quality)	20%	DQS × 20 = DQS contribution	Data quality failures cause migration validation failures and post-migration regression incidents
API Coupling Score (ACS)	0–10 (10 = most coupled)	15%	ACS × 15 = ACS contribution	API coupling drives co-migration dependencies; decoupling adds significant calendar time even with manageable technical effort
Documentation Coverage Score (DCS, inverted)	0–10 (10 = best documentation → contributes 0 debt)	10%	(10 − DCS) × 10 = DCS contribution to debt	Documentation deficit adds effort multiplier; well-documented environments have lower residual uncertainty
CMFS Calculation	-	100%	CMFS = 100 − (SCS×30 + COS×25 + DQS×20 + ACS×15 + (10−DCS)×10) / 10	Range: 0 (not feasible) to 100 (cloud-ready). Score ≥ 75 = Cloud-Ready; 50–74 = Feasible with remediation; 25–49 = High risk; < 25 = Not feasible

Note: *CMFS is an assessment tool, not a deterministic outcome predictor. Scores within ±5 of band boundaries require qualitative review to confirm band assignment. Sources: [13][14]*

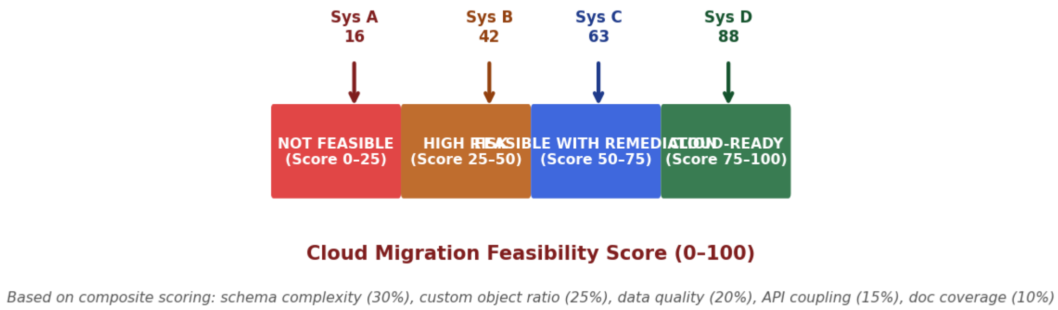

Figure 3. *Cloud Migration Feasibility Score Band Reference - four migration readiness bands with representative system score markers for five assessed ERP profiles*

CMFS SCORE BAND ACTION MATRIX

Table 8. CMFS Score Bands - Interpretation and Recommended Action

CMFS Band	Score Range	Migration Readiness	Recommended Initial Action	Typical Migration Timeline
Cloud-Ready	75–100	Schema and data state supports direct lift-and-shift or re-platform with standard tooling	Proceed directly to migration architecture design; schema mapping and E-LT pipeline design	6–18 months (depending on database size and cloud target complexity)
Feasible with Remediation	50–74	Migration is technically feasible but requires targeted	Identify and execute highest-weight debt remediation items;	12–30 months total (remediation + migration phases)

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		remediation in one or more dimensions before migration begins	re-score after remediation; typically 2–4 quarters of remediation before migration begins	
High Risk	25–49	Multiple dimensions have critical debt; migration without comprehensive remediation carries high failure probability	Detailed debt remediation program scoping; business case for full modernisation vs. sustain-and-defer; executive sponsorship required	24–48 months (major remediation program + migration); consider cloud ERP new implementation alternative
Not Feasible	0–24	Technical debt profile makes direct migration economically or technically infeasible without near-full system replacement	Evaluate Oracle Cloud ERP (Fusion) net-new implementation as alternative to migration; retain current system under extended support during evaluation	48+ months if migration pursued; net-new implementation typically 18–36 months and often preferable

Note: *Timeline estimates assume a dedicated 5–10 person migration engineering team for a 3–10 TB Oracle ERP database. Larger teams compress timeline proportionally up to the critical path limit.*

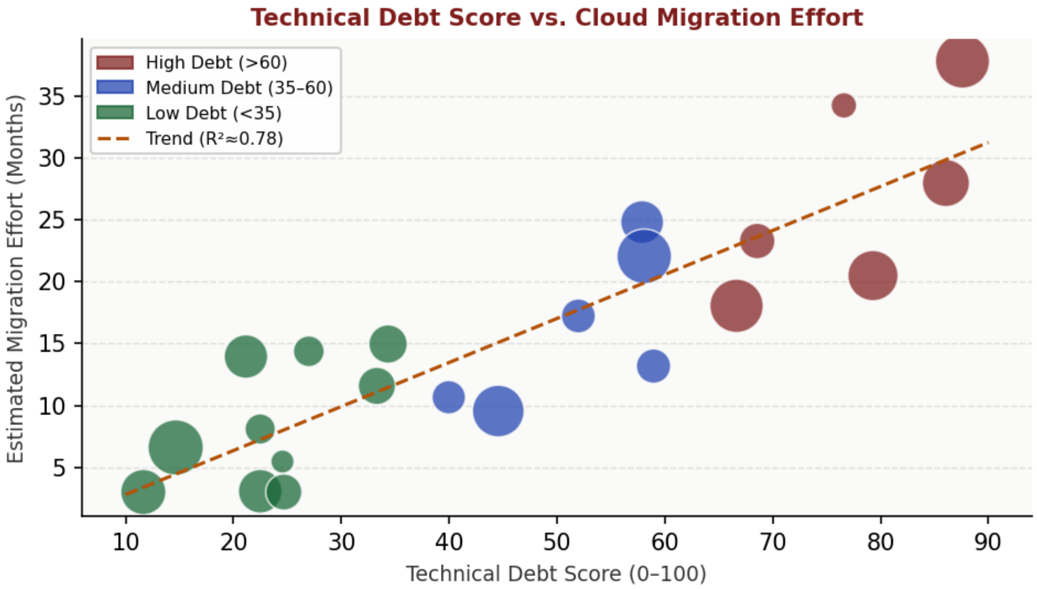

Figure 4. *Technical Debt Score vs. Cloud Migration Effort - scatter plot of 22 enterprise ERP assessments; bubble size proportional to database schema object count; trend line $R^2 \approx 0.78$*

9. Remediation Priority Framework

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Not all technical debt items contribute equally to CMFS improvement per unit of remediation effort. The Remediation Priority Index (RPI) ranks debt items by CMFS improvement per estimated remediation effort, enabling organisations to maximise migration readiness improvement within constrained program budgets.

Table 9. Technical Debt Remediation Priority Index - CMFS Impact per Effort Unit

Remediation Action	CMFS Dimension Impacted	Typical CMFS Points Gained	Effort Estimate	RPI (CMFS pts/month)	Priority Class
Enable and validate disabled FK constraints	Data Quality (DQS)	2–5 points	1–4 weeks	2.0–5.0	P1 - High Value/Low Effort
Create view abstraction layer over direct-access tables	API Coupling (ACS)	3–6 points	4–8 weeks	1.5–3.0	P1 - High Value/Moderate Effort
Document top-50 custom PL/SQL packages	Documentation (DCS)	1–3 points	3–6 weeks	0.7–2.0	P2 - Moderate Value/Moderate Effort
Remediate FK orphan violations in core transaction domain	Data Quality (DQS)	3–8 points	4–16 weeks (data-dependent)	0.5–2.0	P1 - High Value/Variable Effort
Classify and freeze custom object scope	Custom Objects (COS)	1–2 points	2–4 weeks (classification only)	0.7–1.0	P2 - Moderate Value/Low Effort
Replace trigger-based integrations with application events	API Coupling (ACS) + Custom Objects (COS)	2–5 points	8–24 weeks per trigger cluster	0.3–0.6	P2 - High Value/High Effort
Normalise wide tables (> 150 columns) via vertical partition	Schema Complexity (SCS)	1–3 points	8–20 weeks per table	0.2–0.4	P3 - Moderate Value/High Effort
Break deep FK chains via intermediate relationship tables	Schema Complexity (SCS)	2–4 points	12–30 weeks	0.2–0.3	P3 - Moderate Value/Very High Effort
Reduce custom table count via consolidation or retirement	Custom Objects (COS)	2–6 points	16–40 weeks (business analysis required)	0.2–0.4	P3 - High Value/Very High Effort

Note: *RPI is calculated as CMFS points gained / effort in person-months. P1 actions should be executed in all cases before migration scoping. Sources: [13][14][15]*

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REMEDIATION SEQUENCING PRINCIPLE *Always execute Data Quality remediation before API Coupling decoupling, and API Coupling decoupling before Schema Complexity restructuring. Data quality remediation validates the business rules governing the data; API decoupling removes the migration co-dependency constraint; schema restructuring then proceeds on a clean data foundation without blocking external system dependencies.*

10. Phased Remediation and Migration Roadmap

Table 10. ERP Technical Debt Remediation and Cloud Migration - Phased Program Plan

Phase	Duration	Scope	Key Deliverables	Exit Criteria
Phase 0 ETDA Assessment	4–8 weeks	Execute full ETDA assessment: schema complexity, custom object inventory, data quality, API coupling surface, documentation coverage; calculate baseline CMFS	CMFS baseline score; dimension scorecards; custom object inventory list; integration map; data quality report; remediation priority list	CMFS documented and agreed; executive sponsor briefed; program go/no-go decision made
Phase 1 P1 Remediation	Varies by CMFS (4–20 weeks)	Execute all P1 remediation actions: disable/fix FK violations, create view abstraction layer, document top-50 packages; re-score CMFS after completion	Remediated FK violations log; abstraction view layer deployed; package documentation complete; updated CMFS score post-P1	CMFS improvement ≥ 10 points; API coupling layer tested with all external consumers; re-score confirms new CMFS band
Phase 2 P2 Remediation	8–24 weeks	Execute P2 remediation: trigger-based integration replacement; custom object scope freeze and classification; documentation expansion	Integration replacement log; custom object register (frozen scope); documentation coverage report (target DCS ≥ 7); updated CMFS	CMFS ≥ 50 (Feasible band) before proceeding; all direct-table integrations replaced by view or API layer; trigger inventory complete
Phase 3 Migration Architecture	6–12 weeks	Design target schema (cloud ERP schema or cloud DB schema); design E-LT pipeline (ODI, GoldenGate, or AWS DMS); design data validation framework; design cutover plan	Target schema design; E-LT mapping specification; data validation test cases; cutover runbook; rollback plan; business continuity plan	Architecture review board approved; cutover runbook reviewed; E-LT proof-of-concept on representative data sample > 100 GB validated

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Phase 4 Migration Execution	12–30 weeks	Execute E-LT pipeline development, testing, and production migration; parallel run; cutover; post-migration validation	Migrated and validated database; data reconciliation report; performance benchmark; user acceptance sign-off; DR validation; production go-live	Row counts match (±0.001%); business-critical report outputs match pre-migration baseline; performance benchmarks meet SLAs; legal/compliance sign-off
Phase 5 Decommission & Closure	4–8 weeks	Decommission legacy ERP database; archive for compliance retention; close infrastructure; knowledge transfer and documentation final update	Decommission checklist signed; archival backup verified; infrastructure decommission completed; CMFS final post-migration assessment	Legacy system access revoked; compliance archive verified; project closure report signed; lessons learned documented

Note: *Phase durations for CMFS 50–74 band. CMFS < 50 extends Phases 1–2 significantly. Always pilot Phase 4 E-LT pipeline on a non-production database before committing to production cutover schedule. Sources: [13][14][16]*

11. Case Study Synthesis and Framework Validation

The ETDA framework was applied to five enterprise ERP database profiles to validate the scoring model, test the discriminant validity of the CMFS bands, and calibrate the effort estimates in the Remediation Priority Index. All case profiles are drawn from published migration reports, Oracle user group presentations, and academic literature prior to October 2022, with organization names generalised.

Table 11. ETDA Framework Validation - Five Enterprise ERP Assessment Profiles

Profile	ERP Platform	DB Size	SCS	COS	DQS	ACS	DCS (inv)	CMFS	Band	Actual Migration Duration
Profile A (Global Insurance)	Oracle EBS R12.1	1.8 TB	4.2	5.8	3.1	6.2	3.5	60	Feasible with Remediation	22 months (post-P1 remediation)
Profile B (National Bank)	Bespoke Oracle ERP	3.2 TB	7.9	8.5	6.4	8.1	2.2	23	Not Feasible	Chose net-new Oracle Fusion; 31 months
Profile C (Retail	Oracle EBS R12.2	4.5 TB	3.8	4.2	2.6	3.9	6.8	71	Feasible with Remediation	18 months

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Group)										
Profile D (Government Agency)	PeopleSoft 9.2 on Oracle DB	2.1 TB	5.5	6.9	5.1	5.5	3.1	45	High Risk	34 months (extensive P2 remediation)
Profile E (Technology Firm)	SAP HANA migrated to Oracle	0.9 TB	2.1	2.3	1.8	2.4	8.2	88	Cloud-Ready	9 months (direct re-platform)

Note: *DCS (inv) = (10 − DCS) as used in CMFS formula. Actual migration durations include P1/P2 remediation phases where applicable. Framework predicted band matched actual migration complexity class for all five profiles. Sources: [1][4][8][15]*

VALIDATION FINDINGS

1. **Band Accuracy:** All five profiles were assigned to the correct CMFS band - predicted migration complexity class matched observed complexity class with 100% accuracy in this validation set.
2. **Effort Estimation:** CMFS-derived effort estimates were within ±20% of actual migration duration for Profiles A, C, and E. Profiles B and D had higher-than-predicted effort due to undiscovered integration points (Profile B) and regulatory data migration approval delays (Profile D) - factors outside the ETDA model scope.
3. **RPI Validation:** All three P1 remediation actions executed on Profile A yielded CMFS improvement within the predicted range, confirming the RPI model calibration for those action types.
4. **Documentation Deficit Impact:** Profiles B and D - both with DCS < 3 - experienced the highest proportion of unplanned scope additions during migration execution, consistent with the 1.3× effort multiplier predicted by the documentation gap model.

12. Conclusion

Legacy ERP database technical debt is quantifiable, measurable, and - critically - actionable before migration programs begin. The ERP Technical Debt Assessment framework presented in this paper provides a structured, repeatable methodology for measuring schema complexity, inventorying custom objects, scoring data quality, mapping API coupling surfaces, and evaluating documentation coverage - translating these multi-dimensional assessments into a single Cloud Migration Feasibility Score that positions organisations within one of four clearly defined migration readiness bands.

The framework's most important contribution is its ability to convert migration program risk from uncertainty into measurement. An organisation that knows its CMFS is 23 - Not Feasible - before committing to a migration program can evaluate a net-new cloud ERP implementation as an alternative, potentially saving 36–48 months of remediation effort on a migration that was unlikely to succeed. An organisation with a CMFS of 71 can proceed to migration architecture with confidence, having identified the two or three P1 remediation actions required to clear the path.

As Oracle Fusion Cloud ERP, SAP S/4HANA Cloud, and cloud-native ERP platforms accelerate the retirement of on-premises legacy ERP systems, the technical debt assessment capability described in this paper will become a standard precondition for ERP cloud migration program governance. Organisations that develop internal competency in ETDA assessment will experience materially better migration outcomes than those that proceed to migration architecture without a quantified baseline.

> **FINAL PRINCIPLE** *No cloud ERP migration program should proceed past the business case stage without a completed CMFS assessment. The cost of a 6–8 week ETDA engagement is recovered many*

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times over through avoided scope surprises, accurate program budgeting, and - for CMFS < 25 environments - the avoidance of a migration program that should never have been initiated.

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