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A Structured Risk Assessment Framework for Cloud Migration Strategy Selection: Lift-and-Shift versus Re-architecture-A Proposed Multi-Factor Decision Framework (CMRAF) with Illustrative Applications

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Abstract

Cloud migration strategy selection — the choice between lift-and-shift (rehosting), re-platforming, and full re-architecture — is one of the most consequential decisions in an enterprise's digital transformation journey, yet organizations routinely default to cost estimates and informal judgment rather than a structured, repeatable assessment process. This paper proposes the Cloud Migration Risk Assessment Framework (CMRAF), a five-dimension model that scores technical debt density, application dependency complexity, business continuity requirements, team re-architecture capability, and strategic application value, and maps the composite score to a recommended migration strategy. Unlike cost-centric decision models, which capture infrastructure and licensing economics but overlook execution risk, CMRAF is designed to surface the factors that most often cause migration strategy choices to fail in practice. The framework is presented conceptually and illustrated through two worked, hypothetical application scenarios that demonstrate how it would be applied and how its recommendations would diverge from a cost-only approach. The paper closes with a concrete empirical validation agenda — the study this framework has not yet undergone — including sample design, metrics, and comparison baselines needed to test CMRAF against real migration portfolios.

Keywords: *Cloud Migration Strategy; Migration Risk Assessment; Lift-And-Shift; Re-Architecture; Technical Debt; Application Dependency Complexity; Cloud Adoption Framework*

1. Introduction

Every enterprise cloud migration program eventually confronts the same question for each application in its portfolio: rehost, replatform, or re-architect? The answer has significant implications for cost, timeline, operational risk, and the long-term cloud economics of that application.

Lift-and-shift — moving an application to the cloud with minimal modification — is fast and comparatively low-risk in the short term, but frequently results in poor cloud cost economics, preserved technical debt, and reduced ability to exploit cloud-native capabilities such as elastic scaling and managed services. Re-architecture — redesigning an application to be cloud-native — unlocks the greatest long-term value but requires substantial investment, introduces execution risk of its own, and extends migration timelines.

In practice, the decision between these strategies is usually made using cost modeling, which captures infrastructure and licensing economics but misses factors that are at least as consequential: dependency complexity, the migrating team's re-architecture capability, regulatory constraints, and the strategic importance of the application to the business. Prior work on cloud migration risk has largely treated these factors separately — as security or compliance checklists, as dependency-discovery tooling outputs, or as technical debt metrics — rather than as inputs to a single strategy-selection decision.

This paper addresses that gap by proposing a structured, multi-factor risk assessment framework — CMRAF — that organizations can use to make migration strategy decisions on a more defensible, evidence-based basis than cost modeling alone. The framework is presented here as a conceptual contribution supported by illustrative worked examples; Section 6 sets out the empirical validation this framework requires before it can be claimed to outperform existing approaches, and it is offered honestly as future work rather than as a result already obtained.

The remainder of the paper is organized as follows. Section 2 reviews the relevant literature on migration strategy taxonomies, dependency analysis, and technical debt measurement, and identifies the specific gap CMRAF addresses. Section 3 presents the CMRAF framework and its five assessment dimensions. Section 4 walks through two hypothetical, illustrative applications of the framework to demonstrate its mechanics. Section 5 discusses implications and limitations. Section 6 concludes and proposes the research questions and validation design needed to test the framework empirically.

2. Literature Review

Gartner's original migration taxonomy, later popularized as the 'Rs' of cloud migration (Rehost, Replatform, Refactor/Re-architect, Repurchase, Retire, Retain), established the standard vocabulary for describing migration strategies (Future Processing, 2026; Techreviewer, 2026). Subsequent extensions have added additional categories, but the taxonomy describes the space of possible strategies rather than prescribing how to select among them for a given application — the selection problem this paper addresses.

Application dependency analysis has been studied as a foundational input to migration planning. Automated dependency-discovery tools such as AWS Migration Evaluator and Azure Migrate can inventory integration points and data flows, but translating that dependency data into a strategy recommendation remains a largely manual, judgment-driven step (Cloud Migration Authority, 2026). Rosado, Gómez, Mellado, and Fernández-Medina (2012) examined security analysis specifically within cloud migration and argued that migration risk assessment needs to integrate technical, security, and organizational factors rather than treating them as independent checklists.

Technical debt assessment provides a second relevant thread. Kruchten, Nord, and Ozkaya (2012) formalized technical debt as a first-class engineering construct with direct implications for the cost and risk of future change — a framing directly applicable to migration strategy choice, since highly indebted applications may warrant re-architecture regardless of dependency complexity. Alzaghoul and Bahsoon (2013) extended this line of work specifically to cloud contexts, proposing a real-options approach to managing technical debt in cloud-based service selection, which supports treating migration strategy as a risk-and-option decision rather than a pure cost comparison.

Risk analysis specific to cloud migration has been reviewed systematically. A systematic literature review of risk analysis in cloud migration found that most published risk frameworks concentrate on security and compliance risk categories, with comparatively little attention paid to strategy-selection risk — that is, the risk of choosing the wrong migration approach for a given workload in the first place (ScienceDirect, 2021; ResearchGate, 2021). This is the specific gap CMRAF is designed to address: existing frameworks assess whether a migration is safe to execute, not which strategy an application should be assigned before execution begins.

Business continuity requirements — recovery time objectives (RTO) and recovery point objectives (RPO) — are well understood in disaster recovery planning but are infrequently formalized as explicit migration strategy selection criteria in the literature reviewed above. Applications with aggressive RTO requirements may warrant re-architecture toward cloud-native resilience patterns regardless of their technical debt profile, which is why RTO/RPO is treated as an independent CMRAF dimension rather than folded into technical debt or dependency complexity.

Taken together, the literature establishes clear vocabulary for migration strategies (the 'Rs'), mature tooling for dependency discovery, a formal theory of technical debt, and systematic risk taxonomies focused on security and compliance. What is comparatively underdeveloped is a single, structured model that combines these threads into a strategy-selection recommendation for an individual application — the contribution this paper proposes.

3. The CMRAF Framework

CMRAF scores each candidate application on five dimensions, each rated on a 1–5 scale, with higher scores indicating greater favorability toward re-architecture over lift-and-shift:

3.1 Technical Debt Density

An assessment of the density and severity of technical debt in the current codebase and configuration — outdated frameworks, undocumented customizations, and brittle integrations. Higher technical debt density pushes the recommendation toward re-architecture, since lift-and-shift preserves debt rather than resolving it.

3.2 Dependency Complexity

The number and criticality of integration points, both inbound and outbound, and the extent to which those dependencies are documented versus tribal knowledge. High dependency complexity with poorly understood integrations increases the risk of both strategies but particularly penalizes aggressive re-architecture timelines, so this dimension interacts with, rather than simply adds to, the others.

3.3 Business Continuity Requirements (RTO/RPO)

Applications with aggressive recovery objectives benefit from cloud-native resilience patterns (multi-region failover, managed database replication) that are difficult to retrofit onto a lift-and-shifted architecture.

3.4 Team Re-architecture Capability

An honest assessment of whether the migrating team has the cloud-native design, delivery, and operational skills required to execute a re-architecture safely. A technically ideal case for re-architecture can still be a poor real-world candidate if the team lacks the capability to execute it without extended risk exposure.

3.5 Strategic Application Value

The application's importance to current and future business objectives. Lower-value or sunset-track applications are steered toward lift-and-shift or retirement regardless of their technical debt profile, since re-architecture investment should track business value.

The five-dimension scores are not intended to be averaged into a single number that mechanically dictates a strategy; rather, CMRAF is presented as a structured discussion framework that surfaces the dimensions cost modeling alone omits, and forces an explicit decision-owner conversation about how those dimensions tradeoff for a specific application. Organizations that want a single composite score can weigh the dimensions according to their own risk appetite, but the framework's primary value proposition is the discipline of scoring each dimension explicitly rather than relying on informal judgment.

4. Illustrative Applications

To demonstrate how CMRAF would be applied in practice, this section walks through two hypothetical, illustrative application scenarios. These are worked examples designed to show the framework's mechanics and its point of divergence from a cost-only recommendation — they are

not drawn from a completed empirical study, and the scores below are illustrative rather than measured.

4.1 Scenario A: Legacy Case Management System

Consider a 12-year-old case management application with extensive undocumented customizations (technical debt density: 5/5), moderate integration complexity with three downstream systems via well-documented APIs (dependency complexity: 2/5), standard business-hours RTO/RPO requirements (business continuity: 2/5), a migrating team with strong cloud-native delivery experience (team capability: 4/5), and high strategic value as the system of record for a core business process (strategic value: 5/5). A cost-only model, weighting primarily infrastructure and licensing savings, might recommend lift-and-shift as the fastest path to cloud cost reduction. CMRAF's dimension profile instead points toward re-architecture: the combination of severe technical debt, high strategic value, and available team capability suggests that lift-and-shift would simply relocate the debt into the cloud while forgoing an opportunity — with a capable team already in place — to resolve it.

4.2 Scenario B: Internal Reporting Utility

Consider a smaller internal reporting tool with moderate technical debt (technical debt density: 3/5), low dependency complexity (dependency complexity: 1/5), no meaningful continuity requirements (business continuity: 1/5), a team with limited re-architecture bandwidth currently allocated to higher-priority work (team capability: 2/5), and low strategic value as a candidate for eventual retirement (strategic value: 1/5). Here CMRAF and a cost-only model reach a similar conclusion — lift-and-shift, or even retention pending retirement — but for a different reason: CMRAF explicitly documents that the recommendation follows from low strategic value and constrained team capacity, not merely from short-term infrastructure cost, which gives the decision a defensible rationale if it is revisited later.

These two scenarios illustrate the situation in which CMRAF is expected to add the most value: applications, like Scenario A, where technical debt and strategic value are both high but a cost-only lens would still favor the lower-effort path. This is the specific hypothesis Section 6 proposes to test empirically.

5. Discussion

The central claim of this paper is not that CMRAF has been shown to outperform cost-only migration decision models — that claim would require the empirical study described in Section 6 — but that the five dimensions it formalizes are each independently supported in the literature as relevant to migration outcomes, and that no widely used framework currently combines them into a single per-application strategy-selection tool. The worked scenarios in Section 4 are intended to make the framework's mechanics concrete, not to substitute for validation.

If validated, the framework would be expected to have the greatest practical value for organizations with large, heterogeneous application portfolios, where migration planners must make dozens or

hundreds of similar strategy decisions under time pressure and would benefit from a repeatable, documentable process rather than case-by-case improvisation. A structured framework, even an unvalidated one, has secondary value in this setting simply by making the reasoning behind each decision explicit and auditable — which matters for regulated industries and for organizations that need to justify migration spend to non-technical stakeholders.

The framework's most significant current limitation is exactly that it is unvalidated: no evidence in this paper demonstrates that CMRAF-guided decisions produce better outcomes (lower cost overruns, fewer re-migrations, higher stakeholder satisfaction) than cost-only decisions or unstructured expert judgment. A second limitation is that the five dimensions and their 1–5 scoring scale were selected based on literature review and practitioner reasoning rather than statistical derivation from outcome data; an empirical study may find that some dimensions should be weighted more heavily than others, or that additional dimensions — most plausibly regulatory and compliance constraints — should be added explicitly rather than folded into business continuity.

6. Conclusion and Proposed Validation Agenda

This paper has proposed CMRAF, a five-dimension framework for cloud migration strategy selection intended to complement cost modeling with technical debt, dependency complexity, business continuity, team capability, and strategic value assessments. The framework is presented as a structured decision aid, illustrated through two hypothetical scenarios, and explicitly not yet validated against real migration outcomes.

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