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Architecting an Integrated Data Management and Governance Ecosystem for Enhancing Micro, Small, and Medium Enterprises (MSMEs) Promotion in Thailand

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ABSTRACT

Micro, Small, and Medium Enterprises (MSMEs) serve as the cornerstone of Thailand's socio-economic development, contributing significantly to national employment and Gross Domestic Product (GDP). However, public promotion mechanisms remain fundamentally impeded by institutional data silos, fragmented registries, inconsistent semantic standards, and predominantly output-based monitoring across more than thirty disparate government agencies. These structural deficiencies foster administrative redundancies, impede equitable resource distribution, and limit data-driven policymaking. To resolve these challenges, this study formulates a comprehensive conceptual framework and architectural model for an Integrated Data Management System, positioning the Office of Small and Medium Enterprises Promotion (OSMEP) as an ecosystem orchestrator rather than a transactional operator. Grounded in The Open Group Architecture Framework (TOGAF), Design Science Research (DSR), and public governance theories, this research aligns the target architecture with national strategic priorities, including the 20-Year National Strategy, the 13th National Economic and Social Development Plan, and the Digital Government Development Plan. The proposed technical design models Phase C (Information Systems Architectures) by delineating a modern Data Lakehouse repository (Medallion Architecture) and an event-driven, composable Application Architecture. Central to the data layer is the institutionalization of the "SME One ID" as an immutable primary key, enabling seamless record linkage across tax authorities, business registration databases, and alternative credit channels. The application layer introduces automated anti-duplication mechanisms, real-time eligibility verification, dynamic consent management complying with the Personal Data Protection Act (PDPA), and an artificial intelligence-driven engine for precision interventions and prescriptive service matching. To establish sustainable cross-agency collaboration, the study articulates a robust Data Governance Framework incorporating federated data ownership, zero-trust access controls, and strict quality assurance service level agreements (SLAs). Furthermore, to evaluate the multi-dimensional value proposition of public digital infrastructure beyond conventional financial metrics, the study formulates a rigorous Social Return on Investment (SROI) evaluation model.

Keywords: SMEs promotion, Enterprise architecture, Data governance, SME one ID

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INTRODUCTION

Micro, Small, and Medium Enterprises (MSMEs) serve as critical engines driving economic growth across developing and emerging market economies. In Thailand, MSMEs generate approximately 35.2% of the national Gross Domestic Product (GDP) and account for 71.8% of aggregate domestic employment (Office of Small and Medium Enterprises Promotion, 2023). However, amidst structural headwinds induced by geopolitical volatilities, global supply chain reconfigurations, and rapid digital transformation, Thai MSMEs remain constrained by systemic challenges: entrenched productivity stagnation (the productivity paradox), protracted delays in technology and innovation adoption, and pronounced funding deficits within formal credit markets (Beck and Demirguc-Kunt, 2006; OECD, 2021).

Although the Royal Thai Government allocates substantial annual budgetary resources across more than thirty state agencies and multiple ministries to mitigate these constraints, public interventions frequently suffer from 'policy failure induced by data fragmentation.' This structural bottleneck manifests across three core dimensions:

- Data Silos and Structural Fragmentation: State agencies execute mandates strictly within their statutory boundaries, operating isolated database repositories without unified technical interoperability or national data standards. This produces prohibitive data exchange costs and widespread analytical redundancy (Gil-Garcia et al., 2019; Janssen et al., 2012).
- Resource Misallocation and Programmatic Duplication: The absence of real-time, cross-agency verification engines enables well-resourced enterprises to exploit multiple grant mechanisms simultaneously ('double dipping'). Conversely, vulnerable micro-enterprises and grassroots businesses suffer from structural exclusion and support blind spots (Acs et al., 2017).
- Output Bias over Public Value Realization: Monitoring and evaluation regimes remain tethered to activity- and output-based metrics (e.g., training headcount, gross budget disbursement rates) rather than rigorous methodologies capable of quantifying incremental net productivity, long-term solvency, or public value creation (Mazzucato, 2018; Moore, 1995).

To overcome these structural impediments, the Office of Small and Medium Enterprises Promotion (OSMEP) must transition from a transactional project operator into an Ecosystem Orchestrator. This transition requires architecting an integrated data ecosystem that functions as national digital public infrastructure (Jacobides et al., 2018; Moore, 1993; Teece, 2018).

AS-IS SYSTEM ANALYSIS OF THAILAND'S MSME DATA LANDSCAPE

An empirical analysis of Thailand's contemporary MSME data landscape reveals four architectural and governance deficits:

- Semantic and Ontological Inconsistency: Criteria defining enterprise scales across key authorities—such as revenue ceilings defined by the Ministry of Commerce, fixed-asset thresholds set by the Ministry of

Industry, and composite revenue-employment parameters governed by OSMEP—diverge significantly. This semantic interoperability deficit undermines automated, cross-agency data ingestion and entitlement processing (Guijarro, 2007; Legner and Lebreton, 2007).

- Absence of Master Data Management (MDM): MSME registries remain splintered across jurisdictional mandates: the Department of Business Development (DBD) maintains corporate entity registrations, the Revenue Department (RD) oversees tax filings, and the Department of Industrial Promotion maintains factory operating licenses. The lack of a single golden record denies the state a unified customer view, yielding distorted risk modeling and asymmetric targeting (Loshin, 2010; Otto, 2012).
- Batch-Oriented Integration Lag: Data sharing between public entities depends heavily on periodic batch file transfers and physical document verification. The absence of modern application programming interface (API) pipelines and event-driven architectures introduces severe latency, leaving decision-makers with obsolete operational profiles (Curry, 2020).
- The Open Data versus Data Privacy Paradox: Following the enactment of the Personal Data Protection Act B.E. 2562 (PDPA), public agencies have adopted risk-averse data-sharing postures, culminating in administrative inertia. This inertia is compounded by the lack of dynamic, granular consent management frameworks that would otherwise permit secure, enterprise-authorized data exchanges (Digital Government Development Agency, 2023; Zuiderwijk et al., 2014).

STRATEGIC ROLE OF OSMEP AS AN ECOSYSTEM ORCHESTRATOR

Grounded in dynamic capabilities theory and public value creation frameworks, central policy institutions must institutionalize capabilities to sense emerging environmental disruptions, seize opportunities through coordinated resource deployment, and transform legacy administrative architectures (Moore, 1995; Teece, 2018). OSMEP's strategic orientation must anchor upon three functional pillars:

- National Benefits Clearinghouse: Operating an authoritative registry linked to the unified 'SME One ID,' serving as a single gateway that automates eligibility verification across public agencies and lowers transaction costs across the business ecosystem (Guijarro, 2007; Williamson, 1981).
- Evidence-Based Policymaker: Moving beyond intuitive policymaking toward empirical, data-driven governance. By leveraging big data analytics and system dynamics modeling, OSMEP can diagnose operational bottlenecks and deploy interventions tailored to specific corporate life cycles (Head, 2008; Klievink et al., 2017).
- Public Value and Impact Assurance Agent: Institutionalizing Social Return on Investment (SROI) methodologies as mandatory evaluation protocols for all publicly funded SME initiatives, thereby enforcing fiscal accountability and programmatic integrity (Nicholls et al., 2012).

STRATEGIC AND NATIONAL POLICY ALIGNMENT

The target data architecture directly supports the strategic objectives of four major national policy frameworks, as synthesized in Table 1.

Table 1: Alignment between national strategic plans and the integrated MSME data ecosystem.

National Strategic Plan	Core Strategic Mandates	Target Contribution of MSME Data Ecosystem
20-Year National Strategy (2018–2037) (NESDC, 2018)	Competitiveness Enhancement: Elevating the MSME contribution to national GDP to 50%.	Pinpoint high-growth enterprises ('Scalers') via predictive clustering to deliver targeted capital and technical capacity-building (Autio et al., 2014).
13th National Economic and Social Development Plan (NESDC, 2022)	Milestone 2: Transforming SMEs into global innovation players; Milestone 13: Developing an agile public sector.	Implement multidimensional digital and innovation maturity profiling to accelerate MSME integration into global value chains (GVCs).
Digital Government Development Plan (DGA, 2023)	Open Government Data transformation and integrated public service delivery via one-stop service portals.	Enable cross-agency API orchestration through the Government Data Exchange (GDX), standardized under national data governance schemas.
National SME Promotion Master Plan (OSMEP, 2023)	Enhancing MSME productivity and expanding access to domestic markets and public procurement.	Power the Business Development Services (BDS) voucher platform and the SME-GP public procurement price-preference framework.

ENTERPRISE ARCHITECTURE BLUEPRINT (TOGAF FRAMEWORK)

Adopting The Open Group Architecture Framework 10th Edition (The Open Group, 2022), this research models Phase C: Information Systems Architectures, establishing interconnected data and application architectures.

Data Architecture

The data architecture is structured around a modern Medallion Data Lakehouse design pattern (Armbrust et al., 2021), harmonizing structured, semi-structured, and unstructured data across public and private channels:

Bronze Layer (Raw Storage Zone): Acts as an append-only landing zone ingesting real-time event streams and batch extracts in their native formats. Every transaction is appended with cryptographic verification hashes and metadata stamps to maintain strict data lineage and auditability.

Silver Layer (Cleansed and Integrated Hub): Executes programmatic data cleansing, schema standardization against the National Information Exchange Model (NIEM), and cross-database entity resolution anchored to the SME One ID primary key (Christen, 2012). This layer incorporates dynamic tokenization and automated pseudonymization algorithms to enforce PDPA compliance.

Gold Layer (Curated Analytics Marts): Houses highly optimized dimensional star and snowflake data schemas (Kimball and Ross, 2013) that support advanced business intelligence, alternative credit scoring, operational vulnerability modeling, and macro-policy simulation engines.

Application Architecture

The application architecture utilizes an event-driven, composable microservices topology (Newman, 2021; Richards and Ford, 2020), ensuring horizontal scalability and fault isolation:

Interaction Layer: Delivers unified engagement channels, including an MSME Super Portal integrated with ThaID national digital identity, a Government Agency Cockpit, and developer Open APIs.

Core Business Services: Houses critical transactional microservices, notably the SME One ID Verification Service, BDS Marketplace and Voucher Tracker, Dynamic Consent Manager, and the Cross-Agency Anti-Duplication Engine.

Intelligence & Analytics Services: Deploys machine learning engines executing dynamic health diagnostics, prescriptive intervention matchmaking, and macroeconomic impact evaluations.

Integration Gateway Layer: Manages standardized Government Data Exchange (GDX) adapters, Enterprise Service Bus (ESB) event streaming via Apache Kafka, and Open Banking APIs compliant with ISO 20022.

DATA GOVERNANCE FRAMEWORK

Governing data assets within a multi-stakeholder public ecosystem requires synthesizing the Data Governance Institute model (DGI, 2020) with principles of open and collaborative government (Attard et al., 2015; Dawes et al., 2016). The framework establishes three core operational pillars:

Federated Ownership and Trust Architecture: Operationalizing a federated governance structure where primary custodians (e.g., DBD, RD) retain statutory data controller status, while OSMEP operates as a central data processor. System access is authenticated through zero-trust architectures and logged to immutable audit trails.

Granular Dynamic Consent Framework: In alignment with ISO/IEC 29100 Privacy Standards, MSME owners manage consent permissions through self-service interfaces, granting or revoking agency access to financial filings and payroll records in exchange for targeted state benefits (Chellappa and Sin, 2005).

Data Quality Service Level Agreements (SLAs): Establishing mandatory operational thresholds compliant with ISO/IEC 25012 across four core dimensions: completeness (>= 90%), entity matching precision (>= 99.5%), transactional latency (<= 5 minutes for critical event streams), and schema uniformity (ISO, 2008; Weber et al., 2009).

THEORETICAL CONCEPTUAL MODEL

The conceptual model synthesizes Dynamic Capabilities Theory, New Institutional Economics, and Public Value Theory (Moore, 1995; Teece, 2018; Williamson, 1981). It delineates four interconnected transformation tiers:

Foundational Inputs: Cross-ministerial registries, SME One ID master registries, and statutory legal mandates (OSMEP Act, PDPA, Digital Government Act).

Platform Transformation: Modern data lakehouse pipelines, interoperable GDX integrations, federated trust networks, and privacy-preserving consent engines.

Strategic Capabilities: Dynamic enterprise diagnostics, precision policy matchmaking, and frictionless, paperless public service delivery.

Public Value Realization: Macroeconomic GDP expansion, drastic reduction in compliance transaction overheads, expanded liquidity access, and validated social returns.

SOCIAL RETURN ON INVESTMENT (SROI) EVALUATIVE MODEL

To evaluate the broader socioeconomic value of this digital public infrastructure investment beyond conventional financial metrics, this study establishes an SROI evaluative engine based on international standards (Nicholls et al., 2012; Social Value International, 2021). Gross outcome values are determined by monetizing stakeholder impacts using verified financial proxies, as outlined in Table 2.

Table 2: Quantifiable social and economic outcomes and assigned financial proxies.

Stakeholder Category	Quantifiable Social & Economic Outcomes	Assigned Financial Proxy
MSME Entrepreneurs	1. Reduced administrative overhead and paperwork time. 2. Accelerated access to low-interest credit facilities. 3. Incremental gross revenue expansion via BDS vouchers.	1. Monetized hours saved x mean managerial hourly wage. 2. Spread between formal and informal loan interest rates x credit secured (Beck et al., 2008). 3. Net incremental profit margins (McKenzie, 2017).
Public Sector Institutions	1. Elimination of fiscal leakages from duplicate subsidies. 2. Reductions in agency personnel processing time.	1. Absolute monetary value of duplicate disbursements identified and blocked. 2. Aggregate civil servant labor hours saved x standard labor rate.
Macroeconomy & Society	1. Sustainable job creation in the MSME sector. 2. Incremental fiscal revenue generated from business formalization.	1. Annualized wages of newly created formal positions (Acs et al., 2017). 2. Net increase in VAT and corporate tax receipts.

To prevent over-claiming, gross values are adjusted across four standardized deduction parameters: Deadweight (15–25% via Propensity Score Matching against historical control groups; Rosenbaum and Rubin, 1983), Displacement (10–15%), Attribution (20–30%), and a compound

annual Drop-off rate of 20% (Arvidson et al., 2013; Nicholls et al., 2012). The discounted Net Present Value of societal outcomes is benchmarked against Capital Expenditure (CAPEX) and Operational Expenditure (OPEX) over a 5-year lifecycle using a 4.0% social discount rate (Boardman et al., 2018; NESDC, 2022; OECD, 2018).

KEY PERFORMANCE INDICATORS AND DATA METRICS

Performance tracking integrates public sector Balanced Scorecards with ISO/IEC 25012 data quality standards (ISO, 2008; Kaplan and Norton, 1996), structured across four cascading levels:

Level 1 (Technical & Data Quality): Attribute completeness (>= 90%), cross-registry entity resolution accuracy (>= 99.5%), API verification latency (<= 300 ms), and central platform availability (>= 99.9%) (Batini et al., 2009; Christen, 2012).

Level 2 (Operational Efficiency): Grant approval cycle reduction (>= 70%, from 20 days to <= 3 days), cross-agency subsidy duplication interception (100% prior to disbursement), and paperless processing rate (>= 95%).

Level 3 (Targeting Precision & Adoption): Active SME One ID penetration (>= 60% within 3 years), diagnostic recommendation acceptance rate (>= 40%), and dynamic consent granting rate (>= 65%) (Chellappa and Sin, 2005; Davenport, 2018).

Level 4 (Macroeconomic Impact & SROI): Validated SROI ratio achieving >= 1 : 3.2 over 5 years, enterprise 3-year survival rate advantage (>= 15% over control cohorts), and business compliance cost savings (>= 40%) (Audretsch et al., 2019; Nicholls et al., 2012).

RESEARCH METHODOLOGY

This study employs Design Science Research (DSR) (Hevner et al., 2004; Peffers et al., 2007) paired with documentary policy analysis and the Policy Delphi Technique (Linstone and Turoff, 1975) to conceptualize, design, and validate the system architecture:

Phase 1: Contextual and System Requirements Analysis: Executing documentary content analyses across the 20-Year National Strategy, the Digital Government Act, and the Personal Data Protection Act to establish the functional and non-functional architectural baseline.

Phase 2: DSR Artifact Design and Architectural Prototyping: Engineering the conceptual, logical, and technical artifacts, including entity relationship diagrams (ERDs), event-driven microservice configurations, and algorithmic models underpinning the SROI evaluative engine.

Phase 3: Expert Consensus and Delphi Validation: Validating architectural feasibility and policy alignment via a three-round Policy Delphi panel of 21 domain experts with at least a decade of senior-level experience (Okoli and Pawlowski, 2004). The panel includes enterprise architects, digital government directors, economic development specialists, and industry federation executives. Consensus is verified using the Index of Item-Objective Congruence (IOC), requiring a median score >= 4.00 on a 5-point scale and an Interquartile Range (IQR) <= 1.00.

POLICY AND PRACTICAL RECOMMENDATIONS

To transition this architectural framework into operational practice, the study offers recommendations across three key governance dimensions:

Legal and Regulatory Mandates: Enacting a Prime Minister's Office Regulation establishing the SME One ID as the mandatory unique enterprise identifier across all government ministries, operationalizing the Once-Only Principle (OOP) to eliminate repetitive document requests (Kalvet et al., 2018). Concurrently, establish a regulatory sandbox to enable alternative credit scoring utilizing utility and e-commerce data (OECD, 2021).

Institutional and Governance Enablers: Capitalizing a dedicated transformation fund using OSMEP's existing statutory resources to subsidize API and GDX integration for resource-constrained agencies. Formalize dedicated Data Stewardship offices to safeguard metadata standards and SLA compliance (DGI, 2020; Weber et al., 2009).

Technological Scalability and Regional Interoperability: Implementing privacy-preserving federated machine learning across lending networks to model credit risk without exposing raw financial transactions (Yang et al., 2019). Align core data schemas with ASEAN SME Academy and ASEAN Access platforms to support cross-border digital verification (ASEAN Secretariat, 2021).

CONCLUSION

Developing an integrated data management ecosystem for Thai MSMEs represents an administrative architecture transformation that shifts state agencies from working in isolated silos toward a collaborative, co-created public ecosystem. By deploying TOGAF (The Open Group, 2022), the state establishes an agile, decoupled data and application foundation. Integrating Data Governance protocols (DGI, 2020) protects individual privacy and maintains institutional trust. Concurrently, the SROI Model (Nicholls et al., 2012) provides a quantitative framework to ensure capital investments generate measurable social returns. Operating in concert under OSMEP's orchestrator leadership, this integrated architecture ensures government interventions are targeted, transparent, and scalable, building long-term resilience and shared prosperity across Thailand's entrepreneurial economy.

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