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Capability-Driven Enterprise Architecture Maturity Model (CDEAMM) for managing Logistics MSMEs

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Abstract: This study is intended to develop a Capability-Driven Enterprise Architecture Maturity Model (CDEAMM) tailored for Micro, Small, and Medium Enterprises (MSMEs) in the logistics sector. While enterprise architecture (EA) frameworks such as TOGAF, Zachman, and DoDAF provide strong foundations for large organizations, their complexity and resource demands make them unsuitable for smaller enterprises. This research extends prior comparative studies by focusing on capability-driven planning and incremental maturity assessment. The proposed model identifies five key maturity dimensions: Capability Alignment, Governance, Integration, Measurement, and Sustainability, and defines a progressive path for MSMEs to evaluate and enhance their architectural maturity. Using a mixed-method approach that combines literature review, expert interviews, and empirical validation, the study establishes measurable indicators and practical guidelines for MSMEs to advance their digital and operational maturity. The findings highlight that adopting a capability-driven and iterative enterprise architecture approach leads to greater integration efficiency, improved governance, and sustainable competitiveness within the logistics ecosystem.

Keywords **– Capability-Driven Architecture, Enterprise Architecture, MSMEs, Logistics, TOGAF, Sustainability, Integration Maturity, Lightweight Architecture, Governance**

I. INTRODUCTION

Enterprise Architecture (EA) provides a structured mechanism to align business strategy, technology, and operational processes. For large enterprises, EA frameworks such as TOGAF, Zachman, and DoDAF have been successfully used to manage complexity, standardize integration, and ensure long-term scalability. However, logistics MSMEs face constraints such as limited budgets, small IT teams, and rapid operational shifts, which make it impractical to adopt traditional frameworks in their entirety.

As the mainly used enterprise architecture framework-level comparison among TOGAF, Zachman, and DoDAF is already available, that study established the need for lightweight and pragmatic architecture for MSMEs; the current research extends those findings by developing a Capability-Driven Enterprise Architecture Maturity Model (CDEAMM) focused on managing and improving architecture maturity in logistics MSMEs.

In prior research, a comparative study of EA frameworks found that MSMEs benefit most from a lightweight, capability-driven approach, enabling faster implementation with lower overhead. Building on that foundation, this study proposes a **Capability-Driven Enterprise Architecture Maturity Model (CDEAMM)**, which offers MSMEs a measurable pathway to progressively strengthen their enterprise capabilities, governance, and integration maturity.

The CDEAMM framework aims to address three central needs of logistics MSMEs:

1. A straightforward method to assess their EA maturity level.
2. A lightweight governance model aligned with capability priorities.
3. A roadmap that links architectural growth to measurable business outcomes and sustainability.

II. METHODOLOGY

The study follows a mixed-method approach:

- **Literature and standards review:**
  - A comprehensive review of EA frameworks like TOGAF, DODAF, and Zachman.

- Standards review of EA frameworks in MSME-specific adaptations and capability-based models was conducted. Over 30 publications, including TOGAF documentation, LeanIX framework comparisons, and government EA references, were analyzed.

- **Expert Reviews:**
  Interviews were conducted with six professionals, including logistics managers, IT architects, and MSME business owners. The interviews helped identify practical constraints, including budget limitations, staff capabilities, and integration challenges. Evaluation against domain-relevant criteria: cost, skills, time-to-value, operational fit, governance overhead, and scalability.
- **Model Development:**
  Insights from literature and interviews were synthesized to define key dimensions and maturity levels of CDEAMM.
- **Pilot Validation:**
  A prototype model is applied to three logistics MSMEs (one regional courier, one Clearance office, and one supply aggregator) through a structured questionnaire. Data were collected via a 5-point Likert scale to assess the presence of governance, capability alignment, integration, and sustainability practices.
- **Analysis:**
  Descriptive statistics and pattern matching were used to identify trends and validate the logical consistency of maturity levels.

III. Background and Related Work

Ming-Hui Liao (2021), in his case study on integrating enterprise architecture in lean manufacturing, digitalization, and sustainability for a chemical industry in Taiwan, has given insights on adapting a customized TOGAF principles through an in-depth study and came up with a custom lean enterprise architecture framework applicable to most of the chemical firms, transforming. Given the key challenges, this work is relevant to most MSMEs in logistics and takes them into account.

Ganesan, S. K. (2025), in the comparative study, evaluates three major enterprise-architecture (EA) frameworks: The Open Group Architecture Framework (TOGAF), Zachman Framework, and Department of Defense Architecture Framework (DODAF) from the perspective of micro, small, and medium enterprises (MSMEs) operating in the logistics industry. It maps the specific constraints of logistics MSMEs (tight budgets, small IT teams, rapid change) and compares frameworks on governance overhead, tooling, maintenance, and suitability. The findings recommend a lightweight, pragmatic architecture approach: focus on value-driving artifacts (capability maps, minimal governance) and iterative implementation rather than full adoption of a heavyweight framework.

Oberle (2023) applies The Open Group Architecture Framework (TOGAF) in his study to develop an Enterprise IT Architecture model for a Battery manufacturing company. The research aims to support the IT systems for business operations, which have had little guidance for greenfield environments with limited boundaries. The researcher addressed the gaps using the IEC standard approach and using TOGAF as a comprehensive blueprint to support sustainable improvement, helping to make a potential difference in the system. The implementation has references to various TOGAF phases, adaptation which was used to design this specific maturity model taking the similarities in the paper.

IV. Capability-Driven Enterprise Architecture Maturity Model (CDEAMM)

IV.I. Dimensions of Maturity

Figure 1 illustrates five critical dimensions of *Enterprise Architecture (EA) Maturity*, each representing a foundational aspect of how an organization structures, governs, and evolves its enterprise systems for strategic alignment and operational efficiency.

Capability Alignment ensures that EA practices are directly mapped to business processes and organizational goals. This alignment helps bridge the gap between technology capabilities and business strategy, ensuring that every architectural initiative supports measurable outcomes.

Governance and Leadership emphasize the importance of structured oversight, decision documentation, and leadership engagement. Strong governance mechanisms ensure that EA decisions remain consistent, traceable, and strategically aligned. Leadership involvement promotes accountability, transparency, and the prioritization of architectural initiatives.

Integration and Technology Enablement highlights the degree of interoperability and automation within logistics systems. Through APIs, integration frameworks, and data exchange mechanisms, enterprises can streamline workflows, reduce redundancy, and achieve seamless connectivity across applications, partners, and platforms.

Measurement and KPIs define how EA performance and value are evaluated. Metrics such as delivery accuracy, cost efficiency, system uptime, and process improvement serve as tangible indicators of architectural effectiveness. Continuous measurement fosters data-driven decision-making and ongoing optimization.

Sustainability and Adaptability extend EA maturity into environmental and long-term resilience dimensions. Incorporating green logistics, resource efficiency, and adaptability mechanisms enables organizations to sustain operations under dynamic market, regulatory, or technological conditions.

Figure 1. Researcher-developed diagram illustrating the maturity dimensions

Collectively, these dimensions establish a holistic framework that balances strategy, governance, technology, performance, and sustainability, ensuring that enterprise architecture becomes a driver of enduring organizational success.

IV.II. Maturity Level

Level	Label	Description	Typical Characteristics
Ad Hoc	Reactive Operations	No formal EA: systems managed individually.	Manual coordination, data duplication, and no integration.
Aware	Recognition Stage	Initial awareness of the importance of architecture.	Basic process mapping, partial documentation.
Defined	Structured EA Practice	Capability maps created; governance introduced.	Architecture review board (ARB), measurable KPIs.
Managed	Integrated Architecture	EA is embedded in management practices.	Real-time dashboards, partner integrations, and decision traceability.
Optimized	Adaptive Enterprise	Continuous improvement, data-driven adaptability.	AI-enabled monitoring, sustainability indicators.

Table 1. Researcher-developed table illustrating the maturity level and characteristics comparison

IV.III. **Capability mapping**

Figure 2 displays the Capability Mapping for Logistics MSMEs, outlining the key business functions, their associated examples, and the specific Enterprise Architecture (EA) area responsible for their practical design and implementation. It provides a structured view of how a logistics business can translate its operational needs into actionable EA focus areas.

The core of the business is handled by Core Operations, which includes vital functions like Order Management, Fulfillment, and Returns. Architecturally, these map directly to the Business Processes domain, ensuring efficient workflows and alignment with organizational goals.

To maintain connectivity and seamless data flow, the Integration capability is essential, involving functions such as Partner Onboarding, Electronic Data Interchange (EDI), and API Gateways. This is governed by the Technology Enablement EA, which prioritizes interoperability and automation.

Optimizing performance relies on the Analytics capability, with examples like Route Optimization and Inventory Prediction. These functions are fundamentally supported by the Data Architecture, which ensures data quality and accessibility for predictive analysis.

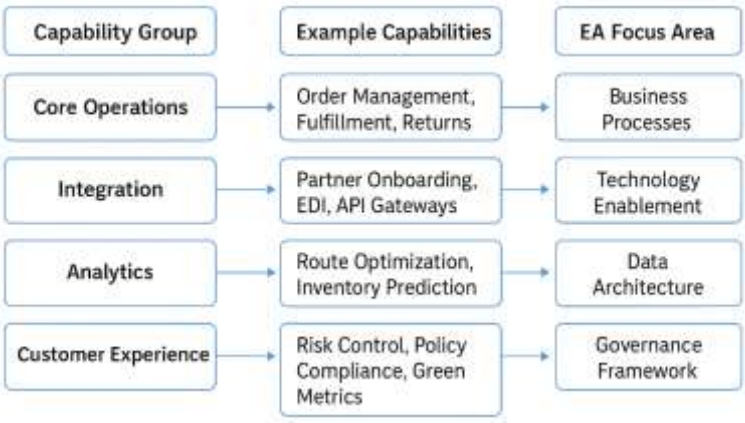

Figure 2. Researcher-developed diagram illustrating the capability group to focus on the area of MSMEs

Driving customer loyalty and transparency is the Customer Experience group, encompassing Tracking Portals and Support Systems. These external-facing tools fall under the Application Architecture focus, which concentrates on user-centric design and system reliability.

Finally, the Governance capability ensures the entire structure operates within boundaries and manages risk, covering Risk Control, Policy Compliance, and Green Metrics. This is managed by the Governance Framework in EA, which provides the necessary oversight and strategic direction. Together, these five groups form a complete architectural blueprint for a modern logistics MSME.

V. RESULTS AND DISCUSSION

The pilot study revealed that most logistics MSMEs in India currently fall into Levels 2 (Aware) and 3 (Defined). Looking into the key observations, which include the capability alignment of the MSMEs that mapped their logistics processes, such as order and inventory management, reported a 20-30% reduction in the manual reconciliation errors. Governance in a small Architecture Review Board (2 to 3 members) improved decision traceability and accountability. Firms with API-based integrations between carriers and warehouses achieved improved tracking accuracy and reduced delay-related costs. A tiny percentage of MSMEs measure fuel efficiency, e-fuel-based vehicles, and paperless process adoption, suggesting sustainability is an emerging but underdeveloped area.

These findings indicate that EA maturity directly influences digital resilience as organizations move to “Managed” levels, operational control, transparency, and decision-making efficiency increase significantly.

Table 2 provides an implementation roadmap for MSMEs

Phase	Capability Identification	Governance Foundation	Integration Enablement	KPI measurement	Sustainability
Timeline	2-4 weeks	1-2 months	2-3 months	Ongoing	Conditional
Activity	Map existing logistics capabilities and align them to business goals.	Form an architecture review board, define architecture decision records (ADRs).	Develop APIs for carrier and warehouse connectivity and implement dashboards.	Track performance metrics like delivery time, billing accuracy, and error rates.	Integrate eco-metrics such as route efficiency, waste reduction, and emission tracking.

Table 2. Researcher-developed table illustrating the implementation plan

This roadmap allows MSMEs to evolve progressively without heavy investment, ensuring quick wins and sustainable architecture maturity. By following the model, MSMEs can gradually formalize their EA practices while maintaining agility in fast-moving logistics environments. This model offers significant practical value to managers and decision-makers in logistics MSMEs by providing a structured mechanism for assessing and benchmarking enterprise architecture maturity. It links IT investments with measurable business capabilities, establishes governance practices that foster agility and innovation, and integrates sustainability metrics into digital transformation initiatives. Through this model, MSMEs can progressively formalize their architecture management while preserving the flexibility essential for success in fast-paced logistics environments.

VI. CONCLUSION

This study developed the Capability-Driven Enterprise Architecture Maturity Model (CDEAMM) for managing logistics MSMEs, addressing the gap between theoretical EA frameworks and practical MSME requirements. The model emphasizes capability alignment, lightweight governance, and measurable outcomes, helping organizations move from ad hoc digital practices to integrated and optimized enterprise architecture management.

The results demonstrate that capability-driven EA enhances operational performance, enables digital integration, and lays the foundation for sustainable growth. Future work will extend this research to a larger dataset across multiple regions and incorporate longitudinal analysis to measure long-term impacts on cost efficiency, sustainability, and digital maturity.

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