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Dissertation

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Theme

AI-Augmented, Event-Driven Microservices for Construction Project Management

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Abstract

BuildOpsSphere is an AI-powered, microservices-based construction project management system that streamlines planning, execution, and oversight across projects, tasks, materials, workforce, documents, notifications, and reporting. The platform combines a service gateway and discovery with domain services and event-driven messaging; CQRS/event sourcing provides traceability and consistency across project lifecycles.

An LLM layer augments operations with automated reporting and contract drafts, contextual chat, and analytical insights, supported by retrieval over project artifacts and resilient model fallback. Security and governance are first class: a conventional authorization server (Keycloak) enforces OAuth2/OIDC flows, sessions/SSO, and group-based access control for role-aligned permissions and auditability.

Documents are stored in self-hosted MinIO (on-prem/LAN), treated as "your servers" for app privacy disclosures (not third-party cloud or on-device); data is encrypted in transit (TLS) and at rest with configurable retention. Containerized deployment with centralized observability enables reproducible environments and operational insight.

Results show automated, professional-grade reports; proactive risk and material-use insights; faster cross-team coordination via event-driven updates and chat; and improved compliance through auditable identities, sessions, and access policies. By coupling domain-centric microservices with AI-assisted reasoning and robust identity, BuildOpsSphere reduces decision latency, increases coordination reliability, and scales securely across heterogeneous environments.

Keywords— Microservices Architecture, CQRS/Event Sourcing, API Gateway Composition, Saga Choreography, Large Language Models, Construction Project Management, OAuth2/OIDC, Container Orchestration, Event-Driven Architecture, MinIO Object Storage