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Applying TOGAF ADM for Developing an IT-Based Hedge Fund

Muhammad Hilmy Haidar Fawwazie[1]*, Firmansyah Putra Pradana[2], and Fachrudin Pakaja[3]

[1,2,3] Faculty of Engineering and Informatics, Gajayana University, Malang, Indonesia,
Email: hilmyhaidar333@gmail.com[1], firmansyahputrapradanaaa@gmail.com[2],
fachrudinpakaja@unigamalang.ac.id[3]

*Corresponding Author Email: hilmyhaidar333@gmail.com

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Abstract

This abstract describes the conceptual design of an enterprise architecture for a hedge fund. Sigma Investment Technologies faces operational challenges and the need for data-driven investment strategies alongside diversification into supporting services. The research objective is to design an enterprise architecture (EA) for Sigma Investment Technologies using TOGAF. A qualitative method with a conceptual case study approach is employed, based on requirements analysis from the business owner and industry best practices. The application of TOGAF resulted in a conceptual enterprise architecture design. This design demonstrates TOGAF's capability to map business elements structurally, covering core processes (such as R&D strategy, live trading, market research, and HPC for simulation) and supporting business processes. This EA design is expected to support decision-making, coordination, efficiency, risk management, and new monetization. It is concluded that this EA design provides a conceptual foundation for system development for modern hybrid hedge funds and can serve as a reference for the financial services industry, with the actual benefits anticipated upon full implementation.

Keyword: TOGAF, Enterprise Architecture, Hedge Fund, Information Technology, Quantitative Trading Strategy

1. Introduction

The global hedge fund industry continues to evolve, driven by advancements in information technology, increasing volume and speed of market data, and investor demand for more sophisticated investment strategies (Getmansky et al., 2015; PwC & Alternative Investment Management Association, 2024). Modern hedge funds no longer focus solely on trade execution but also on developing complex algorithmic strategies, in-depth research involving data mining and Artificial Intelligence, strict risk management, and the ability to adapt quickly to changing market conditions. The rapid development of information technology requires every business line to adapt, including in managing business processes and information systems (George & Baskar, 2024). Sigma Investment Technologies, as an entity in its initial development stage, aims to integrate technology-based hedge fund operations with a series of innovative supporting services, such as financial education, market analysis provision, trading signal services, and community building to reach a wider audience and create alternative revenue streams.

Many SMEs, including those in the more complex financial services sector, do not yet have a comprehensive understanding of how to design information systems that are structured and aligned with business objectives. This can lead to operational inefficiencies and low-quality data used in business

management (Laudon & Laudon, 2020). Although many hedge funds adopt advanced technologies ad-hoc for specific functions, there is often a lack of a holistic enterprise architecture approach (Ross et al, 2006; Pisoni et al., 2021). The lack of structured guidance in designing architecture for a hedge fund entity that also has diverse supporting business lines (education, media, copy trading, and community development) presents a research gap (originality of research). TOGAF, as a comprehensive enterprise architecture framework, offers a methodology for designing, planning, implementing, and managing enterprise architecture (The Open Group, 2018). The application of TOGAF to Sigma Investment Technologies is expected to bridge this gap by providing a structured blueprint for the development of integrated and aligned business and technology capabilities. Research on the specific application of TOGAF for hybrid hedge fund business models like Sigma, particularly leveraging recent technological advancements (Paul & Esther, 2023), is still limited, making this case study relevant (Aier et al., 2009)

This research aims to apply TOGAF in designing the enterprise architecture for Sigma Investment Technologies. The main focus is to develop an information structure and business processes that can support business operations efficiently and integrally, covering: Business, Data, Application, and Technology Architecture for core hedge fund investment activities and supporting business activities, integration between these activities, and architecture governance.

2. Art of Research

Hedge funds are privately managed pooled investment vehicles that aim to deliver absolute returns by employing a variety of advanced investment strategies, including leverage, short-selling, derivatives, and algorithmic trading (Logue, 2023). Unlike traditional mutual funds, hedge funds are often less regulated, allowing more flexibility in their portfolio construction and risk management (Kehinde et al., 2023).

The evolution of hedge funds has been significantly influenced by the rapid development of information technology and the increasing availability of big data and alternative data sources (Kolanovic & Krishnamachari, 2017). As a result, many hedge funds have transitioned from discretionary decision-making toward quantitative and systematic strategies, where algorithmic models play a central role in identifying and exploiting market inefficiencies (Treleaven, Galas, & Lalchand, 2013).

Furthermore, the integration of Artificial Intelligence (AI) and Machine Learning (ML) techniques has opened new possibilities for pattern recognition, high-frequency trading, and predictive analytics in portfolio management (Shaikh et al., 2024). This technological transformation has not only improved execution speed and accuracy but also introduced complexities in system design and data governance within hedge fund operations (Alonge et al., 2023).

Despite these advances, many small and mid-sized hedge funds still lack a coherent enterprise architecture that can align their business strategies with technological capabilities, leading to fragmented systems and operational inefficiencies (Alghamdi, 2024). This study responds to the need for a structured framework to guide such integration using TOGAF ADM.

Research on the design of enterprise architecture (EA) in the financial sector, particularly for technology-driven hedge funds, remains relatively limited. Most existing studies focus on large, well-established organizations or public institutions (Labamaking & Alfan, 2025; Beese et al., 2023). In contrast, entities such as Sigma Investment Technologies, which integrate core quantitative operations with supporting services like education, community engagement, and trading signal distribution, are still underexplored in academic literature.

The Open Group Architecture Framework (TOGAF) has been widely adopted as a systematic methodology for enterprise architecture development (de Oliveira et al., 2021). TOGAF's Architecture Development

Method (ADM) offers a structured process to align business strategies with information systems and technology implementations. Prior research by Bhatia et al. (2023) and Kurakula (2025) demonstrates how TOGAF has been effectively applied in sectors like financial technology to improve system integration, operational efficiency, and documentation of business processes.

In the context of modern hedge funds, technology acts as a core enabler for data-driven investment strategies, adaptive algorithm development, and comprehensive risk management (Grobys et al., 2022). However, many small and medium-sized enterprises (SMEs) still lack the structured understanding required to design information systems aligned with their business goals (Niemi & Pekkola, 2020). This creates a research gap, particularly in architecting hybrid hedge fund models that blend finance, education, media, and community development.

This study aims to apply TOGAF ADM to develop an enterprise architecture tailored to the unique operational structure of Sigma Investment Technologies. The conceptual approach adopted in this research explores how TOGAF's principles and phases can be contextually adapted for a greenfield hedge fund environment. The study contributes to existing literature by presenting a comprehensive case of TOGAF application in a modern financial services startup, offering a potential reference model for similar ventures seeking to integrate diverse business activities under a unified digital architecture.

3. Method

This research uses a qualitative descriptive approach with the aim of describing the application of TOGAF in designing enterprise architecture at Sigma Investment Technologies. This approach was chosen because it allows researchers to explore in-depth the processes and context of information system design in a specific hedge fund business environment. The type of research is descriptive qualitative enterprise architecture design, aiming to systematically describe and analyze how elements in TOGAF are applied in compiling an enterprise architecture for Sigma Investment Technologies.

Data were collected and analyzed through:

- Document and Requirements Analysis: In-depth analysis of Sigma Investment Technologies' business description, desired trading workflow, R&D activities, supporting business activities, and technology constraints. Trading system architecture documents were also analyzed.
- Extensive Literature Study: Review of academic literature, industry publications, case studies, white papers, and official TOGAF documentation.
- Comparative Analysis: Comparing technology platforms and architectural approaches for each identified business function.

The system development framework refers to the TOGAF Architecture Development Method (ADM) (model or design used). Each ADM phase is contextually elaborated according to Sigma's needs, from defining information needs, business processes, organizational structure, to technology implementation. Architecture visualization is proposed using standard diagrams.

4. Result

The application of TOGAF ADM resulted in an enterprise architecture design for Sigma Investment Technologies as follows:

A. Preliminary Phase

This phase focused on establishing the preparedness and foundational elements for undertaking the enterprise architecture effort. Key activities included defining the scope of the enterprise for Sigma Investment Technologies, identifying key business drivers and requirements for the architecture work, and establishing the architecture principles that would guide the subsequent design. These principles, adapted

for Sigma Investment Technologies, covered data, business, application, and technology architecture (Table 1).

Table 1. Principle Catalog

Architecture	Principle	Description
Business Architecture	Strategic Alignment	All business and technology initiatives must be aligned with Sigma's vision, mission, and strategic goals.
	Business Agility	Business processes and supporting systems must be flexible and able to adapt quickly to market changes and new opportunities.
	Client & Community Focus	Services and products are developed considering the needs and experiences of investment clients, students, signal customers, and the community.
Data Architecture	Data as a Strategic Asset	Data is considered a vital asset that must be managed, secured, and optimally utilized for decision-making and innovation.
	Data Quality & Integrity	Data must be accurate, consistent, reliable, and relevant for its intended use.
	Controlled Data Accessibility & Security	Data must be easily accessible by authorized parties but strictly protected from unauthorized access.
	Data Integration	Data from various sources must be able to be integrated to provide a holistic view and support comprehensive analysis.
Application Architecture	Application Modularity	Applications are designed modularly for ease of development, maintenance, and component replacement.
	User-Friendliness	Applications must be intuitive and easy to use by all user categories.
	Application Interoperability	Applications must be able to interact and exchange data with other systems efficiently.
	Application Security	Applications must have strong security mechanisms to protect data and functionality from threats.
Technology Architecture	Standardization & Common Technology	Prioritizing the use of mature, proven technologies with broad support and alignment with available expertise.
	Scalability & Performance	Technology infrastructure must be scalable to handle growth in volume and ensure optimal performance.
	Technology Security & Resilience	Technology infrastructure must be secure, resistant to disruptions, and have a disaster recovery plan.
	Technology Cost Efficiency	Technology selection and management must consider the total cost of ownership (TCO) and provide the best value for investment.
	Adoption of Relevant Technological Innovation	Open to adopting new technologies that can provide a competitive advantage or significant operational efficiency.

Table 2. Information Resource Catalog – Main Business Activities

Category	Quantitative Research & Analysis Platform
Business Process	Strategy Research & Development, Market Data Analysis
Description	System for collecting, processing, analyzing market data, fundamental data, alternative data, and supporting quantitative model development.
User Unit/User	Quantitative Research Team, Data Scientist, Fundamental Analyst
Status	Planned (New)
Usage	Daily research, model development, initial backtesting
Hardware	High-performance workstations, server (cloud-based), access to HPC cluster
Software	Python, R, Jupyter, data analysis libraries (Pandas, NumPy, Scikit-learn), Database (PostgreSQL), Statistical software, Visualization tools
Network	Yes (connection to data providers, internet, internal network)

The Preliminary Phase also involved activities to understand the organizational context and prepare for the architecture development cycles. Part of understanding the enterprise's context involved an initial

cataloging of key information resources relevant to the main business activities (Table 2) and supporting business activities (Table 3). This phase ensured that a clear framework and set of guiding principles were in place before commencing detailed architecture development.

B. Phase A: Architecture Vision

In this phase, the architecture vision serves to define all activities using the company's value chain diagram (Figure 1). The value chain diagram analysis itself serves as a depiction and grouping of each business process activity.

Table 3. Information Resources – Supporting Business Activities

Category	Learning Management System (LMS) & Educational Content Platform
Business Process	E-Class Quantitative Trading, YouTube Content Production
Description	Platform for creating, managing, and delivering online courses; and for producing and distributing educational video content.
User Unit/User	Education Team, Instructors, Students, Marketing Team, Content Creators
Status	Planned (New)
Usage	Delivery of course materials, student interaction, video hosting, content performance analysis
Hardware	Server (cloud-based for LMS SaaS/PaaS), Video production equipment (camera, microphone, lighting), Computers for editing
Software	LMS Platform (e.g., Moodle), Video editing software (e.g., Adobe Premiere), Graphic design tools (e.g., Canva), YouTube Studio
Network	Yes (internet access for all users)

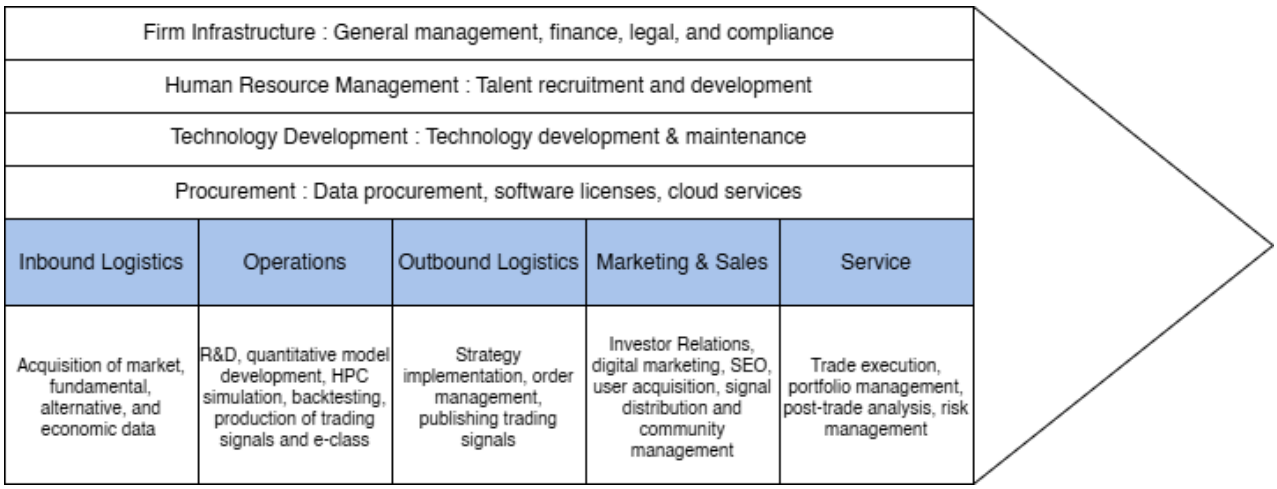

Figure 1: Value Chain Diagram

Description of Sigma's Main Activities :

- Inbound Logistics (Data): Acquisition of market, fundamental, alternative, and economic data.
- Operations (Alpha Generation): R&D, quantitative model development, HPC simulation, backtesting.
- Outbound Logistics (Signals & Orders): Strategy implementation, order management, publishing trading signals.
- Marketing & Sales (Funding): Investor relations.
- Service (Trading & Portfolio): Trade execution, portfolio management, post-trade analysis, risk management.

- Product Development (Education & Signals): Design of e-class curriculum, YouTube/article content, signal products.
- Marketing & Sales (Supporting Services): Digital marketing, SEO, user acquisition.

Description of Sigma's Firm-Wide Supporting Activities:

- Firm Infrastructure: General management, finance, legal & compliance.
- Human Resource Management: Recruitment & talent development.
- Technology Development: Development & maintenance of technology platforms, technology R&D.
- Procurement: Data procurement, software licenses, cloud services.

C. Phase B: Business Architecture

This phase explains the development of the business architecture. Proposed main business process designs include: Registration and User Management for Supporting Services (Figure 2), Quantitative Trading Strategy Development and Release Process (Figure 3), and Educational Content Creation and Distribution Process (Figure 4).

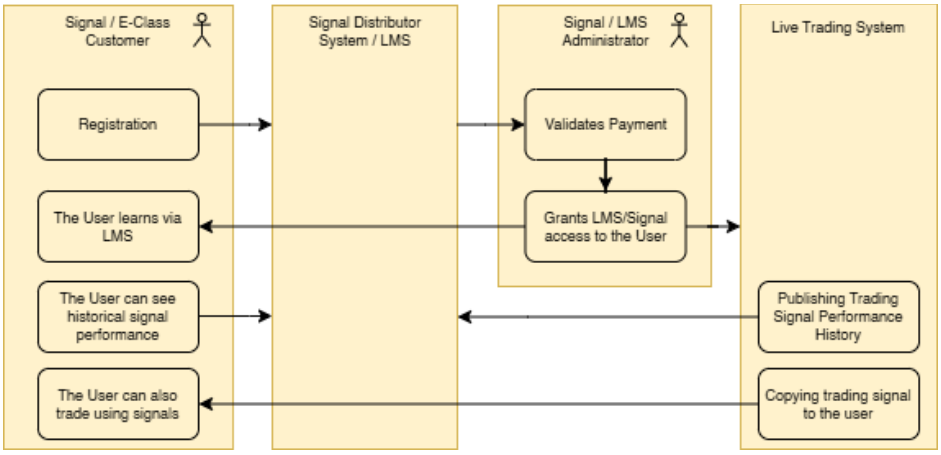

Figure 2: Proposed Registration and User Management for Supporting Services

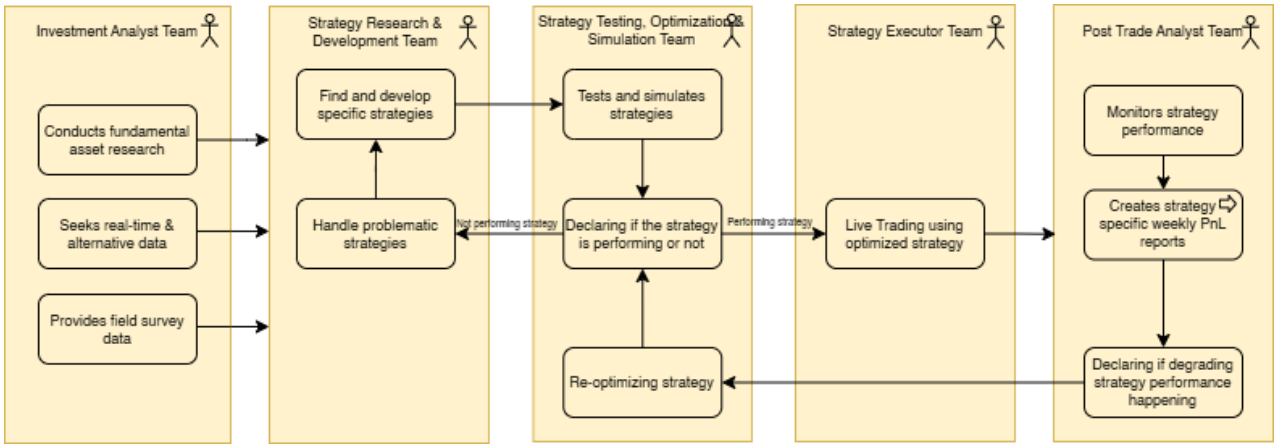

Figure 3: Proposed Quantitative Trading Strategy Development and Release Process

Email Corresponding: *hilmyhaidar333@gmail.com*

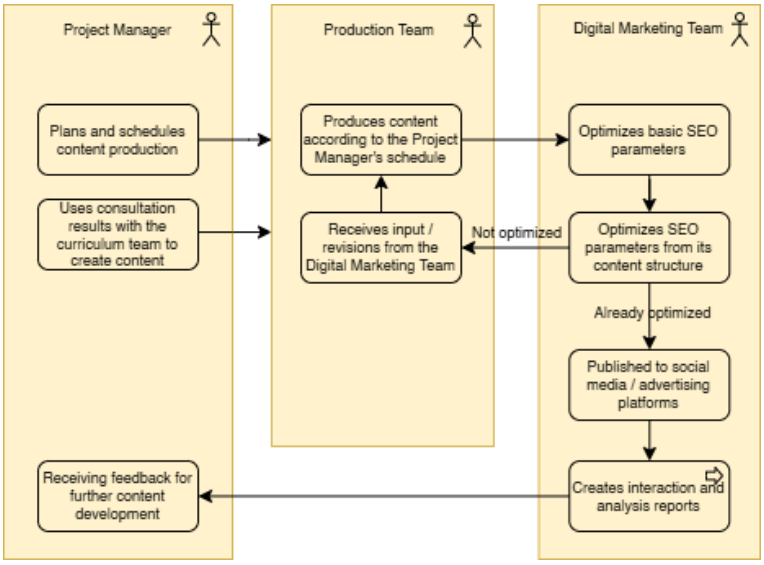

Figure 4: Proposed Educational Content Creation and Distribution Process

D. Phase C: Information Systems Architectures

In this phase, the information system architecture is divided into data architecture and application architecture.

- Data Architecture: A proposed data architecture that has been adjusted to the application proposal is presented in Table 4.
- Application Architecture: The application architecture is designed according to needs; proposed applications are listed in Table 5.

Table 4. Proposed Data Architecture for Sigma Investment Technologies

No.	Main Business Entity	Key Data Entity Examples
1	Trading Strategy Research & Development	Market_Data, Fundamental_Data, Alternative_Data, Economic_Survey_Data, Model_Parameters, Backtest_Results, Simulation_Results, Research_Notes, R&D_Project_Data
2	Trade Execution & Portfolio Management	Trading_Signals_(Internal), Trade_Orders, Executed_Trades, Positions, Portfolio_Valuations, Risk_Metrics, Broker_Data, Post_Trade_Analytics_Data
3	E-Class & Educational Content	User_Accounts_(Students), Course_Catalog, Course_Content, Student_Enrollments, Student_Progress, Certificates, Video_Assets
4	Signal Selling Service	User_Accounts_(Signal Customers), Signal_Products, Trading_Signal_Details, Signal_Subscriptions, Signal_Delivery_Logs, Payment_Transactions
5	Digital Marketing & Community Development	Website_Content, SEO_Keyword_Data, Social_Media_Post_Data, YouTube_Analytics, Community_Interaction_Data, Lead_Information, Marketing_Campaign_Performance
6	User & Financial Management (Cross-Service)	User_Profile, Payment_History, CRM_Data, Access_Logs, Audit_Trails

E. Phase D: Technology Architecture

In this phase, the technology architecture is divided into three proposals: network topology, hardware, and software.

- Network Topology: A network topology with segmentation for dev, test, and production environments is proposed, featuring secure connections to the internet, data providers, and brokers, along with firewalls and network security (Figure 5).

Table 5. Proposed Applications for Sigma Investment Technologies

No.	Main Activity/Function	Example Candidate Applications/Platforms
1	Data Research & Analysis	Python/R, Visualization Tools (like Tableau/Power BI), Market Data Platforms (like Quandl, Bloomberg, Yahoo Finance)
2	Quantitative Strategy Development & Backtesting	Quantitative Strategies Development, Git/GitHub, Backtesting Platforms (QuantConnect, Backtrader)
3	HPC Simulation	Financial Simulation Software, HPC Cluster Management (Slurm, Kubernetes)
4	Trade Execution & Order Management	OMS/EMS (Broker APIs like Interactive Brokers, Alpaca)
5	Risk Management & Post-Trade Analysis	Components in OMS/EMS, Custom Tools, BI Tools (Power BI, Tableau)
6	E-Learning & Educational Content Management	LMS (Moodle/Google Classroom), Video Platform (YouTube), Video Production Software (OBS, Adobe Premiere)
7	Signal Distribution & Subscription Management	Custom Backend with Message Broker (RabbitMQ, Kafka), Signal Distribution Platform (MQL5, myfxbook), Payment Gateway (Xendit, PayPal)
8	Digital Marketing, SEO & Community Development Management	CMS Website (WordPress), SEO Tools (Ahrefs, SEMrush), Social Media Platforms (Instagram, Facebook, Youtube), Email Marketing (Mailchimp), Discord
9	Customer Relationship Management (Cross-Service)	CRM (HubSpot CRM)
10	Finance & General Administration	Accounting Software (Accurate)

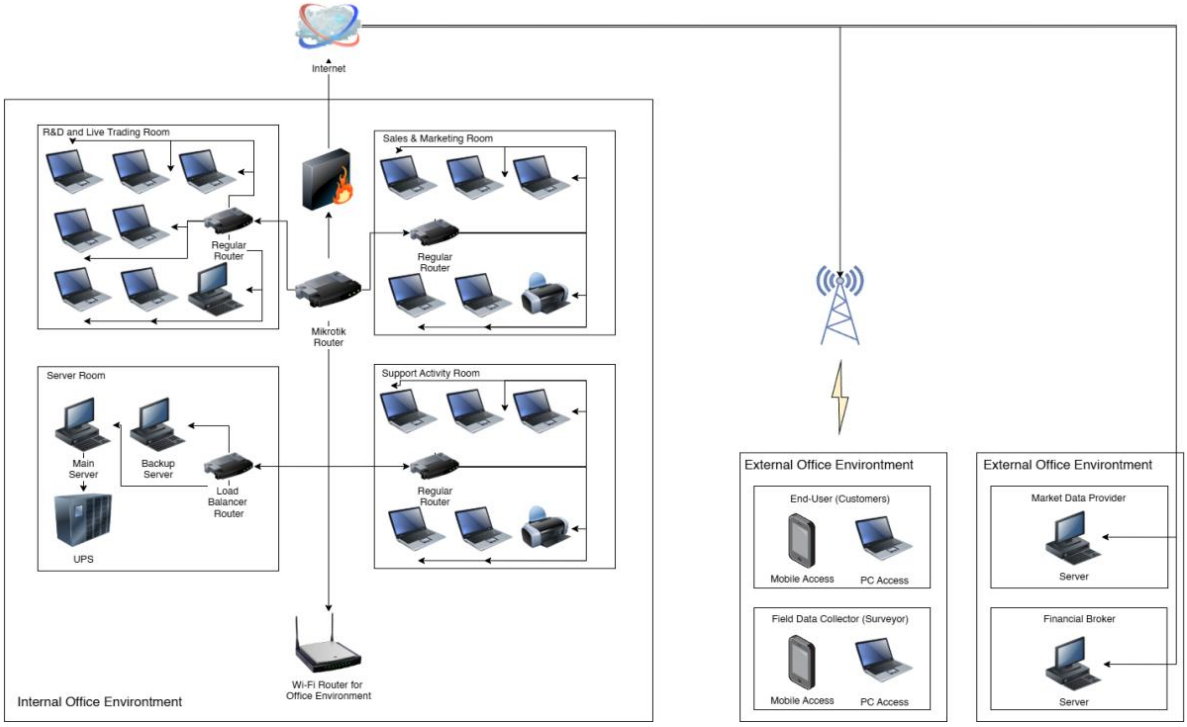

Figure 5: Proposed Network Topology Development

- Proposed Hardware:

Table 6. Proposed Hardware for Sigma

Hardware Need	Description
Application/Web Server	Private, Load balanced or using cloud computing services (depends on business scale, but private is preferably due to data security and compliance).
Database Server	Private, Load balanced or using cloud computing services (depends on business scale, but private is preferably due to data security and compliance).
HPC Cluster	Private HPC (preferably GPU computing) for simulation or using high performance cloud computing services (depends on business scale, but private is preferably due to data and research security).
Storage	SSD, private and using cloud computing services as backup (depends on business scale, but private is preferably due to data and research security).
Virtual Network Devices	Virtual router with bandwidth control feature, Firewall, Load Balancer (for app and database server).
Staff Work Devices	High-performance Laptops/PCs.

- Proposed Software:

Table 7. Proposed Software for Sigma

Software Need	Description
Server Operating System	Linux (Ubuntu Server) / Windows Server.
Web Server	Nginx, Apache.
Database Server	PostgreSQL, MySQL, possibly InfluxDB/KDB+ for high-frequency market data.
Message Broker	RabbitMQ, Apache Kafka (or managed cloud service).
Containerization Platform	Docker, Kubernetes (managed service).
DevOps Tools	Git, Jenkins/GitLab CI/CD, Terraform/Ansible (IaC), Prometheus/Grafana (Monitoring).
Security Software	Antivirus, cloud-native IDS/IPS, WAF.
Office Software	Google Workspace.

F. Phase E: Opportunities and Solutions

In this phase, the designs from the business, information systems, and technology architectures are re-evaluated using a gap analysis to help stakeholders determine which architecture to implement.

For Sigma:

- Opportunity Identification: Building a centralized data platform for more efficient analysis and R&D; developing educational products (e-class, YouTube) as new revenue sources and brand-building tools; launching a trading signal service to monetize core strategies; utilizing digital marketing and community development for user acquisition and building loyalty; using HPC for a competitive advantage in strategy development.
- Proposed Solutions: A modular and phased implementation approach, starting with an MVP (Minimum Viable Product) for each service; utilization of cloud-native solutions and SaaS/PaaS to accelerate development and optimize initial costs; focus on API integration between systems to ensure smooth data flow.

G. Phase F: Migration Planning

This stage involves sequencing the implementation of systems based on priorities. For Sigma, as an initial (greenfield) development, this is more implementation planning than migration from an old system.

- Implementation Project Priorities: Core Data Infrastructure & Basic Quantitative Research Platform; Basic Website & YouTube Channel (including community initiation); MVP E-Class Quantitative

Trading; MVP Core Trading System & Basic OMS/EMS; MVP Signal Selling Service; HPC Capability Development; CRM Integration & Advanced Marketing Automation.

- Implementation Roadmap: Phase 1 (6-12 months): Focus on data foundation, research, basic trading, and initial launch of educational services (website, YouTube); Phase 2 (12-24 months): Development of MVP e-class and signal services, enhancement of trading and R&D capabilities; Phase 3 (24+ months): Service scaling, HPC optimization, feature expansion, and full integration.
- Key Artifacts (Conceptual): Implementation and Migration Plan (Roadmap), Work Package Portfolio, Transition Architectures.

H. Phase G: Implementation Governance

This stage formulates the governance of each implementation, covering organizational, architectural, technological, and information governance. Key aspects include:

- Formation of Project/Architecture Steering Team: Involving representatives from management, business, and technology.
- Review & Approval Process: For each project deliverable and design change.
- Implementation Risk Management: Identification and mitigation of project risks.
- Architecture Compliance: Ensuring implemented solutions align with the target architecture.
- Vendor & Contract Management: If using third-party vendors.
- Key Artifacts (Conceptual): Architecture Contract (between project and architecture team), Compliance Assessments, Risk Register.

I. Phase H: Architecture Change Management

This phase ensures that architectural governance can run and establishes that the company's architecture can be fulfilled.

- Architecture Change Management Process: Mechanism for proposing, evaluating, and approving changes to the existing architecture; analysis of the impact of changes on the baseline and target architecture; maintenance of the Architecture Repository; monitoring technology & business trends to identify future architectural change needs; communication of architectural changes to all relevant stakeholders.
- Key Artifacts: Change Request Register, Updated Architecture Repository, Communication Plan for Changes.

5. Discussion

The application of TOGAF provides a systematic framework for Sigma Investment Technologies, aligning technology with its core business strategies and diversification efforts. The selection of common, cloud-first technologies is intended to support flexibility and cost efficiency for the company. A key aspect of the proposed architecture is the integration between core activities (trading insights) and supporting activities (educational content, signal validation), including community development as a marketing and feedback engine.

However, Sigma faces several challenges. These include the complexity of integrating various systems and processes, the need to acquire and retain appropriate talent, ensuring robust cybersecurity, and adhering to regulatory compliance (e.g., FTC TSR for investment signal/education sales). The presented approach is consistent with the broader need for Small and Medium-sized Enterprises (SMEs) to establish effective digital infrastructures to remain competitive. The research acknowledges that the system implementation is conceptual and, as of this study, has not been fully realized, being limited to the design and mapping stages.

6. Conclusion

This research applied The Open Group Architecture Framework (TOGAF) as an instrument to develop a conceptual enterprise architecture for Sigma Investment Technologies. The application of this framework enabled the systematic detailing of business processes and technology requirements that were initially not comprehensively documented, encompassing all identified business activities. Each business element was subsequently mapped according to the perspectives and focal points within the TOGAF framework, thereby achieving the research's primary objective of producing a comprehensive architectural design.

The practical implications of this design include a more structured mapping of business processes, recommendations for technology appropriate to the business's needs and conditions, and a guide for the owner in designing information systems incrementally. This design offers a strategic roadmap for Sigma to build its technological and operational capabilities, supporting decision-making, and achieving its business objectives. More broadly, it serves as a reference for other entities in the financial services industry aiming to build adaptive digital systems aligned with their business objectives.

This study is limited by its conceptual research object, focusing on a single hypothetical business unit (Sigma Investment Technologies), which means the findings cannot be broadly generalized. As noted, the system implementation has not been carried out comprehensively and is currently confined to the architectural design and mapping phases; only partial implementation has begun. Furthermore, the depth of technical detail for each component may be constrained by the scope of a journal article and the "initial development" nature of the subject.

For future research, it is suggested to test this design through more extensive implementation and evaluate its effectiveness over a specific period. A more in-depth cost-benefit analysis for the various proposed technology options, and further investigation into specific challenges in data and process integration between core trading activities and supporting services within a hedge fund environment, could also be focuses for subsequent research.

Acknowledgments

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