

Enterprise Architecture for a Palm Oil Agribusiness ERP Using TOGAF and ArchiMate

Naura Gena Anasya^{1)*}, Januponsa Dio Firizqi²⁾, Erick Dazki³⁾, Handri Santoso⁴⁾,
Richardus Eko Indrajit⁵⁾

^{1,2,3,4,5)} Department of Information Technology, Pradita University, Tangerang, Banten, Indonesia

¹⁾naura.gena@student.pradita.ac.id, ²⁾januponsa.dio@pradita.ac.id, ³⁾erick.dazki@pradita.ac.id,

⁴⁾handri.santoso@pradita.ac.id, ⁵⁾eko.indrajit@gmail.com

Submitted : Aug 22, 2026 | **Accepted :** Sep 11, 2026 | **Published :** Oct 5, 2026

Abstract: A palm oil agribusiness manages a long value chain, from estate operations and harvesting to milling, sales, and distribution, supported by workforce, finance, and maintenance functions. When these functions grow module by module without a shared architectural plan, the same master data is recorded more than once and the link between business strategy and the supporting systems becomes hard to trace. This study designs an enterprise architecture (EA) for an integrated Enterprise Resource Planning (ERP) implementation in an anonymised palm oil agribusiness company, using The Open Group Architecture Framework (TOGAF) Architecture Development Method (ADM) and ArchiMate 3.1 within a design science research approach. The design draws on the documented business process blueprints of six ERP modules, namely estate management, checkroll, production planning, plant maintenance, finance and control, and sales and distribution, from which 30 business processes and 20 principal data objects were extracted and modelled across the four ArchiMate layers, with an as-is versus to-be gap analysis. The result is an integrated ERP reference architecture, with a shared master data core and a four-stage migration roadmap, that connects the estate-to-sales value chain into one coherent model. Evaluation against four criteria, each with an explicit failure condition, found all 24 module-layer cells populated, all 30 processes traceable from a motivation element to a hosting node, and all four gaps covered by the roadmap. The contribution is a reusable EA reference model for palm oil agribusiness ERP, a domain that has received little attention in prior TOGAF-based case studies.

Keywords: ArchiMate; business process; enterprise architecture; ERP; palm oil agribusiness; TOGAF ADM

INTRODUCTION

The palm oil sector is one of the largest agribusiness industries in Indonesia, and a single company often manages a long value chain that runs from estate operations and harvesting, through milling that produces crude palm oil (CPO) and kernel, to sales and distribution to domestic and export buyers. This core chain is supported by workforce administration for a large field labour force, by finance and control, and by plant maintenance. Each of these functions has its own processes, documents, and data.

To manage this scale, many companies adopt an Enterprise Resource Planning (ERP) system such as SAP. In practice the modules are often implemented in stages, and when they are added without a shared architectural plan the same master data, for example an employee, a plantation block, or a material, is entered in more than one place, and the connection between a business objective and the module that supports it is difficult to follow (Prihandono et al., 2024; Maulana et al., 2023). This makes three tasks harder: tracing how a business objective is realised by concrete processes and systems, finding common capabilities that can be shared, and adding or changing a process in a controlled way.

Enterprise architecture (EA) addresses this need. EA is a set of principles, methods, and models used to design and align an organisation's structure, processes, information systems, and technology (Zachman, 1987; Lankhorst, 2017). By making the links between strategy, business, application, and technology explicit, it supports business and IT alignment and helps manage complexity (Hamidani & Ali, 2025; Fuentes-Quijada et al., 2024).

*name of corresponding author



This is anCreative Commons License This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

Among the available frameworks, the TOGAF Architecture Development Method (ADM) is widely used and provides a phase-based process from architecture vision through migration planning (The Open Group, 2018; Dumitriu & Popescu, 2020); a recent comparative evaluation of EA frameworks for the agricultural sector also identifies TOGAF as the most suitable of the established frameworks (Anbananthen et al., 2024), while ArchiMate provides a layered modelling language that keeps the design analysable (Lankhorst, 2017).

Prior applications of TOGAF ADM and ArchiMate cover domains such as real estate (Widjaja et al., 2025), hospital systems (Purnama et al., 2026), the cruise industry (Watasendjaja et al., 2025), general retail (Hengky et al., 2024), heavy-equipment rental (Safrianto, 2025), electronic government (Darsono et al., 2026), and a civic-technology platform (Prawira et al., 2023). The closest work to the present study is an EA for a circular smart palm ecosystem (Hamdani et al., 2026), two of whose authors are also authors of the present paper; it addresses the ecosystem level rather than the internal, module-based ERP of a single palm oil company across the full estate-to-sales chain. The present architecture differs from it on four axes: the unit of analysis is the internal ERP of one company rather than an inter-organisational ecosystem; traceability is modelled across all four ArchiMate layers down to the hosting node; the motivation layer is instantiated as an explicit stakeholder-driver-goal-outcome chain that the modelled processes realise; and Phases E and F are carried through to a gap analysis and a four-stage, twelve-month migration roadmap. To the best of our knowledge, an EA that integrates the estate, workforce, production, maintenance, finance, and sales processes of a palm oil agribusiness into one ERP reference model has not been reported.

This study designs such an architecture for a palm oil agribusiness company, kept anonymous for confidentiality, using TOGAF ADM (the Preliminary Phase and Phases A to F) and ArchiMate 3.1. Following a design science approach, the architecture is treated as an artefact and checked for consistency, completeness, traceability, and applicability (Hevner & Chatterjee, 2010; Adwan, 2025). The contributions are a reusable EA reference model for a palm oil agribusiness ERP, cross-layer traceability across the six modules, an as-is versus to-be gap analysis that identifies a shared master data core, and a phased migration roadmap. Three questions guide the study: how can the estate-to-sales processes of a palm oil agribusiness be represented as one coherent architecture across the four layers; what data-sharing and integration opportunities appear when the modules are modelled together; and what phased path moves the company from a fragmented state to an integrated ERP.

LITERATURE REVIEW

Enterprise architecture provides an explicit, whole-of-organisation description of how business and technology fit together. Zachman (1987) established the idea that an architectural description is not a single artefact but a set of views, each answering a different stakeholder question, and Lankhorst (2017) consolidated the modelling side of that idea by showing that layered models expressed in one language can be analysed rather than only drawn. The distinction matters for the present study, because a description that cannot be traversed from a business objective to the system that realises it documents an organisation without supporting a decision about it. The studies reviewed below are therefore examined not for the fact that they applied TOGAF, but for how far their models can be traversed and what they leave unmodelled.

The first link in the theoretical chain runs from architecture to business and IT alignment. Maulana et al. (2023) review the strategic alignment dimension and find that EA contributes to alignment by making the dependency between business intent and system capability explicit rather than assumed, so that alignment becomes a property of the model rather than an attitude of the organisation. Hernandez et al. (2026) take the argument further by developing and validating a measurement scale for EA capability and business and IT alignment, which shows that the relationship is treated in the literature as measurable rather than rhetorical. Hamidani and Ali (2025) report that firms with an explicit architecture absorb change triggers more readily because the elements affected by a change can be located, and Prihandono et al. (2024) supply the complementary negative case, in which digital investment made without a structural view of the firm produces uneven performance effects. Read together, these studies support a specific position rather than a general one: alignment follows from traceable structure. This is why the present study treats the stakeholder-driver-goal-outcome chain as a required part of the artefact rather than as an optional view.

The second link runs from alignment to governance. Fuentes-Quijada et al. (2024) map the intersection of EA and IT governance and conclude that the two are mutually dependent, since an architecture without governance is not enforced and governance without an architecture has no object to enforce. Adwan (2025) reaches the same point from the evaluation side by treating the architecture as an artefact whose adoption must be assessed rather than assumed. TOGAF ADM supplies the process that carries this out, structuring EA work as an iterative cycle from the Preliminary Phase through Phases A to F and beyond (The Open Group, 2018), and comparative studies note its strength in governance, flexibility, and configurability (Dumitriu & Popescu, 2020). For this reason the Preliminary Phase is not treated here as a formality: the eight principles of Table 2 are the governance instrument that makes a shared master data core defensible once several estates, mills, and a head office write to it.

The third link runs from governance to ERP integration, and it is here that the literature is thinnest for agribusiness. Kembaren (2022) reports operational-performance gains from ERP in the Indonesian oil palm plantation industry, but treats the ERP as one undifferentiated system, so the result does not indicate which modules or which data produce the gain. Kirana et al. (2024) model SAP procurement at module level and Choliq (2025) models distribution processes; both work at the level of detail this study requires, but each is confined to a single module and therefore does not confront the master data that two modules share. Butarbutar et al. (2023) make the consequence explicit: in their systematic review of ERP post-implementation, continuous system integration is the most frequently reported critical success factor. The pattern across this group is consistent, in that performance studies aggregate above the level at which integration problems occur while process studies sit below it, leaving the module boundary itself unexamined. Wider evidence on agribusiness digitalisation points the same way, with digital transformation improving agricultural enterprise performance where it is structurally embedded rather than added system by system (Yuan et al., 2025).

Applied TOGAF ADM case studies cover real estate (Widjaja et al., 2025), hospital integration (Purnama et al., 2026), the cruise industry (Watasendjaja et al., 2025), retail (Hengky et al., 2024), equipment rental (Safrianto, 2025), electronic government (Darsono et al., 2026), banking channels (Akbar et al., 2025), merchant acquiring (Praharto & Yohanis, 2025), and a civic platform (Prawira et al., 2023). Their common contribution is evidence that the method is domain-agnostic, and Widjaja et al. (2025) and Purnama et al. (2026) in particular carry the work through to a gap analysis, which is the step that turns a description into a plan. Their common limit, for present purposes, is scope: each models an organisation's portfolio of systems rather than the interior of one ERP, so duplication arising between modules of the same ERP is not the object of study. ArchiMate 3.1 supplies the notation, with motivation, business, application, and technology layers that support tracing across layers (Lankhorst, 2017; The Open Group, 2019), and recent work on enterprise modelling confirms that the value of such models depends on how far they can be checked rather than on how completely they are drawn (Rani et al., 2025).

The closest work in domain is Hamdani et al. (2026), which designs an EA for a circular smart palm ecosystem. It operates between organisations, where the integration problem is the exchange of data between parties, and the surrounding literature on palm oil digitalisation shares that orientation, being concerned largely with traceability along the supply chain (Adisetya et al., 2024). The problem addressed here is the opposite one: duplication inside a single company, across modules that already share a platform. Positioned in the chain set out above, the present study takes alignment as the objective, governance principles as the enabling condition, and module-level ERP integration as the site of the problem. Table 1 summarises the representative studies against that position and states the contribution of this work.

Table 1. Summary of representative studies.

No	Reference / focus	Key point	Gap relative to the present study
1	Hamdani et al. (2026) - smart palm ecosystem	Design-science EA for a circular palm ecosystem	Ecosystem level; no internal module-based ERP scope, no cross-layer traceability to the hosting node, no explicit motivation chain, no Phase E to F migration plan
2	Widjaja et al. (2025) - real estate	TOGAF ADM across layers	Not agribusiness; no estate-to-sales chain
3	Purnama et al. (2026) - hospital	TOGAF ADM with gap analysis	Healthcare, different value chain
4	Hengky et al. (2024) - retail	TOGAF ADM and ArchiMate	Generic retail, not ERP modules
5	Safrianto (2025) - equipment rental	EA planning with TOGAF ADM	Asset rental, not agribusiness
6	This study - palm oil agribusiness ERP	TOGAF ADM and ArchiMate 3.1 across four layers for six ERP modules; one model of 90 elements and 248 relationships covering 30 processes and 20 data objects	Addresses the gap: internal estate-to-sales ERP reference model with an explicit motivation chain, cross-layer traceability for all 30 processes, a four-gap analysis, and a four-stage migration roadmap

From Table 1, the gap is that no TOGAF-based EA reference model integrates the estate, workforce, production, maintenance, finance, and sales processes of a palm oil agribusiness ERP with explicit motivation modelling, cross-layer traceability, and a Phase E to F analysis. This is the focus of the present study.

METHOD

The study uses design science research (Hevner & Chatterjee, 2010), which produces and evaluates a concrete artefact through iteration between problem, design, and evaluation. Figure 1 shows the flow: a literature review frames the problem, data collection captures the ERP processes, TOGAF ADM structures the design, a gap analysis and an evaluation assess the result, and the study ends with a migration roadmap. The four subsections below state the data sources and the scope of the modules, the rules used to extract architectural elements from those sources, the modelling procedure, and how the resulting models were reviewed.



Fig. 1 Research methodology based on the design science research cycle.

Research object, data sources, and module scope

The research object is the ERP landscape of a palm oil agribusiness company, referred to throughout as the Company and kept anonymous for confidentiality. Anonymising the organisation, its locations, and its internal system names follows common practice in enterprise-architecture case studies (Widjaja et al., 2025; Purnama et al., 2026) and does not affect the results, which concern the structure of the processes rather than the identity of the company. Standard SAP transaction codes are retained because they are generic to the platform.

The primary sources are six documented business process blueprints, one for each ERP module in scope: estate management, checkroll (field workforce), production planning, plant maintenance, finance and control, and sales and distribution. These are the Company's own approved implementation blueprints, produced during its staged ERP rollout. Each blueprint records the processes of its module together with the responsible roles, the ordered activities, the transaction codes, and the documents and master data used. Together the six documents describe 30 business processes and 20 principal data objects, and these are the elements modelled in this study, as listed in Table 3 and Table 4.

Three criteria governed the selection of the six modules. The first is coverage of the physical value chain, since estate management, production planning, and sales and distribution are the modules through which fresh fruit bunches, crude palm oil, and kernel move from block to buyer, so that omitting any of them would break the estate-to-sales chain the study sets out to model. The second is coverage of the support functions that consume the same master data, since checkroll, plant maintenance, and finance and control attach labour, asset, and financial records to that chain and are therefore the modules in which duplicated master data appears. The third is the availability of a complete and current blueprint, so that every modelled element can be traced to a source document; modules for which such a blueprint was not available at the time of the study were left out of scope. The six modules are the ones that satisfy all three criteria.

Extraction of architectural elements

Each blueprint was read once end to end and then coded a second time against a fixed set of decision rules, so that the same kind of statement always produced the same kind of ArchiMate element. A business actor was recorded wherever a blueprint named a role as responsible for an activity, for example the sales administrator or the weighbridge operator; organisational roles rather than named individuals were used, which also supports the anonymisation. A business process was recorded for each named end-to-end procedure, and its ordered activities were kept as the internal steps of that process. An application component was recorded for the module that carries the process, and an application service where the blueprint described a module as delivering something to another module. A data object was recorded for each master or transaction record named as created, read, or updated; records that appeared in more than one blueprint with the same business meaning, such as the employee master, were merged into a single data object, and this merging is what later exposes the shared master data core reported in Phase C and Phase E. A node or a system software element was recorded where a blueprint named a server, a database, or an interface. Statements describing organisational policy rather than an executed activity were not modelled as processes, while statements expressing an intended result were carried to the motivation layer in Phase A.

Modelling procedure

The extracted elements were assembled into a single ArchiMate 3.1 model held in Archi, and that model is the source of every ArchiMate figure in this paper. Every source and target pair in the model was validated against the ArchiMate 3.1 relationship table published in the Archi model plug-in, which is the table the tool itself applies, and the model was then opened, saved, and rendered by Archi. Notation validity is therefore checkable against a

*name of corresponding author



published table rather than asserted by the authors, and the outcome of that check is reported in the evaluation. Within that constraint the mapping was kept deliberately narrow, so that all six modules would be modelled in the same way. A business actor is assigned to the business process it performs. An application component serves the business process it supports and accesses the data object that process uses. A business process realises both the module goal it contributes to and the business service it delivers. A technology artefact realises the application components and the data objects it carries and is assigned to the node that hosts it, which is how the deployment is expressed. A node serves another node, and system software serves the components it supports. Layer membership follows the ArchiMate layering, with the motivation layer carrying the stakeholder-driver-goal-outcome chain of Phase A, the business layer carrying actors, processes, and functions, the application layer carrying components and data objects, and the technology layer carrying the application server, the database platform, the integration interface, and the deployment artefacts. The resulting model contains 90 elements and 248 relationships across the four layers, and the same colour and shape conventions are used throughout, so that a reader can identify the layer of an element from the figure alone.

Model review and use of AI-assisted tools

The models were reviewed in two passes. The first pass was a check of the model against the source blueprints, process by process, confirming that every process, actor, and data object recorded in a blueprint appears in the model and that no element appears in the model that is not in a blueprint. The second pass was a review of the layer assignment of each element and of the type and direction of each relationship, carried out by co-authors with prior published work on TOGAF ADM and ArchiMate modelling. The blueprints, which are the Company's own approved implementation documents, are the source of record for both passes. Validation with domain experts from the Company in a running ERP environment is identified in the limitations as the next step.

The authors used AI-assisted tools for language editing and for the mechanical layout of the diagrams. The architectural content of the model, meaning which elements exist, which layer each belongs to, and which relationships connect them, was determined by the authors from the blueprints, and every relationship was checked against the ArchiMate 3.1 relationship table as reported in the evaluation. Figures 2 to 6 are exported directly from the model rather than drawn separately, so what a figure shows and what the model contains cannot diverge; Figure 1 is a flow diagram of the research method and is not an ArchiMate view. The authors take full responsibility for the content of the manuscript.

RESULT

Preliminary Phase: architecture principles

The Preliminary Phase sets the governance basis. Eight principles, adapted from the TOGAF catalogue (The Open Group, 2018) and phrased for an agribusiness ERP, guide the design (Table 2). They matter because the modules share master data and because consistency and access control must be handled the same way across estates, mills, and the head office.

Table 2. Architecture principles.

No	Principle	Reason
1	Principles apply to all estates, mills, and units	Consistent data quality across the group
2	Common modules, minimal duplication	Avoid re-entry across modules
3	Data is a shared asset	One source of truth for master data
4	Legal and regulatory compliance	Tax, export, and labour obligations
5	Least-privilege access	Protect financial and workforce data
6	Standard process pattern	Repeatable onboarding of processes
7	Clear IT ownership	Accountable ERP changes
8	Strategy-to-execution traceability	Link objectives to processes and systems

The principles in Table 2 are not generic statements of intent; each one is the reason a later design decision is permitted. Principles 2 and 3, on common modules and on data as a shared asset, are what allow the six modules to be placed on one master data core in Phase C instead of on module-local copies. Principles 4 and 5, on compliance and least-privilege access, constrain that core, because tax, export, and labour records become visible across estates and mills once the data is shared and must therefore be restricted by role rather than by system boundary. Principle 8, on strategy-to-execution traceability, is the principle the evaluation in this section tests directly.

Phase A: Architecture Vision

Phase A sets the business context. The vision is an integrated ERP that connects the estate-to-sales value chain and gives accurate and timely information to management. In the ArchiMate motivation layer this is

*name of corresponding author



This is anCreative Commons License This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

modelled as a chain from stakeholder to driver to goal to outcome: management, as the stakeholder, is driven by the need for efficiency and data accuracy, pursues the goal of integrating the ERP modules on a shared platform, and expects outcomes such as less duplicated data entry, faster reporting, and clearer cost control. Figure 2 shows this chain as it is modelled. The integration goal aggregates one goal per module, so that every business process modelled in Phase B can be traced back to the objective it serves, and the requirement for a shared master data core with scheduled field and mill integration is the element that the gap analysis in Phase E and the roadmap in Phase F act on.

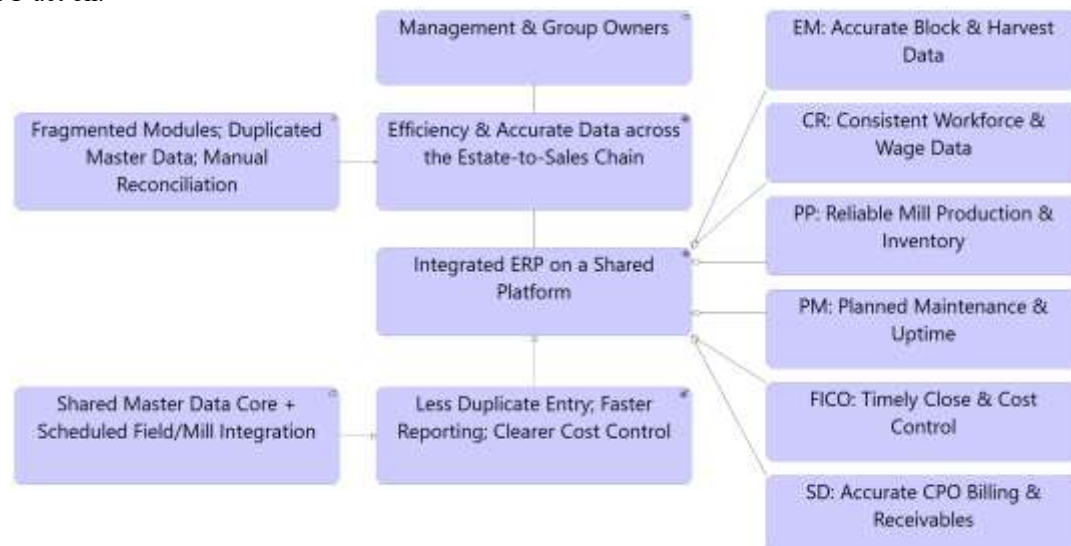


Fig. 2 Motivation view: stakeholder, driver, assessment, goals, outcome, and requirement.

Phase B: Business Architecture

The business architecture models the value chain and the processes within each module. The core chain runs from estate management to harvesting, then to CPO and kernel production, and then to sales and distribution, supported by checkroll, finance and control, and plant maintenance, as shown in Figure 3. Each process is modelled as an ArchiMate business process with ordered steps and assigned actors, following the standardised pattern used by Widjaja et al. (2025) and Hengky et al. (2024). Table 3 lists the processes per module. Figure 4 illustrates the sales and distribution process, in which a sales order leads to billing, delivery with goods issue, and shipment with receivable recording.

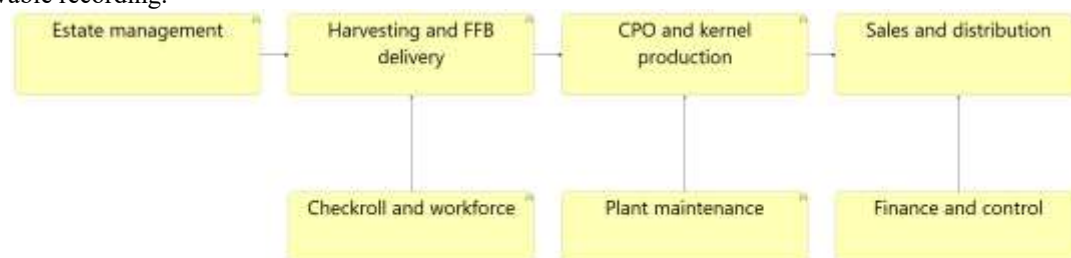


Fig. 3 Business value chain of the palm oil agribusiness.

Table 3. ERP modules and their main business processes.

Module	Main processes
Estate Management (EM)	Garden organisation structure; block declaration; hectare statement; FFB harvesting and delivery to mill; vehicle running account; nursery; workshop
Checkroll (CR)	Worker and job master; recruitment, mutation, and termination; checkroll activity and rates; wage, minimum wage and PTKP, rice ration; deductions; checkroll transactions
Production Planning (PP)	Palm oil mill production; kernel crushing plant; oil and kernel inventory; quality analysis and mass balance
Plant Maintenance (PM)	Equipment master; maintenance planning and work orders; maintenance execution and recording

*name of corresponding author



This is an Creative Commons License This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

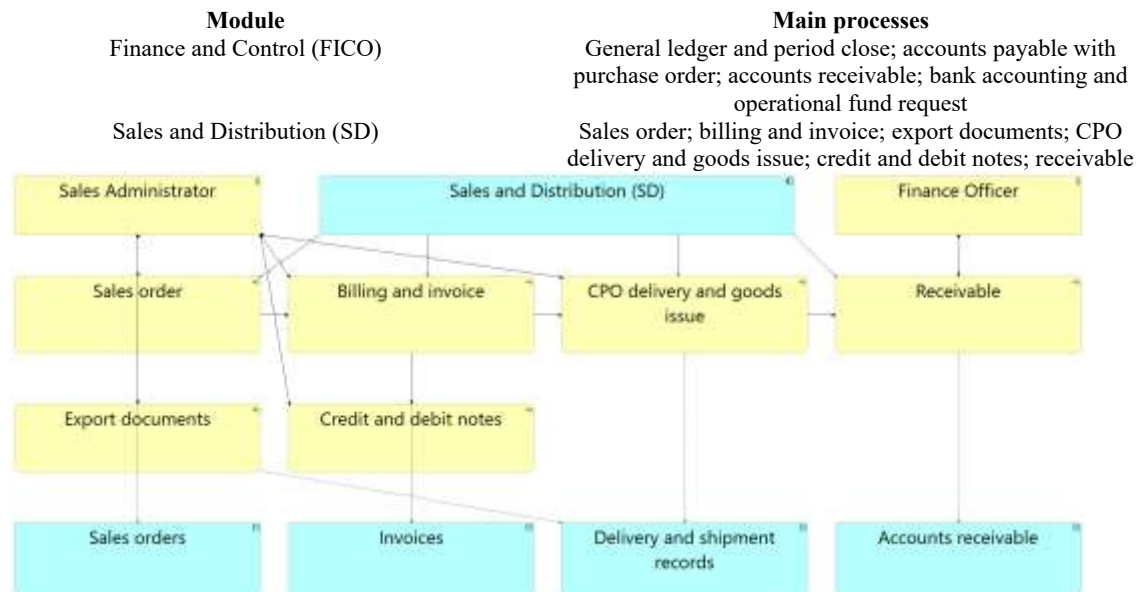


Fig. 4 Business process view of CPO sales and distribution.

Phase C: Application Architecture

The application architecture maps the modules and their data. The six modules run on a shared platform and use common master data, so the same employee, block, material, and customer records are used across processes rather than re-entered. Figure 5 shows how the modules cooperate around the shared core, and Table 4 lists the modules and their main data. The recurrence of shared master data across modules is the main point for consolidation, discussed in Phase E.

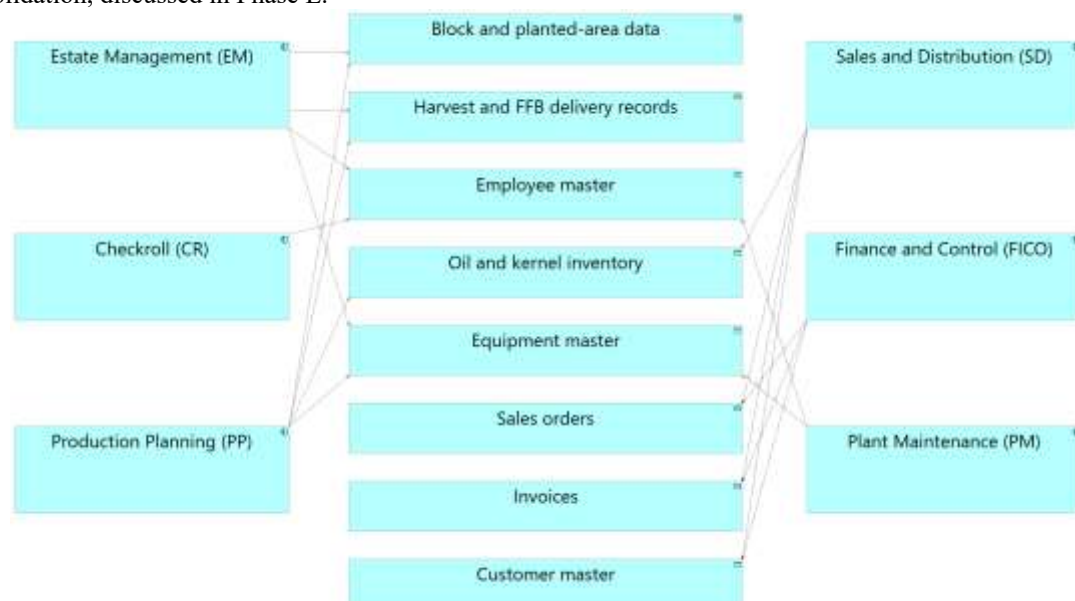


Fig. 5 Application cooperation of the six modules around the shared master data core.

Table 4. ERP modules and main data objects.

Module	Main data objects
Estate Management	Block and planted-area data; Hectare statement; Harvest and FFB delivery records
Checkroll	Employee master; Activity and rate data; Payroll records
Production Planning	Mill production data; Oil and kernel inventory; Quality and mass-balance data
Plant Maintenance	Equipment master; Work orders; Maintenance history

*name of corresponding author



This is anCreative Commons License This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

Module	Main data objects
Finance and Control	General ledger; Accounts payable; Accounts receivable; Bank transactions
Sales and Distribution	Sales orders; Invoices; Delivery and shipment records; Customer master

Table 4 is the point at which duplication becomes visible. Reading down the column of data objects, the employee master is required by checkroll for wage calculation, by estate management for harvesting assignment, and by plant maintenance for work-order execution; the block and planted-area data are required by estate management and by production planning; and the customer master, the sales orders, and the invoices are required by sales and distribution and by finance and control. Of the 20 data objects recorded, 8 are accessed by more than one module, and those 8 are the shared master data core that Figure 5 consolidates. The remaining 12, such as work orders, payroll records, and the hectare statement, stay local to their module and are not candidates for consolidation.

Phase D: Technology Architecture

The technology architecture describes the hosting. The modules run on an ERP application server, and the master and transaction data are held in a single in-memory database platform. Keeping the data on one governed platform is what makes shared use and role-based access practical, which supports the integration proposed in Phase E. Table 5 lists the components.

Table 5. Technology components.

Component	Type	Role
ERP application server	Node	Hosts the ERP modules
In-memory database platform	Node	Holds master and transaction data
Integration interface	System software	Connects field/mill data capture to the ERP

Table 5 is deliberately short, because the technology layer is where the Company's situation matters least to the argument. What the three components have to provide is a single governed store for the shared master data, a single hosting point for the six modules, and a scheduled path for field and mill data capture to reach the ERP without manual re-entry. The integration interface is what closes the technology-layer gap of Table 6, since harvest and weighbridge figures are the data currently reconciled by hand.

Phase E: Opportunities and Solutions

Phase E compares the current (as-is) state with the target (to-be) state, following the gap-analysis approach used by Widjaja et al. (2025) and Purnama et al. (2026). Table 6 lists the results. A single shared master data core removes the re-entry of employee, block, material, and customer records across modules. Connecting field and mill data capture, such as harvest and weighbridge records, to the ERP reduces manual reconciliation between the estate, production, and sales processes. Standardising the process pattern across modules makes reporting from estate cost to sales margin consistent.

Table 6. Gap analysis: as-is versus to-be.

Layer	As-is	To-be	Gap / solution
Business	Processes documented per module; some manual reconciliation	Standard processes linked along the value chain	Standardise pattern; link estate-to-sales
Application	Modules with separate data entry	Integrated modules on shared master data	Single source of truth; integration
Technology	Field and mill data reconciled by hand	Scheduled interface to the ERP	Add integration interface; access control
Motivation	Objectives informal per unit	Explicit stakeholder-goal chains	Model motivation; link goals to processes

Phase F: Migration Planning

Based on the gap analysis, a four-stage roadmap is proposed (Table 7), ordered by priority and dependency. It starts with the shared master data core, then the core value-chain modules, then the support functions, and ends with integrated reporting.

*name of corresponding author



This is anCreative Commons License This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

Table 7. Migration plan.

Stage	Timeline	Focus	Main output
1 - foundation	Month 1-3	Shared master data and platform	Single master data; integration baseline
2 - core chain	Month 4-6	Estate, production, sales	Estate-to-sales processes on the ERP
3 - support	Month 7-9	Checkroll, finance, maintenance	Workforce, finance, and maintenance on the ERP
4 - reporting	Month 10-12	Reporting and control	Group reporting; role-based access; audit trail

The order of the stages in Table 7 follows data dependency rather than convenience. Stage 1 comes first because every later stage writes to the shared master data core, so moving a value-chain module before the core exists would reproduce the duplication the architecture is meant to remove. Stage 2 takes the physical chain, where the reconciliation between field, mill, and sales data is the integration point identified in Phase E, and stage 3 follows with the support functions, which consume records that stage 1 and stage 2 have already made consistent. Stage 4 is last because group reporting across estate cost and sales margin is only meaningful once the preceding three stages have placed those figures on a common basis.

Layered view and evaluation

Figure 6 brings the business, application, and technology layers together, showing how the estate-to-sales processes are supported by the ERP modules and the shared data, which in turn run on the application server and the database platform.

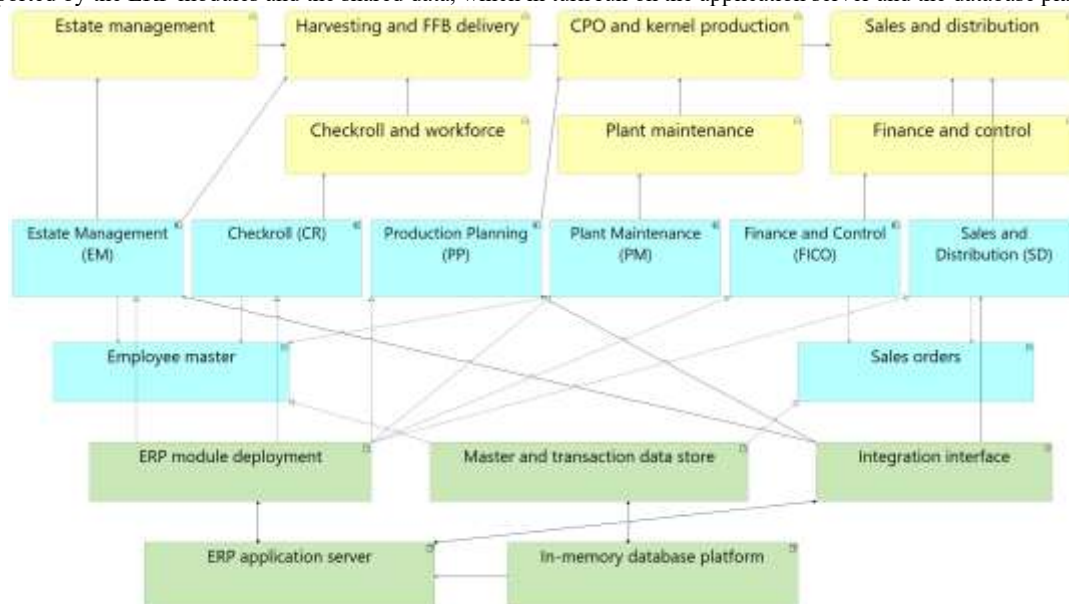


Fig. 6 Layered view of the integrated ERP architecture.

Evaluation of the artefact

The artefact was evaluated against the four design science criteria of consistency, completeness, traceability, and applicability (Hevner & Chatterjee, 2010; Adwan, 2025). Each criterion was turned into a check that is able to fail, applied to a defined population of model elements, and recorded with its outcome. Table 8 reports, for each criterion, what was checked, the condition that would count as a failure, who applied the check, and the result. The object evaluated is the model from which Figures 2 to 6 are exported, which holds 90 elements and 248 relationships across the four layers. The checks were applied against a written checklist by the author who built the model and then re-applied independently by a co-author who did not take part in the modelling; where the two applications disagreed, the source blueprint decided the outcome.

Consistency fails if a relationship connects a source and target pair that the ArchiMate 3.1 relationship table does not permit, or if an element is left with no relationship at all. Every one of the 248 relationships was checked against that table and 248 of 248 are permitted. The check was not vacuous: six impermissible pairs, all of them goal-to-goal realisation in an earlier version of the motivation layer, were found and corrected to aggregation from the parent goal to its module goals before the final model was exported. Listing every element then confirmed that all 90 participate in at least one relationship, and that no two elements carry the same name and type. As an

*name of corresponding author



independent check of the same property, the model exports and validates without error against The Open Group ArchiMate 3.1 Open Exchange schema.

Completeness fails if any of the six modules is absent from any of the four layers. The check was applied module by module across the 24 module-layer cells that six modules and four layers produce. Each module appears in the motivation layer through the goal chain of Phase A, in the business layer through the processes of Table 3, in the application layer through the component and data objects of Table 4, and in the technology layer through the hosting relationship to the application server and database platform of Table 5. All 24 cells are populated.

Traceability fails if a business process cannot be followed upward to a motivation element and downward to a technology node. The check was applied to all 30 business processes extracted from the blueprints, each of which was followed along the path from stakeholder to driver to goal to business process to application component to data object, and from the component through the deployment artefact to the hosting node. All 30 processes completed the path in both directions, which is the evidence for principle 8 of Table 2.

Applicability fails if a gap identified in Phase E is not addressed by at least one stage of the Phase F roadmap. The four gaps of Table 6 were matched to the roadmap of Table 7. The application-layer gap of separate data entry is addressed by stage 1, which establishes the shared master data core. The business-layer gap of non-standard processes is addressed by stage 2 and stage 3, which move the core value chain and then the support functions onto the common process pattern. The technology-layer gap of manual reconciliation is addressed by stage 1 and stage 2 through the integration interface. The motivation-layer gap of informal objectives is addressed by stage 4, which delivers group reporting and role-based access against the modelled goals. All four gaps are covered.

The four checks together establish that the architecture is internally valid, complete over its declared scope, traceable end to end, and matched to an actionable migration path. Measuring operational benefit requires the roadmap to be executed, which is identified in the limitations as the next step.

Table 8. Evaluation against design science criteria.

Criterion	What was checked	Failure condition	Who checked	Result
Consistency	All 248 relationships and all 90 elements of the exported model	A relationship connects a pair not permitted by the ArchiMate 3.1 relationship table, or an element has no relationship	Modeller, then an independent co-author	248 of 248 permitted; 6 impermissible pairs found and corrected; no unconnected and no duplicate element
Completeness	Presence of each of the six modules in each of the four layers (24 module-layer cells)	Any module absent from any layer	Modeller, then an independent co-author	24 of 24 cells populated
Traceability	Path from stakeholder through goal, process, component and data object to the hosting node, for each of the 30 business processes	Any process that cannot be followed upward to a motivation element and downward to a technology node	Modeller, then an independent co-author	30 of 30 processes traced in both directions
Applicability	Coverage of the four Phase E gaps by the Phase F roadmap	Any gap not addressed by at least one roadmap stage	Modeller, then an independent co-author	4 of 4 gaps covered by stages 1 to 4

DISCUSSIONS

Modelling six ERP modules with one pattern shows that TOGAF ADM works for a value chain as long and varied as a palm oil agribusiness, and it extends the range of applied TOGAF studies from retail, healthcare, and real estate (Widjaja et al., 2025; Purnama et al., 2026; Hengky et al., 2024) to an internal agribusiness ERP. This addresses the first research question.

The gap analysis points to shared master data as the element used across almost every module, which makes it the practical focus for a single source of truth. It also shows that the reconciliation between field and mill data capture and the sales process is the main integration point, because harvest, weighbridge, and delivery figures feed both production and billing. This addresses the second research question.

The comparison with Hamdani et al. (2026), the closest work in the same domain, is best made on the four axes on which the two designs differ. On internal ERP scope, that study orchestrates a circular palm ecosystem

*name of corresponding author



This is anCreative Commons License This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

across organisations, whereas the present model works inside one company and links six ERP modules from estate to sales. On cross-layer traceability, the present model carries every one of the 30 processes from a motivation element down to the hosting node, which is the property the evaluation in Table 8 tests. On motivation modelling, the stakeholder-driver-goal-outcome chain of Phase A is instantiated explicitly and each modelled process realises a goal within it. On migration planning, Phases E and F are carried through to a gap analysis with four recorded gaps and a four-stage, twelve-month roadmap that covers all of them. Two of the present authors are also authors of that study, which is stated here so that the comparison is read as an extension of a known line of work rather than as an independent assessment of it. The migration roadmap answers the third research question.

Because the abstract claims a reusable reference model, it is worth stating which parts of the architecture carry that claim and which do not. Three parts are reusable beyond the Company. The first is the layer pattern applied to each module, in which an actor is assigned to a process, a module serves that process, the process accesses a data object, a node hosts the module, and the process realises a goal; any further palm oil ERP module can be added by instantiating that pattern, which is what makes the model extensible. The second is the shared master data core, because employee, block, material, and customer records recur across estate, workforce, production, maintenance, finance, and sales in any integrated palm oil ERP, independently of who operates it, and the consolidation argument of Phase E rests only on that recurrence. The third is the ordering of the migration, since master data, then the physical value chain, then the support functions, then reporting is an order dictated by data dependency rather than by the circumstances of one company.

Three parts are case-specific. The process inventory of Table 3 reflects the Company's own blueprints and operating model, for example its treatment of the vehicle running account and the nursery as estate management processes rather than as separate modules. The technology components of Table 5 are named generically, but the choice of an application server and an in-memory database platform reflects the platform the Company already runs, and the roles rather than the products are what transfer. The twelve-month timeline of Table 7 reflects the Company's readiness and resourcing and would need to be re-estimated elsewhere, although the ordering of the stages would not. A company adopting this model would therefore reuse the layer pattern, the master data core, and the migration ordering, and would re-derive the process inventory, the platform components, and the timeline.

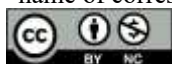
Two limitations bound these results. The architecture is designed from the documented blueprints of a single company and was evaluated analytically rather than in a running ERP, so the figures reported above establish internal validity and coverage of the declared scope rather than operational benefit; generalisability is correspondingly bounded to palm oil agribusinesses with a comparable estate-to-mill-to-sales structure. Both limitations are addressed by the same next step, which is to apply the four checks of Table 8 with domain experts from the Company and with at least one further palm oil operator, and then to evaluate the artefact against implementation outcomes once stage 1 of the roadmap has been executed, replacing the analytical result with measured effects on duplicated data entry and on reporting time. The scope covers the Preliminary Phase and Phases A to F, leaving implementation governance and change management for later work.

CONCLUSION

This paper designed an enterprise architecture for an integrated ERP in a palm oil agribusiness company, kept anonymous, using TOGAF ADM and ArchiMate 3.1 within a design science approach. Drawing on the documented business process blueprints of six modules, it modelled 30 business processes and 20 principal data objects across the motivation, business, application, and technology layers in a single model of 90 elements and 248 relationships, and produced an integrated reference architecture with a shared master data core and a four-stage, twelve-month migration roadmap. The artefact was evaluated against four design science criteria with an explicit failure condition for each: all 248 relationships are permitted by the ArchiMate 3.1 relationship table, all 24 module-layer cells are populated, all 30 processes are traceable from a motivation element to a hosting node, and all four gaps recorded in Phase E are covered by the roadmap. The reusable part of the contribution is the layer pattern, the shared master data core, and the ordering of the migration; the process inventory, the platform components, and the timeline are specific to the Company. Later work should validate the model with domain experts in a live environment.

ACKNOWLEDGMENT

The authors thank the Department of Information Technology, Pradita University, for its academic support. The use of AI-assisted tools in preparing this manuscript is described in the Method section, under model review and use of AI-assisted tools; all content was reviewed and verified by the authors, who take full responsibility for the manuscript. The authors declare no conflict of interest.



REFERENCES

- Adisetya, E., Sunardi, & Gunawan, S. (2024). The conceptual model of Indonesian palm oil supply chain based on blockchain. *IOP Conference Series: Earth and Environmental Science*, 1377(1), 012007. <https://doi.org/10.1088/1755-1315/1377/1/012007>
- Adwan, E. J. (2025). Design and evaluation of a technology/ICT diffusion method for banks—An enterprise architecture perspective. *Journal of Computer Science*, 21(6), 1454–1471. <https://doi.org/10.3844/jcssp.2025.1454.1471>
- Akbar, A. F., Indrajit, E., & Dazki, E. (2025). The enterprise architecture for enhanced mutual fund service integration in digital channel in the banking industry. *Sinkron: Jurnal dan Penelitian Teknik Informatika*, 9(1), 531–547. <https://doi.org/10.33395/sinkron.v9i1.14496>
- Anbananthen, K. S. M., Muthaiyah, S., Thiyagarajan, S., Balasubramaniam, B., Yousif, Y. B., Mohammad, S., & Kalid, K. S. (2024). Evaluating enterprise architecture frameworks for digital transformation in agriculture. *Journal of Human, Earth, and Future*, 5(4), 761–772. <https://doi.org/10.28991/HEF-2024-05-04-015>
- Butarbutar, Z. T., Handayani, P. W., Suryono, R. R., & Wibowo, W. S. (2023). Systematic literature review of critical success factors on enterprise resource planning post implementation. *Cogent Business & Management*, 10(3), 2264001. <https://doi.org/10.1080/23311975.2023.2264001>
- Choliq, A. (2025). Analisis implementasi enterprise resource planning (ERP) pada sistem proses bisnis distribusi kusen menggunakan perangkat lunak Odoo. *Elkom: Jurnal Elektronika dan Komputer*, 18(1), 48–59. <https://doi.org/10.51903/w46hm694>
- Darsono, D., Febriani, S., & Rochmansyah, P. (2026). Enterprise architecture design of SPBE using TOGAF ADM for improving operational efficiency: A case study of the mining sector at the West Java ESDM Agency. *Journal of Electrical, Electronic, Information, and Communication Technology*, 8(1), 111052. <https://doi.org/10.20961/jeeict.8.1.111052>
- Dumitriu, D., & Popescu, M. A. M. (2020). Enterprise architecture framework design in IT management. *Procedia Manufacturing*, 46, 932–940. <https://doi.org/10.1016/j.promfg.2020.05.011>
- Fuentes-Quijada, G., Ruiz-González, F., & Caro, A. (2024). Enterprise architecture and IT governance to support the BizDevOps approach: A systematic mapping study. *Information Systems Frontiers*, 27(3), 865–888. <https://doi.org/10.1007/s10796-024-10473-2>
- Hamdani, I., Indrajit, R. E., & Firizqi, J. D. (2026). Orchestrating the circular smart palm ecosystem: A design science research using TOGAF-based enterprise architecture. *Sinkron: Jurnal dan Penelitian Teknik Informatika*, 10(2), 937–950. <https://doi.org/10.33395/sinkron.v10i2.15828>
- Hamidani, J. Y., & Ali, H. (2025). Enterprise architecture for sustainable SME resilience: Exploring change triggers, adaptive capabilities, and financial performance in developing economies. *Sustainability*, 17(15), 6688. <https://doi.org/10.3390/su17156688>
- Hengky, N., Dazki, E., & Indrajit, E. (2024). Proposed implementation uses TOGAF ADM and ArchiMate—Enterprise architecture in retail industry. *Sinkron: Jurnal dan Penelitian Teknik Informatika*, 8(4), 2172–2184. <https://doi.org/10.33395/sinkron.v8i4.14052>
- Hernandes, A. N., Yoshikuni, A. C., Dwivedi, R., Parisi, C., & Dwivedi, P. (2026). Developing and validating scale for enterprise architecture capability and business–IT alignment. *Journal of Enterprise Information Management*, 38, 1–41. <https://doi.org/10.1108/JEIM-05-2025-0393>
- Hevner, A., & Chatterjee, S. (2010). Design science research in information systems. In *Design research in information systems* (pp. 9–22). Springer. https://doi.org/10.1007/978-1-4419-5653-8_2
- Kembaren, J. (2022). Increasing operational performance through ERP performance in the oil palm plantation industry in Indonesia. *Daengku: Journal of Humanities and Social Sciences Innovation*, 2(5), 640–644. <https://doi.org/10.35877/454ri.daengku1209>
- Kirana, D. A., Saputra, M., & Puspitasari, W. (2024). Enterprise resource planning of procurement process with SAP MM module. *International Journal of Innovation in Enterprise System*, 5(1), 55–64. <https://doi.org/10.25124/ijies.v5i01.120>
- Lankhorst, M. (2017). *Enterprise architecture at work: Modelling, communication and analysis* (4th ed.). Springer. <https://doi.org/10.1007/978-3-662-53933-0>
- Maulana, Y. M., Azmi, Z. R. M., & Phon, D. N. E. (2023). Business-IT alignment through enterprise architecture in a strategic alignment dimension: A review. *Register: Jurnal Ilmiah Teknologi Sistem Informasi*, 9(1), 55–67. <https://doi.org/10.26594/register.v9i1.3084>
- Praharto, S., & Yohanis, A. R. (2025). Implementing TOGAF enterprise architecture in Indonesia's merchant acquiring industry: A framework for digital transformation. *Sinkron: Jurnal dan Penelitian Teknik Informatika*, 9(2), 721–733. <https://doi.org/10.33395/sinkron.v9i2.14668>

- Prawira, D. Y., Kurniawan, R. D., Indrajit, R. E., & Dazki, E. (2023). Enterprise architecture design using TOGAF ADM: The case of KotaKita. *Jurnal Teknologi Sistem Informasi dan Aplikasi*, 6(2), 81–87. <https://doi.org/10.32493/jtsi.v6i2.29416>
- Prihandono, D., Wijaya, A. P., Wiratama, B., Prananta, W., & Widia, S. (2024). Digital transformation to enhance Indonesian SME performance: Exploring the impact of market competition and digital strategy. *Problems and Perspectives in Management*, 22(2), 103–113. [https://doi.org/10.21511/ppm.22\(2\).2024.09](https://doi.org/10.21511/ppm.22(2).2024.09)
- Purnama, W., Indrajit, R. E., & Firizqi, J. D. (2026). An enterprise architecture blueprint for HL7-based RIS–PACS integration using TOGAF ADM: A mobile diagnostic access framework. *Sinkron: Jurnal dan Penelitian Teknik Informatika*, 10(2), 905–916. <https://doi.org/10.33395/sinkron.v10i2.15825>
- Rani, A., Mishra, D., & Omerovic, A. (2025). Enterprise modelling for decision-making in the software ecosystem. *Scientific Reports*, 15(1), 11134. <https://doi.org/10.1038/s41598-025-90916-1>
- Safrianto, R. (2025). Enterprise architecture planning with TOGAF ADM: A case study of a heavy equipment rental service company. *Applied Information System and Management (AISM)*, 8(2), 183–194. <https://doi.org/10.15408/aism.v8i2.46335>
- The Open Group. (2018). *TOGAF® standard, version 9.2*. The Open Group.
- The Open Group. (2019). *ArchiMate® 3.1 specification*. The Open Group.
- Watasendjaja, W., Chudra, G., & Yohannis, A. (2025). Enterprise architecture for the cruise industry: A TOGAF-ADM and ArchiMate-based approach. *Sinkron: Jurnal dan Penelitian Teknik Informatika*, 9(4), 2038–2050. <https://doi.org/10.33395/sinkron.v9i4.15218>
- Widjaja, H., Indrajit, R. E., & Dazki, E. (2025). Transforming real estate: Leveraging TOGAF ADM for digital optimization in enterprise architecture. *Sinkron: Jurnal dan Penelitian Teknik Informatika*, 9(1), 220–231. <https://doi.org/10.33395/sinkron.v9i1.14219>
- Yuan, Y., Wu, H., & Shen, Y. (2025). Achieve sustainable operation of agricultural enterprises: Improving agribusiness performance through digital transformation. *Frontiers in Sustainable Food Systems*, 9, 1547358. <https://doi.org/10.3389/fsufs.2025.1547358>
- Zachman, J. A. (1987). A framework for information systems architecture. *IBM Systems Journal*, 26(3), 276–292. <https://doi.org/10.1147/sj.263.0276>