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An ITIL-Aligned Governance Automation Framework for Hybrid ERP Invoice Workflows: A Design Science Study

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Abstract—Enterprise Resource Planning (ERP) systems often encounter governance challenges during the post-implementation phase, particularly when critical activities such as invoice processing are performed through hybrid workflows outside the formal ERP environment. While prior research extensively covers ERP implementation success⁹, the governance of hybrid workflows remains underexplored. This study employs a Design Science Research (DSR) approach, utilizing an ITIL V4-aligned qualitative case study within the mining industry to identify lifecycle control gaps in ERP-supported processes. The findings reveal that fragmented practices in manual computation and informal approvals weaken auditability and transparency. To address these issues, a governance-embedded automation framework is proposed, positioning ITIL V4 practices as an executable middleware layer rather than a mere advisory function. Prototype implementation using the Odoo platform demonstrates the technical feasibility of embedding structured computation and controlled approval routing without replacing existing ERP infrastructure. Exploratory evaluation indicates that the proposed architecture could potentially reduce the invoice processing cycle time by approximately 20%, enhancing overall task-technology fit and operational traceability.

Keywords—ERP, ITIL V4, Hybrid Workflow, Invoice Automation, IT Governance, Mining Industry

1. INTRODUCTION

Enterprise Resource Planning (ERP) systems have become foundational digital infrastructures for modern organizations by integrating cross-functional business processes, improving data accuracy, and enabling real-time decision making [1]. Through the consolidation of information across finance, procurement, and operations, ERP systems are expected to strengthen operational efficiency, coordination, and strategic control. However, the value of ERP depends not only on implementation success but also on effective lifecycle governance during maintenance and post-implementation management [2], [3], [4].

In practice, many organizations still execute invoice calculation, draft revision, and approval activities outside the ERP environment through spreadsheets, email, and manually

maintained documents, creating hybrid operational environments in which the ERP exists but does not fully govern the workflow lifecycle. These fragmented practices weaken auditability, version control, process transparency, and processing speed [5]. The persistence of such hybrid workflows represents a structural governance misalignment rather than a technology deficiency: the ERP platform is present, but governance execution remains externalized.

This problem can be understood through the Task-Technology Fit (TTF) framework, which argues that information systems improve performance only when their capabilities align with task requirements [6]. When ERP functionality does not adequately support operational needs, users rely on workarounds that fragment governance and reduce system effectiveness. At the same time, organizations increasingly depend on IT service management practices to strengthen control and alignment between IT capabilities and business objectives. Among these practices, ITIL is widely recognized for providing structured lifecycle controls, including service request management, change enablement, incident management, and service level management [7]. Prior studies indicate that ITIL can improve service governance and operational control in digital environments [8], yet its application to ERP-supported business workflows remains limited.

Accordingly, this study asks: How can ITIL-based workflow automation improve governance and task-technology fit in ERP-supported invoice processing within hybrid ERP environments?

This study contributes in three ways. First, it identifies and maps governance gaps across ITIL V4 practice dimensions that emerge in post-implementation ERP operations within hybrid workflow settings. Second, it integrates ITIL V4 governance practices with workflow automation to address operational control limitations at the workflow execution level. Third, it proposes and validates a governance-embedded hybrid ERP architecture that improves invoice lifecycle traceability without replacing existing ERP infrastructure. In contrast to prior ERP automation studies that primarily emphasize efficiency or system optimization, this research operationalizes

ITIL V4 governance principles as an executable automation layer, positioning governance as a built-in mechanism of workflow execution rather than an external supervisory function

II. LITERATURE REVIEW

Previous studies have shown that ERP systems are essential for integrating business processes, improving data accuracy, and supporting operational efficiency across finance, procurement, supply chain, and operations. However, they also indicate that ERP success does not end at implementation, because many organizations still face post-implementation governance issues such as process deviations, fragmented control, and user workarounds outside formal ERP workflows [9], [10], [11], [12].

Organizations increasingly rely on IT governance and IT service management frameworks to manage this complexity. ITIL, as a widely adopted ITSM framework, has been reported to improve service quality, accountability, and operational transparency [13], [14], [15]. However, prior research suggests that ITIL remains mostly applied within IT operations and has not been fully operationalized in ERP-supported business workflows, leaving governance between IT services and operational processes fragmented [16]. Notably, while COBIT provides comprehensive governance mechanisms for strategic alignment and risk management, ITIL V4 offers process-oriented practices—such as Service Request Management, Service Level Management, Change Enablement, and Service Configuration Management—that can be directly operationalized into invoice workflow activities. This distinction motivated the selection of ITIL V4 as the governance reference framework for this study.

Studies on ERP automation report that technologies such as RPA, intelligent document processing, and AI-based orchestration can reduce processing time, improve accuracy, and strengthen operational efficiency [17], [18], [19]. Related studies on invoice processing also show that automation improves transparency, traceability, and reduces delays [20], [21], [22], [23]. However, many organizations still operate hybrid workflows where automated processes coexist with manual activities such as spreadsheet verification and email approvals, creating governance challenges in maintaining accountability and lifecycle control [24]. Critically, existing automation approaches focus on efficiency rather than embedded governance: RPA solutions automate task execution but do not embed lifecycle controls aligned with IT governance frameworks; BPM engines model and monitor processes but are framework-agnostic; and native ERP workflow tools operate within the ERP boundary and cannot govern externalized activities.

Finally, previous studies on T₁₂-Technology Fit argue that system performance depends on the alignment between technology capabilities and task requirements [25]. In ERP contexts, this means automation can improve performance only if it reduces off-system workarounds and supports actual workflow needs [25], [26], [27]. Based on these studies, the gap remains in integrating governance frameworks with automation solutions specifically for post-implementation

hybrid ERP environments [28], [29], [30]. Table I presents a structured analysis of this gap.

TABLE I. RESEARCH GAP ANALYSIS

Study	Focus	Identified Limitation
ERP Value Realization Studies [2], [4]	ERP Implementation and Organizational Performance	Demonstrate organizational benefits of ERP adoption but provide limited discussion on governance challenges emerging during post-implementation operational workflows
Workflow Practice [5]	Operational Workarounds and Process Automation	Identify spreadsheet-based and manual coordination practices but lack governance mechanisms ensuring lifecycle control in hybrid workflows
ITIL Governance Studies [7], [8]	IT Service Governance	Establish governance principles for IT services but do not operationalize governance controls within ERP-supported business workflows
RPA/BPM Automation [17], [19]	Workflow Automation and Process Efficiency	Address automation efficiency but do not embed governance lifecycle controls aligned with ITIL practices in hybrid ERP settings.
This Study	Governance Embedded Automation	Operationalizes ITIL V4 governance as an automation layer that embeds lifecycle control, traceability, and accountability directly into hybrid ERP invoice workflows

Therefore, existing studies reveal a lack of governance-embedded automation approaches addressing post-implementation ERP environments, motivating the design science investigation conducted in this study.

III. RESEARCH METHODOLOGY

This research uses Design Science Research (DSR) to design and evaluate an artifact—an ITIL-aligned automation framework—addressing ERP post-implementation governance challenges. DSR is selected because the primary contribution of this study is the design and instantiation of an artifact rather than the testing of a hypothesis. The proposed framework represents a process-oriented governance artifact developed following DSR principles: problem identification, design, development, demonstration, and evaluation.

A. Case Context

A single-case, embedded design was employed in a mining company where SAP ERP functions as the system of record but invoice verification and approvals operate through hybrid mechanisms including spreadsheets and email. The mining industry was selected because it involves high-volume, multi-parameter invoice processing (incorporating quality adjustments for moisture, ash, and sulphur content) that is representative of governance-intensive hybrid workflows. The single-case design is appropriate for DSR artifact validation at an exploratory stage; generalizability is addressed through the

transferability of the governance framework rather than statistical sampling.

Three informants representing finance operations (R1), IT governance (R2), and operational coordination (R3) roles were selected through purposive sampling to capture cross-functional perspectives of the invoice workflow lifecycle. Informant selection prioritized direct involvement in invoice processing activities to ensure evidence validity.

B. Data Sources and Collection

Evidence triangulation was applied across three sources: (a) semi-structured interviews with the three key informants, each lasting approximately 45–60 minutes using a standardized interview protocol aligned with ITIL V4 practice dimensions; (b) document and artefact review including ERP transaction logs, spreadsheet templates, and approval records; and (c) workflow documentation supporting invoice processing analysis. Interview protocols were designed to elicit evidence on governance gaps across four ITIL V4 dimensions: Service Request Management, Service Level Management, Change Enablement, and Service Configuration Management.

C. Analysis Procedure

Interview transcripts were analyzed using a structured qualitative coding process following three grounded coding stages. During open coding, key statements related to invoice processing activities, governance practices, and workflow constraints were identified. Axial coding grouped related concepts into broader categories corresponding to ITIL V4 operational practices. Selective coding synthesized recurring themes explaining governance gaps within the hybrid ERP workflow. The coding process produced a traceable codebook linking respondent statements to identified governance issues, enabling systematic interpretation of qualitative evidence.

Governance gap analysis was conducted by mapping observed workflow practices against relevant ITIL V4 lifecycle controls to identify structural deficiencies at each invoice workflow stage. Artifact evaluation employed two complementary methods: formative evaluation through expert walkthroughs with operational and IT stakeholders, and summative evaluation using scenario-based performance comparison between baseline and prototype configurations on cycle time, exception rate, and traceability dimensions.

D. Rigor and Ethics

Rigor was ensured through: (a) method triangulation across interviews, documents, and artefacts; (b) a traceable codebook for qualitative coding; (c) archival evidence including ERP logs to corroborate interview claims; and (d) stakeholder validation of design decisions through expert walkthrough. Threats to validity include the single-case design limiting external validity, the small number of informants limiting qualitative saturation, and the scenario-based evaluation limiting empirical precision. These are acknowledged as boundary conditions for the study's contribution. Ethical approvals and anonymization procedures were applied per institutional guidelines.

IV. RESULTS AND DISCUSSION

Findings from the governance gap analysis informed the design requirements of the proposed automation artifact. Results are presented following a problem-design-artifact logic, linking identified governance gaps with the proposed ITIL-based workflow automation solution.

A. ITIL-Aligned Operational Gap Identification

Thematic coding aligned with ITIL V4 practices reveals consistent governance weaknesses across respondents. Monthly invoice volumes range from approximately 20 invoices (R1), 50–70 invoices (R2), and 70–100 invoices (R3), resulting in an estimated cumulative volume of 140–190 invoices per month across operational roles. These findings confirm the presence of a high-volume hybrid operational environment in which digital infrastructure exists but is not embedded within the operational service lifecycle. Table II presents representative evidence from interview coding, mapped against relevant ITIL V4 practices.

TABLE II. EVIDENCE FROM INTERVIEW CODING

Theme	Respondent Evidence	ITIL V4 Practice	Interpretation
Manual Computation Dependency	"Invoice Values. Are calculated manually using Excel before being entered into SAP." (R2)	10 Service Request Management	Indicates absence of system integrated computation
Informal Workflow Routing	"most revisions are sent through email attachments." (R1)	Change Enablement	Workflow lacks structured request tracking
Limited Process Visibility	"Sometimes we wait for quality reports before finalizing the invoice." (R3)	Service Level Management	No SLA monitoring or progress tracking
ERP Lifecycle Separation	"SAP is used only after the invoice is finalized." (R1, R2)	Service Configuration Management	ERP not embedded in operational lifecycle

1) Service Request Management:

All invoice preparation activities rely heavily on manual spreadsheet-based computation without system-embedded automation. No structured system exists to support automated request routing, standardized request registration, or dynamic pricing computation based on shipment variability. Invoice preparation depends on manual coordination and informal communication channels, while SAP is utilized only at the final transaction recording stage rather than as an integrated operational platform.

2) Service Level Management:

No formal Service Level Agreement (SLA) regulates invoice preparation timelines, resulting in inconsistent processing durations across transactions. Invoice completion may require up to five working days, with delays frequently dependent on the availability of external quality verification reports. The workflow lacks real-time progress monitoring and

automated delay notification mechanisms, limiting operational visibility.

3) Change Enablement:

Draft revision and approval processes rely exclusively on email attachment exchange and physical wet signatures. This practice creates no digital audit trail for document revisions, no version control for invoice drafts, and no digital record of approval decisions. The absence of change enablement controls means that unauthorized modifications cannot be detected and approval accountability cannot be systematically maintained.

4) Service Configuration Management:

SAP is used only for final transaction posting after invoice approval is completed externally. This lifecycle separation means that the ERP system does not govern the invoice workflow; it merely records its outcomes. No configuration management controls exist to ensure that invoice parameters are centrally maintained and consistently applied.

B. ITIL-Based Governance Gap Mapping

To structurally identify workflow deficiencies, observed practices were mapped against relevant ITIL V4 lifecycle controls. The mapping indicates that observed inefficiencies originate primarily from governance gaps in workflow design rather than limitations of the ERP system itself. Table III summarizes the governance gaps identified across the invoice workflow stages, along with the proposed automation response for each gap.

TABLE III. ITIL GOVERNANCE GAP MAPPING

Workflow Stage	Observed Practice	Relevant ITIL Practice	Governance Gap	Proposed Automation Response
Invoice Initiation	Email-based request	Service Request Management	No structured request registration	Structured intake form with automated ticket generation in Odoo
Price Computation	Spreadsheet-based calculation	Service Level Management	No automated validation	Rule based engine with quality-adjusted tonnage computation
Draft revision	Email attachment exchange	Change Enablement	No digital version control	Versioned document management with change log
Approval	Wet signature	Change Enablement	No digital approval log	Configurable multi-level digital approval workflow
SAP entry	Final posting only	Service Configuration Management	ERP not integrated in workflow; high re-entry risk	Automated SAP synchronization after approval completion

C. Scenario-Based Performance Estimation

Based on interview findings, respondents estimated that computation and revision activities account for approximately 40% of the five-day invoice processing cycle. Since the proposed architecture automates computation-related activities through rule-based processing and embedded validation controls, a scenario analysis was conducted to estimate potential time savings.

Under the scenario where automation reduces manual computation and revision effort by approximately 50%, the estimated reduction in processing time is one working day, resulting in a revised processing cycle of four days. This corresponds to an indicative efficiency improvement of approximately 20%.

It must be emphasized that this estimation is a scenario-based analytical illustration derived from stakeholder interviews and expert judgment. It does not constitute an empirically validated performance measurement. The estimation represents a conservative scenario; actual improvements would depend on organizational adoption factors, system integration depth, and change management effectiveness. Table IV presents a structured comparison of baseline and prototype performance dimensions.

TABLE IV. SCENARIO-BASED PERFORMANCE COMPARISON: BASELINE VS PROTOTYPE

Evaluation Dimension	Baseline (As-Is)	Prototype (To-Be)	Estimated Improvement
Invoice Processing Cycle Time	5 working days (avg.)	4 working days (projected)	~20% cycle time reduction
Computation Accuracy	Manual verification error-prone	Rule-based validation embedded	Structural elimination of manual computation errors
Approval Traceability	No digital log; physical signature only	Full digital approval trail with timestamps	Full auditability achieved
Version Control	Email-based; no tracking	Versioned draft management in Odoo	Complete change history maintained
ERP Integration	Manual re-entry post-approval	Automated SAP synchronization	Reduction of data re-entry effort

D. Prototype Validation Using Odoo

Based on the identified governance requirements, a functional prototype was implemented using Odoo, an open-source ERP platform. The prototype operationalizes structured invoice automation through parameterized pricing logic, rule-based computation, configurable approval routing, and embedded validation controls before ERP synchronization.

The proposed governance-embedded hybrid ERP architecture integrates ITIL-aligned controls directly into invoice lifecycle automation. Rather than replacing the existing SAP infrastructure, the model introduces an intermediary workflow control and rule-based automation layer between operational users and the legacy financial system. The architecture operationalizes four ITIL V4 governance mechanisms as executable workflow components:

- Service Request Management layer: structured intake form with automated ticket generation, replacing email-based invoice initiation.
- Service Level Management layer: rule-based computation engine that automatically applies quality-adjusted pricing parameters (moisture, ash, sulphur content), eliminating manual spreadsheet calculation.
- Change Enablement layer: versioned document management with digital approval routing and complete change logging, replacing email attachment exchange and physical signatures.
- Service Configuration Management layer: centralized pricing rules, approval thresholds, and quality parameters, ensuring consistent application across all invoice transactions.

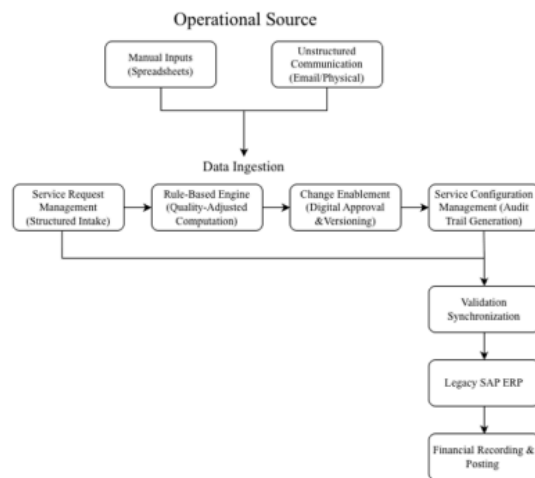


Fig. 1. Governance-Embedded Hybrid ERP Architecture Model

Figure 1 illustrates the proposed architecture, which embeds ITIL V4 practices including Service Request Management, Service Level Management, Change Enablement, and Service Configuration Management into a structured workflow execution model. A rule-based automation engine operates between operational users and the legacy SAP ERP, ensuring validated computation and controlled approval routing prior to final ERP posting. This layered design enables governance injection without disrupting core financial infrastructure.

To validate the proposal model, a functional prototype was implemented using Odoo an open source ERP platform. The prototype operationalizes structured invoice automation

through parameterized pricing logic, rule-based computation, configurable approval routing, and embedded validation controls before ERP synchronization. The implementation demonstrates how governance-aligned controls can be embedded as a structured automation layer while maintaining SAP as the final recording system.

The prototype was evaluated through expert walkthrough validation involving operational and IT stakeholders assessing governance feasibility, workflow traceability, and operational practicality. Stakeholder evaluation confirmed that the governance-embedded architecture addresses the identified ITIL V4 gaps and demonstrates technical feasibility without requiring replacement of the existing SAP infrastructure. Implementation considerations remaining for future work include: system scalability to higher invoice volumes; failure handling and fallback procedures for middleware unavailability; organizational adoption barriers; and integration complexity when connecting to different legacy ERP platforms beyond SAP.

E. Comparative Analysis

To contextualize the relative value of the proposed approach, Table V presents a structured comparison with alternative workflow automation and governance approaches.

TABLE V. COMPARATIVE ANALYSIS OF GOVERNANCE AND AUTOMATION APPROACHES

Approach	Governance Control	Non-Intrusive Integration	ITIL Alignment	Invoice Specific Design
This Study (ITIL-Embedded Middleware)	Embedded lifecycle controls (SRM, SLM, CE, SCM)	Yes – Odoo layer preserves SAP	Explicit V4 operationalization	Yes
Native ERP Workflow (SAP)	Limited to built-in approval flows	N/A (replaces legacy)	Not ITIL-aligned	Partial
RPA Solutions	Task automation only; no governance layer	Yes, but brittle to UI changes	Not governance-oriented	Partial
BPM Engines	Process modeling and monitoring	Varies by platform	Framework-agnostic	Partial
Standalone ITIL ITSM Tools	Strong IT governance coverage	Separate from ERP workflow	Full ITIL alignment	No

The comparison indicates that existing approaches address either automation efficiency (RPA, BPM) or IT governance (ITIL ITSM tools) but do not combine embedded lifecycle controls with non-intrusive ERP integration in an invoice-specific design. The proposed ITIL-embedded middleware approach simultaneously satisfies all four comparison

dimensions within a hybrid ERP context. RPA or BPM solutions may remain preferable where governance depth is less critical or where ERP replacement is feasible.

F. Discussion

These findings suggest that governance in ERP environments should not be treated solely as a managerial control layer but as an embedded operational capability. The primary limitation in invoice processing performance in the studied organization did not stem from ERP system availability, but from the structural separation between system infrastructure and operational control execution. Critical stages of the invoice lifecycle remained externally governed through manual spreadsheets and informal communication, reducing process visibility and limiting lifecycle accountability.

By integrating ITIL governance principles within workflow automation, this study demonstrates how post-implementation ERP challenges can be addressed without replacing existing enterprise systems. The concept of "governance-as-execution"—positioning ITIL V4 practices as executable automation logic rather than advisory guidelines—extends the application domain of ITIL beyond IT operations into ERP-supported business workflows. This repositioning has implications for how organizations approach post-implementation ERP governance: rather than treating ITIL as an IT department framework, organizations can operationalize ITIL practice logic directly within business process automation layers.

The TTF lens provides explanatory value for understanding why hybrid workflows persist: when ERP functionality does not support all operational task requirements, users create workarounds that externalize governance. The proposed framework addresses this misalignment by extending ERP governance coverage to encompass the full invoice lifecycle, thereby improving task-technology fit without requiring ERP replacement.

1) ITIL Principle Operationalization

The proposed architecture does not merely adopt ITIL V4 as a reference taxonomy but operationalizes its core principles into executable workflow logic. The principle of "optimize and automate" informs the rule-based computation engine; "think and work holistically" underpins the integration of approval routing within lifecycle governance; and "focus on value" shapes the embedding of validation checkpoints prior to ERP posting. Through this translation, ITIL principles are repositioned from advisory governance guidelines into structured automation logic within a hybrid ERP environment.

Customer	Super A	Invoice Date	Mar 22
Value	40,000.00	Invoice Value	40,000.00
Part of Loading	Production Topping Rate	SS Quantity	40,000.00
Part of Discharge	Crushing Port		
Shipment Date	Price Adjustment		
TOTAL MOISTURE			
Adjustment Weight	0.01		
T4 Dislocation	4,000.00		
ASH CONTENT			
Adjustment Weight	0.00		
A40 Dislocation	0.00		
SULPHUR			
Adjustment Weight	0.00		
T4 Dislocation	0.00		
FINAL INVOICE			
Total Invoice	36,000.00		

Fig. 2. Automated Quality-Adjusted Invoice Computation

Figure 2 presents the rule-based computation interface, where quality parameters (e.g., moisture, ash, sulphur) automatically generate tonnage adjustments and recalculated invoice values. This configuration replaces spreadsheet-based calculation with system-embedded validation, ensuring traceable and governance-aligned processing prior ERP posting.

The prototype was evaluated through expert walkthrough validation involving operational and IT stakeholders to assess governance feasibility, workflow traceability, and operational practicality.

These findings suggest that governance in ERP environments should not be treated solely as a managerial control layer but as an embedded operational capability. By integrating ITIL governance principles within workflow automation, this study demonstrates how post-implementation ERP challenges can be addressed without replacing existing enterprise systems.

V. CONCLUSION

This study demonstrates that the primary limitation in invoice processing governance stems not from ERP system availability, but from the structural separation between system infrastructure and operational control execution. To address this, a governance-embedded hybrid ERP architecture was proposed and validated, operationalizing ITIL V4 mechanisms as an executable automation layer through a rule-driven Odoo middleware between operational users and the legacy SAP system. Scenario-based estimation indicates a potential cycle time reduction of approximately 20%, though this remains an exploratory illustration rather than an empirically validated measurement, contingent on automation scope, adoption depth, and organizational change factors.

The study contributes a replicable governance-embedded design pattern applicable to other post-implementation ERP contexts where hybrid workflows create governance gaps. Limitations include the single-case design limiting generalizability, three informants precluding formal saturation claims, and scenario-based evaluation not constituting empirical validation. Future research should pursue longitudinal performance evaluations using real workflow data, comparative cross-organizational validation, scalability examination across larger deployments, and investigation of integration complexity with cloud-based ERP platforms.

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