

Streamlining Local Content Verification Through an Integrated Information System for Framework Contract Schemes

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ABSTRACT

The verification process of Local Content Requirements (*Tingkat Komponen Dalam Negeri*/TKDN) for services under the Framework Contract scheme involves multiple actors, interconnected business process stages, and various related documents, making information management increasingly complex when conducted without an integrated information system. Unlike conventional verification mechanisms, the Framework Contract scheme is characterized by hierarchical relationships among a Framework Contract, multiple Work Orders, partner companies, verification activities, and certificate issuance. These characteristics increase the complexity of data management, document traceability, and coordination among actors, thereby requiring an information system approach capable of integrating the entire business process. This study aims to develop an information system that supports the digitalization of the TKDN service verification process under the Framework Contract scheme through integrated business process management. The study employed an applied research approach using the Research and Development (R&D) method, which included data collection through observation, interviews, and document review, followed by requirements analysis, system design, system development, and functional validation using Black Box Testing. The developed system integrates the management of Framework Contracts, Work Orders, partner companies, surveyor assignments, survey implementation, verification report preparation, Quality Control review, and certificate issuance within a single integrated information platform. The testing results indicate that all core system functions operated in accordance with operational requirements and were able to support a more structured, integrated, and traceable verification process. In addition to improving data consistency and coordination among actors, the system also supports centralized document management, thereby reducing the potential for information duplication during the verification process. This study provides a practical contribution through the digitalization of the TKDN service verification process and an academic contribution through a business process-based information system model that integrates hierarchical relationships among entities within the Framework Contract scheme. The proposed model is expected to serve as a reference for the development of information systems in other verification and certification processes with similar business process characteristics.

Keywords: Information System; Local Content Verification; Framework Contract; Business Process Digitalization; Verification.

INTRODUCTION

The rapid advancement of information technology has accelerated digital transformation across various industries, including the management of business processes that were previously performed manually. Information systems have evolved beyond simple data recording tools into strategic platforms that integrate business processes, improve operational efficiency, strengthen coordination among organizational units, and support faster and more accurate decision-making (Faccia & Petratos, 2021; Raghavendra & Vemula, 2025). Business process digitalization also enhances transparency, traceability, and accountability through centralized management of data and documents (Mpehle & Mudogwa, 2020; Wang et al., 2020).

As business processes become increasingly complex, organizations require information systems capable of managing verification activities in an integrated manner. Verification processes typically involve multiple stakeholders, interconnected workflows, and numerous supporting documents, requiring mechanisms that

ensure data consistency, process traceability, and compliance with established procedures (Wang et al., 2020; Alao et al., 2020). Previous studies have demonstrated that digitalized verification systems facilitate centralized document management, improve stakeholder coordination, reduce redundant activities, and enhance transparency and accountability throughout the verification lifecycle (Guo et al., 2021; Raghavendra & Vemula, 2025). Consequently, modern information systems serve not only as administrative tools but also as integrated platforms that support comprehensive business process governance through the management of data, documents, and verification activities (Faccia & Petratos, 2021).

To strengthen national industrial competitiveness, the Government of Indonesia has implemented the Domestic Component Level (TKDN) policy, which encourages the utilization of domestic resources, products, and services in accordance with the country's industrial development strategy. In addition to the manufacturing sector, this policy is also applied to the service sector, where verification plays a critical role in ensuring compliance with national regulations. The TKDN service verification process requires systematic administrative and technical procedures to validate the consistency between submitted documents, project implementation, and regulatory requirements. Consequently, successful verification depends not only on accurate document examination but also on effective coordination among all participating stakeholders (Wang et al., 2020; Raghavendra & Vemula, 2025). In practice, TKDN service verification can be conducted through several contractual mechanisms, one of which is the Framework Contract scheme, which involves considerably more complex administrative and verification processes than conventional direct submission mechanisms.

The Framework Contract scheme possesses unique business process characteristics that distinguish it from conventional verification approaches. Rather than being initiated directly by partner companies, the verification process begins with a Framework Contract established between the client and the service provider, followed by the issuance of multiple Work Orders to partner companies responsible for executing individual projects. Unlike conventional verification processes, where one contract generally corresponds to a single verification process, a Framework Contract may generate multiple Work Orders involving multiple partner companies.

This hierarchical structure substantially increases the complexity of data management, document control, and stakeholder coordination throughout the verification lifecycle, from initial administrative registration to certificate issuance (Faccia & Petratos, 2021; Raghavendra & Vemula, 2025). Conventional procurement and contract management systems are generally designed to support one-to-one relationships between contracts and business processes. Consequently, they are unable to effectively maintain data consistency, document traceability, and the relationships among business entities required in a Framework Contract environment. The one-to-many relationship between Framework Contracts, multiple Work Orders, partner companies, survey activities, quality control, and certificate issuance therefore requires a dedicated information system capable of managing these hierarchical dependencies within a unified platform.

Previous studies have proposed various information systems to support procurement digitalization, contract management, supplier evaluation, and business process automation (Faccia & Petratos, 2021; Guo et al., 2021; Omar et al., 2021; Raghavendra & Vemula, 2025). These studies demonstrate that information systems improve operational efficiency, transparency, stakeholder collaboration, and document management across different business domains (Wang et al., 2020; Alao et al., 2020; Raghavendra & Vemula, 2025). Nevertheless, existing studies primarily focus on procurement or contract management processes characterized by linear one-contract-to-one-process relationships. They do not adequately address the hierarchical and interdependent relationships inherent in TKDN service verification under the Framework Contract scheme, where a single Framework Contract is associated with multiple Work Orders, partner companies, survey activities, quality control reviews, and certificate issuance. Such business process characteristics require an integrated information model capable of preserving data consistency, maintaining end-to-end traceability, and managing hierarchical relationships among business entities throughout the verification lifecycle.

Accordingly, this study aims not only to develop an integrated information system that supports the digitalization of TKDN service verification under the Framework Contract scheme but also to propose a Hierarchical Contract-Based Information Integration Model that systematically integrates hierarchical

relationships among business entities throughout the verification process. The proposed model constitutes the primary academic contribution of this study and is expected to serve as a conceptual reference for designing information systems supporting other verification and certification processes that exhibit similar hierarchical business process characteristics.

METHODOLOGY

Research Design

This study employed an applied research approach using the Research and Development (R&D) method to develop an information system that supports the TKDN service verification process under the Framework Contract scheme. Applied research was selected because the study focuses on addressing practical challenges encountered in the verification process, while the R&D method enables the systematic design, development, implementation, and validation of an information system that meets operational requirements.

The research adopted the Research and Development (R&D) framework proposed by Sutisna and Rahman (2025), which consists of six sequential stages: problem identification, requirements analysis, system design, implementation, testing, and evaluation (Sutisna & Rahman, 2025). This framework ensures that the proposed solution is developed systematically, beginning with the identification of operational problems and concluding with system validation to verify that the implemented functions satisfy business process requirements.

The research process was carried out through the stages of problem identification, business process analysis, system requirements analysis, system design, implementation, testing, and evaluation. Each stage produced specific deliverables that served as inputs for the subsequent stage, thereby ensuring a structured and iterative development process. Consequently, the outcomes generated at each stage formed the basis for the following activities until an information system capable of supporting the operational requirements of the TKDN service verification process was successfully developed.

The overall research framework is illustrated in Figure 1, which presents the complete system development process from problem identification through system evaluation.

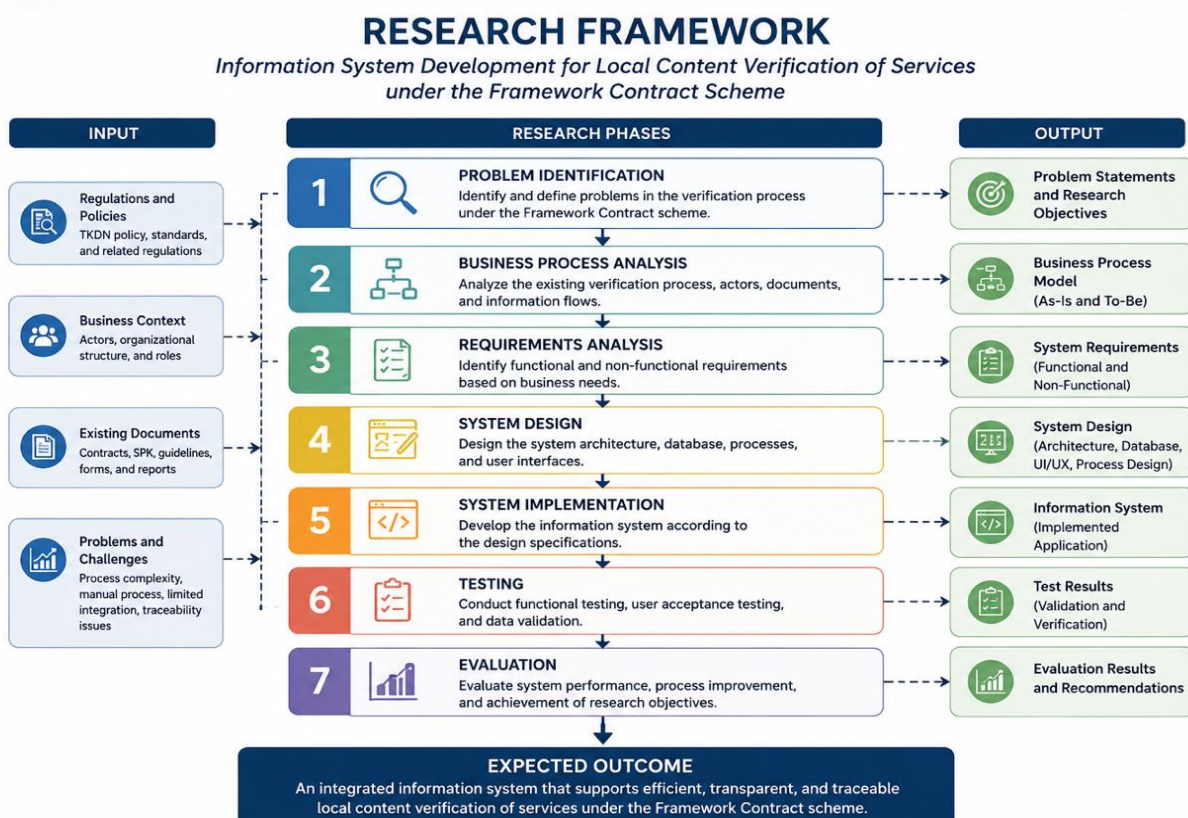


Figure 1. Research framework for the development of an information system supporting local content verification for services under the Framework Contract scheme.

Data Collection

Data were collected to obtain comprehensive information regarding the business processes, user requirements, and supporting documents involved in the TKDN service verification process under the Framework Contract scheme. Three data collection techniques were employed: observation, interviews, and document analysis.

Observation was conducted on the existing verification process to identify workflow activities, stakeholder roles, document flows, and the relationships among business processes. Semi-structured interviews were conducted with one Project Manager, two Surveyors, and one Quality Control officer who were directly involved in the verification process. Participants were selected using purposive sampling based on their roles and responsibilities within the primary stages of the verification workflow, ensuring that the collected information adequately represented the operational requirements of each business function. The interviews focused on identifying system requirements, operational challenges, and user expectations for the proposed information system.

Document analysis was performed by reviewing the relevant TKDN regulations, Framework Contract documents, Work Orders, administrative forms, survey reports, and other supporting documents used throughout the verification process. The information obtained from these three data collection techniques served as the primary basis for business process analysis, system requirements identification, and the subsequent design and development of the proposed information system.

Table 1. Research Data Sources

Data Source	Technique	Number of Sources	Purpose
Business process observation	Observation	Process activities	Identify the verification workflow
Project Manager	Interview	1	Identify system requirements and work assignment process
Surveyor	Interview	2	Identify survey and reporting process
Quality Control	Interview	1	Identify review and certification process
Operational documents	Document study	Various documents	Identify administrative documents and requirements
Regulations	Document study	Applicable regulations	Identify regulatory compliance requirements

Requirements Analysis

The requirements analysis was conducted to identify the functional and non-functional requirements of the proposed information system for supporting the TKDN service verification process under the Framework Contract scheme. The analysis was based on the findings obtained from the observation, interviews, and document analysis conducted during the data collection stage. The analysis focused on identifying the stakeholders involved, business process activities, supporting documents, relationships among business entities, and information requirements at each stage of the verification process.

The analysis resulted in a comprehensive system specification consisting of functional and non-functional requirements. The functional requirements served as the basis for developing the core system modules, including the management of clients, Framework Contracts, Work Orders, partner companies, surveyor assignments, survey execution, Quality Control reviews, and certificate issuance. The non-functional requirements defined the expected system quality attributes, including data security, information integrity,

usability, and end-to-end process traceability, ensuring that the system effectively supports the operational requirements of the verification process.

Information System Development

The information system was developed based on the requirements identified during the previous analysis stage. The development process focused on translating the system requirements into an integrated solution capable of supporting the entire TKDN service verification process under the Framework Contract scheme. This stage included the design of the system architecture, database structure, and user interface, all of which were aligned with the business workflow and the operational requirements of each stakeholder involved in the verification process (Faccia & Petratos, 2021).

The proposed system was subsequently implemented as an integrated information platform that manages the complete verification lifecycle. The system supports the management of clients, Framework Contracts, Work Orders, partner companies, surveyor assignments, survey execution, verification report preparation, Quality Control (QC) reviews, and TKDN certificate issuance. The implementation was guided by the proposed Hierarchical Contract-Based Information Integration Model, which integrates the hierarchical relationships among business entities to ensure consistent management of data, documents, and verification activities throughout the verification process (Guo et al., 2021; Faccia & Petratos, 2021).

To ensure that the developed system fulfilled operational requirements, each functional module was implemented based on the system specifications established during the requirements analysis stage. This approach supports effective stakeholder coordination, centralized document management, reliable information sharing, and end-to-end traceability across all stages of the verification process (Raghavendra & Vemula, 2025; Faccia & Petratos, 2021).

System Testing

System testing was conducted to verify that all developed functions operated in accordance with the operational requirements of the TKDN service verification process under the Framework Contract scheme. The system was evaluated using Black Box Testing and User Acceptance Testing (UAT).

Black Box Testing was employed to validate the functional correctness of the system by examining the expected outputs generated from predefined input scenarios without considering the internal program structure. Test scenarios were designed to represent the operational activities performed at each stage of the verification process.

The testing covered all major system modules, including the management of clients, Framework Contracts, Work Orders, partner companies, surveyor assignments, survey execution, verification report preparation, Quality Control (QC) reviews, and TKDN certificate issuance. The objective was to verify that each module satisfied the specified functional requirements while supporting the integration and continuity of the overall verification workflow.

Following functional validation, User Acceptance Testing (UAT) was conducted with representative end users to evaluate the operational suitability of the developed system within the actual verification process. The UAT involved representatives from the Project Manager, Surveyor, and Quality Control roles to assess whether the implemented functions adequately supported their operational activities. Due to organizational confidentiality and non-disclosure policies, the detailed UAT instruments and evaluation results are not presented in this paper.

The UAT also provided qualitative feedback from representative users regarding workflow suitability, ease of use, and functional completeness. This feedback was used to confirm that the implemented functions aligned with operational requirements prior to deployment.

RESULTS AND DISCUSSION

Existing Business Process

The TKDN service verification process under the Framework Contract scheme differs substantially from the conventional direct submission mechanism. Instead of being initiated by a partner company, the verification process begins with the establishment of a contractual relationship between the client and the service provider through a Framework Contract. This contractual agreement is subsequently followed by the issuance of one or more Work Orders, which authorize partner companies to execute the assigned activities and become the subject of the verification process.

The verification process involves multiple stakeholders with distinct roles and responsibilities throughout the workflow. The Marketing team is responsible for registering administrative information derived from the Framework Contract and Work Orders. Subsequently, the Project Manager assigns surveyors to conduct field verification activities. The survey findings are documented in verification reports, which are reviewed by the Quality Control (QC) team before the issuance of the TKDN certificate. This workflow demonstrates strong interdependencies among stakeholders, business documents, and verification activities, requiring each stage to be completed sequentially to maintain data consistency and end-to-end traceability.

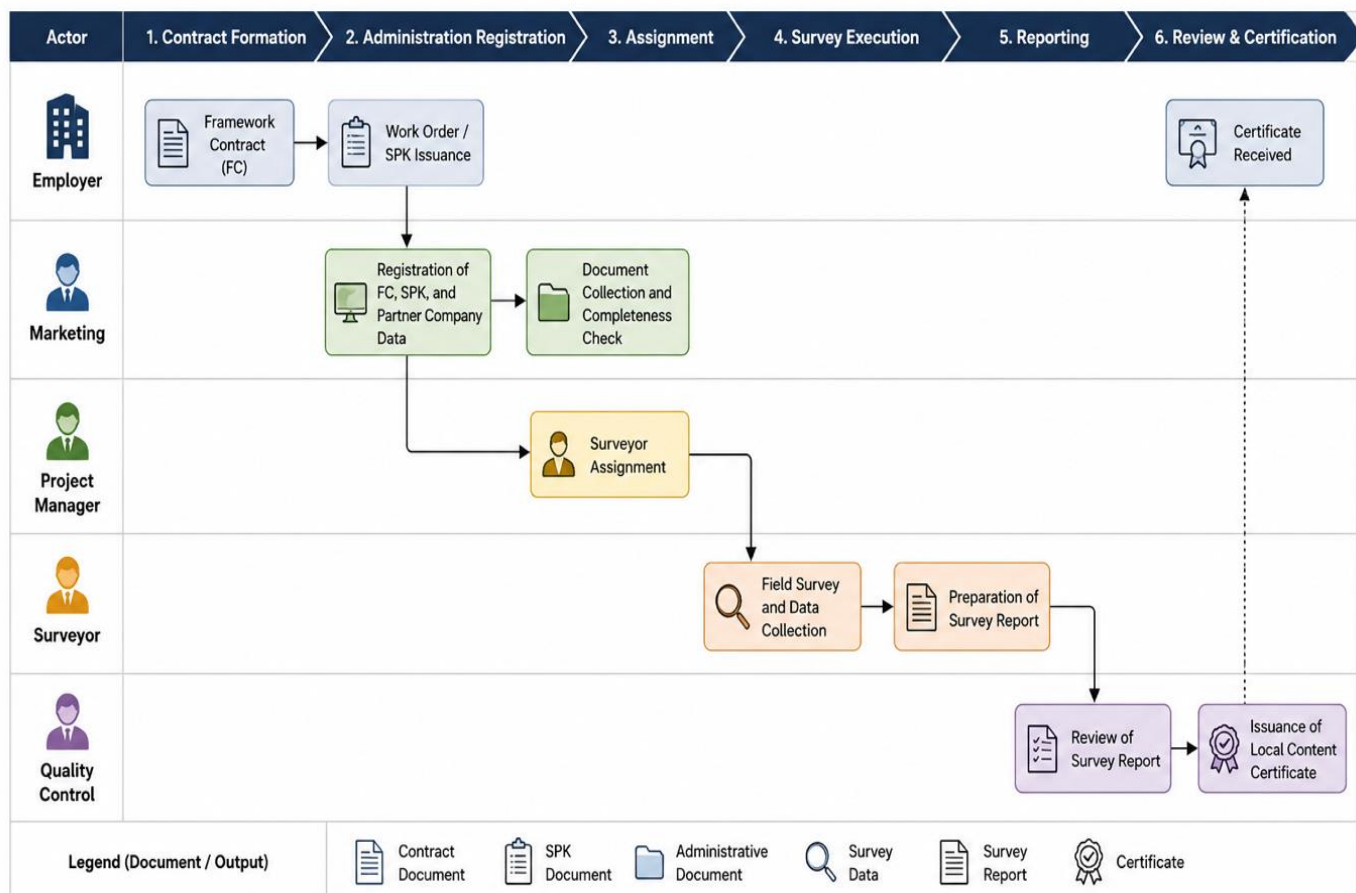


Figure 2: Existing Business Process of Local Content Verification for Services under the Framework Contract Scheme

Figure 2 illustrates the existing business process, beginning with the establishment of the contractual relationship and ending with the issuance of the TKDN certificate. Each stage generates information and supporting documents that serve as prerequisites for subsequent activities. Consequently, delays or inconsistencies at any stage may affect the overall verification process. These findings highlight the need for an integrated information system capable of managing business activities, documents, and information flows

within a unified platform, thereby improving process coordination, information consistency, and traceability throughout the verification lifecycle (Faccia & Petratos, 2021; Wang et al., 2020).

Proposed Business Process

Based on the analysis of the existing workflow, a redesigned business process supported by an integrated information system was developed to manage the entire TKDN service verification process under the Framework Contract scheme. The proposed business process was designed according to the Hierarchical Contract-Based Information Integration Model, which establishes structured relationships among business activities, stakeholders, and supporting documents within a unified workflow. This approach enables information to flow consistently from administrative registration through certificate issuance while maintaining data integrity across all verification stages (Faccia & Petratos, 2021; Guo et al., 2021).

Within the proposed process, each completed activity automatically generates the information required for the subsequent stage. The registration of Framework Contracts, Work Orders, and partner companies provides the foundation for surveyor assignment. Survey findings are then documented in verification reports and submitted to the Quality Control (QC) team for review before the TKDN certificate is issued. By integrating these activities within a single information platform, the proposed process minimizes isolated data management, reduces information redundancy, and improves document traceability throughout the verification lifecycle (Wang et al., 2020; Faccia & Petratos, 2021).

The proposed workflow also establishes clear responsibility boundaries for each stakeholder according to their respective roles. Users are authorized to perform only the activities assigned to their responsibilities, while the system enforces a sequential workflow by ensuring that each verification stage can proceed only after the successful completion of its predecessor. This mechanism strengthens process governance, improves monitoring and documentation, and enhances coordination among stakeholders compared with the existing verification process (Raghavendra & Vemula, 2025).

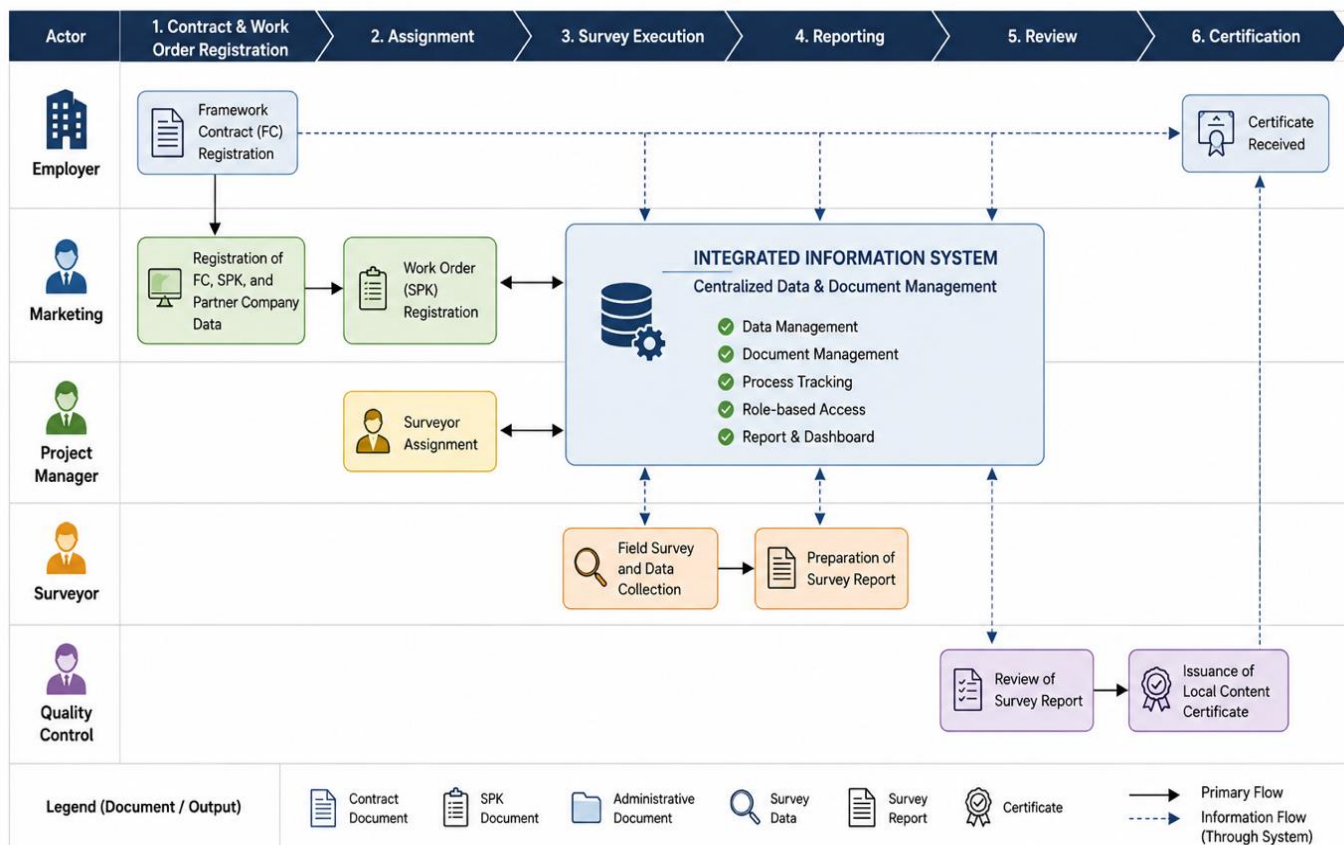


Figure 3. Proposed Business Process of Local Content Verification for Services under the Framework Contract Scheme (To-Be Process)

Figure 3 illustrates the integrated verification workflow implemented through the proposed information system. The process establishes end-to-end connectivity among Framework Contracts, Work Orders, partner companies, surveyor assignments, survey execution, verification reports, Quality Control reviews, and TKDN certificate issuance. The proposed business process demonstrates how the integration model improves information consistency, strengthens end-to-end traceability, reduces redundant data handling, and facilitates more effective document management and stakeholder coordination throughout the TKDN verification process (Faccia & Petratos, 2021; Wang et al., 2020; Guo et al., 2021).

Integrated Information System Design

Based on the proposed business process, an integrated information system was designed to support the entire TKDN service verification process under the Framework Contract scheme. The system architecture was developed based on the proposed Hierarchical Contract-Based Information Integration Model, which integrates business activities, stakeholders, and supporting documents within a unified platform. This design enables administrative processes, survey execution, Quality Control (QC) reviews, and certificate issuance to be managed through a consistent and traceable information flow while supporting centralized information management across the verification lifecycle (Faccia & Petratos, 2021; Guo et al., 2021).

The system integrates the primary business entities involved in the verification process, including clients, Framework Contracts, Work Orders, partner companies, surveyor assignments, survey results, verification reports, Quality Control reviews, and TKDN certificate issuance. The hierarchical relationships among these entities ensure that business data and supporting documents remain consistently connected throughout the verification process, thereby improving information traceability, preserving data integrity, and facilitating effective coordination among stakeholders (Wang et al., 2020; Faccia & Petratos, 2021).

In addition to integrating business data and documents, the system incorporates role-based access control to ensure that each stakeholder performs only the activities corresponding to their assigned responsibilities. The workflow is governed through sequential process control, allowing subsequent verification activities to proceed only after the successful completion of preceding stages. This mechanism improves process consistency, reduces administrative errors, strengthens stakeholder coordination, and provides centralized, reliable information to support operational decision-making throughout the verification process (Raghavendra & Vemula, 2025; Faccia & Petratos, 2021).

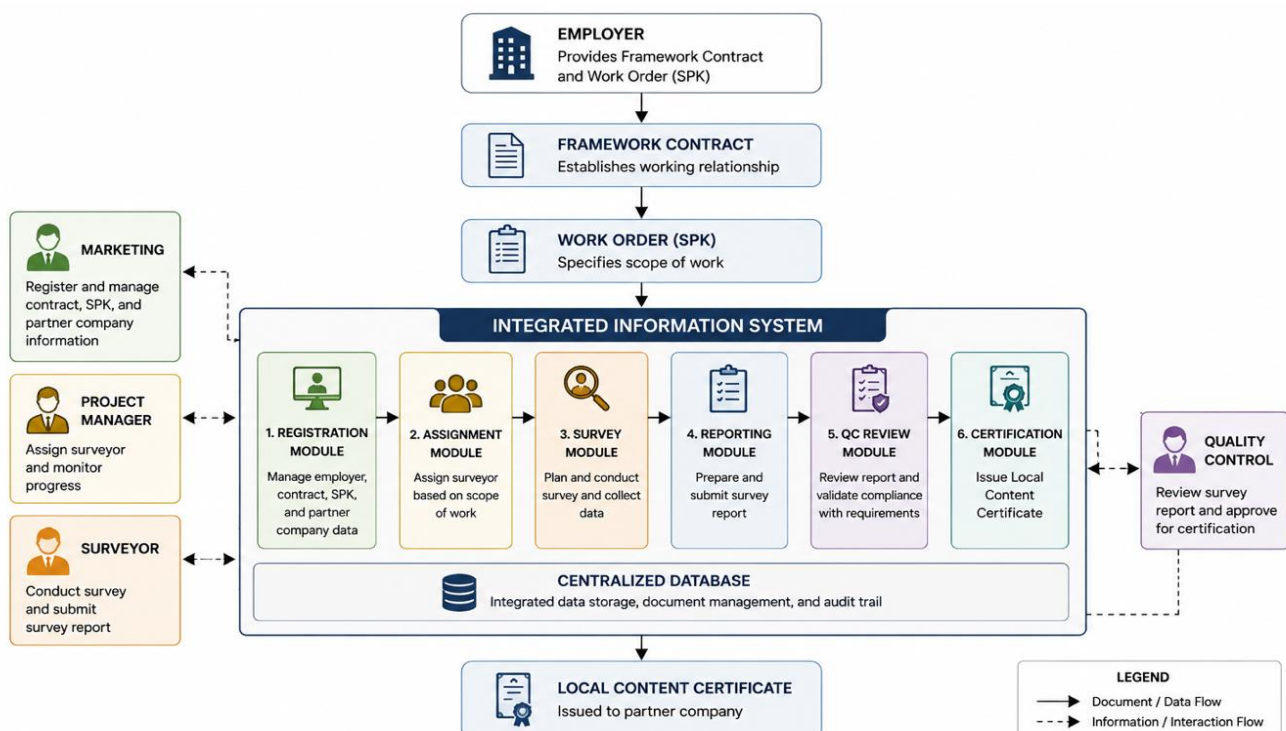


Figure 4: Conceptual Model of the Integrated Information System for Local Content Verification (Framework Contract Scheme)

Figure 4 presents the proposed integration model that establishes hierarchical relationships among clients, Framework Contracts, Work Orders, partner companies, surveyor assignments, survey execution, verification reports, Quality Control reviews, and TKDN certificate issuance. The model demonstrates how these interconnected business entities support a continuous flow of information while ensuring document traceability, data consistency, and effective stakeholder coordination throughout the verification process. As the core contribution of this study, the proposed model provides a structured approach for integrating complex verification workflows under the Framework Contract scheme into a single information management platform (Faccia & Petratos, 2021; Wang et al., 2020).

System Testing Results

Following the completion of the system development phase, the proposed system was evaluated using Black Box Testing to verify that all functional modules operated in accordance with the specified requirements of the TKDN service verification process under the Framework Contract scheme. The testing was conducted using predefined test scenarios that represented the operational activities performed at each stage of the verification workflow. Each scenario was designed to validate the functional behavior of the system by comparing the expected outputs with the actual outputs generated from predefined inputs, without evaluating the internal implementation of the application.

The testing results indicate that all major system functions operated as intended and satisfied the functional requirements established during the requirements analysis stage. Each module successfully supported the responsibilities of its respective stakeholder, including administrative registration, surveyor assignment, survey execution, verification report generation, Quality Control (QC) review, and TKDN certificate issuance. All test scenarios produced the expected outputs, and every functional module successfully passed the Black Box Testing process.

Table 2. Summary of Black Box Testing Results

No	Functional Module	Testing Scenario	Expected Result	Actual Result	Status
1	Registration	Save registration data	Registration successfully stored	Registration successfully stored	Pass
2	Assignment	Assign surveyor	Assignment successfully recorded	Assignment successfully recorded	Pass
3	Survey	Submit survey data	Survey data successfully saved	Survey data successfully saved	Pass
4	Reporting	Generate survey report	Survey report successfully generated	Survey report successfully generated	Pass
5	Quality Control	Review survey report	Review successfully completed	Review successfully completed	Pass
6	Certification	Issue TKDN certificate	Certificate successfully generated	Certificate successfully generated	Pass

In addition to functional testing, User Acceptance Testing (UAT) was conducted with representative users from the Project Manager, Surveyor, and Quality Control roles to evaluate the operational suitability of the proposed system. The participants confirmed that the implemented functions adequately supported the verification workflow and fulfilled the operational requirements of their respective responsibilities. Due to organizational confidentiality and non-disclosure policies, detailed UAT questionnaires and evaluation records are not included in this paper.

Overall, the testing results demonstrate that the proposed system successfully satisfies both functional and operational requirements for TKDN service verification under the Framework Contract scheme. More

importantly, the results confirm that the proposed Hierarchical Contract-Based Information Integration Model effectively maintains the relationships among business entities throughout the verification lifecycle. By preserving information consistency, document traceability, and controlled workflow execution, the proposed approach enhances stakeholder coordination and provides a reliable foundation for integrated verification management (Faccia & Petratos, 2021; Wang et al., 2020; Guo et al., 2021).

User Acceptance Testing

In addition to functional validation through Black Box Testing, the proposed system was evaluated using User Acceptance Testing (UAT) involving representative end users from the primary stakeholder groups participating in the TKDN service verification process, namely the Project Manager, Surveyor, and Quality Control (QC) roles. The objective of the UAT was to assess whether the developed system adequately supported operational activities, aligned with the proposed business workflow, and was suitable for practical implementation within the TKDN service verification process.

The UAT results indicated that the participating users considered the implemented system to be consistent with their operational requirements and capable of supporting an integrated verification workflow. The evaluation also confirmed that the proposed system facilitated role-based task execution, centralized information management, and end-to-end coordination among stakeholders throughout the verification lifecycle.

Overall, users indicated that the integrated workflow simplified task execution by providing centralized access to project information, reducing repetitive administrative activities, and improving coordination among stakeholders. Although quantitative usability scores are not presented due to organizational confidentiality, the feedback confirmed that the system was considered practical and appropriate for supporting daily verification activities.

Due to organizational confidentiality and the Non-Disclosure Agreement (NDA) governing the implementation environment, the detailed UAT instruments, evaluation scores, and supporting documentation cannot be disclosed in this paper. Nevertheless, the successful completion of the UAT provides additional evidence that the proposed Hierarchical Contract-Based Information Integration Model is not only functionally correct but also operationally applicable in supporting the TKDN service verification process under the Framework Contract scheme.

DISCUSSION AND RESEARCH IMPLICATIONS

The findings demonstrate that the proposed information system successfully integrates the entire TKDN service verification process under the Framework Contract scheme into a unified and structured workflow. The successful completion of both Black Box Testing and User Acceptance Testing confirms that the proposed solution is not only functionally correct but also operationally suitable for practical implementation. By establishing continuous relationships among Framework Contracts, Work Orders, partner companies, surveyor assignments, survey execution, Quality Control (QC) reviews, and TKDN certificate issuance, the system enables centralized information management while improving stakeholder coordination and end-to-end document traceability throughout the verification lifecycle (Faccia & Petratos, 2021; Wang et al., 2020).

These findings are consistent with previous studies demonstrating that integrated information systems improve business process coordination, organizational transparency, and information consistency. Faccia and Petratos (2021) reported that Enterprise Resource Planning (ERP) and Accounting Information Systems enhance coordination across organizational processes, while Raghavendra and Vemula (2025) emphasized the role of integrated information systems in strengthening transparency and accountability within procurement management. Unlike these studies, however, the present research addresses the unique characteristics of TKDN service verification under the Framework Contract scheme, where verification activities depend on hierarchical relationships among contractual documents, stakeholders, and business entities.

Beyond improving business process integration, the proposed system also enhances data reliability by maintaining consistent relationships among clients, Framework Contracts, Work Orders, partner companies,

survey results, verification reports, and issued certificates. Centralized information management reduces the risk of data inconsistency, duplicate documentation, and administrative errors commonly encountered in fragmented verification environments. Consequently, the proposed approach provides a more reliable information foundation for verification activities, auditing, and operational decision-making throughout the verification process (Faccia & Petratos, 2021; Wang et al., 2020).

Although previous studies have investigated the digitalization of procurement, electronic contract management, and blockchain-based contract administration (Guo et al., 2021; Omar et al., 2021; Agrawal et al., 2021), they generally focus on linear procurement workflows and do not address the hierarchical structure of TKDN service verification under the Framework Contract scheme. This research demonstrates that the hierarchical dependencies among clients, Framework Contracts, Work Orders, partner companies, surveyors, Quality Control personnel, and certification activities require a dedicated information integration approach that differs from conventional procurement systems.

Accordingly, the principal contribution of this research is the proposal of the Hierarchical Contract-Based Information Integration Model, which provides a structured framework for managing hierarchical relationships among business entities throughout the verification lifecycle. Unlike previous information system models that primarily support procurement or contract management, the proposed model explicitly preserves hierarchical dependencies across verification activities, thereby strengthening information consistency, end-to-end traceability, and stakeholder coordination. The model therefore offers a conceptual foundation that may be adapted to other verification and certification processes exhibiting similar hierarchical business structures.

From a practical perspective, the proposed system enables organizations to manage verification activities through a more structured, transparent, and centrally coordinated workflow. From an academic perspective, the proposed integration model extends existing research on information system integration by introducing a domain-specific framework for managing hierarchical contractual relationships within complex verification processes. This contribution broadens the application of integrated information systems beyond conventional procurement environments and provides a reference for future studies involving certification, compliance verification, and other document-intensive business processes.

Table 3. Comparison Between Existing and Proposed Business Process

Aspect	Existing Process	Proposed Process
Data Management	Separate	Integrated
Document Storage	Distributed	Centralized
Traceability	Limited	End-to-end
Coordination	Manual	System-supported
Monitoring	Periodic	Continuous
Information Consistency	Risk of duplication	Single integrated source

As summarized in Table 3, the proposed information system introduces several operational improvements over the existing business process. Integrating business data and supporting documents within a single platform reduces fragmented document management, minimizes duplicate records, and improves information consistency across interconnected business entities. Furthermore, the integrated workflow ensures that verification activities are executed sequentially and documented systematically, thereby enhancing monitoring capabilities and end-to-end traceability. Although this study did not quantitatively measure improvements in processing time or reductions in administrative errors, the implementation results indicate that the proposed approach simplifies stakeholder coordination and provides a more effective mechanism for managing the TKDN service verification process than the previous manual workflow.

The comparison presented in Table 3 demonstrates qualitative improvements achieved through the implementation of the proposed system. Compared with the previous manual process, the integrated information system improves document traceability, strengthens information consistency, supports centralized document management, and facilitates coordination among stakeholders. Although quantitative indicators such

as processing time, error reduction, and productivity were beyond the scope of this study, the observed improvements indicate that the proposed system provides a stronger operational foundation for managing TKDN service verification activities.

CONCLUSION

This study successfully developed an integrated information system to support the TKDN service verification process under the Framework Contract scheme. The proposed system digitalizes and integrates the entire verification workflow, encompassing the management of Framework Contracts, Work Orders, partner companies, surveyor assignments, survey execution, Quality Control (QC) reviews, and TKDN certificate issuance within a unified and traceable information platform. The results of both Black Box Testing and User Acceptance Testing demonstrate that the developed system satisfies the required functional specifications and effectively supports the operational requirements of the verification process.

The primary contribution of this research extends beyond the implementation of an information system. This study proposes the Hierarchical Contract-Based Information Integration Model, a domain-specific framework designed to manage hierarchical relationships among contractual documents, business entities, and stakeholders throughout the TKDN service verification lifecycle. By preserving these relationships within a single integrated workflow, the proposed model improves information consistency, document traceability, stakeholder coordination, and centralized information management. From an academic perspective, this work expands the application of integrated information systems to verification and certification domains, which have received considerably less attention than procurement, contract management, and supplier management systems.

This study has several limitations. The proposed system was implemented and evaluated within a single organizational environment and a specific TKDN service verification scheme, which may limit the generalizability of the findings. Furthermore, the evaluation focused on functional correctness and user acceptance without quantitatively assessing operational performance indicators such as processing time, administrative error reduction, or productivity improvements.

Future research may extend the proposed model through integration with Enterprise Resource Planning (ERP) systems and the National Industrial Information System (SIINas) to enable automated data exchange and greater interoperability across organizational platforms. Additional research may also investigate the application of data analytics and Artificial Intelligence (AI) to support intelligent document verification, anomaly detection, real-time process monitoring, and decision support. Furthermore, quantitative evaluations involving multiple organizations are recommended to measure the operational impact of the proposed model on efficiency, information quality, and user acceptance across broader implementation contexts.

Future research should include quantitative performance evaluation using measurable indicators such as processing time, document accuracy, administrative error rates, productivity improvements, and standardized usability assessments involving broader groups of system users.

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