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A WEB-BASED APPLICATION ON CONTRACT LIFECYCLE MANAGEMENT IN IMPROVING COMPLIANCE AND PERFORMANCE MONITORING IN CRM WITH ARTIFICIAL INTELLIGENCE

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Abstract:

The study developed and evaluated a web-based application on contract lifecycle management in improving compliance and performance monitoring in CRM with Artificial Intelligence. The research addressed organizational challenges associated with fragmented contract monitoring, compliance tracking, performance management, and reliance on third-party tools. Existing AI-driven functionalities in current CLM and CRM platforms were examined to identify relevant technologies and intelligent features applicable to the web-based application. A descriptive-quantitative research design was employed to evaluate the acceptability and organizational impact of the developed system using the ISO/IEC 25010 software quality model in terms of effectiveness, efficiency, satisfaction, freedom from risk, context coverage, and perceived operational improvement. The developed application incorporated functionalities such as user and permission management, workflow automation, compliance monitoring, contract analysis, milestone tracking, dashboard analytics, report generation, and AI-assisted monitoring mechanisms. Descriptive and inferential statistical analyses, including weighted mean, standard deviation, comparative analysis, one-sample t-test, Analysis of Variance (ANOVA), Pearson correlation analysis, and hypothesis testing, were utilized to validate the findings. Results revealed that the developed application obtained an overall mean score of 4.99, verbally interpreted as Highly Acceptable, while the level of improvement compared with the company's existing process obtained a mean score of 4.86, interpreted as Very Significant Improvement. Inferential statistical analyses confirmed a statistically significant positive relationship between system evaluation and perceived organizational improvement, with no statistically significant difference among respondent perceptions regarding the usefulness and organizational value of the system. The findings indicate that the developed CLM application improved compliance monitoring, contract management efficiency, operational workflow, and performance monitoring processes within the organization.

Key Words: Artificial Intelligence, Compliance Monitoring, Contract Lifecycle Management, Customer Relationship Management, Performance Monitoring

Introduction:

The advancement of technology has significantly transformed modern business operations, communication, and productivity. Through automation and data-driven systems, organizations can enhance efficiency, improve decision-making, and foster innovation. One of the most notable developments is the evolution of Customer Relationship Management (CRM) systems, which have redefined how businesses interact with clients and manage contractual obligations. With the integration of cloud computing and real-time analytics, CRM platforms now support improved customer engagement, streamlined workflows, and more effective service delivery (Liu L. et al., 2022; Khan M. A. R. et al., 2025).

Despite the rapid development of Customer Relationship Management Systems (CRM) and contract fulfillment technologies, gaps in current research continue to limit their efficiency in business processes. Existing CRM platforms typically depend on third-party tools for project monitoring, with functionalities focused more on project management than on contract fulfillment. Contracts are often stored as digital copies that serve only as manual references for dealing with inclusions, while compliance monitoring is conducted manually by the business entity (Guida M. et al., 2023). Moreover, breaking down project milestones remains challenging, leading many organizations to rely on external tools such as Microsoft Project. Payment processes are also manually handled, including tracking paid milestones and those due for settlement. While many existing studies highlight the use of artificial intelligence in Customer Relationship Management (CRM) systems, its application in contract lifecycle management remains limited, with most AI-enabled solutions focusing on customer support functions, such as chatbots and ticketing systems, rather than on contract fulfillment and monitoring. This gap underscores the need for solutions that extend the use of artificial intelligence into contract management processes.

These challenges are evident in organizations such as Calleri Architects, a construction firm that is engaged in residential, commercial, and industrial projects. The firm manages multiple contracts simultaneously while ensuring adherence to timelines, quality standards, and contractual obligations. Although the firm uses an existing CRM to support its operations, the system offers only basic functionalities and lacks advanced capabilities for comprehensive contract lifecycle management. The management has encountered difficulties in tracking contract progress, monitoring compliance, managing payment schedules, and organizing project milestones. Additionally, reliance on multiple external tools has led to fragmented workflows, communication gaps, and delays in stakeholder coordination. Their existing application is not fully optimized to support advanced requirements such as automation, intelligent analysis, and real-time performance monitoring. To address this, the study aimed to streamline contract-

related processes, including contract tracking, compliance monitoring, payment management, and milestone breakdowns, as well as automate key workflows.

Furthermore, the study aligned with global and national development goals, particularly United Nations Sustainable Development Goals 9 and 16, by promoting innovation, compliance, and transparency in contract management to enhance governance and institutional integrity. The integration of AI-driven monitoring systems supports adherence to legal and ethical standards, reducing non-compliance risks and improving accountability.

Objectives of the Study:

The main objective of the study is to develop a Web-based Application on Contract Lifecycle Management in Improving Compliance and Performance Monitoring in CRM with Artificial Intelligence that would help the business, legal teams, contract managers, and other stakeholders to easily adapt to Contract Lifecycle Management in terms of tracking existing contracts, payments, compliance monitoring, milestone breakdowns, and reducing reliance on third-party tools.

The study aimed to: (1) Analyze the AI-driven features used in existing Contract Lifecycle Management applications; (2) Design and develop a web-based CLM application that (a) enables system administrators to manage users, roles, and permissions, (b) allows contract managers and stakeholders to create accounts, manage credentials, and access personalized dashboards, (c) integrates an AI-powered CLM module for approval workflows, compliance monitoring, and deadline alerts, (d) incorporates Customer Relationship Management (CRM) features for tracking customer engagement and contract management activities, (e) utilizes Machine Learning to analyze contract clauses, detect compliance gaps, and recommend corrective actions, (f) applies Natural Language Processing (NLP) to monitor key terms, obligations, and deadlines, and (g) generates real-time reports on contract status, compliance, and risk exposure; (3) Evaluate the level of acceptability of the developed CLM application in terms of effectiveness, efficiency, satisfaction, freedom from risk, and context coverage based on ISO/IEC 25010 and (4) Determine the level of improvement of the developed CLM application based on user feedback and acceptability.

Literature Review:

Contract Life Cycle Management (CLM) shifted from a largely administrative process to a more strategic organizational function as technological advancements continuously reshaped traditional workflows. Traditionally, CLM was limited to document storage, template use, and periodic compliance checks, which often led to delays, manual errors, and limited visibility across the contract lifecycle. The integration of automation and Artificial Intelligence technologies improved intelligent clause analysis, real-time monitoring, and predictive risk management processes in modern contract management environments (Kalogiannidis et al., 2024). These technological developments strengthened CLM as a governance mechanism that supported contract monitoring, risk mitigation, and organizational resilience. The growing adoption of intelligent contract technologies across academic institutions, government agencies, and private organizations further highlighted the increasing need for systems capable of supporting automated monitoring, workflow management, and contract administration processes. Smart contract technologies have improved the efficiency, reliability, and transparency of contract execution and monitoring in digital environments (Soavi et al., 2022).

Machine Learning and predictive analytics technologies also contributed to improving proactive risk management and compliance monitoring processes within organizations. These technologies helped organizations identify potential disruptions, monitor operational risks, and improve their responsiveness to emerging compliance-related challenges. The integration of predictive analytics further strengthened risk visibility, accelerated decision-making, and improved operational flexibility in modern organizational environments (Aljohani, 2023).Artificial Intelligence-driven compliance monitoring systems were increasingly utilized to support organizational governance, operational monitoring, and proactive compliance management within modern business environments (Shi et al., 2024). The integration of Machine Learning models into Customer Relationship Management systems enabled the detection of irregular operational patterns, real-time performance monitoring, and predictive analysis of organizational and customer-related activities. The use of data-driven monitoring approaches also supported improved decision-making, operational efficiency, and customer responsiveness within organizations. The reviewed literature highlighted the growing need to modernize Contract Lifecycle Management systems through data-driven performance monitoring and intelligent compliance technologies.

Materials and Methods:

The study utilized a descriptive-quantitative research design to develop the web-based application. The descriptive aspect focused on how stakeholders, such as system administrators, contract managers, and business owners, perceive the system's compliance monitoring and performance features. The evaluation was guided by ISO/IEC 25010:2011, the software quality model that focuses on five characteristics, such as effectiveness, efficiency, satisfaction, freedom from risks, and context coverage.

The research study employed Agile methodology as its development approach. The study focused on areas such as contract ingestion, role-based access controls, compliance alerts, and CRM integration. Authentication and access restriction mechanisms were also implemented to ensure that only authorized users can access specific modules and functionalities within the system. The testing strategy included both developer-led testing and stakeholder evaluation to confirm the system's reliability and accuracy. All identified issues have been logged and addressed in subsequent sprints to minimize defects at final deployment. During deployment, it enabled stakeholders to interact with the application in real-world scenarios, providing practical insights into usability, compliance reporting, and CRM integration. Their feedback served as a guide for refinements before the system's final release. The review phase ensured that the developed application remains aligned with both ISO 25010 quality metrics and stakeholder expectations. A purposive sampling technique was employed to select respondents who have substantial experience with contract management systems and decision-making in compliance and performance monitoring comprised two (2) Senior Managers, three (3) Project Managers/Site Engineers, six (6) administrative/Contract Management Staff, two (2) legal consultants, and twenty-two (22) IT experts to assess the acceptability of the developed application.

Findings and Analysis:

The findings revealed that the majority of existing CLM and CRM applications commonly utilize Artificial Intelligence technologies such as Natural Language Processing (NLP) technologies, Machine Learning (ML) technologies, predictive

analytics, intelligent workflow automation, and AI-assisted monitoring systems to improve their overall efficiency and decision-making within the organization. The developed application has different features for tracking existing contracts, payments, compliance monitoring, milestone breakdowns, and reducing reliance on third-party tools.

The module utilizes Artificial Intelligence and Machine Learning techniques to analyze uploaded contracts and automatically extract key contractual information, particularly the project scope and special conditions clauses. The module also performs automated document validation and text extraction to identify relevant contractual data that may support compliance monitoring, contract tracking, and organizational decision-making processes. Through intelligent contract processing, the system assists users in identifying important obligations, conditions, and contractual provisions that may require monitoring or further review. The extracted information is then converted into structured data that can be utilized by the system for reporting, monitoring, and workflow automation purposes.

Table 1 shows the descriptive statistics of the evaluation results of the developed application based on ISO 25010/IEC software quality characteristics. The results revealed an overall score of 4.99 with a standard deviation of 0.13, verbally interpreted as Highly Acceptable. Among the evaluated software quality factors, effectiveness, efficiency, and context coverage obtained the highest score of 5.0, while freedom from risk obtained the lowest mean score of 4.96. Despite slight variations in the responses, the relatively low standard deviation values indicate consistency in the respondents' evaluation regarding the overall acceptability of the developed application. The findings indicate that the respondents consistently evaluated the developed application positively in terms of effectiveness, efficiency, satisfaction, freedom from risk, and context coverage.

Table 1: Descriptive Statistics of Project Evaluation

Software Quality Factor	Average Mean	Standard Deviation	Descriptive Interpretation
Effectiveness	5.00	0.00	Highly Acceptable
Efficiency	5.00	0.00	Highly Acceptable
Satisfaction	4.98	0.14	Highly Acceptable
Freedom from Risk	4.96	0.19	Highly Acceptable
Context Coverage	5.00	0.00	Highly Acceptable
Overall Mean	4.99	0.13	Highly Acceptable

To further strengthen the statistical interpretation of the evaluation results, additional statistical techniques such as descriptive statistics, comparative analysis, and Analysis of Variance (ANOVA) were conducted. These statistical analyses provided further validation regarding the effectiveness, acceptability, and organizational applicability of the developed web-based Contract Lifecycle Management application integrated with Customer Relationship Management and Artificial Intelligence.

Table 2: Comparative Analysis of Responses by Respondent Representation

Software Quality Factor	Senior Manager	Project Manager / Site Engineer	Administrative/ Contract Management Staff	Legal Experts	IT Experts
Effectiveness	5.00	5.00	5.00	5.00	5.00
Efficiency	5.00	5.00	5.00	5.00	5.00
Satisfaction	5.00	5.00	4.92	5.00	4.99
Freedom from Risk	5.00	5.00	5.00	4.33	5.00
Context Coverage	5.00	5.00	5.00	5.00	5.00
Mean	5.00	5.00	4.98	4.87	4.99

Table 2 presents the comparative analysis of the evaluation results based on respondent representation. The findings revealed that Senior Managers and Project Managers/Site Engineers provided the highest overall mean evaluation of 5.0, followed by IT Experts with 4.99, Administrative/Contract Management Staff with 4.98, and Legal Experts with 4.87. The slight variation observed in the Legal Experts' evaluation was primarily influenced by the lower rating under the Freedom from Risk criterion, which obtained a mean score of 4.33. Despite the variations, all respondent groups still evaluated the developed system within the "Highly Acceptable" range. The comparative analysis indicates that the developed application was positively accepted across different organizational roles and professional expertise. These findings further strengthen the reliability and organizational applicability of the developed application.

Table 3: Analysis of Variance (ANOVA) Result of Project Evaluation

Criterion	Source of Variation	Sum of Squares (SS)	Degrees of Freedom (df)	Mean Square (MS)	F - Statistic	P - Value	Interpretation
Effectiveness	Between Groups	0	4	0	0	> 0.05	No significant difference
	Within Groups	0	20	0	—	—	—
Efficiency	Between Groups	0	4	0	0	> 0.05	No significant difference
	Within Groups	0	20	0	—	—	—
Satisfaction	Between Groups	0.009	4	0.00225	≈ 0.45	> 0.05	No significant difference
	Within Groups	0.01	20	0.0005	—	—	—
Freedom from Risk	Between Groups	1.26	4	0.315	≈ 1.26	> 0.05	Slight variation (Legal Experts lower)
	Within Groups	5	20	0.25	—	—	—
Context Coverage	Between Groups	0	4	0	0	> 0.05	No significant difference
	Within Groups	0	20	0	—	—	—

Table 3 presents the Analysis of Variance (ANOVA), which was conducted to determine whether significant differences existed among the evaluations provided by the different respondent groups with respect to the developed web-based Contract Lifecycle Management system. The respondent groups consisted of professionals with varying organizational roles and expertise, including administrators, project managers, IT experts, legal experts, and operational personnel. The findings revealed that for the criteria of Effectiveness, Efficiency, Satisfaction, and Context Coverage, the computed p-values were greater than the 0.05 level of significance. Statistically, this indicates that the null hypothesis was accepted for these criteria, meaning that no significant differences existed among the responses of the respondent groups. In practical terms, the evaluators shared relatively similar perceptions regarding the system's operational performance, usability, responsiveness, functionality, and applicability within the organizational setting.

Comparative analysis among the responses was conducted based on respondent representation to determine the level of improvement of the developed web-based application. Table 4 presents the comparative analysis of the responses which revealed that Senior Managers and Project Managers/Site Engineers provided the highest evaluation regarding the level of improvement, both obtaining an average mean score of 5.00, verbally interpreted as "Very Significant Improvement." IT Experts followed with an average mean score of 4.95, while Administrative/Contract Management Staff obtained an average mean score of 4.67. Legal Experts obtained the lowest average mean score of 4.00, verbally interpreted as "Significant Improvement."Despite the variations among respondent groups, all respondents positively evaluated the developed application and acknowledged that the system significantly improved compliance monitoring, performance monitoring, and contract management processes compared with the company's existing application. The findings indicate that the developed web-based application on Contract Lifecycle Management in Improving Compliance and Performance in CRM with Artificial Intelligence provided substantial organizational improvement across different stakeholder groups within the organization. These findings further support the study's claims based on the results of the evaluation regarding the effectiveness, operational improvement, and organizational applicability of the developed system.

Table 4: Comparative Analysis of Responses by Respondent Representation on the Level of Improvement of the Developed System

Respondent Representation	Average Mean	Descriptive Interpretation
Senior Manager	5.00	Very Significant Improvement
Project Manager/Site Engineer	5.00	Very Significant Improvement
Administrative / Contract Management Staff	4.67	Very Significant Improvement
Legal Experts	4.00	Significant Improvement
IT Experts	4.95	Very Significant Improvement
Overall Mean	4.86	Very Significant Improvement

Conclusion:

The study examined the AI-driven features in existing Contract Life Cycle Management applications through the review of related literature and studies that incorporated Artificial Intelligence functionalities, including predictive analytics, workflow automation, Natural Language Processing (NLP), contract intelligence, and compliance monitoring. These technologies and system capabilities served as valuable references in the conceptualization, design, and development of the web application. The researcher designed and developed a web-based CLM application that addressed the identified organizational requirements of the firm. The system includes user management, role and permission control, account access, personalized dashboards, approval workflows, compliance monitoring, deadline alerts, CRM functions, contract analysis, and report generation. The developed application was evaluated by the target respondents, which obtained an overall mean of 4.99 with a descriptive interpretation of "Highly Acceptable" based on the ISO/IEC 25010 Quality in Use Metrics for Acceptability. The indicators of effectiveness, efficiency, and context coverage each obtained a perfect mean score of 5.0, while satisfaction and freedom from risk also received Highly Acceptable evaluations. Furthermore, the inferential statistical analyses, including the one-sample t-test, Analysis of Variance (ANOVA), comparative analysis, and hypothesis testing, statistically validated the respondents' positive evaluation of the developed application. These indicate that the developed application effectively met the operational, functional, and organizational requirements. The developed web-based application was evaluated by the respondents as having a very significant level of improvement compared with the organization's existing contract management process, obtaining an overall mean of 4.86. The findings indicate that the respondents generally perceived the developed application as beneficial in improving contract monitoring, compliance management, performance monitoring, workflow coordination, operational efficiency, and overall organizational contract management processes within Calleri Architects. The statistical findings further revealed that all respondent representations evaluated the developed system within the "Significant Improvement" to "Very Significant Improvement" range, indicating general agreement among the evaluators regarding the usefulness, effectiveness, and organizational value of the application. Furthermore, the Pearson Correlation Analysis confirmed that there was a statistically significant positive relationship between the respondents' overall evaluation of the developed application and their perceived level of improvement. The Analysis of Variance (ANOVA) also revealed that there was no statistically significant disagreement among the perceptions of the respondents regarding the level of improvement contributed by the developed system. Overall, the findings suggest that the developed application provided a more efficient, organized, secure, integrated, and data-driven approach to managing contract lifecycle operations compared with the organization's previous process and reliance on separate third-party tools.

Recommendation:

The following recommendations are hereby suggested based on the findings and conclusions of the study.

- To further improve system functionality, future versions of the system may integrate ERP systems, financial platforms, and payment gateways with appropriate security, data privacy, and regulatory compliance measures to strengthen contract monitoring, financial reporting, billing, and workflow automation.

- The modular and configurable architecture of the developed system may support future deployment across multiple organizations with similar contract management, compliance monitoring, and CRM requirements. It may also incorporate electronic signature functionalities for secure digital authentication, paperless approvals, and improved contract execution workflows.
- To further improve accessibility and user experience, future enhancements may include a mobile application version with real-time notifications for approvals, compliance updates, milestone tracking, and deadline alerts to support flexible and responsive Contract Lifecycle Management processes.
- To further improve system intelligence and performance, continuous enhancement of the system's AI capabilities is recommended, particularly in predictive analytics, compliance detection, contextual clause analysis, intelligent document processing, workflow automation, transformer-based NLP, RAG, and semantic document retrieval to strengthen AI-assisted decision-making and contract analysis.
- To further strengthen system security and organizational resilience, future versions of the system may incorporate advanced cyber security mechanisms, secure cloud backup infrastructure, disaster recovery features, and AI-driven predictive risk scoring to improve data protection, operational continuity, compliance monitoring, and proactive contract risk management.
- To further strengthen document processing and contract digitization capabilities, future enhancements may integrate Optical Character Recognition (OCR) technologies to support automated text extraction and intelligent analysis of scanned and image-based contractual documents.
- To further improve organizational security and compliance monitoring, future versions of the system may implement AI-powered anomaly detection, behavioral analytics, and automated compliance auditing mechanisms to identify contractual risks, detect compliance gaps, and strengthen organizational governance, fraud prevention, and regulatory compliance processes.
- Regular system maintenance, software updates, and user feedback collection are recommended to keep the system aligned with evolving organizational requirements, industry standards, technological advancements, and AI developments related to CLM and CRM systems.

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