

Leveraging Artificial Intelligence for Legal Document Management and Case Analytics: The FORMULATELEGAL System

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Abstract

The increasing complexity and volume of legal documentation have created significant administrative challenges for legal institutions, particularly within government litigation departments. Traditional legal workflows rely heavily on manual document processing, data entry, and case tracking, which often lead to inefficiencies, delays, and potential human errors. This study aims to develop and evaluate FORMULATELEGAL, an artificial intelligence (AI)-powered legal automation and data management system designed to streamline document processing, case tracking, and legal drafting within the Civil Division of the Attorney General's Chambers of Malaysia. Drawing on prior research in legal analytics and natural language processing, AI technologies such as machine learning, optical character recognition (OCR), and natural language processing (NLP) were integrated to automate document extraction, classification, and summarization processes. The study adopted a developmental research design using the system development life cycle (SDLC) approach, incorporating system design, implementation, and performance evaluation phases. A dataset of civil litigation documents was processed using modules including LexExtract, DocuDraft, ScanLex, and CivilTrack, while system performance was evaluated using precision accuracy, processing time, and system efficiency indicators. The results demonstrate that the automated system significantly improved document processing accuracy and reduced document handling time while enabling centralized case data management and real-time monitoring of litigation activities. These findings confirm that AI-enabled legal automation systems can enhance productivity, reduce administrative workload, and improve information accessibility within legal institutions. Furthermore, the implementation of such digital legal infrastructure supports Sustainable Development Goal (SDG) 16, which promotes strong institutions, transparency, and efficient justice systems. Overall, the study highlights the potential of AI technologies to transform legal administrative processes and contribute to the digital transformation of public legal services..

Keywords: Legal automation; Artificial intelligence in law; Natural language processing; Legal document management; OCR technology; Case management systems; Digital justice; SDG 16.

1. Introduction

The legal sector is characterized by the intensive use of textual information, including statutes, pleadings, contracts, court judgments, and legal correspondence. Legal practitioners must constantly review, interpret, and organize vast volumes of documentation in order to prepare cases, conduct research, and maintain accurate records. With the continuous growth of litigation and regulatory documentation, the volume and complexity of legal data have increased substantially. Managing such large datasets using conventional manual processes poses significant challenges to legal institutions, particularly those responsible for handling high volumes of civil litigation. Legal professionals frequently spend substantial time reviewing and organizing documents rather than focusing on analytical and strategic legal tasks. Studies have shown that the manual extraction and analysis of legal information from documents is both time-consuming and prone to errors due to the complexity and scale of legal texts (Khalid, 2024; Jiang et al., 2023).

In many government legal departments, including those responsible for civil litigation, the administrative burden associated with document management is particularly pronounced. A single legal case may generate thousands of pages of supporting materials, including affidavits, pleadings, contracts, and correspondence. These documents often

exist in different formats such as scanned files, printed records, and digital text documents. Without integrated digital systems, legal officers must manually review, categorize, and track these materials, resulting in inefficiencies and inconsistencies in data management. The reliance on manual documentation processes can lead to delays in case preparation, difficulties in retrieving relevant information, and increased risk of human error in legal documentation. Consequently, the efficiency of legal services and the overall effectiveness of litigation management may be compromised.

Recent technological advancements in artificial intelligence (AI), particularly in the fields of machine learning and Natural Language Processing (NLP), have provided new opportunities to address these challenges. NLP technologies enable computers to analyze and interpret human language, allowing automated extraction of meaningful information from unstructured legal texts. Such technologies have been increasingly applied in legal analytics, document classification, case summarization, and automated legal research (Modi et al., 2023). By leveraging these capabilities, legal technology solutions can significantly improve the efficiency and accuracy of document processing, enabling legal practitioners to focus on higher-level analytical tasks rather than routine administrative work.

In addition, AI-driven legal document management systems have demonstrated the potential to streamline workflows by automating tasks such as document review, classification, and retrieval. These systems can process large volumes of electronic data, identify relevant information, and reduce the time required for document analysis. As a result, legal professionals can access critical case information more quickly and make more informed decisions during litigation processes. Furthermore, the integration of AI with centralized databases allows for better organization of legal records and facilitates the development of advanced analytical tools for monitoring legal trends and case progress.

Despite these advancements, many public sector legal institutions still rely on fragmented or partially digitized systems that do not fully exploit the capabilities of modern legal technology. Challenges such as unstructured document repositories, limited searchability of scanned documents, and lack of centralized case management systems continue to hinder operational efficiency. Moreover, the absence of automated tools for document drafting, data extraction, and case tracking increases the workload of legal professionals and administrative staff. These limitations highlight the urgent need for integrated legal technology platforms capable of automating routine processes while maintaining the accuracy and confidentiality required in legal practice.

In the context of Malaysia, the Attorney General's Chambers plays a crucial role in representing the government in civil litigation matters. As the number and complexity of cases continue to increase, there is a growing demand for technological solutions that can support legal officers in managing extensive legal documentation and case records. Implementing an intelligent legal automation system can help improve document accessibility, reduce administrative workload, and enhance the overall efficiency of litigation management within the institution.

Therefore, this study aims to examine the development and implementation of FORMULATELEGAL, an AI-powered legal automation and data management system designed to streamline document processing, case tracking, and legal drafting within the Civil Division of the Attorney General's Chambers of Malaysia. The purpose of this study is to explore how the integration of artificial intelligence, OCR, and NLP technologies can improve legal workflow efficiency, enhance data accessibility, and support more effective litigation management.

Literature Review

The integration of artificial intelligence (AI) into legal practice has attracted increasing scholarly attention as legal institutions seek technological solutions to manage growing volumes of legal documentation and complex litigation processes. Previous studies have highlighted the role of legal technology in improving efficiency, accuracy, and accessibility in legal workflows. Technologies such as Natural Language Processing (NLP), machine learning, and Optical Character Recognition (OCR) have been widely explored for automating document review, legal research, and case management. These technologies enable systems to extract structured information from unstructured legal texts, facilitating faster data retrieval and analysis (Jiang et al., 2023). As legal documents often exist in large quantities and diverse formats, automated information extraction has become a critical component in modern legal information systems.

One major variable in legal technology research is legal document automation, which refers to the use of AI tools to generate, classify, and process legal documents automatically. Studies indicate that AI-assisted drafting tools can significantly reduce repetitive tasks involved in preparing pleadings, contracts, and affidavits. Such systems improve productivity by allowing legal practitioners to focus on analytical tasks rather than routine documentation (Ashley, 2017). Furthermore, document automation systems equipped with machine learning algorithms can recognize legal patterns and assist in summarizing lengthy documents, thereby reducing time spent on manual review.

Another key variable is data management and centralization in legal systems. Effective data management platforms

provide centralized repositories that store case records, metadata, and legal documents in structured formats. According to Surden (2019), centralized legal databases enhance information accessibility and support collaborative work among legal professionals. When legal information is properly organized and indexed, practitioners can retrieve relevant documents quickly, enabling more efficient case preparation and strategic decision-making. In government legal departments, centralized case management systems also improve transparency and oversight by providing real-time access to case status and litigation trends.

The third important variable relates to OCR-based document digitization, which enables the conversion of scanned or printed legal documents into machine-readable text. OCR technology plays a crucial role in digitizing historical legal records and enabling search functionality within document repositories. Research indicates that combining OCR with NLP techniques allows automated classification and extraction of key legal information from scanned documents, significantly improving document management efficiency (Kienle et al., 2020). However, the effectiveness of OCR systems often depends on document quality and formatting, which remain important considerations in legal technology implementation.

The theoretical foundation underpinning this study is primarily derived from the Technology Acceptance Model (TAM) and Information Systems Success Model (ISSM). The Technology Acceptance Model, introduced by Davis (1989), explains how users adopt new technologies based on perceived usefulness and perceived ease of use. In the context of legal automation systems, TAM suggests that legal professionals are more likely to adopt AI-powered tools when they perceive them as improving work efficiency and simplifying complex tasks. Meanwhile, the Information Systems Success Model developed by DeLone and McLean (2003) emphasizes the importance of system quality, information quality, and service quality in determining the effectiveness of information systems. This model is particularly relevant for evaluating legal automation platforms, where reliability, accuracy, and accessibility of legal information are essential for successful implementation.

Conceptually, this study positions legal automation, OCR-based digitization, and centralized data management as key technological components that influence legal workflow efficiency and case management effectiveness. Legal automation tools support document drafting and information extraction, while OCR technology facilitates the digitization and searchability of physical documents. Centralized databases integrate these outputs into a unified platform that enables monitoring, visualization, and analysis of litigation data. Together, these components form an integrated legal automation ecosystem capable of transforming traditional legal administrative processes into more efficient and data-driven workflows.

Overall, prior research demonstrates that AI-enabled legal systems can significantly enhance the management of legal documentation and case information. By integrating automation technologies with centralized information systems, legal institutions can improve productivity, reduce manual workload, and strengthen decision-making capabilities. These findings provide a strong theoretical and empirical foundation for the development and implementation of AI-powered legal automation platforms such as FORMULATELEGAL.

Research Methodology

This study employed a developmental and applied research design to examine the development and implementation of the FORMULATELEGAL system as an AI-driven legal automation and data management platform. Developmental research is commonly used in information systems and technology-based studies to design, develop, and evaluate technological solutions within real-world environments (Richey & Klein, 2021). In the context of this study, the research design focused on developing an integrated legal technology system and evaluating its effectiveness in improving document management, case tracking, and legal drafting processes within the Civil Division of the Attorney General's Chambers of Malaysia. The research adopted a system development life cycle (SDLC) approach consisting of several stages, including requirement analysis, system design, implementation, and evaluation. This structured approach ensures that technological solutions are systematically developed and assessed for functionality and usability (Sommerville, 2022).

The research procedure began with the identification of operational challenges in existing legal workflows, particularly those related to manual document handling, fragmented case data, and time-consuming drafting processes. Following this stage, system requirements were defined based on consultations with legal officers and administrative staff involved in civil litigation. The development process then proceeded with the design and implementation of the core modules of the FORMULATELEGAL system, including LexExtract for document parsing and summarization, DocuDraft for AI-assisted drafting, ScanLex for OCR-based document digitization, and CivilTrack for case monitoring and visualization. After system development, pilot testing was conducted to evaluate the system's performance in real operational conditions. Feedback from legal practitioners was collected and incorporated into

system refinement to ensure usability and reliability (Kharuddin & Ismail, 2017).

The sampling procedure in this study involved the use of purposive sampling, which is commonly applied in information systems research where specific datasets relevant to the research objectives are selected (Creswell & Creswell, 2023). The sample consisted of legal documents and case files obtained from civil litigation records managed by the Civil Division. A dataset of approximately 1,000 active case files was selected for analysis, including pleadings, affidavits, legal correspondence, and supporting documents in various formats such as PDF files, scanned images, and digital text documents. These documents provided the necessary data for evaluating the system's ability to perform automated extraction, classification, and document management functions (Kharuddin et al, 2018).

The data collection process involved both automated and manual techniques. Legal documents were collected from digital repositories and physical records, which were subsequently digitized using OCR technology embedded in the ScanLex module. The OCR engine converted image-based documents into machine-readable text, enabling further processing by natural language processing algorithms. Metadata such as case numbers, filing dates, parties involved, and document categories were extracted and stored in a structured relational database using MySQL. Additional system performance data, including processing time, extraction accuracy, and classification outcomes, were automatically recorded during system testing. Collecting these metrics allowed for systematic evaluation of the system's effectiveness in handling large volumes of legal documentation (Jiang et al., 2023).

The data analysis phase focused on evaluating the accuracy and efficiency of the automated document processing system. Accuracy was measured using a standard information retrieval metric known as precision, which evaluates the proportion of correctly identified documents relative to the total number of documents processed. Precision is calculated using the following formula:

$$Precision = \frac{TP}{TP + FP}$$

where TP (True Positives) represents correctly extracted or classified documents, and FP (False Positives) represents incorrectly identified results (Aggarwal, 2022). In addition, time efficiency was evaluated by comparing the average time required for manual document processing with the time required when using the automated system. Table 1 illustrates the key evaluation metrics used in the analysis.

Table 1: Evaluation Metrics for FORMULATELEGAL System Performance

Metric	Description
Precision	Accuracy of document extraction and classification
Processing Time	Time required to process legal documents
Document Coverage	Number of documents successfully digitized and stored
System Efficiency	Reduction in manual workload and administrative tasks

Overall, the methodology adopted in this study enabled a systematic evaluation of the FORMULATELEGAL system by combining system development practices with empirical performance analysis. The integration of AI technologies, OCR, and structured data management provided a robust framework for assessing how automation can improve legal document processing and case management in government legal institutions.

Data Analysis, Results, and Findings

The data analysis in this study focused on evaluating the effectiveness of the FORMULATELEGAL system in improving legal document processing, case management, and workflow efficiency within the Civil Division. The analysis was conducted using performance indicators that measured document extraction accuracy, document classification performance, document processing time, and overall workflow efficiency. Data were obtained from the processing of civil litigation case documents through the system's modules, including LexExtract, DocuDraft, ScanLex, and CivilTrack. The analysis combined descriptive statistics and performance evaluation metrics to determine the effectiveness of the system in achieving the objectives of legal automation and centralized data management. Similar evaluation approaches have been widely used in artificial intelligence and information systems research to assess system performance and reliability (Aggarwal, 2022; Jiang et al., 2023).

Document Extraction and Classification Accuracy

One of the key indicators used in evaluating the system was the accuracy of document extraction and classification performed through the integration of OCR and natural language processing technologies. The system processed a

large collection of legal documents and extracted relevant metadata such as case numbers, filing dates, document types, and party information. The results of the document extraction and classification process are summarized in Table 1.

Table 1: Accuracy of Document Extraction and Classification

Module	Documents Processed	Correctly Extracted	Incorrectly Extracted	Precision (%)
ScanLex (OCR)	1,000	880	120	88.0
LexExtract (NLP Parsing)	1,000	905	95	90.5
Document Classification	1,000	892	108	89.2

The results presented in Table 1 indicate that the system achieved a high level of accuracy in processing legal documents. The OCR component, implemented through the ScanLex module, achieved a precision rate of 88%, demonstrating strong performance in converting scanned legal documents into machine-readable text. Meanwhile, the LexExtract module, which applied natural language processing techniques for parsing and summarizing legal texts, recorded a precision rate of 90.5%, indicating that the system was able to identify and extract relevant legal information with a high degree of reliability. Document classification, which categorized documents into types such as pleadings, affidavits, and correspondence, achieved an accuracy rate of 89.2%.

These results demonstrate that the integration of OCR and NLP technologies significantly improves the ability to process large volumes of legal documentation. The system effectively transformed unstructured legal texts into structured and searchable information, thereby improving accessibility and reducing the need for manual document review. The results are consistent with previous studies suggesting that AI-based document processing systems can significantly enhance the accuracy and efficiency of legal data extraction (Surden, 2019).

Processing Time and Workflow Efficiency

Another important dimension of the analysis involved evaluating the impact of the FORMULATELEGAL system on document processing time. The time required for document preparation and data entry was compared between traditional manual workflows and automated processing using the system. The results are summarized in Table 2.

Table 2: Comparison of Manual and Automated Document Processing Time

Task	Manual Processing (Average Minutes)	Automated Processing (Average Minutes)	Time Reduction (%)
Document Digitization	15.2	5.8	61.8
Document Classification	12.5	4.6	63.2
Metadata Extraction	10.8	3.9	63.9
Case Data Entry	14.1	5.2	63.1
Average	13.15	4.88	62.9

The results presented in Table 2 indicate a substantial improvement in processing efficiency following the implementation of the FORMULATELEGAL system. Manual document processing required an average of 13.15 minutes per task, whereas automated processing reduced the average time to approximately 4.88 minutes. This represents an overall time reduction of approximately 62.9%. The most significant improvements were observed in metadata extraction and document classification tasks, which experienced time reductions exceeding 63%.

These findings demonstrate that automation significantly improves operational efficiency within legal workflows. By reducing the time required for repetitive administrative tasks, the system enables legal practitioners to focus more on legal analysis, case strategy, and decision-making. The reduction in processing time also contributes to faster case preparation and improved responsiveness in litigation management.

Case Data Centralization and System Utilization

In addition to accuracy and efficiency improvements, the system was evaluated based on its ability to centralize and manage case information within a unified platform. The CivilTrack module provided a centralized repository for case records, enabling real-time tracking of litigation activities and document status. The results of the system's case data management capabilities are summarized in Table 3.

Table 3: Case Data Centralization and System Utilization

Indicator	Value
Total Case Files Stored	1,000
Digitized Documents	8,450
Average Documents per Case	8.45
Search Retrieval Accuracy	91.3%
Average Retrieval Time	2.4 seconds

The results in Table 3 demonstrate that the system successfully centralized a large volume of legal documentation within a structured database. A total of 1,000 case files containing 8,450 documents were digitized and stored within the system, resulting in an average of approximately 8.45 documents per case file. The search functionality achieved a retrieval accuracy rate of 91.3%, allowing users to locate relevant documents quickly. Additionally, the average document retrieval time was recorded at approximately 2.4 seconds, demonstrating the efficiency of the system's search and indexing capabilities.

The ability to centralize legal data significantly enhances organizational transparency and case monitoring. Legal officers can access case information, review relevant documents, and monitor litigation progress through a single integrated platform. This feature improves collaboration among legal teams and reduces the risk of document misplacement or duplication.

The findings of this study indicate that the implementation of the FORMULATELEGAL system significantly improved legal document processing, case management, and workflow efficiency. The integration of OCR and NLP technologies enabled accurate extraction and classification of legal documents, achieving precision rates close to 90%. Additionally, the system substantially reduced the time required for document processing tasks, with an average time reduction of approximately 62.9%. The centralized case management platform also enhanced accessibility to legal information, allowing users to retrieve documents quickly and monitor case progress effectively.

Overall, the results demonstrate that AI-powered legal automation systems can provide substantial benefits in legal administrative environments. By automating repetitive tasks, improving document accessibility, and providing real-time case insights, FORMULATELEGAL contributes to a more efficient and data-driven approach to legal case management.

Discussion and Recommendations

The findings of this study demonstrate that the implementation of the FORMULATELEGAL system significantly improves the efficiency, accuracy, and accessibility of legal document management and case tracking processes within the Civil Division of the Attorney General's Chambers of Malaysia. The primary objective of this research was to modernize legal document management through the integration of artificial intelligence, automation technologies, and centralized data management systems. The results confirm that the integration of OCR and natural language processing technologies effectively automated document extraction and classification, achieving high accuracy levels while reducing the need for manual document review. These outcomes support previous research indicating that AI-driven legal technologies can significantly improve the efficiency of legal workflows by transforming unstructured legal texts into structured and searchable data (Surden, 2019; Jiang et al., 2023).

The first research objective focused on automating the extraction, drafting, and data entry processes associated with legal documentation. The findings indicate that the AI-based modules embedded in the FORMULATELEGAL system successfully reduced repetitive administrative tasks and improved document processing accuracy. Automated extraction and classification functions achieved precision rates approaching 90%, demonstrating the system's effectiveness in identifying relevant legal information from large document collections. This finding aligns with studies showing that machine learning and NLP techniques can significantly enhance document processing

performance and reduce human error in legal information management (Ashley, 2017). By automating these processes, legal practitioners can allocate more time to analytical and strategic legal activities, which ultimately enhances the overall quality of legal services.

The second research objective was to enable OCR-based digitization of printed legal documents to improve document accessibility and searchability. The findings confirm that the ScanLex module effectively converted scanned documents into machine-readable text, thereby enabling efficient indexing and retrieval of legal information. The ability to digitize historical legal records is particularly important in government legal departments where many documents still exist in paper-based formats. Previous studies emphasize that OCR technology plays a critical role in digital transformation by facilitating the transition from physical documentation to searchable electronic records (Kienle et al., 2020). The successful implementation of OCR within the FORMULATELEGAL system demonstrates its potential to enhance knowledge management and information accessibility in legal institutions.

The third objective of the study involved centralizing case-related data within a unified system to improve monitoring and accessibility. The results demonstrate that the CivilTrack module successfully consolidated case files, document metadata, and extracted legal information into a centralized database. This centralized data management approach improved transparency and enabled real-time monitoring of litigation progress. According to DeLone and McLean (2003), effective information systems improve organizational performance by enhancing information quality, system usability, and accessibility. The findings of this study support this theoretical perspective by demonstrating that centralized legal data systems facilitate more efficient case management and support better decision-making.

The fourth objective aimed to provide visualization tools that allow legal practitioners to interpret litigation trends and monitor case progress. The dashboard features embedded within the system enabled users to analyze case distribution, document status, and workload patterns through graphical visualizations. These analytical tools provide valuable insights that support strategic decision-making and resource allocation. Research has shown that data visualization and analytics play an increasingly important role in legal practice by enabling practitioners to identify patterns and trends within large datasets (Modi et al., 2023).

Beyond institutional efficiency, the outcomes of this study are also closely aligned with the United Nations Sustainable Development Goals (SDGs), particularly SDG 16: Peace, Justice and Strong Institutions. This goal emphasizes the importance of building transparent, accountable, and efficient institutions that ensure access to justice for all (United Nations, 2023). By improving the efficiency and transparency of legal document management and litigation processes, the FORMULATELEGAL system contributes to strengthening institutional capacity within the public legal sector. Additionally, the digitization and centralization of legal records support improved governance, accountability, and public service delivery.

Overall, the findings of this research confirm that AI-powered legal automation systems can significantly transform traditional legal administrative processes. The integration of OCR, NLP, and centralized data management technologies improves the speed and accuracy of document processing while enhancing access to legal information. These findings are consistent with previous literature emphasizing the transformative potential of artificial intelligence in legal practice and public administration (Surden, 2019; Ashley, 2017).

In conclusion, this study demonstrates that the FORMULATELEGAL system provides an effective technological solution for addressing the challenges associated with large-scale legal documentation and case management. The system successfully automated document processing tasks, improved information accessibility, and enabled centralized case monitoring. These improvements contribute to more efficient legal workflows and enhanced institutional performance within the Civil Division of the Attorney General's Chambers of Malaysia.

Based on the findings of this study, several recommendations can be proposed. First, future research should explore the integration of predictive analytics and machine learning models capable of forecasting litigation outcomes based on historical case data. Such capabilities would further enhance the strategic decision-making capacity of legal practitioners. Second, the system could be expanded to include AI-assisted legal research tools, which would allow users to automatically identify relevant legal precedents and statutes from large legal databases. Third, integration with national e-filing and judicial information systems could further streamline case management and reduce duplication of administrative tasks. Finally, continuous training and capacity building for legal practitioners should be implemented to ensure effective adoption of AI-based legal technologies. By strengthening both technological infrastructure and user competency, legal institutions can fully realize the benefits of digital transformation in legal services...

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