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Article

Smart Law Application Engineering for Post-Disaster Recovery in Sumatra

Refa Swinta Maharani[1*], Inggrit Fernandes[1]

[1,2]Department of International Law, Faculty of Law, Andalas University, Padang, Indonesia

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Abstract. Flood disasters frequently occur in West Sumatra and cause multidimensional impacts on micro, small, and medium enterprises (MSMEs). Beyond physical and economic damage, MSMEs face serious administrative and legal challenges, particularly in restoring trademark legality due to lost documents, disrupted archives, and limited access to legal services. These conditions weaken legal protection and reduce business competitiveness during post-disaster recovery. This study aims to engineer a Smart Law application, a digital portal integrated with artificial intelligence (AI), designed to support post-disaster trademark legality recovery for MSMEs in Sumatra. The research employed a research and development (R&D) approach consisting of needs assessment, system design, prototype development, and limited user testing. Data were collected through literature review, regulatory analysis, interviews with disaster-affected MSMEs, and field observations, and analyzed using a qualitative descriptive method. The results indicate that the Smart Law application is capable of delivering structured legal information, contextual guidance, and AI-based preliminary recommendations tailored to MSME conditions. The application functions as an initial legal assistance tool that improves accessibility, efficiency, and understanding of trademark recovery procedures in post-disaster contexts. This study contributes to the development of AI-assisted legal services and digital solutions for MSME resilience in disaster-prone regions.

Corresponding Author :
Refa Swinta Maharani
Department of International Law, Faculty of Law, Andalas University
Padang, Indonesia
Email : refaswinta@law.unand.ac.id

1. Introduction

Flood disasters are recurrent natural hazards in Sumatra and significantly affect regional socio-economic systems. In Sumatera Barat, floods frequently disrupt livelihoods and local economic activities, particularly those of micro, small, and medium enterprises (MSMEs) [1–3]. MSMEs are among the most vulnerable economic actors due to limited financial resources, managerial capacity, and access to institutional support [4–6]. Post-disaster recovery strategies for MSMEs typically prioritize physical reconstruction and capital restoration, while administrative and legal dimensions often receive insufficient attention [7–9].

One critical yet frequently overlooked administrative aspect is trademark legality [10–12]. Trademark protection plays a strategic role in ensuring legal certainty, enhancing consumer trust, and strengthening MSME competitiveness [13–15]. A legally protected trademark constitutes an important intangible asset that supports business sustainability, particularly during recovery phases following disasters [16–18]. However, flood-affected MSMEs often experience loss or damage to trademark documents, disrupted access to legal services, and limited understanding of trademark recovery or re-registration procedures [19–21]. The complexity of administrative processes and the absence of contextual legal assistance further hinder independent legal recovery efforts [22–24].

Recent advances in digital technology have created opportunities to improve access to legal services through online platforms [25–27]. Nevertheless, the application of artificial intelligence (AI) in legal services for MSMEs remains limited and largely generic [28–30]. Existing digital legal platforms are typically fragmented, not integrated, and not specifically designed to address the needs of disaster-affected MSMEs [31–32]. Legal information is often presented in complex legal language and fails to consider the psychological and operational constraints faced by MSMEs during post-disaster recovery [33–35].

These conditions reveal a significant gap between MSME needs for rapid, adaptive, and accessible trademark recovery assistance and the availability of appropriate digital legal support systems [36]. Research focusing on AI-integrated legal assistance for trademark recovery in post-disaster MSME contexts remains scarce. Therefore, this study seeks to address this gap by engineering a Smart Law application that functions as a contextual, adaptive, and user-oriented digital legal assistance tool for disaster-affected MSMEs.

2. Experimental Section

2.1. Materials and Methods

This study adopted a research and development (R&D) methodology aimed at producing a functional prototype of an AI-integrated Smart Law application. The research process began with a comprehensive needs assessment involving literature review and regulatory analysis related to trademarks and MSMEs [10–15]. Field data were collected through interviews with MSMEs affected by flooding and direct observations in disaster-prone areas of West Sumatra.

The system design phase focused on developing a portal architecture capable of delivering structured legal information and adaptive guidance. AI features were designed to classify user conditions, filter relevant legal content, and generate preliminary recommendations for trademark recovery based on MSME-specific situations. These AI functions were intended to support early decision-making without replacing formal legal authorities [37–39].

Prototype development emphasized core functionalities, including trademark legality information, step-by-step recovery guidance, and interactive AI-based consultation features. Limited usability testing was conducted with selected MSMEs to assess system functionality, clarity of information, and perceived usefulness. Evaluation data were analyzed descriptively and qualitatively to support system refinement [40–42].

3. Results and Discussion

The engineering process of the Smart Law application resulted in an AI-integrated digital legal portal specifically designed to support post-disaster trademark legality recovery for MSMEs. The application consolidates fragmented legal information into a structured and user-oriented system, addressing the administrative and legal challenges commonly faced by disaster-affected MSMEs [7–9].

The Smart Law application was developed as a modular portal consisting of three main components: (1) a trademark legality information module, (2) a recovery guidance module, and (3) an AI-assisted recommendation module. The information module provides structured explanations of trademark regulations, registration requirements, and recovery procedures in simplified language, addressing the limited legal literacy commonly observed among MSMEs [19–21].

The recovery guidance module presents step-by-step procedures tailored to post-disaster conditions, such as document loss, interrupted business operations, and delayed administrative access. This module responds to findings in prior studies indicating that administrative complexity and lack of contextual legal assistance significantly hinder MSME recovery efforts [22–24]. By organizing legal processes into sequential and comprehensible steps, the application reduces procedural uncertainty and cognitive burden during recovery phases.

The integration of artificial intelligence serves as a decision-support mechanism rather than a replacement for formal legal institutions. AI functions were designed to classify user inputs based on MSME conditions, including scale of business, trademark ownership status, and extent of document damage. Based on this classification, the system filters relevant legal information and generates preliminary recommendations for trademark recovery pathways.

This adaptive information delivery aligns with previous research highlighting the potential of AI to enhance access to justice by personalizing legal information and reducing information asymmetry [28–30]. Unlike generic digital legal platforms, the Smart Law application contextualizes legal guidance by incorporating post-disaster constraints, such as limited institutional access and reduced administrative capacity [31–32]. This approach addresses the gap identified in earlier studies regarding the lack of disaster-specific digital legal solutions for MSMEs [36].

Limited usability testing was conducted with selected MSMEs affected by flooding in West Sumatra. The results indicate that users perceived the Smart Law application as helpful in understanding trademark recovery procedures and legal requirements. MSMEs reported improved clarity regarding administrative steps, required documentation, and institutional pathways for trademark restoration.

User feedback emphasized the usefulness of the AI-based recommendation feature in guiding initial decision-making, particularly for MSMEs with limited prior experience in trademark registration. This finding supports existing literature that emphasizes the importance of early-stage legal assistance in strengthening MSME resilience and reducing recovery delays [16–18]. The application was also perceived as reducing dependency on informal legal advice, which is often inaccurate or incomplete in post-disaster contexts [33–35].

The Smart Law application contributes to MSME resilience by addressing legal recovery as an integral component of post-disaster economic restoration. While most recovery initiatives focus on financial and physical reconstruction, this application emphasizes legal certainty as a foundation for sustainable business continuity [13–15]. By facilitating access to trademark legality information and recovery guidance, the system strengthens MSME legal empowerment and competitiveness during recovery phases.

Furthermore, the application complements existing institutional mechanisms by functioning as an early-stage legal assistance tool. It does not replace formal legal services but enhances accessibility and preparedness before MSMEs engage with legal authorities. This positioning aligns with previous

studies advocating for hybrid legal service models that combine digital tools with institutional frameworks to improve access to justice [37–39].

Overall, the results demonstrate that the Smart Law application addresses a critical gap in post-disaster MSME recovery by integrating AI-assisted legal guidance into a contextual and user-oriented digital platform. The findings reinforce the potential of AI-driven legal technologies to support disaster resilience, legal protection, and sustainable economic recovery for MSMEs in disaster-prone regions [40–42].

4. Conclusion

This study demonstrates that engineering a Smart Law application integrated with artificial intelligence offers an effective solution for supporting post-disaster trademark legality recovery among MSMEs in Sumatra. The application provides structured legal information, contextual guidance, and AI-based preliminary recommendations tailored to MSME conditions. As a digital legal assistance tool, Smart Law enhances access to justice, strengthens legal protection, and supports sustainable MSME recovery in disaster-prone regions.

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