

An Intelligent Fuzzy Expert System for Evaluating the Cybersecurity Posture of Document Management Systems

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Abstract

Document management systems (DMS) have become the connective tissue of digital administration in government, finance, healthcare and higher education. They concentrate sensitive records, approval workflows and long lived institutional memory in a single attack surface. Existing cybersecurity-evaluation instruments, however, are either generic information-security maturity questionnaires or fuzzy risk models tuned to other software classes such as learning management systems and industrial control systems; none captures the document-oriented controls—lifecycle integrity, retention and disposition, non-repudiation through electronic signatures, and fine-grained content access—that determine the real security posture of a DMS. This paper proposes an intelligent evaluation system that combines a purpose-built DMS cybersecurity risk taxonomy (eight domains decomposed into forty-one leaf factors) with a two-tier hierarchical Mamdani fuzzy expert system. Tier-1 engines convert linguistic, expert-assessed evidence for each domain into interpretable domain scores. The domain weights, obtained from a nine member expert panel through the Analytic Hierarchy Process, are then applied in a tier-2 engine that fuses the weighted scores into a single Document Management System Cybersecurity Index (DMS-CSI) on the unit interval, while preserving domain level diagnostics for remediation prioritisation. The model is anchored to the NIST SP 800-30, ISO/IEC 27001 and BS 7799 reference formulations and validated on six real-world DMS deployments. Pearson correlations between the proposed index and the three standards together with an independent expert assessment range from 0.988 to 0.999 (bootstrap 95% lower bounds ≥ 0.956), and a sensitivity analysis confirms that the platform ranking is invariant to $\pm 20\%$ weight perturbations and to changes in the membership functions and defuzzifier. The framework offers organisations a reproducible, auditable and interpretable means of benchmarking DMS security.

Keywords

Document management system, cybersecurity evaluation, fuzzy expert system, Mamdani inference, information security risk assessment, ISO/IEC 27001, decision support.