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A Linear Sequential Model for Cloud-Based ECM: Comparative Analysis with On-Premises ECM

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ABSTRACT

The rapid growth of digital information has made effective enterprise content management (ECM) essential for modern organizations. While traditional on-premises ECM systems have long supported information management needs, the shift toward cloud-based ECM offers enhanced scalability, accessibility, and cost-efficiency. Decision-makers now have the option to use cloud computing and migrate ECM systems to the cloud. Having a cloud solution can provide a significant competitive edge. For instance, it can guarantee quicker ECM deployment and lower fixed IT department costs. This paper focuses on the evolution from on-premises to cloud-based systems and proposes a linear sequential model of cloud-based ECM. It presents a conceptual framework addressing key concerns, including stages of the linear sequential model that arise in cloud-based ECM adoption. A structured literature review was conducted using major databases to support the development of the proposed model. Furthermore, the paper highlights the comparative advantages of cloud-based ECM over traditional systems, including enhanced business efficiency, real-time collaboration, and improved resource utilization. By analyzing these aspects, the paper underscores how cloud-based ECM systems transform information management, providing organizations with the tools to drive innovation and maintain a competitive edge. It is crucial to comprehend all options and activities throughout the installation of ECM in the cloud to reap the most excellent possible benefits. This study proposes and describes a broad model for cloud-based ECM implementation.

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1. INTRODUCTION

Document management, web content management (including web portals), record management, and business process management are just a few of the many topics covered by ECM. Capturing, storing, organizing, indexing, conserving, and retrieving all types of content within the organization are essential components of ECM systems [1]. ECM systems are costly and challenging for many businesses to install. Rather than creating, managing, and operating an ECM system internally, everything can be accessed online by using cloud computing [2]. Businesses can concentrate their time

and resources on company operations by delegating ECM-related duties to a remote site, including document management, archiving, or workflow. The option to hire computer services from a third-party source is a significant advantage. Subscription-based billing consumes hardware or software resources as a service [3].

For many businesses, cloud content management is an unavoidable answer. In a recent Association of Information and Image Management study, 46% of participants said they would choose cloud-based document and content management software in three years [4]. Any change, whether positive or negative, has some risk. Identification and quantification of the hazards are essential. Typically, cloud ECM initiatives begin with a desire to reduce expenses and boost user efficiency. The projects frequently fail. IT managers can prevent the fiasco by using the model and the risk list that have been described [5]. ECM solutions are now essential tools for contemporary enterprises due to the quick expansion of digital transformation. ECM ensures operational efficiency and legal compliance while making it easier to organize, store, and retrieve large volumes of data [6]. ECM solutions are essential for handling unstructured content, including documents, emails, and multimedia files, and optimizing workflows as businesses look to improve their digital strategies [7].

Although several authors have proposed and assessed methods for deploying software, little is known about the evolution of Cloud ECM from an organizational standpoint. The waterfall model is the foundation of the model that is being given [8]. According to Sun et al. [9], the waterfall model is a software development process paradigm where all phases are completed in a predetermined order with little to no iterations. ECM in the Cloud is adapted from the general model. The outcome is a seven-phase Cloud ECM development approach. According to this model's phases, the specific issues associated with an implementation are divided into seven groups [10]. The Document Management System and the Workflow Management System are two components of the ECM system that the organization has put into place [11]. The relative importance of each risk is often ranked as a percentage of the overall cost uncertainty in a sensitivity analysis [12]. Implementation solutions like Google Drive Enterprise, AWS WorkDocs, and Microsoft Azure Content Services were taken into consideration for cloud ECM adoption in this study.

Thus, this article aims to introduce a Cloud ECM development model, and risks are grouped based on the model's phases. This paper's findings are presented to propose a Sequential Model of the cloud-based ECM approach. This paper aims to provide a suitable Cloud ECM development methodology. The literature review is the first step, which gathers the essential knowledge. The study begins with data collected from several surveys and studies. The reference section of the article contains a list of all the sources used. This study reviews well-known platforms, such as Google Drive Enterprise, AWS WorkDocs, and Microsoft Azure Content Services, as typical solutions to investigate the adoption of cloud-based ECM. The architectural models covered include hybrid-cloud frameworks, SaaS multi-tenancy, and RESTful API connections. Additionally, the report gives comparable performance indicators summarised in Table 2 and suggests a novel taxonomy of cloud ECM problems, specifically Security & Privacy, Regulatory Compliance, Vendor Lock-in, Latency and Availability, and Integration Complexity. For this study, there are three main related topics to be reviewed, namely cloud computing, enterprise content management (ECM), and cloud-based ECM.

1.1. Cloud Computing

According to Di Modica and Foschini [13], Cloud computing is a new type of computing that is dynamically scalable and may be thought of as standard virtualized resources and services via the Internet. Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS) are the three distinct categories into which cloud services can be divided. The SaaS model is counted as the best approach for enhancing ECM to cloud-ECM systems. Instead of offering software packages for individual users to purchase, the SaaS model provides software applications as online services. The three leading cloud delivery options organizations use today are private, public, and hybrid. Private clouds offer IT operations or functions "as a service" through an intranet, inside the company, and behind the firewall [14]. IT operations or functionalities are offered "as a service" via the Internet in public clouds. In hybrid clouds, activities or functions depend on security needs, criticality, architecture, and other criteria. The internal and external service delivery techniques are combined [15].

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1.2. Enterprise Content Management

Enterprise Content Management (ECM) is the organization's strategies, techniques, and resources used to gather, organize, store, protect, and distribute documents and materials of organizational procedures [16]. According to North et al. [17], the Document Management System is the core of the ECM since it serves as a central store for documents and other data used by different enterprise applications and ECM components. The capacity of users to locate information in the repository quickly and efficiently is essential to a successful ECM system [18]. Users can search the information however they see fit using an effective metadata-based ECM system. "Structured information about a document, data, or other information content" is one of the metadata definitions. Authors, titles, publishing dates, access permissions, and so on are examples of metadata [19].

1.3. Cloud-Based ECM

Every business must consider the pros and cons of cloud computing (CC). Numerous articles address the advantages of employing cloud computing to distribute ECM [20]. For instance, it discusses easier and faster deployment, expansion, and reduced deployment costs [21]. Cloud ECM solutions could not meet current business demands, and customization isn't always feasible. Data fragments are kept on servers owned by other parties. The business must agree to general updates and maintain a steady Internet connection. According to survey participants, the perceived security risk is the most significant barrier preventing cloud migration (61%), followed by a lack of compliance standards [22].

CC and ECM systems have changed how businesses store, manage, and access data. These systems offer performance, security, scalability, and cost-effectiveness. Scalability and flexibility are two of the best things about cloud-based ECM. Businesses can add more storage and processing power without buying expensive hardware. ECM, in contrast to on-premises ECM, needs significant infrastructure investments [23]. Another big benefit is that cloud solutions are cost-effective because they use a pay-as-you-go model, lowering capital and operational costs. Security and compliance are much better when you use cloud-based ECM because providers use industry-standard encryption, multi-factor authentication, and continuous monitoring to ensure you follow rules like ISO certifications [24]. In traditional ECM, each organization is responsible for its security. However, cloud providers handle security measures well. Cloud-based ECM also makes it easier for people to work together and access information because it lets users access and share documents from anywhere with centralized access control. This makes sure that only authorized users can see and change content [25]. Another great thing about the cloud is that it handles updates and maintenance automatically. Cloud providers take care of security patches and system improvements, which cuts down on IT work and ensures that businesses always use the most recent software version [7]. Cloud ECM also has disaster recovery and data backup options that make it less likely that data will be lost or the system will fail. This differs from on-premises ECM, which needs expensive and complicated recovery plans [26].

Additionally, cloud providers effectively handle issues related to regulatory compliance and data residency. They ensure that all foreign and regional data protection laws are followed, making it easy for businesses to meet compliance requirements [27]. Cloud-based ECM also has better speed and efficiency because the infrastructure optimizes system performance. This is not the case with on-premises ECM, which may have problems with hardware limitations [24]. In conclusion, cloud-based ECM is better than traditional on-premises ECM because it is cheaper, safer, more scalable, and easier for everyone to work together. This makes it the best choice for businesses that want to go digital and gain a competitive edge in today's data-driven world [28]. Considerations of user experience and adherence to regulatory frameworks, such as the General Data Protection Regulation (GDPR) and the Health Insurance Portability and Accountability Act (HIPAA), are pivotal to the successful adoption of cloud-based ECM. Recent empirical trends further highlight a growing preference for cloud ECM solutions, particularly in the context of remote and distributed work environments.

2. METHODOLODY

The phases of the software cycle and the sequence in which they are carried out are described by the Linear Sequential (LS) Model. There are numerous models, and many businesses use their own, yet they all follow remarkably similar trends. Each phase produces deliverables needed by the subsequent life cycle phase [29]. The LS model of the IBM Partner Software Development Life Cycle, or SDLC, is the foundation for the Cloud ECM development paradigm [30]. According to the paradigm, the five stages of system delivery are planning, design and implementation, testing, deployment, and maintenance. The general model has been adjusted for cloud-based ECM systems. The seven generic phases comprise the Cloud ECM concept. The phase Maintenance is renamed, and two more stages are introduced.

The Cloud-Based ECM Linear Sequential Model, as in Figure 1, aims to facilitate the adoption and operation of the paradigm, which commences with the Start phase, which triggers the process and is succeeded by the Planning phase, during which essential criteria and objectives are delineated [31]. The Prepare for Cloud phase emphasizes establishing the requisite infrastructure and confirming preparedness for cloud migration. Organizational content is assessed, structured, and formatted during the Prepare Contents phase for incorporation into the ECM system. The process subsequently transitions to Design and Implementation, during which the system architecture is formulated, and the ECM solution is executed [3]. Testing ensures the system's functionality, dependability, and organizational compatibility. The Cloud-Based ECM system is functional after validation, and Cloud Maintenance provides support and enhancement. Running and Improving emphasizes constant improvement to meet changing organizational needs [32]. As the comprehensive framework for constructing a cloud-based ECM system, this sequential approach addresses data preparation, system integration, and long-term maintenance. Testing ensures the system's functionality, dependability, and organizational compatibility [3].

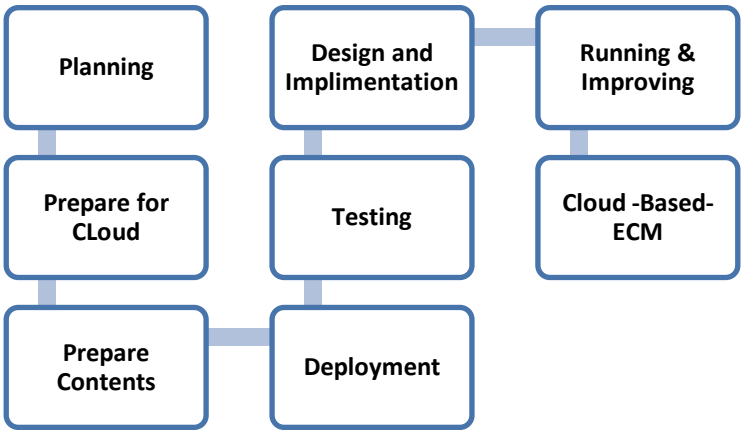

Figure 1. A Step-by-Step Process of Cloud-Based ECM Adoption Phases (Source: Klegova and Rabova [31])

According to Klegova and Rabova [31], this research study employed a step-by-step process, as depicted in Figure 1. Each phase in the model is interconnected and dependent on the completion of the previous phase before the next can begin. It illustrates the sequential flow of processes, ensuring that each phase is executed appropriately to facilitate a smooth transition to the next stage. For further elaboration, Figure 2 provides a detailed description of the proposed enhanced Cloud-Based ECM, explaining each phase along with its associated challenges and key considerations. This study adopts a conceptual approach supported by a structured literature review. Relevant peer-reviewed articles were sourced from Scopus, Web of Science, and IEEE Xplore using keywords such as "cloud-based ECM," "enterprise content management," and "ECM deployment." Selected literature was synthesized thematically to identify common trends, challenges, and best practices. Based on these insights, a linear sequential model for cloud-based ECM implementation was proposed to address the gaps identified in existing studies. This study proposes a novel taxonomy categorizing the key challenges of cloud-based ECM adoption: Security and Privacy, which pertain to safeguarding sensitive information in shared environments; Regulatory Compliance, ensuring adherence to data protection laws and industry

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standards; Vendor Lock-in, the difficulty of migrating away from a chosen provider; Latency and Availability, referring to performance fluctuations and service uptime; and Integration Complexity, the challenges of connecting cloud ECM with existing enterprise systems. Comparative performance metrics corresponding to these categories are summarised in Table 2.

The model depicted in the figure outlines a seven-phase framework for implementing Cloud-Based Enterprise Content Management (ECM), emphasizing the challenges and issues pertinent to each phase. The process adheres to a systematic and overlapping structure, necessitating the completion of each phase before advancing to the subsequent one. This methodical approach guarantees the mitigation of potential risks at each stage, resulting in a more seamless transition and effective implementation of the ECM system. The initial phase of planning is counted for the entire work process. Lack of consumer engagement, insufficient top management commitment, ambiguous business objectives, and poor requirement orientation of the system are the issues during the first phase. For the betterment of and success of the second phase, the requirements of the first phase must be completed successfully. Preparing for the cloud is the second phase, which includes the issues of IT security, processes, legal challenges, and sufficient disaster recovery planning. In the Prepare Content phase, undefined content structures, unclear audits, and an ambiguous ECM cycle can hinder the seamless migration of information to the cloud. Proper content structuring and clear audits ensure data integrity and compliance. The Design and Implementation phase encounters poor planning, unclear customization, an undefined system-level agreement, and incorrect user interface development. Effective planning at this stage is essential to optimize the system for user-friendliness and efficiency.

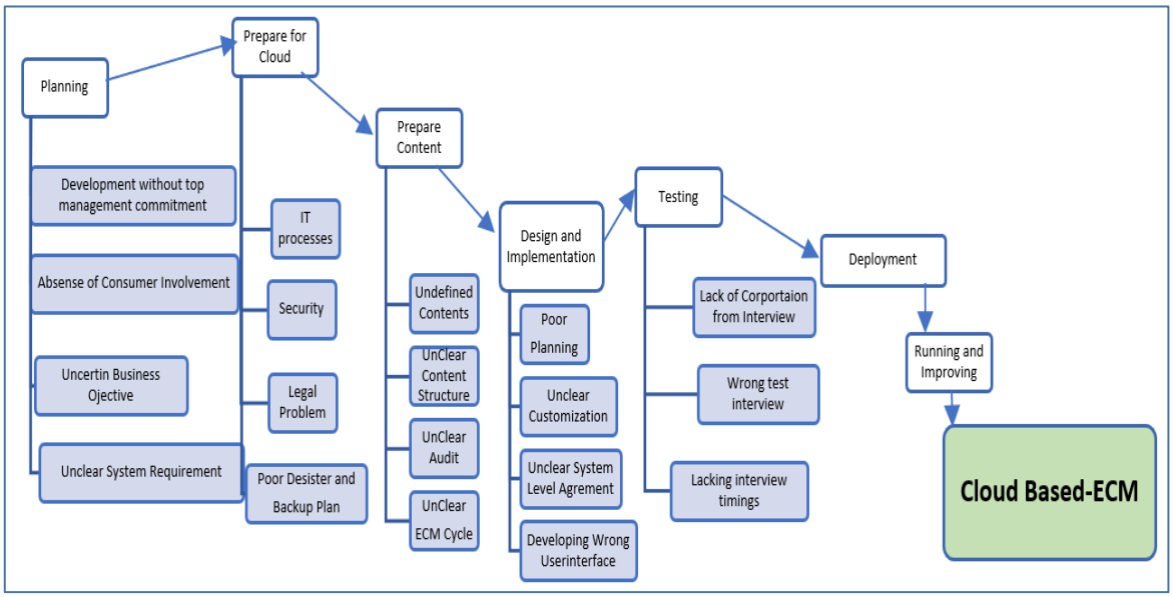

Figure 2. Enhanced Linear Sequential Cloud-based ECM Model

The Testing phase verifies the system's functionality and assesses its performance against established criteria. Nonetheless, insufficient cooperation during interviews, improper test procedures, and scheduling conflicts may adversely affect the accuracy of testing. Upon completion of testing, the Deployment phase commences, emphasizing the operationalization of the system. The purpose of the testing phase is to check the system's functionality and functionality. Furthermore, scheduling conflicts, lack of cooperation during interviews, and incorrect test procedures impact the testing accuracy. The deployment stage is more focused on the optimization of the system. Cloud maintenance and running, and improving the phase concern for the continuous monitoring of the system. This paper's contribution lies in structuring the phase systematically and moving to each step, checking and addressing the issues. This proposed model approach ensured the efficient, scalable, and secure implementation of a cloud-

based ECM system that is beneficial for business and data management for better collaboration. This research also helps to resolve the issues related to each phase and associated with cloud migration to strengthen the ECM's power and cost-efficiency.

3. RESULT AND DISCUSSION

Table 1 highlights the significant difference between cloud-based and on-premises-based ECM. Their characteristics include deployment, performance, update, compliance, user integration, accessibility, and disaster recovery. ECM technologies are essential for digital information management. Traditional on-premises ECM systems require organizations to maintain infrastructure, security, and compliance. However, cloud-based ECM solutions provide enterprises with a more scalable, cost-effective, and efficient alternative [33]. This detailed comparison highlights the key differences between On-Premises ECM and Cloud-Based ECM and the benefits of cloud-based solutions. Enterprises host and maintain on-premises ECM, needing dedicated infrastructure and IT professionals. Cloud-based ECM is more flexible and easier to implement. Enterprises have complete control over security, access management, and firewalls with on-premises ECM. However, this also means they are responsible for establishing and updating security measures. On the other hand, cloud-based ECM adheres to industry security requirements, where the cloud provider assures comprehensive security features such as encryption, multi-factor authentication, and constant monitoring. For sophisticated and resource-intensive regulatory compliance, on-premises ECM users must do it themselves [34].

Table 1. Cloud vs. On-Premises ECM Comparative Analysis

Characteristic	On-Premises ECM	Cloud-Based ECM
Deployment	Hosted by organizations	Cloud service infrastructure hosted by a third party
Security Control	Organizations had full control over access and security firewalls.	Industry standards manage all cloud security.
Compliance	Need to meet the regulatory needs	All are controlled by ISO standard-based
Data Ownership	All data controlled by the organization	All data is controlled by the cloud provider's servers
Access Management	Manual configuration	Built-in tools with Centralized access for access management and identity.
Scalability	It is expensive to scale an organization because of limited infrastructure.	Scalable with highly installed resources
Cost	Hardware, software, and maintenance are high costs.	Lower investment for maintenance
Maintenance	Internally managed by the organization's IT department.	The cloud service provider handled maintenance and updates.
Disaster Recovery	In-house disaster recovery solutions	The cloud provider offers disaster recovery options and robust backup
Updates	Manual upgrades and updates	The cloud provider regularly and automatically provides updates
Performance	network performance optimized on a local level	Dependent on provider infrastructure and internet connectivity
Data Residency	Physical proximity and control	Depending on the cloud service provider
Compliance Challenges	Industry compliance requirements on the local level	Data storage and jurisdiction challenges

Furthermore, this also means they are responsible for establishing and updating security measures. On the other hand, cloud-based ECM adheres to industry security requirements, where the cloud provider assures comprehensive security features such as encryption, multi-factor authentication, and constant monitoring. For sophisticated and resource-intensive regulatory compliance, on-premises ECM users must do it themselves [23]. Cloud-based ECM providers solve security and legal needs because they meet ISO certifications. The company owns and protects all data with an on-premises ECM system. Cloud-based ECM, however, is highly scalable, allowing businesses to increase storage and

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computing power as needed without significant additional costs. On-premises ECM requires substantial investment in hardware, software, and ongoing maintenance, making it a high-cost solution. On the other hand, Cloud-based ECM operates on a subscription-based model, reducing capital expenditure and shifting costs to an operational expense model [35]. This makes it a more cost-effective option, especially for small and medium-sized businesses. Organizations using on-premises ECM must manage maintenance internally, requiring dedicated IT teams to handle system updates and troubleshooting. Cloud-based ECM eliminates this burden, as the cloud provider handles maintenance and updates, ensuring continuous system improvements without IT intervention. On-premises ECM requires an in-house disaster recovery plan, including backup solutions that can be costly and complex [36]. Cloud-based ECM offers built-in disaster recovery solutions with automated backup and failover mechanisms, ensuring minimal downtime and data loss in case of system failures [28].

On-premises ECM requires an in-house disaster recovery plan, including backup solutions that can be costly and complex. Cloud-based ECM offers built-in disaster recovery solutions with automated backup and failover mechanisms, ensuring minimal downtime and data loss in case of system failures [24]. On-premises ECM is optimized for local network performance, making it ideal for organizations prioritizing internal data transfer speeds. Cloud-based ECM, however, relies on internet connectivity and the provider's infrastructure, which can impact performance depending on bandwidth availability [24]. On-premises ECM allows organizations to have physical control over their data storage, which benefits businesses operating in regions with strict data sovereignty laws. Cloud-based ECM, however, stores data on the cloud provider's servers, which may lead to jurisdictional challenges if data needs to comply with specific regional regulations [37]. Organizations must carefully review their cloud providers' data residency policies to ensure compliance. While on-premises ECM provides complete control and data ownership, it comes with higher costs, limited scalability, and increased IT responsibilities [32].

In contrast, cloud-based ECM offers significant advantages, such as efficiency, no hardware investments, and lower maintenance costs. Scalability – Easily adjust resources based on business needs - Security & Compliance – Managed by providers with industry-standard security frameworks [38]. Automatic Updates & Maintenance – Eliminates the need for manual intervention. Disaster Recovery – Robust backup solutions with minimal downtime. Enhanced Accessibility – Remote access and centralized management tools. Organizations looking for a flexible, cost-effective, and secure ECM solution should strongly consider cloud-based ECM, which provides long-term benefits, reduces operational complexity [39], and improves flexibility, agility, and scalability [40].

4. CONCLUSION

The study emphasizes the transformative potential of cloud-based ECM systems in enhancing business efficiency through modernized information management. ECM systems, whether on-premises or cloud-based, are pivotal in organizing, storing, retrieving content, ensuring compliance, and streamlining workflows. However, cloud-based ECM surpasses traditional systems by offering scalability, cost efficiency, and accessibility, which are critical for organizations operating in dynamic and globalized environments. The transition to cloud-based ECM systems represents a paradigm shift, addressing limitations of traditional models such as rigid infrastructure and high costs. Despite their benefits, adopting cloud-based solutions raises security, compliance, and organizational readiness concerns. The findings underscore the importance of balancing these challenges with the opportunities offered by enhanced collaboration, real-time data accessibility, and integration with existing systems. Ultimately, modern ECM systems, particularly cloud-based ones, are positioned as enablers of innovation, supporting digital transformation initiatives and empowering organizations to harness the full value of their information assets. ECM provides a platform for securely managing all structured and unstructured content across the enterprise. Seeing the benefit of "renting" software, corporations are increasingly using content management in the cloud. Based on the literature study results, we proposed a Cloud ECM model with a list of potential risks. All risks from the list have been categorized into the ECM cloud model's phases. The most significant elements of several content management systems are combined in this paper's architecture and design of a cloud-based integrated interface that combines the best aspects of different cloud-based content management systems. This design can benefit any firm deploying a cloud-based content management system. The system is dependable and flexible enough. It

can be further developed to include a more secure user authentication technique and an automatic resource allocation process.

The research highlights cloud-based ECM systems' revolutionary capacity to improve corporate productivity via modernized information management. Whether deployed on-premises or in the cloud, ECM systems are essential for organizing, storing, and retrieving content, guaranteeing compliance, and optimizing workflows. Cloud-based ECM outperforms traditional systems by providing scalability, cost efficiency, and accessibility, which are essential for organizations functioning in dynamic and globalized contexts. The shift to cloud-based ECM solutions signifies a fundamental change, overcoming the constraints of conventional models, which include inflexible infrastructure and elevated expenses. Nevertheless, the advantages of cloud-based technologies produce apprehensions regarding security, compliance, and organizational preparedness. The findings highlight the necessity of reconciling these problems with the advantages presented by improved cooperation, immediate data accessibility, and interaction with current systems. Modern ECM systems, especially in the cloud, facilitate innovation, bolster digital transformation efforts, and enable organizations to leverage their information assets fully. To improve decision-making and predictive content management, future studies should investigate the incorporation of sophisticated AI-driven analytics into cloud ECM systems. Furthermore, longitudinal research evaluating how cloud ECM adoption affects compliance and organisational performance over time would yield insightful empirical data.

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