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Development of the Smartcoop Website Using a Rapid Application Development Approach (Case Study: CV. Four Vision Media)

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Abstract

The SmartCoop Website Management System (WMS) is used as a promotional tool for CV Four Vision Media. An evaluation of the current system revealed limited technology compatibility, weaknesses in access security mechanisms, and suboptimal content management. To address these issues, this study implemented the Rapid Application Development (RAD) method, which allows for an iterative and structured development process through the stages of requirements planning, design, construction, and implementation. The development results demonstrated improved content management flexibility, multilingual content support, and a strengthened authentication system. Functional testing using a black box approach demonstrated that all features performed according to established specifications. These findings demonstrate the effectiveness of the RAD approach in WMS development to improve the quality and reliability of websites used as a promotional tool for companies.

Keywords: Website Management System, Rapid Application Development, System Security, Promotional Media.

1 INTRODUCTION

The rapid evolution of information technology compels organizations to leverage web platforms as strategic assets for corporate communication and brand equity. Web platforms have transitioned from passive information repositories into core determinants of corporate identity, institutional credibility, and service quality. In a highly competitive digital ecosystem, web architecture must continuously accommodate emerging technological paradigms, facilitate seamless API integration, and enforce robust access control mechanisms. Consequently, a Website Management System (WMS) requires an adaptable, secure, and sustainable architecture to effectively align with dynamic operational demands.

In this context, the SmartCoop web platform, operated by CV Four Vision Media, functions as a primary digital interface for corporate offerings. Empirical evaluation of the existing system, however, reveals critical structural impediments: framework incompatibility with modern software libraries, suboptimal access security controls, and rigid content management capabilities that compromise operational efficiency and administrative flexibility. These deficiencies create a substantial performance gap between organizational requirements and legacy system capabilities, thereby undermining the platform's promotional efficacy.

Addressing these challenges necessitates a comprehensive modernization of the WMS focusing not merely on feature expansion, but on elevating technical quality, security posture, and architectural resilience without requiring a complete system rewrite. An incremental, target driven engineering strategy represents a viable pathway to preserve legacy stability while progressively optimizing system performance and reliability.

Accordingly, this study aims to engineer an upgraded WMS for SmartCoop to enhance technical compatibility, fortify security mechanisms, and streamline content administration. To realize this objective, the research adopts the Rapid Application Development (RAD) methodology. RAD is selected due to its iterative, collaborative, and user centric lifecycle, which mitigates integration risks and enables granular system adaptations more effectively than traditional linear software development models.

While RAD has been extensively investigated within software engineering literature, prior research predominantly examines greenfield developments focused on fundamental Create Read Update Delete (CRUD) operations. Empirical studies addressing the adaptation of RAD within brownfield engineering contexts specifically refactoring legacy systems burdened by technical debt, security vulnerabilities, and tightly coupled operational workflows remain scarce.

Consequently, the scientific novelty and methodological contribution of this research reside in formulating an adapted RAD framework tailored for legacy WMS modernization. This framework incorporates multi factor authentication (Email OTP and 2FA), decentralized content governance, and modern third party API integration (Google Analytics 4 and reCAPTCHA Enterprise) while preserving uninterrupted operational continuity.

Beyond technical implementation, this study advances the empirical understanding of RAD methodologies applied to organizational web architecture. The resulting insights and framework provide a replicable reference model for legacy system refactoring, demonstrating how security, operational flexibility, and administrative efficiency can be significantly enhanced without executing high risk, full system overhauls.

2 LITERATURE REVIEW

2.1 Software

Software refers to a structured collection of computer programs, accompanied by the necessary documentation and configuration data required for the system to be operated, developed, and maintained effectively [23]. Software is an engineering product developed through a systematic process to fulfill user and organizational needs, where the success of the software is strongly influenced by the development approach used [9].

Software engineering plays a crucial role in bridging user requirements with technical solutions that can be effectively implemented. Sommerville [27] states that the success of software is determined not only by technical aspects, but also by the system's alignment with user needs and the organizational context.

2.2 Rapid Application Development (RAD)

Rapid Application Development (RAD) is an approach in software engineering that emphasizes development speed through iterative processes, the use of prototypes, and intensive user involvement. This approach emerged in response to the limitations of traditional development methods, which tend to be time consuming and inflexible regarding changing requirements. RAD prioritizes rapid system construction by utilizing reusable components and iterative evaluations based on user feedback [23]. It distinguishes itself from traditional development models through an iterative approach that positions users as an integral part of the system design and evaluation process [31]. According to Shaker [26], RAD comprises four primary phases requirements planning, user design, construction, and cutover which are systematically applied to produce a functional system within a relatively short timeframe.

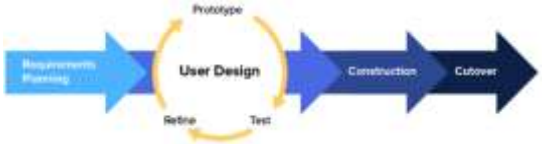

Figure 1. RAD Stages

2.3 Unified Modeling Language (UML)

Unified Modeling Language (UML) is a standard visual modeling language used to describe, design, and document software systems. UML was developed to unify various modeling techniques that were previously used in isolation, thereby providing a consistent modeling language that is widely applicable in information system development [6]. UML is based on the concept of system representation through visual diagrams that portray both the structural and behavioral aspects of a system. According to Booch, Rumbaugh, and Jacobson [6], UML modeling aims to simplify system complexity by decomposing it into specific viewpoints relevant to development requirements. UML is categorized into three main categories: Structural Diagrams, Behavioral Diagrams, and Interaction Diagrams.

2.4 Internet

The Internet is a network of networks that enables the exchange of data, information, and services through core protocols such as Transmission Control Protocol (TCP) and Internet Protocol (IP) [16]. According to Forouzan [8], the Internet enables real time information delivery and supports the integration of various web based services that are dynamic and interactive.

2.5 *Website Management System* (WMS)

A Website Management System (WMS) is a software system designed to manage, update, and control the content and functional components of a website in a structured manner through a dedicated interface. According to Pressman and Maxim [23], custom developed software systems enable developers to design functions, data structures, and control mechanisms that align more closely with user business processes, thereby enhancing the flexibility and effectiveness of system management.

2.6 OTP and 2FA Security

Authentication mechanisms that rely solely on a single factor, such as a username and password, exhibit high vulnerability to security attacks, including credential theft and brute force attacks [28]. A One Time Password (OTP) is an authentication mechanism utilized as a second factor in the implementation of Two Factor Authentication (2FA). An OTP is a temporary authentication code

that is valid for a single use within a single authentication session. This code is dynamic and has a short validity period, thereby preventing reuse. According to Alasmary [2], the implementation of OTP is effective in preventing credential misuse because even if the primary password is compromised, the dynamic and short lived OTP code continues to safeguard the authentication process.

Figure 2. How the OTP security system works

Two Factor Authentication (2FA) is an authentication method that requires users to provide two distinct forms of identity verification before gaining access to the system. The implementation of 2FA significantly reduces the risk of unauthorized access, particularly in web based systems with privileged users, such as administrators [1]. This is because successful authentication relies not merely on a single type of credential, but requires a combination of two distinct factors, thereby making it more difficult to be exploited by unauthorized parties.

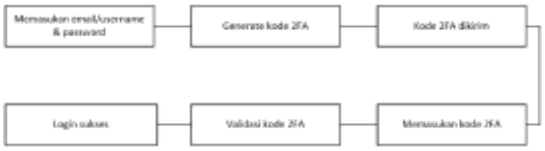

Figure 3. How the 2FA security system works

3 RESEARCH METHODOLOGY

This study employs a system development approach using the Rapid Application Development (RAD) methodology. This approach was selected because it enables the development process to be conducted iteratively and adaptively in response to user requirements. The research focuses on the development of a Website Management System (WMS) for the SmartCoop website at CV Four Vision Media.

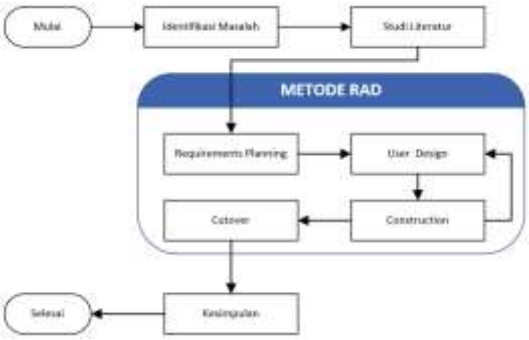

Figure 4. Research Flowchart

The Rapid Application Development (RAD) method was implemented in this research through a participatory approach through four main stages:

1. Requirements Planning: WMS Admin and CV. Four Vision Media's operational team were involved in structured interviews to identify technical challenges in the Laravel 7 based system. The results of this phase identified five key requirements: 2FA/OTP authentication, self-service account recovery, dynamic pricing plan management, dynamic homepage content management, and multilingual features.

2. User Design: Users and developers collaboratively designed the WMS backend interface and UML diagrams. Users provided input on the responsive design of the multilingual input layout using a tab system and QR Code scanning for 2FA & OTP.

3. Construction (Iteration and Modification): This stage consisted of three main iterations based on user feedback:
   a. Iteration 1 (Security): Developed the OTP and 2FA modules. Based on user feedback regarding security risks, the system was modified to include a 5 minutes OTP expiration and an email token based Forgot Password mechanism.

   b. Iteration 2 (Content Management): Developed CRUD modules for Pricing Plans and Homepage Content. User feedback resulted in a centralized interface modification that allows admins to independently change pricing and multilingual text without developer assistance.

   c. Iteration 3 (External API): Integration of Google Analytics 4 and Google reCAPTCHA Enterprise into the contact form to meet spam protection requirements.

4. Cutover: Users performed final verification through Black Box testing across all functional scenarios to ensure all modifications met operational requirements before the system was deployed.

3.1 Problem Identification

The problem identification phase was conducted to define the core issues of the SmartCoop website as the research object through direct observation of the existing system. The analysis focused on technical and content management aspects within the Website

Management System (WMS), encompassing technological compatibility, security levels, and the system's capacity to support the company's promotional needs. This process was carried out through document reviews, evaluation of existing features, and discussions with relevant stakeholders. The identification results revealed framework version incompatibilities with modern technologies, sub optimal security and access recovery mechanisms, and content management feature limitations that impacted the operational efficiency of the website.

3.2 Literature Study

The literature study phase was conducted to establish a conceptual foundation supporting the research by reviewing various scientific sources, including textbooks, academic journals, conference proceedings, technical documentation, and relevant prior studies related to website development, Website Management Systems (WMS), system security, and the Rapid Application Development (RAD) methodology. This review aims to gain a comprehensive understanding of the concepts, principles, and practices that serve as reference points in developing the SmartCoop website. Furthermore, the literature study aids in understanding the characteristics and phases of RAD, as well as its relevance to system development that is iterative and user centric. The findings of this review serve as the foundation for constructing the theoretical framework, selecting the methodological approach, and designing the system in subsequent phases.

3.3 Requirement Planning

This stage serves as the initial phase in the Rapid Application Development (RAD) methodology, focusing on the structured formulation of system requirements. During this phase, a requirements analysis is conducted based on the identified problems to define both functional and non functional requirements for the SmartCoop website, ensuring alignment with the company's operational and promotional needs. The planning process involves coordination with relevant stakeholders to identify WMS user requirements, including those of administrators and content managers. This activity encompasses defining the features to be developed, such as security mechanism enhancements, more flexible content management, and technological adjustments. Additionally, development scope constraints are established to ensure that the research remains within its intended boundaries.

3.4 User Design

The user design phase focuses on collaborative system design between developers and users. During this phase, the requirements formulated during the requirements planning phase are translated into a more structured and comprehensible system design. The design encompasses the formulation of system workflows, feature structures, and user interface designs for the Website Management System (WMS). Furthermore, business processes and user interactions are modeled to ensure that feature usage workflows are clearly understood prior to the implementation phase. The resulting design is then communicated to and evaluated with company stakeholders to gather feedback and ensure alignment with operational requirements.

3.5 Construction

This phase focuses on system implementation based on the design agreed upon during the user design phase. During this stage, coding, configuration, and feature integration into the SmartCoop website are carried out, encompassing the development of WMS modules, framework adjustments, the application of security mechanisms, and the implementation of user interface designs according to established specifications. This phase is iterative in nature, allowing each development increment to be tested and evaluated alongside users to ensure alignment with requirements. If any deficiencies are identified, refinements are made prior to proceeding to the next phase. The output of this phase is a fully functional system ready to enter the testing stage.

3.6 Cutover

The cutover stage represents the final phase, focusing on testing and deploying the developed system. During this phase, the SmartCoop website is thoroughly tested to ensure that all features function in accordance with the established requirements without causing functional errors. Testing is conducted on the core features of the WMS, including access security mechanisms, content management, and the system's user interface. Once the system is verified to meet specifications, it is deployed into the company's operational environment. This stage also encompasses final adjustments should any minor issues arise during the testing process.

3.7 Conclusion

The conclusion stage represents the final phase of the research process, conducted to comprehensively evaluate the overall system development outcomes. In this phase, the results from each preceding phase ranging from requirements planning, user design, construction, to cutover are analyzed to assess the extent to which the developed system addresses the identified problems and achieves the research objectives. This evaluation serves as the foundation for determining the effectiveness of applying the RAD methodology to the implemented WMS development.

4 RESULTS AND DISCUSSION

4.1 System Development Results

The WMS development was conducted based on the requirements formulated during the requirements planning phase. The implementation results demonstrate improvements in content management flexibility, external service integration, and the strengthening of access security mechanisms.

4.1.1 Implementation of Multi Layered Authentication (OTP)

The system was developed by incorporating an OTP authentication mechanism as an additional verification layer following the login process using a username and password. This implementation aims to mitigate the risk of unauthorized access to the system.

Figure 5. OTP Verification Form

4.1.2 Implementation of reCAPTCHA Enterprise

To enhance security on contact forms, the system was integrated with the reCAPTCHA Enterprise service. This feature functions as a validation mechanism to ensure that submitted data originates from legitimate users.

Figure 6. Contact Form Page

This integration enables the system to perform initial filtering of activity indicated as bots or spam, thereby enhancing the reliability of the received data.

4.1.3 Google Analytics 4 Integration Improvements

The system was unable to display visitor statistical data optimally. Following the development phase, the Google Analytics 4 integration was successfully updated, enabling visitor information to be displayed centrally within the WMS.

Figure 7. Google Analytics 4 Visitor Graph

This enhancement enables administrators to directly monitor website performance through the management system.

4.1.4 Dynamic and Multilingual Content Management

The development also encompasses modules for managing pricing packages and homepage content, which can be dynamically updated. The system supports multilingual content management, thereby enabling information to be tailored to user needs.

Figure 8. Manage Pricing Packages

Figure 9. Manage Home Content

Figure 10. Multilingual Content Form

This feature enhances administrative flexibility and facilitates information updates without requiring changes to the source code structure.

4.1.5 Black Box Testing

System functionality validation was executed during the Cutover phase using the Black Box Testing methodology to verify that all refactored modules met the defined functional requirements. A total of 12 test cases were formulated, covering multi factor authentication (Email OTP and TOTP 2FA), self service account recovery, dynamic content and pricing package management, multi language support, and external API integrations (Google Analytics 4 and reCAPTCHA Enterprise). As detailed in Table 1, 100% of the test cases (12 out of 12) were successfully executed with a 'Pass' status, confirming that the modernized SmartCoop WMS operates with high stability and meets all practical requirements.

Table 1. Black box testing

Input Data	Expected Output	Actual Output	Stat
Test Scenario 1 Valid Email OTP Verification			
Valid Username, Password, and correct 6 digit Email OTP	System grants access to WMS dashboard	Redirected to WMS dashboard successfully	Pass
Test Scenario 2 Invalid Email OTP Verification			
Correct Login credentials, incorrect OTP code	System denies access and displays error message	"Invalid OTP code" displayed	Pass
Test Scenario 3 Expired Email OTP Verification			
Valid OTP entered after 5 minute timeout	System denies access due to OTP expiration	"OTP code expired" displayed	Pass
Test Scenario 4 Valid 2FA OTP Verification			
Valid 6 digit OTP from Google or Microsoft Authenticator	System authenticates user and opens WMS dashboard	Authenticated successfully	Pass
Test Scenario 5 Invalid 2FA OTP Verification			
Incorrect 6 digit OTP code	System rejects login attempt and shows warning	Warning message displayed	Pass
Test Scenario 6 Self Service Password Recovery (Valid Email)			
Registered admin email in "Forgot Password" form	Reset password token sent to user email	Password reset link received via email	Pass
Test Scenario 7 Self Service Password Recovery (Unregistered Email)			
Non existent or empty email in recovery form	System rejects request and shows error message	"Email not found" notification displayed	Pass
Test Scenario 8 Dynamic Pricing Package Management			
Create, edit, or delete pricing tiers via WMS CRUD interface	Pricing updates dynamically on public site without code modification	Pricing details updated dynamically	Pass
Test Scenario 9 Dynamic Homepage Content Management			
Modify text/banner sections via WMS admin panel	Homepage content updates dynamically on public landing page	Homepage content reflected correctly	Pass
Test Scenario 10 Multi language Content Input			
Input content in Indonesian and English via tabbed forms	Public site displays content according to selected language switcher	Language switched and displayed properly	Pass
Test Scenario 11 Google Analytics 4 Integration			
Load GA4 analytics tab on WMS dashboard	Real time traffic data and visitor metrics displayed correctly	GA4 traffic metrics rendered properly	Pass
Test Scenario 12 Google reCAPTCHA Enterprise Verification			
Submit public contact form with reCAPTCHA verification	Spam/bot submissions blocked; legitimate user entries passed	Bot submissions filtered and form submitted	Pass

4.2 Discussion

The research findings demonstrate that applying the RAD methodology positively impacts the effectiveness of the system development process. The iterative nature of RAD enables each phase from requirements planning to implementation to be carried out incrementally with continuous evaluation. This approach minimizes the risk of development errors, as adjustments can be made before the system proceeds to the next stage. Consequently, feature enhancements and technical improvements can be implemented without altering the overall system architecture, thereby maintaining system stability.

From a security perspective, the implementation of multi layered authentication via an OTP mechanism, alongside reCAPTCHA Enterprise integration, significantly improves access

control and user validation. Adding a verification layer not only reduces the risk of unauthorized access but also enhances the system's reliability in filtering potentially harmful activities, such as repeated login attempts and automated data submissions by bots. This demonstrates that reinforcing security through dual factor authentication and external validation effectively elevates overall system protection.

Beyond security aspects, the development of dynamic content management modules and multilingual support enhances the website's operational flexibility. Administrators can update content, configure pricing packages, and manage homepage elements without direct intervention in the source code. This increases management efficiency and accelerates the promotional information update process, making the website more adaptive to business needs.

Overall, the findings of this study demonstrate that the RAD approach is effectively applied to WMS development requiring enhanced technology compatibility, strengthened security, and content flexibility within a relatively short implementation timeframe. This effectiveness is reflected in achieving the research objectives without disrupting the underlying structure of the pre existing system.

Methodologically, the results of this study expand the application of RAD from merely prototyping new applications to a legacy system refactoring strategy, particularly emphasizing the speed of interface iteration in new applications. This study has proven the effectiveness of RAD in mitigating security risks and restructuring existing systems. Structured iteration in RAD has been proven to facilitate the integration of high security modules (Email OTP and 2FA) as well as modern API updates (Google Analytics 4 and reCAPTCHA Enterprise) smoothly without causing downtime to business operations.

Table 2. Systematic Comparison of SmartCoop WMS Before and After Development

Dimension	Legacy System	Modernized WMS	Observed Improvement & Impact
Technology Compatibility	Based on deprecated Laravel 7 framework, unable to support modern libraries and legacy recaptcha v2.	Codebase updated and refactored to support modern third party libraries and Google reCAPTCHA Enterprise.	Resolves technical debt, ensures long term framework maintainability, and prevents API deprecation risks.
Authentication & Access Security	Single factor authentication (username & password only); password recovery required manual developer intervention in the database.	Multi Factor Authentication implemented (Email OTP + 2FA via Google/Microsoft Authenticator) with self service password reset via email token.	Hardens system against brute force attacks and eliminates single point of failure/developer dependency in account recovery.
Content & Pricing Management	Static homepage content and pricing packages hardcoded or queried directly from DB without a management UI.	Dynamic WMS CRUD modules enabling non technical admins to create, edit, or delete pricing tiers and homepage content dynamically.	Decentralizes operational control to business administrators, reducing turnaround time for content updates to zero.
Analytics Integration	Incompatible with Google Analytics 4 (GA4) due to legacy library restrictions; no traffic monitoring on WMS dashboard.	Integrated GA4 API displaying real time visitor traffic, pageviews, and user engagement metrics directly within the WMS dashboard.	Empowers administrators with data driven decision making capabilities inside the WMS.
Multilingual Functionality	Restricted to a single language (Indonesian); unable to support international marketing campaigns.	Multi language management via tabbed input fields in WMS and dynamic frontend language switcher.	Expands business reach to international clients and improves user experience for multi regional audiences.

The systematic comparison in Table 2 demonstrates a significant transformation from a rigid legacy system to a modern, dynamic, and secure WMS. The results of this study provide three key contributions to the software engineering domain: First, most RAD research focuses on greenfield development, limited to prototyping new applications with basic transactional interfaces. This study demonstrates that RAD is also highly effective when applied to brownfield refactoring to address technical debt in an outdated framework (Laravel 7) without disrupting business continuity. Second, from a security and operational perspective, the addition of Email OTP, 2FA and self service account recovery modules effectively eliminates operational dependency on developers. A key barrier to traditional WMS where every price or password change requires coding intervention from programmers can be addressed through structured RAD iterations that transfer full control to business administrators. Third, the integration of modern APIs such as Google Analytics 4 and Google reCAPTCHA Enterprise demonstrates that the RAD approach can facilitate rapid third party ecosystem

integration within short iteration cycles, while simultaneously expanding a company's market reach through multilingual functionality.

5 CONCLUSION

Empirical findings demonstrate that modernizing SmartCoop's Website Management System (WMS) through the Rapid Application Development (RAD) methodology effectively addressed the architectural and functional limitations identified during the initial diagnostic phase. Framework refactoring improved system interoperability and technology compatibility, enabling seamless integration with modern web services to support the company's operational and promotional objectives. The platform's security posture was significantly strengthened through layered access controls specifically email based credential recovery and two factor authentication (2FA/OTP) which mitigated the risk of unauthorized access. Furthermore, the implementation of a dynamic content governance module and multilingual support optimized administrative flexibility and operational efficiency. A systematic evaluation confirmed that all functions operated within defined specifications, demonstrating RAD's ability to deliver structured and adaptive system improvements while maintaining core architectural integrity.

Scientifically and methodologically, this study concludes that the RAD approach is not only effective for new (greenfield) software projects, but also serves as a robust reference framework for the safe and efficient refactoring of existing (brownfield) web systems, successfully resolving technical debt without disrupting ongoing business operations.

To advance this line of research, future research should incorporate performance evaluation and quantitative security benchmarking, along with comparative empirical analysis with alternative software development methodologies.

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