KnE Social Sciences
IJESAS
International Joint Seminar on Education, Social Science and Applied Science
Volume 2024

Research Article

# Enhancing Intellectual Property Information System Quality with RAD and FMCDM

**Adi Pratomo[1]*, Mey Risa[2], and Agus Irawan[3]**

[1]Digital business, State Polytechnic of Banjarmasin, Indonesia
[2]Business Administration, State Polytechnic of Banjarmasin, Indonesia
[3]Information Management, State Polytechnic of Banjarmasin, Indonesia

**ORCID**
Adi Pratomo: https://orcid.org/0000-0002-7471-8993

**Abstract.**
In the development of intellectual property information systems, the Rapid Application Development (RAD) method and Fuzzy Multi-Criteria Decision Making (FMCDM) were often used to enhance the quality and effectiveness of system development. This research aimed to analyze the effectiveness of implementing the RAD and FMCDM methods in the development of intellectual property information systems at Poliban. The study employed a qualitative approach through a case study of the development of intellectual property information systems at Poliban. The RAD and FMCDM methods were applied in the development of intellectual property information systems during the user design stages, followed by an analysis of the quality and effectiveness of system development. The research results indicated that the application of the RAD and FMCDM methods in the development of intellectual property information systems at Poliban was effective and could improve the quality of system development. Using the RAD method, system development could be executed quickly and efficiently, while the FMCDM method allowed for more accurate and precise decision-making during system development. The combination of the RAD and FMCDM methods led to the creation of a better and more effective intellectual property information system.

**Keywords:** fuzzy multi-criteria decision making, information system, intellectual property, rapid application development

Corresponding Author: Adi Pratomo; email: adipratomo@poliban.ac.id

**Published**: 3 July 2024

Publishing services provided by Knowledge E



Selection and Peer-review under the responsibility of the IJESAS Conference Committee.



## 1. INTRODUCTION

Intellectual property (IP) has become a critical asset for many organizations, especially in the era of information technology and digitalization. According to Albers et al. (2017), the value of IP has surpassed physical assets in many companies, and it is essential for them to protect and manage their IP assets efficiently [1]. Since the technological process is shorter, organizations consider intellectual property rights (IPR) protection of knowledge is unnecessary [2]. In the context of higher education, the development of an effective system to manage intellectual property becomes crucial for universities and polytechnics to support their research and innovation activities. Effective management of intellectual property (IP) is a crucial concern, influencing the utilization and

constraints of research outcomes, as well as exerting an impact on the competitiveness of technology-driven enterprises [3].

Developing an efficient system to manage IP is not an easy task and requires a systematic and structured approach. One of the methodologies widely used for software development is Rapid Application Development (RAD). RAD is a methodology that emphasizes prototyping and iterative development to quickly deliver usable software products. The choice of the RAD method over the waterfall method was made due to its capability to expedite the process of website development [4]. Websites are extensively utilized as tools for delivering services and disseminating information in the present times [5]. The term Rapid Application Development (RAD) model is employed to denote adaptive approaches to software development [6]. Although it has advantages, RAD has some limitations in terms of decision-making and project management [6,7,8] .

To address these limitations, this research integrates Fuzzy Multi-Criteria Decision Making (FMCDM) with RAD for the development of the IP management system at Banjarmasin State Polytechnic. FMCDM is a decision-making method suitable for handling complex and uncertain problems with multiple criteria [9]. By integrating FMCDM with RAD, this study aims to enhance the decision-making process and project management in the development of the IP management system. The findings of this research are expected to provide recommendations for selecting the appropriate and effective software development methodologies for the IP management system and other information systems.

## 2. METHOD

The research employed the case study method to assess the application of RAD and the Fuzzy Multi-Criteria Decision Making Method in developing intellectual property information systems. The study examines the development process and measures the impact on system quality. Intellectual Property management involves IP registration, document examination, data storage, submission, and information presentation..

### 2.1. Research Instrument

The research tool used to obtain decision recommendations is Fuzzy Multi Criteria Decision Making. Data is collected using questionnaires and interviews [10]. Meanwhile, the system design employs the use case diagram and ER Diagram .

## 2.2. Rapid Application Development (RAD)

The RAD (Rapid Application Development) method is a software development approach used to quickly produce applications. This approach combines prototyping with iterative methods in the software development process [11].

RAD is a software development method that allows developers to expedite the development process by reducing the time required to create software applications [12]. RAD enables developers to concentrate more on meeting user needs and enhancing the product's quality. In this model, there are several stages of system development [13]. In the Requirements Planning phase, users and developers convene to analyze and address existing issues while determining the essential elements for creating the application system [14, 15]. During the User Design stage, a proposed design is crafted to align with the specified requirements. In this research, Unified Modeling Language (UML) tools are employed to illustrate the system design [16, 17]. The Construction phase marks the initiation of system development, where program code is written (commonly referred to as coding) to translate the system design into a functional application [18]. The Cutover phase involves transitioning the developed prototype to the production environment, employing a Rapid Application Development (RAD) approach [19].

## 2.3. Fuzzy Multi-Criteria Decision Making (FMCDM)

FMCDM is a decision-making method that employs fuzzy logic theory to address uncertainty in evaluating criteria. It is utilized to select the best alternative from several options while taking into account conflicting criteria [20]. FMCDM is a decision-making method used to tackle complex problems by considering multiple uncertain criteria and parameters [21, 22]. This method is particularly well-suited for decision-making in software development, as such decisions often rely on complex and uncertain criteria [23]. The process of implementing Fuzzy Multi-Criteria Decision Making (FMCDM) includes the identification and assessment of criteria and sub-criteria, conversion of linguistic scales to fuzzy values, measurement of acceptability, calculation of fuzzy weights, determination of priorities, decision-making, and subsequent result evaluation [24].

The application of FMCDM allows for a more systematic and comprehensive decision-making process, incorporating uncertainty and preferences that may exist in the decision-making process [25, 26].

### 2.4. System Development Method

The development of information systems is the process of developing software used to meet the information needs of an organization or company. The information system development process includes several stages, such as requirement analysis, design, implementation, and testing [27]. James Martin is credited with formalizing the Rapid Application Development (RAD) method. These stages emphasize the user's involvement, rapid prototyping, and faster delivery of a functional system [11].

Several previous studies have discussed the integration of the RAD method and FMCDM in information system development [23, 25, 26]. The simultaneous use of the RAD method and FMCDM in the development of intellectual property information systems can expedite the development process and enhance the quality of the resulting product. System development at each stage applies FMCDM to analyze alternatives determined by the involved parties.

## 3. RESULTS AND DISCUSSIONS

The study is undertaken to respond to the research query on how incorporating Fuzzy Multi-Criteria Decision Making (FMCDM) into Rapid Application Development (RAD) influences the decision-making process and the overall quality of developing the Intellectual Property Information System. The specific focus is on the Intellectual Property Information System at the State Polytechnic of Banjarmasin.

### 3.1. User Design

#### 3.1.1. Identification of criteria and sub-criteria and determination of weights using a fuzzy approach

In the "User Design" phase of RAD, FMCDM involves identifying criteria and sub-criteria for user interface and experience. Weights are then assigned using a fuzzy approach, transforming linguistic scale assessments like "Very Low" to "Very High" into fuzzy numbers. See Table 1 for the typical representation of these assessments [23, 26, 28].

### 3.1.2. Evaluating Alternatives Using Fuzzy Approach

To perform the evaluation using the fuzzy approach, the linguistic scale that has been converted into fuzzy numbers is used, as explained earlier [29]. Table 1 illustrates the evaluation results for each alternative:

TABLE 1: Evaluate user design alternatives.

| Criteria/Sub-criteria | Fuzzy Weight | Alternative 1 | Alternative 2 | Alternative 3 |
|---|---|---|---|---|
| User Interface (UI) – High | (0.3, 0.5, 0.7) | Moderate | High | High |
| User Interaction – Very High | (0.5, 0.7, 1) | Moderate | Very High | High |
| Functionality – Moderate | (0.1, 0.3, 0.5) | Low | Very High | Moderate |
| User Support – Moderate | (0.1, 0.3, 0.5) | Low | Very High | Moderate |
| Adaptability - Low | (0, 0.1, 0.3) | Low | High | Moderate |

### 3.1.3. Aggregation of Fuzzy Values

To calculate total scores for each requirement, fuzzy value aggregation is done using the max-min method. This method considers the minimum value for inferior components and the maximum value for superior components across all trapezoidal fuzzy numbers. Table 2 illustrates the aggregated values for each alternative using the max-min method [30].

TABLE 2: Aggregation of Fuzzy Values in user design.

| Alternatif | A1 Inferior | A1 Superior | A2 Inferior | A2 Superior | A3 Inferior | A3 Superior |
|---|---|---|---|---|---|---|
| Alternatif 1 | 0 | 0.5 | 0.3 | 1 | 0 | 0.7 |
| Alternatif 2 | 0.3 | 1 | 0.3 | 1 | 0.3 | 1 |
| Alternatif 3 | 0 | 0.7 | 0 | 1 | 0 | 0.7 |

Based on the aggregation using the max-min method, Alternative 2 has the highest total score, followed by Alternative 3, and then Alternative 1. Therefore, according to this evaluation, Alternative 2 is the best choice based on the specified criteria and sub-criteria.

### 3.1.4. User Design Rangking

Based on the previous fuzzy value aggregation, we obtained total scores for each alternative. Therefore, based on the conducted evaluation, Alternative 2 is the top priority based on the requirements, followed by Alternative 3, and then Alternative 1 as the last priority.

### 3.1.5. System Functional Requirements

Based on Alternative 2, here are the expected application features. System functional requirement based on alternative 2:

TABLE 3: System functional requirement based on alternative 2.

| Feature Category | Feature Description |
|---|---|
| User Interface (UI) | User-friendly responsive UI |
| Integration | Supports integration with other platforms |
| Search Functionality | Advanced search with filtering and sorting |
| Intellectual Property Registration | Registering new intellectual property rights |
| Data Protection | Advanced data encryption and regular backups |
| User Authentication | Multi-factor authentication support |
| Customization Capability | Allows customization of appearance and functionality |
| Scalability | Cloud infrastructure allowing scalability |

### 3.1.6. Use case diagram

Based on the use case in Figure 1. this system provides various functions for the management of intellectual property, including the ability for general users, researchers/lecturers, and administrators to view, search, and register intellectual property. Researchers/lecturers can access registration status information, while administrators have roles in verification, validation, and providing feedback on registrations. Additionally, administrators can comprehensively manage intellectual property data, including editing, deleting, or updating information. The entire user management, including the addition, editing, or deletion of accounts, is also under the control of administrators. Thus, this system offers an integrated solution for the effective and efficient management of intellectual property aspects.

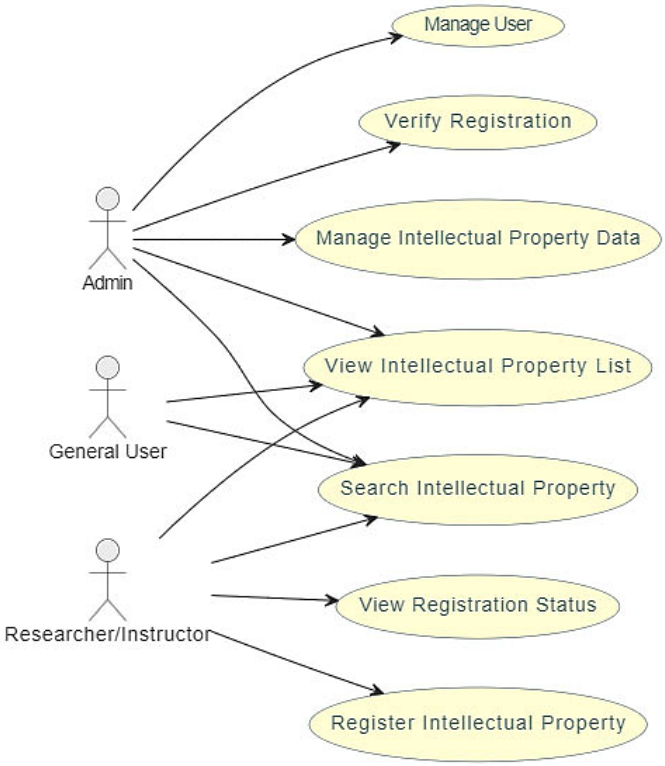


**Figure** 1: System use case diagram.

### 3.1.7. User Interface Diagram

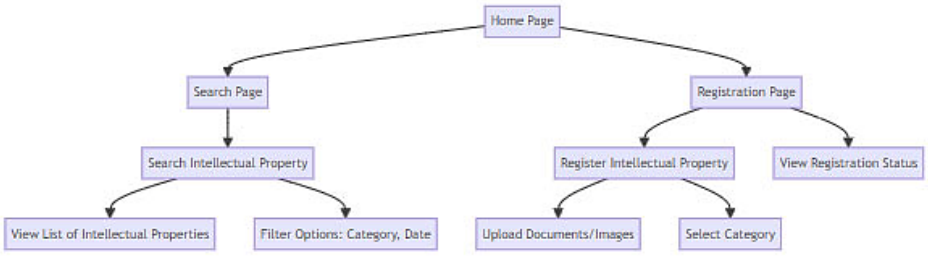


**Figure** 2: Homepage structure.

In Figure 2., the user interface diagram for the Intellectual Property System reveals components like the Main Page, Search Page, Registration Page (for Researchers/ Lecturers), Registration Status Page, and Admin Dashboard. These components encompass essential functionalities, such as presenting recent intellectual properties, information search, and the registration process for researchers..

### 3.1.8. Database Design

Creating the database schema for a web-based intellectual property information system involves a deep understanding of various aspects like copyrights, patents, trademarks, and industrial designs. Figure 3. illustrates the schema, including entities such as User, IntellectualPropertyType, IntellectualProperty, Trademark, Patent, Copyright, ChangeLog, and Communication, with detailed attributes and relationships. For instance, each user can have multiple intellectual properties, and each intellectual property is owned exclusively by a single user. Trademarks, Patents, and Copyrights are specializations of IntellectualProperty, connected through KI_ID.

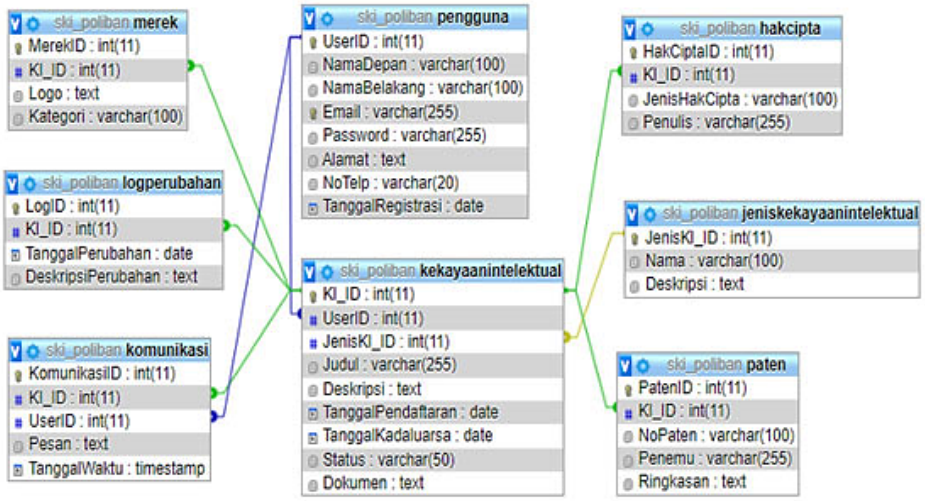


**Figure** 3: Database Design.

## 3.2. Analysis

The analysis in Table 4 shown the importance of developing an intellectual property information system and the effectiveness of applying the Rapid Application Development (RAD) and Fuzzy Multi-Criteria Decision Making (FMCDM) methods in the development of the system:

From the above analysis, it can be concluded that the development of an intellectual property information system at Banjarmasin State Polytechnic (Poliban) is highly important, and the application of RAD and FMCDM methods has proven effective in improving the quality and effectiveness of system development. The combination of these two methods can result in a superior and more effective system.

Table 4: Analysis.

| Analysis Aspect | Findings |
|---|---|
| IP Information System Needs | It is essential to support academic and research activities. |
| | The use of RAD and FMCDM methods is often employed to enhance system development quality. |
| | |
| Application of RAD and FMCDM Methods | RAD enables rapid and efficient system development. |
| | - FMCDM facilitates more accurate and precise decision-making in system development. |
| | |
| Effectiveness of Applying RAD and FMCDM | - The application of RAD and FMCDM methods is effective in enhancing the quality of system development. |
| | - RAD and FMCDM methods can be used in combination to produce a better and more effective intellectual property information system.<br>- The development time for the system, from requirements to design, using the traditional method is approximately 1 week. Meanwhile, the development time using RAD with FMCDM is 3 days. |

## 4. CONCLUSION

Integrating Fuzzy Multi-Criteria Decision Making (FMCDM) into Rapid Application Development (RAD) has notably enhanced decision-making throughout various development phases, as evidenced by the Intellectual Property Information System development in this study. RAD and FMCDM were applied during requirement identification and user design, with FMCDM evaluations conducted in each phase.

Implementing FMCDM within the RAD framework enhances the intellectual property information system at the State Polytechnic of Banjarmasin, providing a systematic and data-oriented approach. This ensures effective fulfillment of user requirements, mitigates risks during development, and tailors the system to the unique needs of intellectual property, increasing the likelihood of successful implementation.

The research centers on requirement identification and user design phases, leaving the evaluation of FMCDM and RAD in later stages for future study. Generalizability may be limited by intellectual property system characteristics, and the transferability of the proposed approach to other information systems needs more investigation. The study does not deeply delve into integration challenges, indicating a potential area for future research.

## ACKNOWLEDGMENTS

The author would like to express the utmost gratitude to P3M and the management team at State Polytechnic of Banjarmasin for their support, which has made this research endeavor possible.

## References

[1] Albers S, Koirala B, Sarker S. “Intellectual Property Management: A Review of Literature.,” In: Proceedings of the 20th Pacific Asia Conference on Information Systems (PACIS). pp. 1–14., Langkawi, Malaysia.

[2] S. Ali and H. Tang, “Is Intellectual Property Beneficial to Knowledge Management? Literature Review on Organizational Knowledge Protection.,” Journal of the Knowledge Economy. vol. 14, no. 4, p. 2023. https://doi.org/10.1007/s13132-022-00904-3.

[3] Holgersson M, Aaboen L. “A literature review of intellectual property management in technology transfer offices: From appropriation to utilization.,” Technology in Society. vol. 59, p. 2019.

[4] G.W. Sasmito, D.S. Wibowo, and D. Dairoh, “Implementation of Rapid Application Development Method in the Development of Geographic Information Systems of Industrial Centers.,” Journal of Information and Communication Convergence Engineering. vol. 18, no. 3, p. 2020.

[5] Pratomo A, Irawan A. M.R.-J. of P. Conference, and undefined 2020, “Similarity detection design using Winnowing Algorithm as an effort to apply green computing.,” iopscience.iop.org. vol. 1450, p. 12065, 2020.

[6] A. Setiawan and E. Yulianto, “Implementation of risk control self assessments using rapid application development model in bank operational risk management process.,” Journal of Theoretical and Applied Information Technology. vol. 97, no. 11, p. 2019.

[7] S.L.L. and S.M. Chen. The development of a decision support system for selecting the appropriate software development methodology. Appl Soft Comput. 2013;13(1):291–300.

[8] Agarwal R, Prasad J, Tanniru M, Lynch J. “Risks of Rapid Application Development.,” Communications of the ACM. vol. 43, p. 2000. https://doi.org/10.1145/352515.352516.

[9] Chen SJ, Chen SM, Huang CH. Fuzzy multi-criteria decision-making for evaluating the performance of financial holding companies in Taiwan. Expert Syst Appl.

2006;31(4):803–13.

[10] J. Tamošaitienė, H. Sarvari, M. Cristofaro, and D.W.M. Chan, “Identifying and prioritizing the selection criteria of appropriate repair and maintenance methods for commercial buildings.,” International Journal of Strategic Property Management. vol. 25, no. 5, p. 2021.

[11] J. Martin, Rapid application development., 1991.

[12] 12. Aldosari MA. A Study of the Rapid Application Development (RAD) Methodology. International Journal of Computer Science and Network Security. 2016;16(6):21–4.

[13] “Rapid Application Development (RAD) | Definition, Steps & Full Guide,” https://kissflow.com/application-development/rad/rapid-application-development/

[14] Eva M. “Requirements acquisition for rapid applications development.,” Information and Management. vol. 39, no. 2, p. 2001. https://doi.org/10.1016/S0378-7206(01)00082-9.

[15] Gupta A, Poels G, Bera P. “Using Conceptual Models in Agile Software Development: A Possible Solution to Requirements Engineering Challenges in Agile Projects.,” IEEE Access. vol. 10, p. 2022.

[16] Dennis A, Wixom BH, Tegarden D. System Analysis and Design: An object-oriented approach with UML, 5th ed., 2015.

[17] D.A. Abdulmonim, Z.H. Muhamad, and B. Alathari, “Using the object mapping approach from analysis to implementation for developing student registration system.,” Indonesian Journal of Electrical Engineering and Computer Science. vol. 14, no. 2, p. 2019. https://doi.org/10.11591/ijeecs.v14.i2.pp1030-1038.

[18] R. Vijay Anand and M. Dinakaran, “Popular agile methods in software development: Review and analysis.,” International Journal of Applied Engineering Research. vol. 11, no. 5, p. 2016.

[19] Nurhaida I, Ayumi V, Noprisson H, Ratnasari A, Utami M, Putra ED. “Web Development Using WISDM and RAD.,” In: 2020 International Conference on Information Technology Systems and Innovation, ICITSI 2020 - Proceedings (2020).

[20] L.Z.-I. and control and undefined 1965, “Fuzzy sets.,” Elsevier. p.

[21] Kahraman C, Onar SC, Oztaysi B. Fuzzy Multicriteria Decision-Making: A Literature Review. International Journal of Computational Intelligence Systems. 2015;8(4):637–66.

[22] Azhar NA, Radzi NA, Wan Ahmad WS. “Multi-criteria Decision Making: A Systematic Review.,” (Recent Advances in Electrical & Electronic Engineering (Formerly Recent Patents on Electrical & Electronic Engineering). vol. 14, no. 8, p. 2021.

[23] Sasongko IH, Wulansari H, Supriyati T. “The Integration of Rapid Application Development (RAD) and Fuzzy Multiple Criteria Decision Making (FMCDM) in Developing Health Information System.,” In: IOP Conference Series: Materials Science and Engineering (2017).

[24] i. Kaya, M. Çolak, and F. Terzi, “A comprehensive review of fuzzy multi criteria decision making methodologies for energy policy making,” (2019). https://doi.org/10.1016/j.esr.2019.03.003.

[25] D.D. Utomo, K. Mutijarsa, and R. Fathoni, “Fuzzy Decision Making in Rapid Application Development for E-Learning System.,” International Journal of Emerging Technologies in Learning. p. 2021.

[26] Mokoena KP, Dlodlo T. “Fuzzy Multi-Criteria Decision-Making (FMCDM) Approach for Software Development Methodology Selection: A Case of Small and Medium Enterprises.,” Information Technology Journal. p. 2019.

[27] K. Kendall, J. Kendall, K. Kendall, and J. Kendall, Systems analysis and design., 2002.

[28] Hanine M, Boutkhoum O, Tikniouine A, Agouti T. “A new web-based framework development for fuzzy multi-criteria group decision-making.,” SpringerPlus. vol. 5, no. 1, p. 2016. https://doi.org/10.1186/s40064-016-2198-1.

[29] G. Büyüközkan and M. Güler, “A combined hesitant fuzzy MCDM approach for supply chain analytics tool evaluation.,” Applied Soft Computing. vol. 112, p. 2021.

[30] Y. Liu, C.M. Eckert, and C. Earl, “A review of fuzzy AHP methods for decision-making with subjective judgements,” (2020). https://doi.org/10.1016/j.eswa.2020.113738.