*Advances in Social Science, Education and Humanities Research, volume 647*
**International Conference on Applied Science and Technology on Social Science 2021 (iCAST-SS 2021)**

# Design of Risk Rating Applications for Village Credit Institutions

*Jeni Susanti
Accounting Department
Politeknik Negeri Bali
Badung, Bali, Indonesia
susanti@pnb.ac.id

I Gede Made Karma
Accounting Department
Politeknik Negeri Bali
Badung, Bali, Indonesia
igmkarma@pnb.ac.id

Ni Wayan Kurnia Dewi
Accounting Department
Politeknik Negeri Bali
Badung, Bali, Indonesia
wayankurniadewi@pnb.ac.i

***Abstract*—The Covid-19 pandemic has had a profound impact on the economic capacity and purchasing power of the general public. This condition automatically affects the ability of the people to fulfill their obligations, especially paying off the credit they have already taken. Credit has the potential to become bad credit. On the other hand, some people have started withdrawing their savings and deposits. This situation is certainly very worrying for financial institutions, especially the Village Credit Institution (LPD), which is the backbone of the economy of traditional village communities in Bali. LPDs must be managed with care. In this prudence, the manager in addition to maintaining the level of health, is also required to monitor the level of risk of his LPD. This risk rating becomes important in conducting supervision, prudence and anticipation in the operational management of the LPD. This research was conducted in an effort to help LPD prepare an information system for assessing the level of risk for its institution. The research was conducted using the Waterfall system development stages, with an object-oriented approach. At the initial stage, this research focused on designing the required information system, through the stages of object-oriented analysis and design (OOA and OOD). The resulting design is a component of the system, which can later be used as a reference in the final stages of system development, namely the object-oriented programming (OOP) stage.**

***Keywords— LPD; economic crisis; risk factor; risk rating; system design***

## I. INTRODUCTION

To support the economic activities of the community, traditional villages in Bali generally form business entities belonging to traditional villages. One of the business entities is a financial institution. This financial institution has an operational area that is only limited to the area of the traditional village. This financial institution is called the People's Credit Institution (LPD) [1]. The management of this LPD is regulated based on Bali Governor Regulation number 44 of 2017 and the customary rules that apply in the traditional village. The traditional village head is directly involved in determining the operational policies of the LPD, by including social norms and customary sanctions in it [2][3]. The traditional village, as the owner of this financial institution, is entitled to a portion of the profits obtained by the LPD, which is then used as village development funds [4]. In terms of regulation, financial indicators and coverage, LPD shows very good and promising things [5].

The Balinese people, who rely heavily on tourism for their lives, have been devastated by the prolonged impact of the Covid-19 pandemic and have shown no signs of ending this. The economic ability and purchasing power of the people have drastically decreased, which has an impact on the decline or loss of their ability to fulfill their obligations, especially in paying credit, so that they have the potential to become bad loans [6]. People began to withdraw their savings or deposits. This situation is of course also worrying because it can disrupt the economy of a country. In this case the government has an important role in maintaining the health of a financial institution [7].

The soundness of a financial institution indicates the institution's ability to carry out its activities formally, fulfill all its responsibilities and comply with banking regulations [8][9]. This level of soundness also reflects the financial position of the institution [10][11]. Therefore, periodic analysis must be carried out, to anticipate possible vulnerabilities [12]. Various methods such as the CAMEL method, RGEC, fuzzy zero-order Takagi-Sugeno-Kang (TSK) and Risk Based Bank Rating can be applied to measure the level of health, taking into account different factors and conditions. The factors used include the determinants of profit growth rates, corporate governance, income,

capital, management, the level of total assets, loans and trading assets of these financial institutions [13][14][15][16].

Knowing the soundness of financial institutions is in the interest of many parties, especially Bank Indonesia as the supervisory authority [17]. A good level of soundness of financial institutions will certainly increase public confidence, which in turn will support overall economic growth [18][19]. In the recent crisis situation, the implementation of good governance is important to prevent failure and fraudulent practices [20]. Considering the importance of risk factors, Bank Indonesia through Bank Indonesia Regulation no. 13/1/PBI/2011 requires to conduct a bank soundness assessment based on a Risk-Based Bank Assessment [21][22]. Health assessment includes risk and performance profiles [23]. The assessment of bank health using the RGEC method is actually an assessment of bank health that has considered the risk element in it [24][25]. As the name implies, in the application of this method, a number of factors will be considered, namely Risk Profile, Good Corporate Governance (GCG), Earning, and Capital [26][27]. The risk profile factor is associated with the implementation of risk management, the GCG factor is associated with the existence and implementation of corporate governance, the Earning factor is associated with the ability to earn profits and the Capital factor is associated with capital adequacy [28][29]. This method is considered appropriate to be applied in crisis situations such as recent [30].

LPD managers are required to apply the precautionary principle in the management of this financial institution. This is stated in Governor Regulation number 44 of 2017. Many things related to LPD management have been regulated and stipulated in this regulation. This includes control issues. By implementing and complying with the provisions set forth in this regulation, it is certain that an LPD will not experience difficulties in its operational process. To measure the level of health, LPD uses the CAMEL method [31]. In addition to health problems, the risk level factor is an important thing to know in the economic crisis situation due to the recent Covid-19 pandemic. For LPD officers, it is important to carry out supervision, caution and anticipation in the operational management of the LPD. To assist LPDs in monitoring their risk rating, this study was conducted. This research is focused on analyzing the applicable provisions and rules related to risk rating determination, and then used as a reference for designing information systems. This information system is expected to be able to provide information about the LPD risk rating in real time and up to date.

## II. LITERATURE REVIEW

Based on the Bali Governor's Regulation Number 44 of 2017 which is used as the basis for managing an LPD, the risk rating is assessed using a qualitative approach on various risk factors faced by LPDs, which include credit risk factors, liquidity risk, operational risk, and capital risk. The basis for determination and calculation is as follows:

### *2.1 Credit Risk Factor*

Credit risk factors are determined by 2 types of ratios, namely:

1) Earning asset quality ratio which is a comparison between earning assets classified to earning assets.

$$\text{PAQ ratio} = \frac{\text{Earning assets classified}}{\text{Productive Assets}} \text{ x } 100\% \quad (1)$$

2) The ratio of allowance for possible losses on earning assets, which is the ratio between the reserve for doubtful accounts established to the reserve for doubtful accounts that must be established.

$$\text{AWEA ratio} = \frac{\text{Reserve for doubtful accounts established}}{\text{Reserve for doubtful accounts that must be established}} \text{x } 100\% \quad (2)$$

### *2.2 Liquidity Risk Factors*

Determination of liquidity risk factors is based on 2 (two) ratios, namely:

1) Ratio of Basic Surplus to liabilities that can be paid immediately. Basic surplus is the difference between liquid assets that can be used and liabilities that can be paid immediately in the next week. If the liquid assets are greater than the liabilities that can be paid immediately, it will be an excess difference (positive) and a less difference (negative).

   Basic Surplus = (Assets - Liabilities ) with maturity up to 7 days reduced again by 5% Cash Ratio.

$$\text{Cash ratio} = \frac{\text{Cash + Savings + Deposit + Current Account + Another LPD Savings}}{\text{Immediate Liabilities + Savings + Deposit}} \quad (3)$$

2) Liquidity Index Ratio. Liquidity index is a number that shows the magnitude of the ratio between the sum of the multiplication of liabilities with their respective weights to the sum of the multiplication of assets with their respective weights.

$$\text{Liquidity index} = \frac{\Sigma \text{ Weighted Liabilities}}{\Sigma \text{ Weighted Assets}} \quad (4)$$

### *2.3 Operational Risk Factors*

Determination of operational risk factors is based on six operational component ratios, namely:

1) The effectiveness ratio is based on the achievement of the LPD soundness credit score. In assessing the achievement of credit scores, the ratio of productive asset quality is used. Formula :

$$\text{Effectiveness ratio} = 20 - \frac{\text{Earning asset quality ratio}}{0.15} \quad (5)$$

2) Efficiency ratio is based on the ratio between operating costs and operating income at the end of the reporting month, expressed in percent. Formula:

$$\text{Efficiency ratio} = \frac{\text{Operating costs}}{\text{Operational income}} \text{ x } 100\% \quad (6)$$

3) Economic ratio, calculated based on the ratio between total assets and the number of human resources. This ratio is compared at the end of each month/period and from this comparison the progress is calculated with the average measurement for the last quarter/period.
4) Current ratio, measured from the average length of loan disbursement after complete documents are received.
5) Safe ratio, measured by the number of events that harm the LPD due to manipulation, corruption, collusion, and nepotism and calamities in the last one year. (Taken from the last one year data)
6) The orderly ratio, measured by the number of violations against the applicable provisions within one year (from the results of the last inspection).

### *2.4 Capital Risk Factor*

The capital risk factor is the risk due to insufficient capital as the main source of financing for LPD operational activities so that it is not sufficient to cover all business risks faced. The capital risk factor is assessed from the minimum capital adequacy ratio (MCA Ratio) which is the ratio between capital to risk-weighted productive assets (RWA) expressed in percent. Formula:

$$\text{MCA ratio} = \frac{\text{Capital}}{\text{Risk-weighted earning assets}} \text{ x } 100\% \quad (7)$$

Furthermore, the risk rating for each factor is determined based on the provisions in Table I.

Each risk rating obtained from each component will determine the amount of penalty that will be used as the basis for determining the LPD risk level. The penalty value is then summed and averaged for all factors, and then used as a reference to determine the overall risk level. The amount of penalty for each risk factor with each component and the reference for determining the overall risk level are presented in Table II and Table III.

TABLE I. RISK RATING PROVISIONS FOR EACH RISK FACTOR

| Risk Rating | Risk Factor | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Credit | | Liquidity | | Operational | | | | | | Capital |
| | 1 | 2 | 1 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | |
| Very Low | < 5% | > 90% | > 10 % | > 1.00 | > 90 | < 75% | > 1.00% | 1 – 2 day | 0 | 0 | > 15.00% |
| Low | > 5% – 7.85% | 81% – < 90% | > 5 % – 10 % | 1.00 | 81 – < 90 | > 75% – 79.75% | 0.75% – 1.00% | >2 – 3 day | 1 | 1 | > 12.00% – 15.00% |
| Moderate | > 7.85% – 10.1% | 66% – < 81% | 0 – 5 % | 0.81 – < 1.00 | 66 – < 81 | > 79.75% – 83.5% | > 0.5% – 0.75% | >3 – 4 day | 2 | 2 | 12.00% |
| High | >10.1% – 12.35% | 51% – < 66% | <0 – -10 % | 0.66 – < 0.81 | 55 – < 66 | > 83.5% – 87.25% | 0.00% – 0.5% | >4 – 5 day | 3 | 3 | 6.80% – 11.90% |
| Very High | > 12.35% | 0% – < 51% | < -10 % | < 0.66 | < 55 | > 87.25% | < 0.00% | > 5 day | > 3 | 4 | < 6.80% |

TABLE II. PENALTY PROVISIONS FOR EACH RISK RATING OF EACH RISK FACTOR

| Risk Factor | Risk Factor Component | Weight | Penalty Against Risk Rating | | | | |
|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 |
| 1. Credit | | 40% | 100 | 200 | 300 | 400 | 500 |
| | a. Ratio of classified assets to earning | 20% | 50 | 100 | 150 | 200 | 250 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | assets | | | | | | |
| | b. The ratio of allowance for possible losses on earning assets to earning assets that must be established. | 20% | 50 | 100 | 150 | 200 | 250 |
| 2. Liquidity | | 24% | 60 | 120 | 180 | 240 | 300 |
| | a. Basic Surplus | 12% | 30 | 60 | 90 | 120 | 150 |
| | b. Liquidity Index | 12% | 30 | 60 | 90 | 120 | 150 |
| 3. Operational | | 6% | 15 | 30 | 45 | 60 | 75 |
| | a. Effectiveness | 1% | 2.5 | 5 | 7.5 | 10 | 12.5 |
| | b. Efficiency | 1% | 2.5 | 5 | 7.5 | 10 | 12.5 |
| | c. Economic | 1% | 2.5 | 5 | 7.5 | 10 | 12.5 |
| | d. Current | 1% | 2.5 | 5 | 7.5 | 10 | 12.5 |
| | e. Safe | 1% | 2.5 | 5 | 7.5 | 10 | 12.5 |
| | f. Orderly | 1% | 2.5 | 5 | 7.5 | 10 | 12.5 |
| 4. Capital | The ratio of capital to assets is weighted by risk. | 30% | 75 | 150 | 225 | 300 | 375 |
| Sum | | 100% | 250 | 500 | 750 | 1.000 | 1.250 |
| Average Penalty Risk | | | 62.5 | 125 | 187.5 | 250 | 312.5 |

Based on the average value of the risk penalty, the risk rating is then determined according to the provisions in Table III.

TABLE III. RISK RATING PROVISIONS BASED ON AVERAGE PENALTY

| Average Penalty Risk | Risk Rating |
|---|---|
| ≤ 62.5 | Very Low |
| > 62.5 – 125 | Low |
| > 125 – 187.5 | Moderate |
| > 187.5 – 250 | High |
| > 250 – 312.5 | Very High |

## III. RESEARCH METHODS

The development of a system is carried out in a gradual, continuous and interrelated process. The method used is the Waterfall method [32]. The research, which aims to produce an LPD risk level assessment system, will be carried out with an object-oriented approach, with three main stages. The three stages are object-oriented analysis (OOA), object-oriented design (OOD) and object-oriented programming (OOP) [33][34]. At the OOA stage, a search for information related to the needs of the system being built will be carried out, which is related to what and how the system to be built will work. The results of this analysis phase are outlined in several object-oriented models using UML (Unified Modeling Language). The OOD stage, as the next stage, is the stage to determine the design of the system components to be built. The resulting system design will describe the components that make up the system and what the interactions between them are like. This design will then be translated into a system in the OOP stage. The system is built using a certain programming language [35][36][37]. This research only focuses on the two initial stages of object-oriented system development, namely OOA and OOD.

## IV. RESULTS AND DISCUSSION

The results of the analysis of the rules and regulations related to risk ranking will provide an overview of what kind of information system should be built. This description is commonly referred to as information system requirements, which can be modeled with use case diagrams, as shown in Fig. 1. In general, this system will be operated by users who are categorized as general users and assessors, with their respective functions and roles. The provision of data required by the system related to the determination of risk ratings can be carried out by all users. Meanwhile, only the assessor user can perform the function to determine the risk rating. User assessors are the LPD management and supervisory team.

The system built will have 2 (two) main functions, namely inputting supporting data and assessing LPD risk levels. In the data input function, there are 3 (three) data to be inputted, namely LPD financial report data in the form of profit and loss statements and balance sheets, as well as data related to LPD operational activities. Financial report data does not actually need to be inputted if the use of this system is integrated with the LPD financial information system. The risk assessment function will handle the calculation and determination of the LPD risk level. This function will be complemented by the determination of the risk level for each of the risk determinants, namely Credit, Liquidity, Operational and Capital risk factors, and then the overall risk level is determined, which is the LPD risk level itself. Determination is carried out in accordance with applicable rules and regulations.

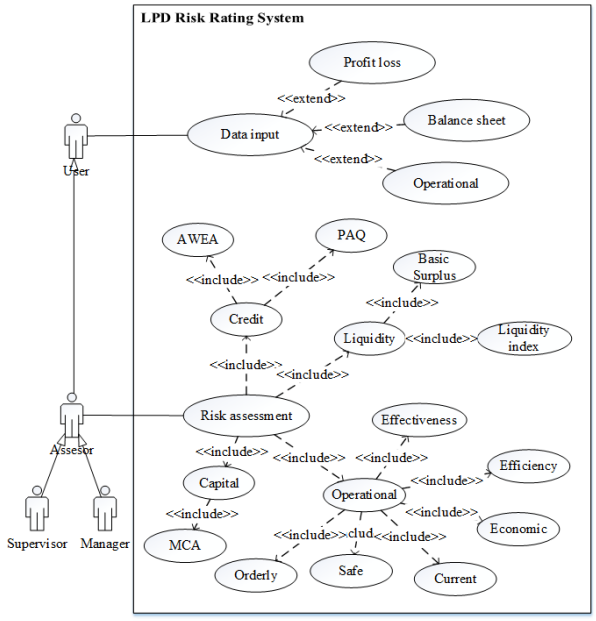


Fig. 1. Use Case Diagram of Risk Rating

From the description of system requirements according to the results of the analysis stages, how this system works can be described in a Sequence Diagram as presented in Fig. 2. The diagram depicts the interaction and communication between objects in the system. User and Assessor objects are two objects that represent the user group of the system, the group that will operate this system. This group of users will interact with the system via the frmMainMenu object, which is the controller of the system's main functions. To be able to operate the system, the user must first login through the frmLogin object. This frmLogin object will determine whether the user can operate the system or not, and determine what facilities/functions it can operate. All users can carry out the data input process, while only users with the Assessor category are allowed to carry out risk determination.

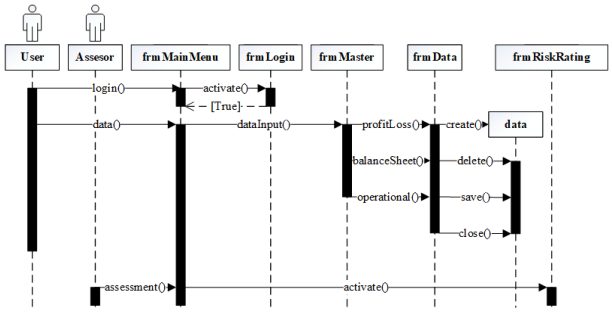


Fig. 2. The Sequence Case Diagram of Risk Rating

The process of inputting system support data will be handled by the frmMaster object, and managing data objects will be handled using the frmData object. Data management includes adding new data, editing existing data and deleting data that is no longer needed.

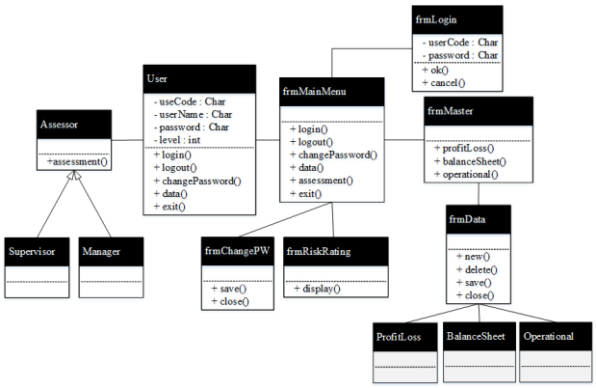


Fig. 3. The Design Class Diagram of Risk Rating

The risk level assignment process will be handled by the frmRiskRating object. This process can only be operated by the Assessor and the determination of the risk level will be carried out by assigning a level to each of the determinants of the risk level.

Referring to the description of the results of the analysis and class identification stages, the system design to be built can then be arranged. The system design shows the components that make up the system and how they interact or relate to each other. This design is depicted in a design class diagram, as shown in Fig. 3.

As described previously, and as shown in Figure, the system will be operated by the user. This user will be distinguished based on the level value of the class attribute, namely 0 or 1. Level 0 is assigned to ordinary users, while level 1 is to appraiser users. User assessors consist of Supervisor and Manager. All users will be able to perform the Login, Logout, Change Password, Data Input and Exit functions, while only the Assessor can perform the Assessment function.

All functions that can be performed by the user will be followed up by the system through a menu which is handled by the frmMainMenu class. Handling each function will involve other classes, which are frmLogin for Login function, frmChangePW for change password function, frmMaster for data input function, and frmRiskRating for assessment function. In the data input function, in addition to inputting new data, the system also provides other facilities such as editing and deleting existing data. This process will be carried out by the frmData class. There are 3 types of data that will be handled, namely income statement data, balance sheets and data related to operations required by the system. Each of these data will be stored in a table in a database.

This class diagram of the system will be used as the basis for program development of this system. Each class in this class diagram will be translated into program classes and interfaces which are components or architecture of the program, as well as entities that

are translated into data tables, as a place to accommodate data that is processed in the system.

## V. CONCLUSION

The risk rating of a Village Credit Institution (LPD) is influenced by several risk factors, namely credit, liquidity, operations and capital. Each factor is then measured by several ratios, which are measured or calculated based on the income statement, balance sheet and data related to LPD operations. The value of this ratio will determine the level of risk of each factor, and at the same time determine the amount of penalty, which is finally accumulated to determine the overall level of risk. The descriptions related to this procedure are then analyzed and outlined in several model diagrams, which are then translated into design class diagrams, which are the results of the system design to be built. The results of this design will be used as the main reference in the development of the LPD risk rating information system.

## ACKNOWLEDGMENT

The author would like to express his gratitude to the Director of the Bali State Polytechnic and the Chair of the Bali State Polytechnic P3M who have provided grants to finance this research. To Mr. I Made Ariana, SE., M.Si, Ak and Mr. I Ketut Suwintana, S.Kom, MT., who has provided many instructions, directions and inputs related to determining the risk rating of financial institutions and guidance in developing the information system produced in this research. Thank you and the highest appreciation.

## REFERENCES

[1] H. D. Seibel, "Culture and governance in microfinance: Desa pakraman and lembaga perkreditan desa in bali," in *Microfinance in Developing Countries: Issues, Policies and Performance Evaluation*, 2013.

[2] L. Arsyad, "Assessing Factors Affecting the Repayment Rate of Microfinance Institutions: A Case Study of Village Credit Institutions of Gianyar, Bali," *Gadjah Mada Int. J. Bus.*, 2013, doi: 10.22146/gamaijb.5618.

[3] J. I. Kosasih and D. Hendrawan, "Existence of entities 'village credit institutions/lembaga perkreditan desa (lpd)' local community in Bali viewed from financial control system in Indonesia learning from Bali local genius in increasing the local economy," *Int. J. Appl. Bus. Econ. Res.*, 2016.

[4] R. Misra, "Muntigunung Lembaga Perkreditan Desa, Indonesia: Village Ownership as a Model for Remote Outreach of Financial Services," 2008.

[5] L. Arsyad, "An Assessment of Microfinance Institution Performance: The Importance of Institutional Environment," *Gadjah Mada Int. J. Bus.*, 2005, doi: 10.22146/gamaijb.5579.

[6] J. H. Wijaya, E. M. Utami, and M. H. M. Saudi, "Effect of bank health level (Using rgec method) on profit growth," *Int. J. Psychosoc. Rehabil.*, 2020, doi: 10.37200/IJPR/V24I2/PR200689.

[7] L. A. Stella and R. Puspitasari, "Analysis of Bank Rating with RGEC Method Case Study at PT Bank Mandiri (Persero) Tbk for the Period 2013–2017," 2020, doi: 10.2991/aebmr.k.200522.046.

[8] B. Gunawan and K. M. Arvianda, "Bank Health Level Analysis Using CAMELS and RGEC Methods on PT Bank Panin Dubai Syariah Ltd.," 2019.

[9] F. J. Christian, P. Tommy, and J. Tulung, "Bank Health Analysis using RGEC Method in BRI and Mandiri Bank Period 2012-2015," *J. EMBA J. Ris. Ekon. Manajemen, Bisnis dan Akunt.*, vol. 5, no. 2, 2017.

[10] A. Lebbe and A. Rauf, "Towards Increasing the Financial Performance: An Application of CAMEL Model in Banking Sector in the Context of Sri Lanka," *Res. J. Financ. AccountingOnline)*, 2016.

[11] O. Lisa and B. Hermanto, "Analysis of Risk Profile, Good Corporate Governance, Earnings, and Capital (Rgec) in Syariah Commercial Banks and Conventional Commercial Banks," *Int. J. Soc. Sci. Bus.*, vol. 4, no. 1, pp. 58–65, 2020.

[12] S. Sahota and B. Dhiman, "Relative performance analysis of scheduled commercial banks in India: A camel model approach," *Indian J. Financ.*, 2017, doi: 10.17010/ijf/2017/v11i5/114251.

[13] C. Akhyar, . M., . A., and G. Syamni, "Profit Growth in Indonesian Sharia Bank: the Impact of RGEC," *Int. J. Eng. Technol.*, 2018, doi: 10.14419/ijet.v7i3.30.18437.

[14] V. E. Candara and P. Y. Jayanto, "The Effect of RGEC Method, Management, and Cooperation Identity on The Health Level of BMT," *Account. Anal. J.*, 2017, doi: 10.15294/aaj.v6i3.18350.

[15] A. Abadi, "A new method to analyze bank performance level in Indonesia using fuzzy model," *Int. Math. Forum*, 2016, doi: 10.12988/imf.2016.611143.

[16] D. P. Morgan, "Rating banks: Risk and uncertainty in an opaque industry," *Am. Econ. Rev.*, 2002, doi: 10.1257/00028280260344506.

[17] Y. Devianto and S. Dwiasnati, "Banking Health Assessment Using CAMELS And RGEC Methods, Using OJK's Banking Financial Statement Data," *Int. J. Eng. Comput. Sci.*, 2018.

[18] Y. Octafilia and E. Wijaya, "Study of Conventional Bank Health in Indonesia from 2012 to 2017," 2020, doi: 10.2991/aebmr.k.200331.015.

[19] M. J. F. Esomar, L. Loppies, and E. Turukay, "The analysis of the influence of risk profile, good corporate governance, earning and capital (RGEC) towards the company value in the sub-sector of foreign exchange private national commercial bank which is listed on the Indonesia stock exchange (IDX)," *Int. J. Adv. Sci. Technol.*, 2020.

[20] Z. Zainuddin and Y. Djaelani, "Applying Risk Profile, Good Corporate Governance, Earning and Capital (RGEC) Method to Predict the Bank Health (Case Study on PT. Bank Tabungan Negara)," *Accountability*, 2018, doi: 10.32400/ja.24570.7.02.2018.16-32.

[21] M. Permatasari and P. Sawitri, "Health Assessment of Government Banks in Indonesia using Risk-Based Bank Rating," *J. Bus. Econ.*, 2018, doi: 10.35760/eb.2018.v23i2.1827.

[22] R. D. Hadiwidjaja and Y. Widiastuti, "Assessing the Effect of Bank Performance on Profit Growth Using RGEC Approach," *Rev. Integr. Bus. Econ. Res.*, vol. 5, no. 3, p. 87, 2016.

[23] K. E. Tuwo and F. J. Tumewu, "The Analysis of Bank Soundness using Risk-Based Bank Rating Method (RBBR) at

PT. Bank SulutGo," *J. EMBA J. Ris. Ekon. Manajemen, Bisnis dan Akunt.*, vol. 6, no. 4, 2018.

[24] I. Andriyani, R. P. Mayasari, and D. S. Aryani, "Soundness Rating of Commercial Banks Before and After Implementation of RGEC Method In Indonesia," *J. Keuang. dan Perbank.*, 2018, doi: 10.26905/jkdp.v22i1.1549.

[25] I. Andriyani, R. P. Mayasari, and D. S. Aryani, "Soundness Rating of Commercial Banks Before and After Implementation of RGEC Method in Indonesia," *J. Keuang. dan Perbank.*, vol. 22, no. 1, pp. 162–169, 2018.

[26] D. Rahayu and S. Suhendro, "Health Analysis of Bank Mandiri and Bank BCA with RGEC Method 2010-2014.," *J. Ilm. Wahana Akunt.*, vol. 11, no. 1, pp. 1–14, 2016.

[27] L. A. Africa, "Financial Distress Prediction Using RGEC Model on Foreign Exchange Banks and Non-Foreign Exchange Banks," *J. Account. Strateg. Financ.*, vol. 2, no. 1, pp. 48–55, 2019.

[28] R. G. Mais and D. I. Sari, "Evaluation of banks health rate of Indonesia and Malaysia Islamic bank with RGEC method," *Int. J. Appl. Bus. Econ. Res.*, 2015.

[29] R. Prihatni, "Effect of risk profile, good corporate governance, earnings, and capital on growth income in banking services listed in Indonesia stock exchange," *Acad. Account. Financ. Stud. J.*, 2019.

[30] J. Susanti, I. G. M. Karma, and N. W. K. Dewi, "Application Development for Assessing the Health Level of Village Credit Institutions Using the RGEC Method," in *International Conference on Science and Technology on Social Science (ICAST-SS 2020)*, 2021, pp. 66–71, doi: https://doi.org/10.2991/assehr.k.210424.014.

[31] I. G. M. Karma and N. K. Sukasih, "Designing Application for Determining the Health Level of Village Credit Institutions with the CAMEL Method," Oct. 2019, [Online]. Available: https://www.atlantis-press.com/article/125920667.

[32] R. S. Pressman, *Software Quality Engineering: A Practitioner's Approach*. 2014.

[33] C. Larman, *Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and the Unified Process (2nd Edition)*. 2001.

[34] J. Whitten and L. D. Bentley, *Systems Analysis and Design Methods*. McGraw-Hill Education, 2007.

[35] M. Boggs and W. Boggs, *Mastering UML with Rational Rose 2002*. Alameda, CA, USA: SYBEX Inc., 2002.

[36] E. Kindler and I. Krivy, "Object-oriented simulation of systems with sophisticated control," *Int. J. Gen. Syst.*, vol. 40, no. 3, pp. 313–343, 2011, doi: 10.1080/03081079.2010.539975.

[37] J. Rumbaugh, I. Jacobson, and G. Booch, *Unified Modeling Language Reference Manual, The (2Nd Edition)*. Pearson Higher Education, 2004.