# The optimization of asset liability management in mitigating operational risk

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**Abstract**

The idea of this research is to analyze the asset and liability management function to maximize the net income of Islamic banking in the era of digitalization and to minimize digital risk as a part of operational risk. The object of this research is the Islamic Bank in Indonesia with the amount of 10 banks. The analysis of the data presents the condition of the asset and liability component of 10 banks and the growth of net income. Afterward, the solver program applies linear programming to acquire high net income with low risk of operational risk. Islamic banking will achieve the minimum growth of operational risk about 11,26% and attain the maximum net income when they eager to enhance their liability, equity, and temporal syrkah fund.

Keywords: Asset Liability Management (ALMA), Linear Programming, Digital Risk

**Abstrak**

Penelitiaan ini bertujuan untuk menganalisa fungsi *Asset and Liability Management (ALMA)* dalam memaksimalkan pendapatan bersih (*net income*) perbankan syariah di era digital dan untuk mengurangi risiko digital sebagai bagian dari risiko operasional. Objek penelitian ini adalah 10 perbankan Syariah di Indonesia. Analisa data menunjukkan kondisi komponen asset dan kewajiban 10 bank beserta pertumbuhan pendapatan bersihnya. Setelah itu, diterapkan pemrograman linear untuk mendapat pendapatan bersih yang tinggi dengan risiko operasional yang rendah. Perbankan Syariah akan mendapatkan pertumbuan risiko operasional yang rendah sebesar 11.26% dan pendapatan bersih yang tinggi ketika bank Syariah bersedia untuk meningkatkan liabilitas, ekuitas, dan dana syirkah temporer.

Kata kunci: *Asset Liability Management (ALMA)*, Pemrograman Linear, Risiko Digital

## Introduction

Digital has become ubiquitous in this era; where all aspect of human life depends on this condition. It has already revolutionized many sectors, such as education, banking, law, and others. The use of an intelligent system in the operational of industries is one of the characteristics of digitalization; it has been spreading in trade and business. The Intelligent system requires a transfer of knowledge from experts and experienced people to novice system, in order policymaker in every sector able to make prediction and decision with massive data that provided accurately (Carlsson, 2018). Digitize system came with numerous convenient. It has an essential impact on organizational performance, and it has significance as a source for value creation (Martinez, 2009).

The Value creation will appear owing to the innovation of the industries. The financial system, primarily Islamic Banking is one of the sectors that have a digitized system which is inherent in their core business. The worth of Islamic banking will increase when they integrate the idea of Financial technology in their business model. Cavalcante (2013) describes the business model as exploring the technical challenges and performing new practices. The concept of innovation in business model acquiring new knowledge, discussing new ideas, and contacting and interacting with others, for example, new business partners. Islamic Banking institutions have started to collaborate with the fintech ecosystem to create an environment able to satisfy all customer needs. This sector is one of a significant industry that can not be separated by digitalization. They have to manage their massive data for their sustainable business excellently. When a bank considers innovating their business model based on societal and environmental needs and adjusting with new development sustainably, they will create superior customer and firm value (Bocken et al., 2019). Hence, customer, the banker, and industries feel the ease of the digitizing system; they do banking transaction efficiently and effectively.

In the first side, the use of digital tools for work has a positive relation with worker performance, and it is related to dimensions of subjective well-being (Lindberg et al. 2018). When the banker optimistic and institution facilitate them by several convenient in their job, they can improve their performance to achieve their goal, which is in line with the company's purpose. The enhancement in banker performance leads to the evolve of banking performance. In the other side, the innovation of product based on Technology gives chances to have significant cost advantages owing to the lower cost banking operation for 24 hours. This condition simplifies the customer in accessing banking product ubiquitously. Others advantages are increasing profitability and facilitate lower risk than traditional banking products (Akhisar et al., 2015)

Notwithstanding, the advantageous of digitalization is increasing profitability and having lower risk, banking sectors have to notice the cybersecurity for their digital system to secure public money. Islamic Banking, as a financial intermediary, has a significant role in managing society money, both funding and financing. This institution has a goal to maximize profit, but at the same time, it has to preserve the liquidity for prudential banking. Profitability and liquidity are highlights in studying Asset and Liability Management, which the purpose of this study is the maximization of profit and minimization of risk (Mitra, Schwaiger, 2011). ALM has a significant role in mitigating risk in Islamic Banking.

Furthermore, in this era of digitalization, Asset and Liability Management has a fundamental task to minimize the risk that causes by the digitizing system. Mobile banking with various features and data management process are robust of artificial intelligence in Islamic banking. ALCO (Asset Liability Committee) as the guardian of ALM will make a better prediction and decision accurately by the help of this function of the digitizing system. They can control and identify kinds of risks to prevent the fragility of the institution.

The salient risk in Islamic banking after credit risk is an operational risk. This kind of risk, refer to Bank's inadequacy in identifying processes, systems, people, or external events predicament, which lead to losses (Pena et al., 2018). The system, in this case, refers to the use of information technology in banking transaction. Nowadays, technological advances have spurred in financial innovation, owing to the proliferation of financial products. Bank has to emphasize precise scrutiny on this proliferation to avoid the hindrance in operational banking.

A novel framework of this research is optimization of asset and liability management with liquidity risk as to the constraint to maximize Islamic banking net income and to minimize operational risk as to the main risk of digital risk. Scant previous researchers that concern on this topic, they discuss the asset-liability management model based on robust optimization techniques (Gülpinar, N., & Pachamanova, D. 2013), the optimal of Asset-liability management to maximize

the expected utility using the method of stochastic control (Xiao, 2016), an optimization model to decide bank asset-liability management strategy endogenously (Birge, J. R., & Júdice, P. 2013). There were several types of research that provide studying Asset-liability management and discussing operational risk. But there were not combine that two focusing research. This research tries to explore ALM with operational risk with a linear programming approach.

## Digitalization

According to McKensey & Company, IIF (2017), digitalization have several specific characters. The first is Data management (Qualified processes in managing data to simplify the access). The second is Process and workflow automation (Standardize of computerization in accomplishing daily activities). The third is Advanced analytics and decision automation (Deep analysis to make prediction and decision accurately with the help of artificial intelligence) 4. Cohesive, timely, and flexible infrastructure (The flexibility of virtualization a modernized data environment) 5. Smart visualization and interfaces (The applications provide data for users) 6. External ecosystem (Adjustment of a business model based on the evolving intelligence system). 7. Talent and culture (The future success of the industry will rely on the successful cooperation between multitasking human and machine intelligence (Carlsson, 2017).

This digital era arrives with concepts such as the forth-industrial revolution, or Industry 4.0. The German government presents this concept at the Hannover fair 2013, and it represents the governmental support for the open-ended digitalization of the economy and its importance organizational performance and economic wealth (Martinez, 2009). It was a strategic program that evolves from the adoption of computers and automation to independent and intelligence systems fueled by data and machine learning to develop sophisticated production. (Kagermann et al., 2013).

Frank et al., (2019) Present a conceptual framework for Industry 4.0 technologies in manufacturing firms; this technology conveys two core component. The first is Front-end technologies consider four dimensions: Smart Manufacturing, Smart Products, Smart Supply Chain, and Smart Working and the second is based technologies that consider four elements: internet of things, cloud services, big data, and analytics. The construction of Industry 4.0 depends on 1) the digitization and integration of the horizontal and vertical value chain. 2) The digitization of products and services and 3) the introduction of innovated business models (Gilchrist, 2016)

The vision of Industry 4.0 is that in the future, industrial businesses will construct global networks to connect their facilities as cyber-physical systems, which will connect and control each other intelligently by sharing information. The cyber-physical methods as the critical element in the industry 4.0 will take the shape of smart factories, smart machines, intelligent storage facilities, and conversant supply chains, that will provide tremendous improvements in the whole of industrial processes. These are what we call the horizontal value chain. Another critical element is the integration of the vertical manufacturing processes (sales, logistics, and finance, among others) and associated IT systems. Industries will realize the vision when they integrate the horizontal systems with the vertical business processes (Gilchrist, 2016).

The application of Industry 4.0 or The Industrial Internet of Things (IIoT) in several sectors as a concept of digitalization referred to the digital revolution and the digital disruption. The former decipher about the transformation of digitalization that gives a lot of benefits for user and industries, and the latter describes several factors that harm the digitizing system. Cyber-physical systems, and the digital universe, not only create the issue of cybersecurity (data security, systems fault tolerance, cyber resiliency, etc.) but has already been the subject of severe analyses. Such development of production systems also increases the risk of fragility. Data security and protection against unauthorized persons are becoming hot topics as series of company research

showing that enterprises feel threatened by the dangers of cyber-attacks fuelled by Industry 4.0. And once a widespread perception over inefficient cybersecurity is here to stay, the speed of technology diffusion (Kovacsa, 2018).

Others problem due to industry 4.0 is enormous job losses. Computerization, automation, and machine learning or so-called intelligent system and artificial intelligence replace worker in the workplace. The second complex issue is the impact of computerization on people's mental status. Beyond the empirical evidence that dismissal increases criminal activity. At the same time, Big Databases do always contain discretionary correlations given primarily by the size and not by the nature of the data. There may be several hidden errors in these databases, and even a small failure can lead to misapprehensions. The digitizing system inevitably leads to numerous problem that will increase the number of digital risk as a part of the operational risk.

## Asset and Liability Management

In the first side, ALM is the instrument that uses by Financial institution, mainly Islamic banking, for decision making to arrange the maximization of stakeholder value, to increase return and to reduce risk. ALM is related to equity, asset, and liability. Islamic banking has to manage that three component of ALM to make a prudent investment that increases the value of capital, equivalent commitments, and protect from the financial crisis. In the other side, ALM is a future-oriented process to measure, monitor and control the impact of interest rates alteration on the bank's earnings, asset value, liquidity and capital requirements (Brick, 2012).

The primary ALM purpose is to connect different bank activities into a single unit, facilitating liquidity and balance sheet management, which is crucial for ensuring the regular operation of the bank, service delivery and consistent and profitable growth of the bank. ALM provides timely identification of potential problems and risks of operating in the bank's balance sheet and income ( Novickytė, L., & Petraitytė, I. (2014).

Islamic banking has to emphasis several risks in their business:
a. Credit Risk is a risk due to the failure of customers or other parties to fulfill obligations to the Bank by the agreed agreement.
b. Market Risk is a risk in the balance sheet and administrative account position due to changes in market prices, including risks in the form of changes in the value of assets that can be traded or leased.
c. Liquidity Risk is a risk due to the inability of the Bank to meet maturing obligations from cash flow funding sources or high-quality liquid assets that can be pledged, without disrupting the Bank's activities and financial conditions.
d. Operational Risk is the risk caused by inadequate internal processes, internal process failures, human errors, system failures, or the occurrence of external events that affect the Bank's operations.
e. Legal Risk is a risk due to lawsuits and weaknesses in juridical aspects.
f. Reputation Risk is a risk due to a decrease in stakeholder confidence level that comes from negative perceptions of the Bank.
g. Strategic Risk is Risk due to inaccuracy in making and implementing a strategic decision and failure to anticipate changes in the business environment.
h. Compliance Risk is a risk due to the Bank not complying with and not implementing the applicable laws and regulations, and Sharia Principles.
i. Rate of Return Risk is the risk due to changes in the price of return paid by the Bank to customers because there is a change in the rate of return received by the Bank from the distribution of funds, which can affect the behavior of customers of the Bank's third-party funds.

j. Investment Risk (Equity Investment Risk) is a risk due to the Bank taking part in the loss of the business of the customer financed in financing based on profit and loss sharing.

**Operational Risk**

Bank for international settlement (BIS) convey three different methods for measuring operational risk, as stated in the Basel II policy (BCBS, 2006):

a. Basic Indicator Approach (BIA) to estimate the value at risk applying a rate of 15% to the average of gross financial and non-financial income of a banking institute during the three previous years.

b. Standardized Approach (TSA) divides the operations of a financial entity in eight business lines (Corporate Finance, Trading & Sales, Retail, Commercial, Payment & Settlement, Agency Services, Asset Management, Retail Brokerage). Each track has a beta factor associated that varies between 12% and 15%, calculated concerning the income generated by the line. The beta factor represents a risk weight for determining OpVaR.

c. Advanced Measurement Approach (AMA) permits banks to develop their operational risk models to quantify OpVaR. Although regulators do not define a particular modeling technique, one common aim of AMA models is to determine the Aggregate LD (ALD) using the distributions of frequency and severity of risk events at a certain confidence level and time horizon. This measurement is the more exceptional level of granularity to convey a detailed analysis of risk method in the banking institution (Pena et al., 2018). AMA framework combines four sources of information:

    a. Internal operational risk loss data

    b. Relevant external operational risk loss data

    c. Scenario analysis of expert opinion

    d. Bank-specific business environment and internal control factors

Furthermore, BCBS and several local banking regulators identify that BIA and TSA is not valuation approach in predicting the OpRisk capital. Also, AMA is difficult to compare across banks due to the authority of each bank to use their model in measuring the operational risk. In 2016 Basel Committee for Banking Supervision issue the new standard for measuring operational risk. It was the Standardised Measurement Approach (SMA) with a simple formula (BCBS, 2016). SMA recommend superseding the three approaches of operational risk measurement (BIA, TS, and AMA).

However, based on (Peters et al., 2016) SMA has several weakness and pitfalls such as instability, risk insensitivity, super-additivity, and the implicit relationship between SMA capital model and systemic risk in the banking sector. They promote to keep using AMA and recommend an alternative standard to unify internal model of every bank.

Based on the Loss Distribution Approach (LDA)(Chi Xu et al. 2019) offer another measurement of operational risk owing to occurrences of the loss mismatch problem which is the critical issue in constructing interdependency between different risk. Researcher introduces the concept of mean severity of loss event and creates a double correlation model.

## Method

The research data is annual reports from each Islamic Banks in Indonesia from 2015 to 2018. The population of this study is 14 Islamic banks in Indonesia, based on purposive sampling by several criteria; ten Islamic banks are the object of this paper. Afterward, the solver program applies linear programming to acquire high net income with low risk of operational risk. The research applies linear programming method which is the novel method during the Second World War. At the linear programming model, which is optimized, is called the objective

function. The services, products, and projects are sharing by limited resources which are named variables. The resources limitations are shown as inequalities, which they are called constraints.

## Result and Discussion

### Description of the Asset liability and operational Risk

**Table 1.** The Element of Asset and Liability

| Bank | Component of Asset and Liability (in million rupiah) | | | | Net Income | Basic Indicator Approach (BIA) |
|---|---|---|---|---|---|---|
| | Asset | Liability | Temprary Syirkah Funds | Equity | | |
| BMS | 6,516,426 | 956,831 | 4,473,975 | 1,085,621 | 60,521 | 1,235,269 |
| BSM | 83,864,392 | 12,274,962 | 64,343,285 | 6,839,896 | 396,342 | 7,376,156 |
| BMI | 57,962,750 | 9,467,500 | 44,344,500 | 4,151,250 | 56,750 | 3,980,500 |
| BNIS | 31,800,750 | 6,099,000 | 22,514,000 | 3,188,000 | 307,250 | 2,942,240 |
| BRIS | 30,343,976 | 8,970,334 | 18,253,815 | 3,119,827 | 125,134 | 2,572,109 |
| BCAS | 5,592,600 | 120,325 | 4,335,000 | 1,137,275 | 41,625 | 266,111 |
| Panin Sy | 8,323,133 | 842,226 | 6,409,359 | 1,071,524 | -218,736 | 416,987 |
| BSB | 6,585,364 | 1,250,238 | 4,535,759 | 799,367 | -13,582 | 362,620 |
| MayBank Sy | 1,256,430 | 641,273 | 357,365 | 615,157 | -133,159 | 251,687 |
| BTPN Sy | 8,428,836 | 775,863 | 5,401,031 | 2,251,941 | 554,299 | 2,550,380 |

The table depicts the average asset, components of liability, net income, and Basic Indicator Approach (BIA) as a tool to measure operational risk included digital risk, research period between 2015 and 2018. It is vividly seen that BSM has the highest RWA of operational Risk (BIA) with the amount of 7,376,156 (in a million rupiah) and it has an enormous asset among another bank. That condition conveys that BSM allocates more capital included equity to minimize the risk. In the opposite Maybank, Sharia has the lowest BIA with 251,687, and it has the most economical asset.

### Solver Analysis

### Answer Report

**Table 2.** The Answer Report of Solver

Objective Cell (Min)

| Cell | Name | Original Value | Final Value |
|---|---|---|---|
| $M$44 | Average RWA | 11.26% | 11.26% |

Variable Cells

| Cell | Name | Original Value | Final Value | Integer |
|---|---|---|---|---|
| $H$44 | Average Aset Growt | 9.53% | 9.53% | Contin |
| $I$44 | Average Liability Growth | 18.43% | 18.43% | Contin |
| $J$44 | Average temporer fund | 5.54% | 5.54% | Contin |
| $K$44 | Average Equity | 29.81% | 29.81% | Contin |
| $L$44 | Average Net income | -133.37% | 0.00% | Contin |

Constraints

| Cell | Name | Cell Value | Formula | Status | Slack |
|---|---|---|---|---|---|
| $H$47 | Max Aset Growt | 40.94% | $H$47>=$H$44 | Not Binding | 31.41% |
| $I$47 | Max Liability Growth | 234.38% | $I$47>=$I$44 | Not Binding | 215.95% |
| $J$47 | Max temporer fund | 48.95% | $J$47>=$J$44 | Not Binding | 43.41% |
| $K$47 | Max Equity | 508.49% | $K$47>=$K$44 | Not Binding | 478.68% |
| $L$47 | Max Net income | 805.83% | $L$47>=$L$44 | Not Binding | 805.83% |

The answer report depicts the average growth of RWA operational risk is 11.26%. This amount is the minimum growth determined in this research based on historical data. Maximize RWA of operational risk as a measurement with the digital risk inherent lead to maximize the growth of net income until 805.83%. The Islamic banking with the low asset, they underwent a sharp increase in net income although it seems ridiculous. Maximization of net profit will occur when Islamic banking eager to take full advantage of their asset and liability. In the table of constraint above, illustrate that Islamic banking has to enhance their Asset, Liability, Syirkah temporary fund and equity with sustainable growth under or equivalent with 40.94%, 234.38%, 48.95%, and 508.49% respectively. Islamic banking has to manage their funding, which derives from the first party (equity), Second party (liability) and Third-party (Syirkah temporary fund) to enhance banking asset.

**Table 3.** The Limit Report of Solver

| Cell | Objective Name | Value | | | | | |
|------|------|-------|---|---|---|---|---|
| $M$44 | Average RWA | 11.26% | | | | | |

| Cell | Variable Name | Value | Lower Limit | Objective Result | Upper Limit | Objective Result |
|------|------|-------|-------|-------|-------|-------|
| $H$44 | Average Aset Growt | 9.53% | 0.00% | 11.26% | 40.94% | 11.26% |
| $I$44 | Average Liability Growth | 18.43% | 0.00% | 11.26% | 234.38% | 11.26% |
| $J$44 | Average temporer fund | 5.54% | 0.00% | 11.26% | 48.95% | 11.26% |
| $K$44 | Average Equity | 29.81% | 0.00% | 11.26% | 508.49% | 11.26% |
| $L$44 | Average Net income | 0.00% | 0.00% | 11.26% | 805.83% | 11.26% |

The average growth of each component asset and liability have a lower limit and upper limit to reduce operational risk with an account of 11,26%. This limit depends on enlarging each element of asset and liability.

## Conclusion

Asset and liability management as the core of banking have a cumbersome task to enhance the institution profit and reduce several risks in Islamic banking. This study conveys several iterations trial-error based on the data by the solver program. The best iteration for the ALM condition of ten Islamic banking is minimizing the amount of operational risk in the level of 11.26%.

This research did not explain deeply about the measurement of digital risk owing to there is no specific regulation and previous research that provide the formula for quantifying digital risk. Another limitation of this research is the usage of measurement for operational risk for all Islamic banking is Basic indicator approach. It is used for standardizing of the analysis in order comparing between the bank, while there are several advanced measurements based on banking self-assessment. Hence, it is essential for the next research to construct a model of digital risk as apart of operational risk and use another approach for measuring operational risk.

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