

Designing a Company Risk Register and Risk Monitoring System to Assist in Managing Aircraft MRO Risks

Raditia Dhamayanti¹, Glenny Chudra², Alfa Yohannis³

Pradita University, Banten, Indonesia

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✉ Corresponding Author

Glenny Chudra,

Pradita University,

Tel. +62 85777505255

Glenny.chudra.s2@student.p

radita.ac.id

ABSTRACT

This company specializes in maintenance, repair, and overhaul (MRO) services for aircraft. MRO activities are crucial to ensuring the safety and reliability of aircraft operations. However, these activities also involve various risks that can affect the performance and reputation of companies in multiple fields. To manage these risks effectively, a system for risk registration and monitoring has been designed for companies in the MRO industry. This paper presents the design of the Risk Register and Monitoring System, which includes the identification, assessment, and management of risks related to the activities of all existing units within companies in the MRO industry. This system is designed to provide a structured approach to risk management, which can help companies in the MRO industry manage risks across all units. The proposed system consists of several components, including automation for performing risk registers and monitoring through a website. This system allows companies in the MRO industry to assess the severity of risks, simplify risk management strategies, and streamline the risk registration process. As a result, companies in the MRO industry can minimize the impact of risks from each unit and enhance efficiency and effectiveness in risk management.

INTRODUCTION

Maintenance, Repair, and Overhaul (MRO) is an integral part of the aviation industry, playing a role in maintaining optimal aircraft safety and performance [1]. However, like other industries, MRO activities also involve risks that require careful management to minimize their impact on the company's operations and reputation. Equipment failure, human error, and natural disasters can result in accidents or significant damage to aircraft, impacting customer confidence and overall company performance [2]. Therefore, it is crucial for MRO companies to initially identify risks, understand and manage those risks, and minimize their impact on the company[3].

Risk management in the MRO industry has become increasingly important due to the rapid growth of the global aviation industry. In recent years, the increasing number of commercial flights and new aircraft has heightened the demand for reliable and effective MRO services [4]. In this case, proper risk management becomes crucial for MRO companies, as it provides a solid foundation for ensuring the safety and performance of aircraft effectively.

Several companies employ different approaches in the risk management stage. However, the most common method for conducting risk assessment in risk management is using ISO 31000:2018 to establish risk criteria, identify risks, and analyze risks[5]. In the risk assessment process, risk assessments use impact and likelihood [6], which use a risk matrix to determine the priority of hazards for improvement [7].

According to research by [8], technology, tools, and applications can help and facilitate all tasks. Therefore, to make risk assessments easier, a system has been created to help companies deal with large units and risks. The following are several methods for developing risk monitoring, including iterative, spiral, v-model, and Rapid Application Development (RAD) [9]. SDLC will be chosen as the method for developing the system because it involves highly detailed stages, starting from planning through to maintenance. Expectantly, this research will facilitate MRO companies in conducting risk assessment and monitoring while also providing insights for other companies aiming to streamline their risk monitoring processes.

METHOD

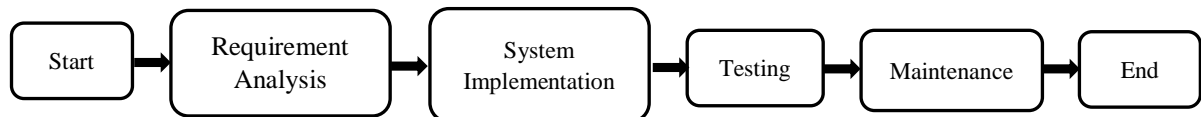


Figure 1. Research Stages

During the development of risk register and risk monitoring systems for companies in the MRO industry, the technical utilize is the SDLC (Software Development Lifecycle) method because it allows for revisions and returns to the design stage in case of system changes. The SDLC is relevant to the development project of risk register and risk monitoring systems for companies in the MRO industry because it provides a clear and structured framework for project management. The SDLC method requires thorough planning and documentation because its strength lies in its reliable structure.

SDLC is a software development method that focuses on short iterations to develop, test, and release features regularly. Utilizing Agile SDLC in designing Risk Registers and Company Monitoring systems in the MRO industry is crucial for managing aircraft MRO risks because it enables the handling of complex and dynamic requirements through rapid and adaptive iterations. Agile also reduces project risks by identifying and addressing issues earlier, ensuring efficient and responsive design processes.

When designing a Risk Register and Risk Monitoring System for companies in the MRO industry, Agile SDLC is applied by understanding initial requirements, sprint planning, iterative development, continuous collaboration and feedback, and continuous testing. Phased implementation and incremental iterations ensure the system adapts to requirements. MRO industry companies accept the final product for aircraft MRO risk management.

RESULTS AND DISCUSSION

The system development begins with risk registration and progresses to risk monitoring, utilizing the Microsoft environment for risk registration and Pandas, NumPy, and Python for the risk monitoring system. The application development stages using SDLC with the following phases:

1. Planning

At this stage, interviews will be conducted with users (Risk Analysts) regarding risk register requirements and risk monitoring systems. The results of the user interviews include:

- Currently, there is no system for automatically adding risk registers.
- Still conducting interviews using conventional methods for risk monitoring
- Determine the appropriate automation flow for the risk register system.

2. Analysis

After understanding the existing requirements, analyze the system, which includes:

- The risk register utilizes SharePoint and includes a Microsoft List, which serves as the database for risk registration.
- Each unit's Risk Officer will input the potential risks. The Risk Officer had previously discussed those risks with their unit's Risk Owner (Vice President).

- After completing the input, the Risk Analyst will use Power Automate to send the first-tier approval request to the Risk Owner, followed by the second-tier approval request to the VP of Unit Accounting.
- If it is successfully approved, it means the risk is already registered and added to the Microsoft risk monitoring list in SharePoint.
- The risk monitoring in the Microsoft list will be exported to an Excel file, making it easier to create dashboards using Python and Pandas, Numpy, and Seaborn libraries.
- Insert the Streamlight link into the SharePoint main page to open risk monitoring.

3. Design

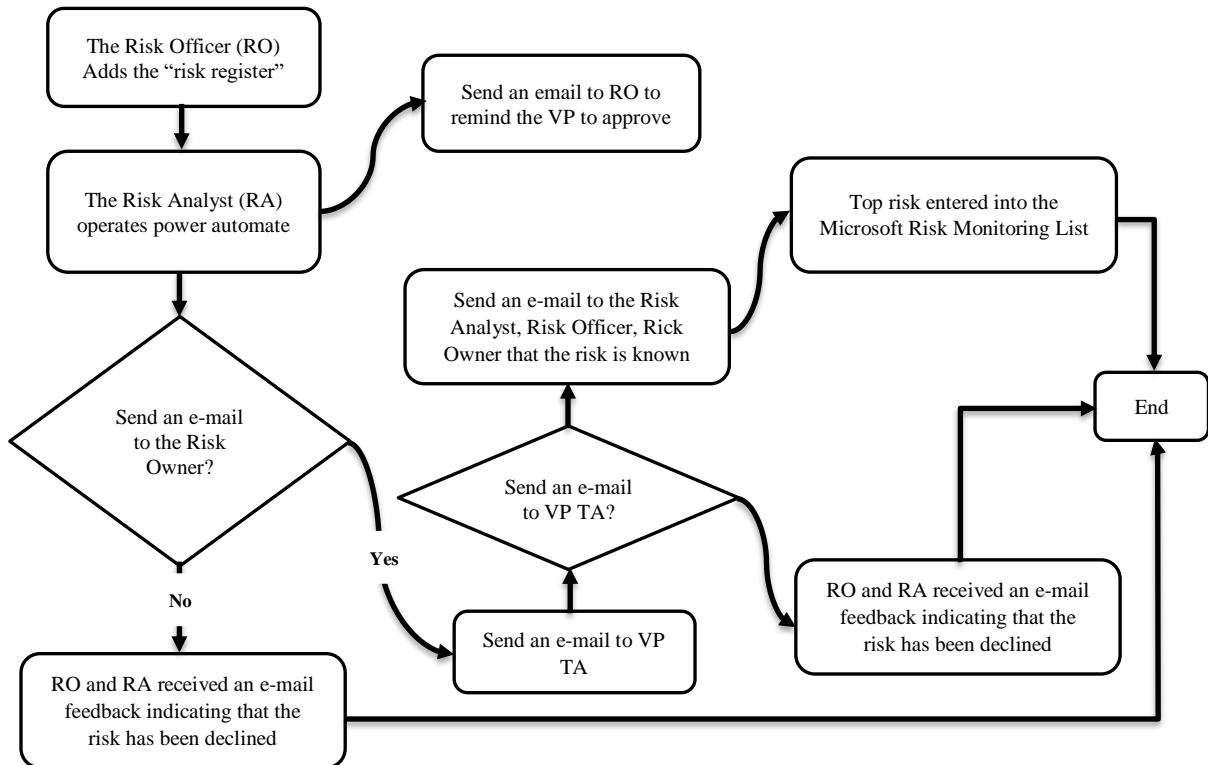


Figure 2. Risk Registration Stages

Once completed then the risk that has the status “Top Risk: Yes” will be entered into risk monitoring. Figure 3 show the flow of risk monitoring:

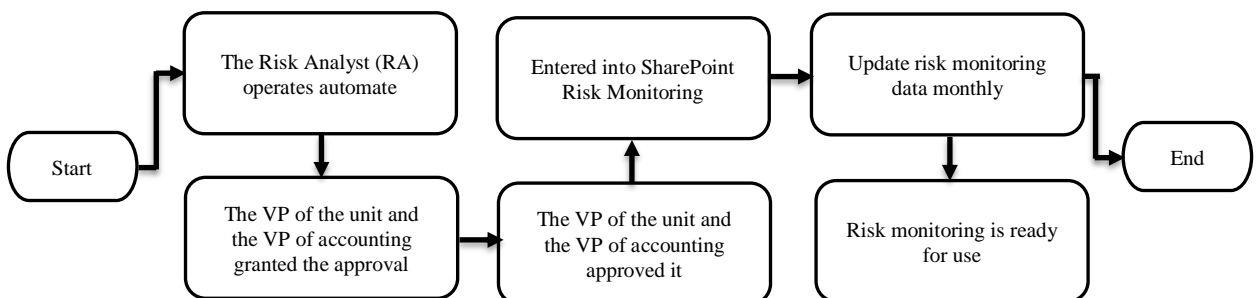


Figure 3. Stages of Risk Monitoring

A risk monitor and risk limit map will monitor risks that move to risk monitoring as shown on Figure 4:

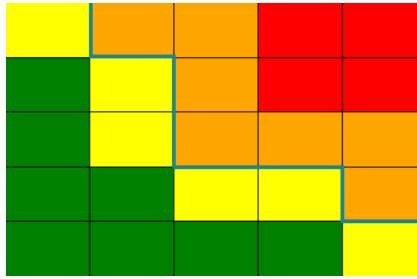


Figure 4. Image of A Risk Map for Risk Monitoring Dashboard

Divide risk monitoring into 5x5 maps with overlapping consequences and likelihood on each existing risk. The blue line represents the limit or risk appetite. Consequences from left to right are values of 1-5, and the likelihood from bottom to top, which are also values of 1-5, is the risk detail as shown in Figure 9.

4. Implementation and Testing

Divide the implementation into two parts: risk register automation and risk monitoring dashboard, with the following details:

- Implementation of risk register automation:
First, make prior approvals for the Risk Owner:

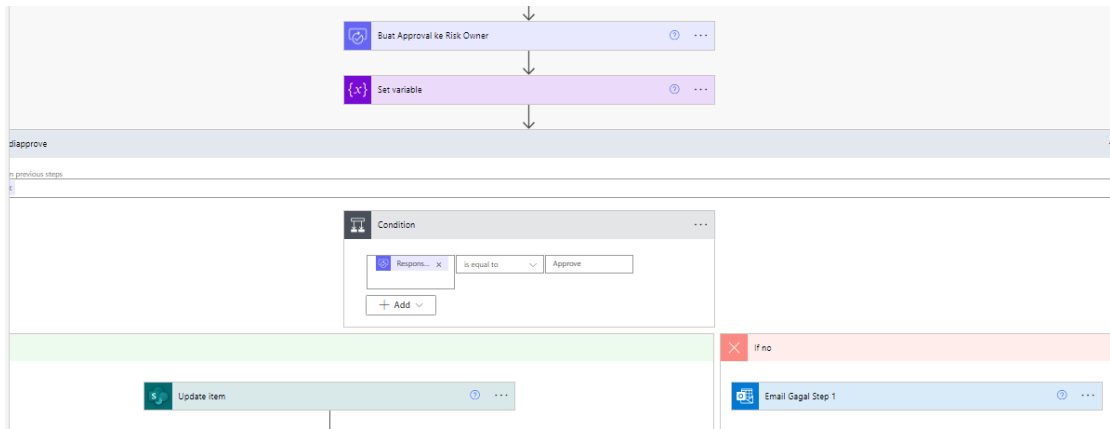


Figure 5. Approval 1 for Risk Owner

If it fails, the Risk Owner and the Risk Analyst will receive an email stating that the risk registration failed. If it succeeds, it will proceed to the second approval, which is approval by the VP of Accounting.

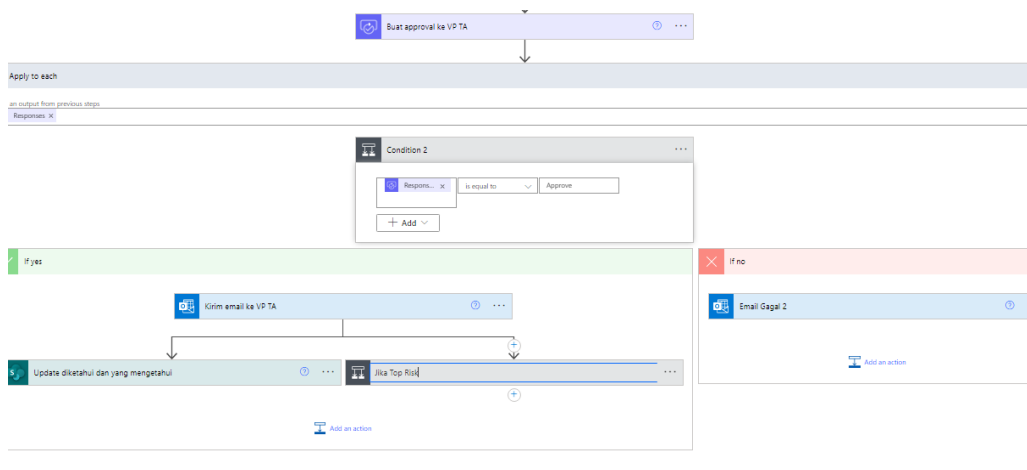


Figure 6. Approval 2 for VP TA

If the second approval fails the same as the first approval, there will be email feedback to the risk officer and the risk analyst that the risk registration has failed to be registered. If successful, it will update the known Microsoft list and find out. If a value in the Top Risk column is "Yes," duplicate the existing data to the Microsoft Risk Monitoring list to facilitate monitoring.

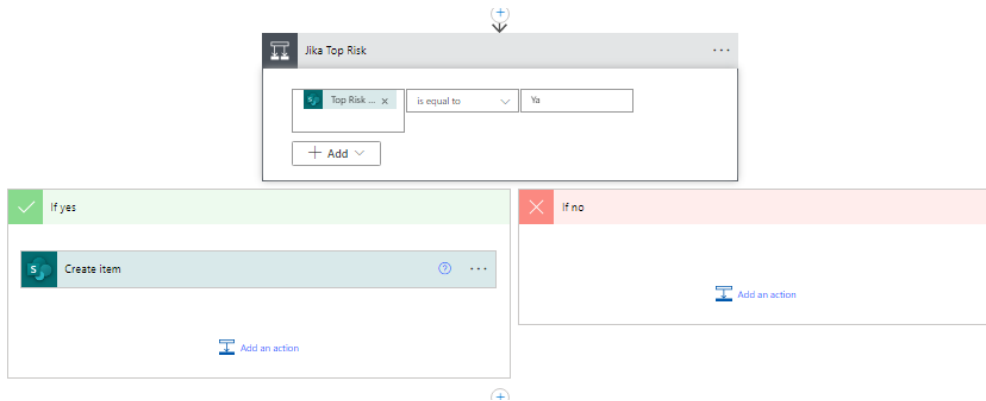


Figure 7. Duplication of Data List From Risk Register to Risk Monitoring

- Implement dashboard risk monitoring
Implement risk monitoring using Python programming languages and libraries for data science, such as Numpy, Pandas Seaborn, and others. Creating a risk monitoring dashboard requires setting up a data frame, which is already available in the Microsoft list of risk monitoring.

```
## update
import streamlit as st
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import openpyxl
from openpyxl import load_workbook
```

Figure 8. Python Library Used

If the data is already available, the next step is to set up the image used as the risk map background of the dashboard risk map (Figure 8). In the processing phase, two data sets, inherent risk value, and residual risk value, are used. Then, sort by data based on unit and Title to make each unit risk a single mapping:

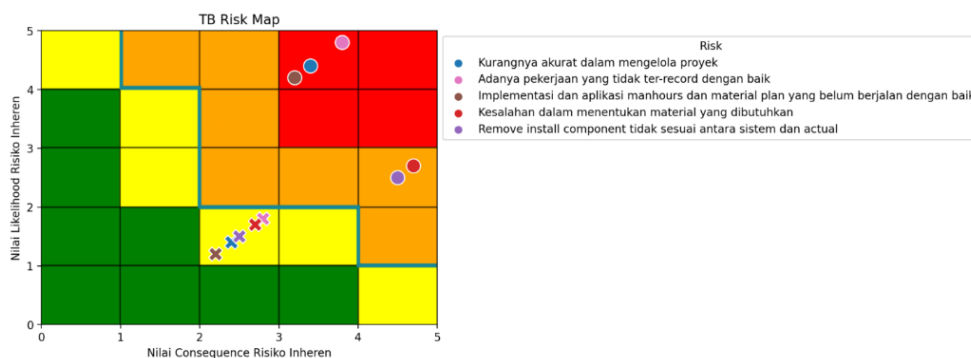


Figure 9. Example of Risk Mapping Unit X

After completing risk mapping, proceed to create the dashboard using Streamlit. Streamlit will display the home page to select the unit.

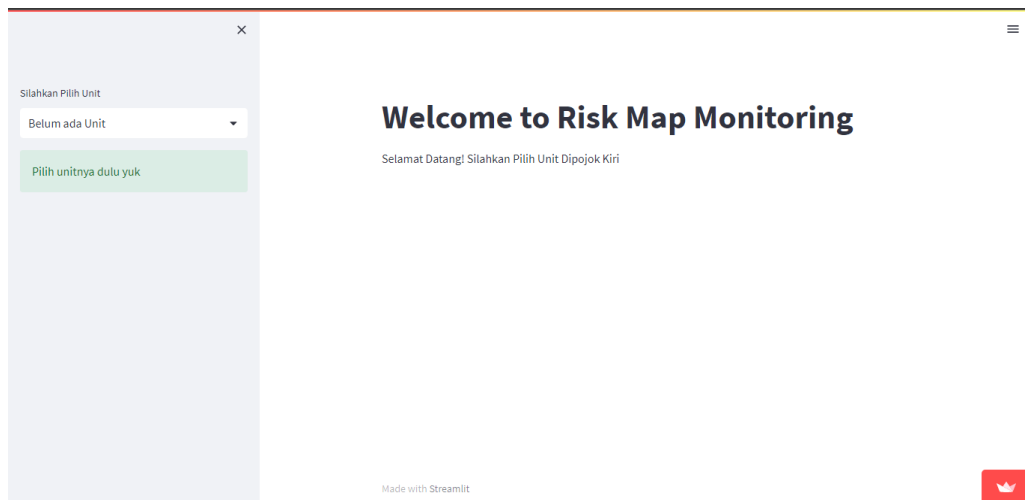


Figure 10. Streamlit Homepage Image

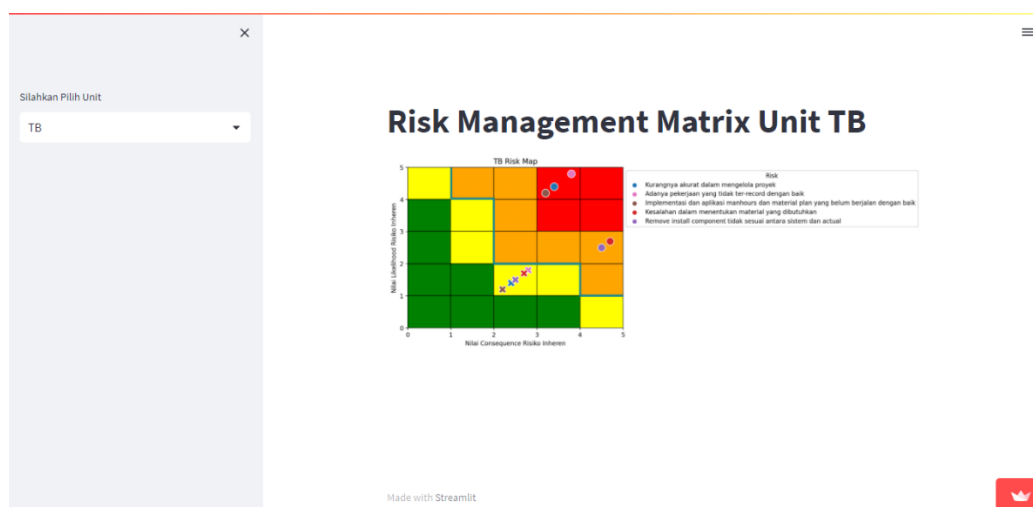


Figure 11. Streamlit When One of the Units is Selected

5. Maintenance

If there are some changes after risk registration and risk monitoring because you have to register risk before the dateline, some of the things that need to be changed are:

- Send approval to the Risk Owner and Risk Officer by e-mail. The Risk Officer on duty reminds the Risk Owner
- If did not receive a response, send another e-mail within 7 days
- Include a PDF containing a guide to how to risk register in an e-mail

Users will be involved in User Acceptance Testing (UAT) to ensure this change functions appropriately. UAT will ensure that the system meets user needs and expectations before full implementation. Users involved in testing will provide feedback to ensure that all changes work correctly and meet operational requirements.

6. Application Discussion

The system built for risk register and risk monitoring uses a streamlit-based website using the Python programming language. Streamlit was chosen because it integrates Python

libraries well, which is important for data analysis and visualization. The data taken comes from the Company's PowerApps, which is exported to Excel. The processed data will be cleaned and grouped according to the Company's division or unit in the MRO Industry to facilitate monitoring and analysis of risks associated with each division or unit.

In a previous study [11], the development of the research system at Unjani was successfully implemented using the Agile Model despite limitations in the number of developers and budget cost. This model is successful because it cuts out several rigid processes, such as excessive documentation in problem collection and evaluation, which is divided into several stages. As a result, the system developed has been used by LPPM and all researchers at Jenderal Achmad Yani University.

This model facilitates flexibility in swiftly adjusting to evolving project requirements, reducing development costs and time by eliminating unnecessary processes and actively involving users in every stage of development. Moreover, the periodic delivery of results allows stakeholders to apply them immediately in research activities. Despite the streamlined evaluation process, the Agile Model still enables continuous user feedback, which can be utilized to enhance the system's quality incrementally.

A previous study [12] found that the use of Streamlit with the Python programming language offers several benefits, particularly when creating data-driven web applications and visualizations. The simplicity of Python and the user-friendly interface of Streamlit enable rapid development. Its open-source nature, with no licensing fees, promotes open science and facilitates automatic data updates and real-time information retrieval.

CONCLUSION

The risk registration process will be improved and simplified, particularly for corporations with large divisions (units), as it is carried out automatically and digitally. Monitoring risks also becomes more practical due to easy data updates and dashboard access. In the future, it is anticipated that the dashboard will become more powerful and that the automation process will be made more efficient

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