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Mapping to predict and prioritize branches affected by natural disasters based on web applications and Google Maps geocoding methods in the group audit and risk advisory. (case study: PT. Astra International, tbk.)

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Abstract. Group Audit and Risk Advisory (GAnRA) PT Astra International Tbk has several divisions; one of them is Risk Advisory (RA) Division. RA Division is responsible for data collection of the branches that affected by natural disasters to know the state of the branch after the disaster. But this time, the business process is running ineffective and inefficient. The meaning of ineffective here is when RA Division should call whole Sales Operation (SO) Head Office (HO) and affiliate company (affco) HO. While the meaning of inefficient here is when RA Division should pay the entire cost of the phone to call SO HO and affco HO. Therefore, RA Division requires an application that can predict the branches affected by natural disaster, namely Risk Dashboard. This application is developed by waterfall methodology, ASP.NET programming language, SQL Server Management Studio database, and Google Maps Geocoding Technic. This application makes the time needed to find a branch to be only a few seconds from the previous one which took almost a day. With this application, it makes RA Division faster in analysing the data for reporting and updating Business Continuity Plan (BCP).

1. Introduction

1.1. Background

Indonesia is an archipelago which is circled by the most active earthquake path in the world, the Pacific Ring of Fire. It is an area that often experiences earthquakes and volcanic eruptions surrounding the basin of the Pacific Ocean. About 90% of earthquakes in the world and 81% of the largest earthquakes occur along the Pacific Ring of Fire [1]. Based on these facts, PT Astra International Tbk requires estimates for branches that are potentially affected by natural disasters.

PT Astra International Tbk is a multinational company with a number of Sales Operations (SO) of more than 500 branches and a number of affiliated companies (affco) of more than 190 companies spread throughout the territory of Indonesia. The Risk Advisory (RA) Division was formed by PT Astra International, Tbk. that is responsible for carrying out data collection on branches prone to disasters. The data collection is carried out to fill the Damage Assessment Form that contains information about the state of the post-disaster branch. After the Damage Assessment Form data is collected, then the RA Division will analyze the data for the need to make a Business Continuity Plan (BCP) report and update.

But at present, business processes that are running are considered ineffective and inefficient. Ineffective is the RA Division has to call all affco HO and SO HO even though unnecessary whereas every affco HO and SO HO has branches in the affected area. Inefficient, the RA Division has to pay telephone charges to call affco HO and SO HO. Affco HO and SO HO need to ask which branches are affected by the disaster and the time needed to get the branch data by calling almost 1 day (5-11 hours). This ineffective and inefficient business process makes the RA Division looking for alternative solutions. The solution offered is to do business process automation (BPA) [2]. BPA implementation requires an application that can estimate the branches affected by the disaster in a short time [2].

1.2. Related Research
Before this research was conducted, many researchers had conducted research on location search technology. Research was conducted by Muhammad Soleh entitled Google Maps-Based Application Design to Find nearby Tourist Locations [3]. Muhammad Soleh said the location search technology was able to accelerate getting the nearest location information and optimizing the user's journey to reach the location. This conclusion was reinforced by Rizal and Latifah in a study entitled Designing Application Sites for Jakarta City Using Android-Based Sequential Search Algorithms [4]. Ilham's research entitled Application of Mapping Boarding Houses around UMS Based on Google Map API concluded that the existence of mapping applications using the google map API can help students to determine the choice of boarding houses [5].

Subsequent research was conducted by Intan Okta Sari in a research entitled Application Location Based Service (LBS) Location Search Palembang Nature-Based Android concluded that LBS application is expected to provide information that is accurate, clear and accurate to determine the location points of Palembang Nature, and can facilitate local and foreign tourists and the public [6]. Furthermore, Muthumurugesan in research Smart Way to Track the Location in Android Operating System says LBS using GPS to locate user's current location and the user can select the new destination of their interest or they can choose the predetermined destination location which is closer to the current location [7].

Wasim Ahmad in his research A Google Map Based Social Network (GMBSN) for Exploring Information about a Specific Territory explained that GMBSN users can choose their desired city of interest from the list. The selected city will be highlighted on the Google map. After choosing some cities from the map, the user will be able to select some categories from the list and start finding and sharing information about the desired city of any country [8]. Sharma and Morwal in their research Location Tracking Using Google Geo-location API claimed that Location tracking will be helpful for various applications. By using this system, users obtain the current geographical position of the hosting device or the user [9].

Garude and Haldikar conduct research entitled Real-Time Position Tracking System Using Google Maps API V3 to enable the owner or a third party to track the vehicle's location, collecting data in the process from the field and deliver it to the base of operation [10]. Ibrahim and Mohsen in their research Design and Implementation an Online Location Based Services Using Google Maps for Android Mobile stated that LBS using Google map helps tourist or some users use it to add place on map or can delete place from map or review the information about some places on map, also can calculate route, duration and distance between any to point or place on map [11].

All of these researches discuss the same problem, namely the need to find locations quickly and accurately. These researches also applied the same solution, using Google Maps technology. Thus it can be said that Google Maps can be used as a solution to the problem of finding branches in GAnRA.

1.3. Problem Formulation
The problems of searching for branches in the current business process are how to make the branch search process shorter [1]; how to find out the affco and SO branch distribution maps in Indonesia [3] [4] [5] [6] [7] [8] [9] [10] [11]; how to prioritize branches affected by natural disasters [3] [4] [5] [8] [10]; how to know the time and location of a disaster [4] [11].

1.4. The Purpose

The purpose of this research is to create a Risk Dashboard application to support the implementation of the BPA that is able to:

1. Shorten the branch search time to 2 seconds.
2. Create an affco and SO branch distribution map in Indonesia.
3. Prioritize branches that are estimated to be affected by a disaster with a risk profile.
4. Provide information in the form of notification to the RA Division in the event of a disaster.

2. Phase and Methodology

2.1. Research Stages

In this research, the research process was carried out in the following stages:

1. Problem Formulation
2. Research Design
3. Business Process Automation (BPA)
4. Geocoding Google Maps
5. Software Development
   a. Planning
   b. Analysis
   c. Design
   d. Implementation
6. Application Testing
7. Conclusions and Suggestions

The problem formulation stage is done by collecting data through interviews and literature study methods [2] [12]. Interviews are conducted to obtain information related to the problems that exist in the current business process and the solutions needed through users who are the staff of the RA Division. Literature study is carried out by collecting related documents and studying theories and previous studies as a basis for solving problems.

The next stage is the Business Process Automation (BPA) which uses two popular techniques, namely problem analysis and root cause analysis. After the BPA phase is carried out, software development will begin using the waterfall methodology. After the software has been developed, the next step is to test the application [2].

2.2. Business Process Automation

BPA replaces the manual process into a computerized process. BPA can make business processes more efficient but does not provide significant benefits to the organization. Problem analysis and root cause analysis are two popular techniques in BPA [2].

This research uses both techniques. Problem analysis is a technique used to analyze the current state of the system, then look for solutions that can be developed for the new system. Whereas root cause analysis is a technique that focuses on problems, not solutions. The analyst starts by asking the user to list the problems that exist, then prioritizing the problem in the order of importance, which starts from the most important, then finds the root of the problem. Every possible cause of the problem is investigated and a solution is sought. Descriptions of the problems found were carried out with fishbone diagramming techniques [13].

2.3. *Google Maps Geocoding*

The Google Maps launched in 2005 has revolutionized online mapping service applications on the World Wide Web. Based on Asynchronous JavaScript and XML (AJAX), a new type of client/server interaction was introduced in Google Maps to maintain a continuous connection between the client and the server for immediate downloading of additional map information [14].

The Geocoder class helps in determining the geo-coordinates (latitude, longitude) for a given address which is called as forward geocoding and possible addresses for a given set of geo-coordinates which is called as reverse geocoding. In Android, forward geocoding is done by using getLatitude() and getLongitude() methods and reverse geocoding is done by using getFromLocation method [15]. Conversion from address to latitude and longitude is called geocoding. For example, we can convert addresses like Yogyakarta to (-7.797224, 110.36879). To convert it, we use the Geocoding API in JavaScript language [15] [16].

2.4. *Software Development Methodology*
The methodology which is used in developing the Risk Dashboard application is the waterfall methodology. It is a methodology that uses a formal step-by-step approach that moves from one phase to the next. Project progress with the waterfall methodology is not permitted to retreat to the previous phase because it follows the behavior of the waterfall. The waterfall methodology was chosen because the time to identify the system needs was planned long before the system development began. Identifying the system requirements aims to minimize changes in needs in the middle of the system making process [2].

2.5. *Test Methodology*
To find out the results of the development process in this research, steps are used to test it as follows:
1. Perform input on data displayed during testing.
2. Prepare the environment needed for the testing process that is ready for use, such as a computer that has a web browser with a smooth internet network.
3. Determine the sequence of functions to be carried out at the time of testing.
4. Test the application to prove that the application development has been completed.
The results of this testing activity will be discussed in the Discussion subsection.

3. Results and Discussion

3.1. *Risk Dashboard Application*
To help this automation process will be developed an application called the Risk Dashboard. It is a web-based application that is used to predict and prioritize branches affected by natural disasters based on the value of risk profile. This application runs on a Windows operating system that can be accessed using a web browser and internet.

The Risk Dashboard application is developed for 3 months and 2 weeks, starting in March 2017 and ending in June 2017. Risk Dashboard application development is divided into 4 stages, namely planning, analysis, design and implementation. The planning stage is to carry out a feasibility test for technology, costs, and organization. The feasibility test will determine whether the application is feasible to build or not.

The next stage is the analysis phase which analyzes the current business process (as-is system) and looks for the problem, then looks for solutions that can be used to design a new system (to-be system). Furthermore, the solutions produced will be a requirement that must be met by the system to be developed. The need for the Risk Dashboard application is illustrated through UML diagrams [2]. There are four main diagrams used, namely the Use Case Diagram, Class Diagram, Sequence Diagram and the State Machine Diagram. In addition to the four diagrams mentioned above, the Risk Dashboard also uses the Physical Data Model (PDM) as a detailed description of the database in physical form [2]. The making of this PDM is obtained from the class diagram transformation process [2]. The result of the analysis is that the application must be able to do:
• Search for branches based on company, region, location or coordinates and radius.
• Find out the distribution of branches in a region.
• Display the detailed information of a branch along with the risk profile that is owned.
• Displays detailed information of several branches in the form of summarize tables.

- Create branch reports based on search results.
- Display the latest disaster warnings from Meteorological, Climatological, and Geophysical Agency/ BMKG.
- Process and upload branch data.
- Process data risk profile.
- Processing user data.
- Processing company data.
- Processing regional data.

After the analysis stage, the next stage is the design stage. It designs the specification of programs/ codes, user interfaces, database, files, hardware and network infrastructure suitable for application development [2]. In accordance with the users work environment and facilitate their work, the application is designed to be developed based on the web. To search and find branches in order to map out the predictions and prioritize the branches affected by natural disasters, it is designed to use geocoding techniques on Google Maps. For its architecture, it is designed using three-tier model.

The last stage is the implementation stage, which is the stage where the application is built. At this stage, coding and testing of the application are carried out. It is built using the ASP.NET language with framework 4.5 and SQL Server Management Studio database. The test was conducted to convince users that the system has functionality that is in accordance with the design created, there are no bugs/errors and the addition of validation to prevent human error [2]. In addition, test was also conducted to ensure that the automation process is running according to user requests.

3.2. Discussion

Based on the root-cause analysis that has been carried out [2], it is obtained an overview of the problems faced which are described using the fishbone diagram (**Figure 1**). It can be seen that there are two main problems in branch search activities, namely tools and processes. Based on the problems described in the fishbone diagram, automation is performed on branch search activities. Automation of activities carried out focuses on eliminating existing problems. Like making branch search features that are fast, accurate and can use several parameters, such as company, region, location or coordinates and radius. In addition, a disaster notification feature is also created that contains information on the timing and coordinates of the disaster.
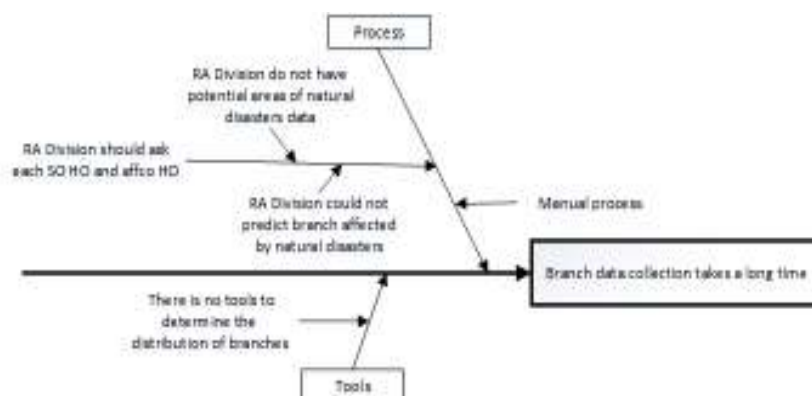

Figure 1. Fishbone Diagram Root Caused Analysis

After the Risk Dashboard application has been developed, testing is performed on every function that is owned. There are 25 main functions. Based on the results of the tests performed, it can be concluded that the Risk Dashboard application was successfully built because it meets the needs of the user and is suitable for use. The results of the Risk Dashboard application testing can be seen in Table 1.

Table 1. Result of Testing the Risk Dashboard Application

No	No. UR	User Requirements	Results		No	No. UR	User Requirements	Results	
			Pass	Failed				Pass	Failed
1	RD01	Upload Branch	√		16	RD016	Edit Risk Profile	√	
2	RD02	Add Branch	√		17	RD017	Delete Risk Profile	√	
3	RD03	View Branch	√		18	RD018	Add User	√	
4	RD04	Edit Branch	√		19	RD019	View User	√	
5	RD05	Delete Branch	√		20	RD020	Edit User	√	
6	RD06	Add Company	√		21	RD021	Delete User	√	
7	RD07	View Company	√		22	RD022	Search Branch	√	
8	RD08	Edit Company	√		23	RD023	View Detail a Branch	√	
9	RD09	Delete Company	√		24	RD024	View Detail Branches	√	
10	RD010	Add Region	√		25	RD025	Export Branch	√	
11	RD011	View Region	√						
12	RD012	Edit Region	√						
13	RD013	Delete Region	√						
14	RD014	Add Risk Profile	√						
15	RD015	View Risk Profile	√						

After all application functions pass the test, then an experiment is conducted to find out how long it will take to map the predictions and priorities of the branches affected by natural disasters. To conduct it, use data from 10 branches affected by the disaster. Previously taken data from 10 branches affected by the disaster on the old system, then compared with the results using the Risk Dashboard Application. The results of the experiment can be seen in Table 2.

Table 2. Experiment Results between Old and New System

No.	Branch Name	Old System (hour)			Risk Dashboard Application (second)		
		Total of Call HO	Damage Assessment	Total	Total of Call HO	Damage Assessment	Search for Branch
1	Branch 1	5	4	9	0	0	3
2	Branch 2	4.5	4	8.5	0	0	4
3	Branch 3	4	5	9	0	0	5
4	Branch 4	5.5	3.5	9	0	0	3
5	Branch 5	5	4	9	0	0	5
6	Branch 6	6	4	10	0	0	4
7	Branch 7	5	4.5	9.5	0	0	5
8	Branch 8	6.5	3.5	9	0	0	4
9	Branch 9	5	5	10	0	0	3
10	Branch 10	5.5	4	9.5	0	0	2

Based on these experiments, there is a very large time difference, where when searching and finding branches in the old system requires an average time of 1 day (5-11 man-hours), but using the Risk Dashboard Application only takes a few seconds. The Risk Dashboard application helps the Risk Advisory Division no longer need to call all affco HO and SO HO when natural disasters occur to get branches that are predicted to be affected by natural disasters. In the new system there is no need to fill in the Damage Assessment Form because it will report the level of damage obtained from BMKG. It also helps the Risk Advisory Division only needs to search using the application to get a list of branches that are predicted to be affected by natural disasters.

4. Conclusions and Suggestions

4.1. Conclusions
Based on the research, BPA implementation by developing a Risk Dashboard application is able to:
1. Shorten the branch search time to a few seconds.
2. Show the distribution of Affco and SO branches in Indonesia.
3. Prioritize branches obtained from search results through a risk profile.
4. Display notifications when a disaster occurs in Indonesia,

From the elaboration of the results that have been achieved, it can be concluded that the purpose of BPA implementation with the Risk Dashboard application is able to map to predict and prioritize branches affected by disasters.

4.2. Suggestions
Based on the results of the tests that have been carried out, some suggestions can be taken into consideration for future Risk Dashboard application developers, namely:
1. Completing the remaining 23 branches of Affco and SO. For now, the Risk Dashboard application is able to search on 5 branches of SO and affco, because the data of the SO and affco branches are not complete. Therefore it is necessary to complete the SO and affco branch data so that the Risk Dashboard application can perform branch searches optimally.
2. Adding function to save disaster history so that disaster-prone areas in Indonesia and branches in the area can be identified.
3. Adding function to calculate the loss and risk analysis of the branches that are estimated to be affected by the disaster.

Acknowledgments

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