GEOGRAPHIC INFORMATION SYSTEM MAPPING OPPORTUNITIES OF INVESTMENT IN NATURAL STONE, BATIK, AND RATTAN INDUSTRIES IN CIREBON DISTRICT

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ABSTRACT

Cirebon Regency is one of the regencies in West Java Province. The geographical location of Cirebon Regency is at positions 6 ° 30'-7 ° 00 'South Latitude and 108 ° 40'-108 ° 48' East Longitude. Area of Cirebon Regency, which is 990.36 Km^2. Access to Cirebon Regency is very easy. There is easy access to Cirebon Regency, for example West Java International Airport, Cipali Toll Road, and International Ports which make investors interested in investing in Cirebon Regency. These reasons make investors interested in investing in Cirebon Regency. Tebut, the Department of Investment and Integrated Services One (DPMPTSP) The door has not had a device or medium for displaying data attribute geographically because of the way that made the DPMPTSP in providing information on investment opportunities based solely on activities with the help of *power point* and participate exhibitions held by third parties. This method is not effective and efficient even though the relevant agency already has map data that has been digitized but not utilized. As a result information dissemination becomes uneven and a lot of budget is wasted. DPMPTSP requires a system that displays geographical attribute data in the form of geographic information systems to map investment opportunities in natural stone, batik and rattan industries in Cirebon Regency. The results of thetest *Black box, User Acceptance Test* (UAT), *and the beta* carried out can be concluded that the system can assist DPMPTSP in determining the mapping of investment opportunities and assist investors in finding information about mapping investment opportunities in the natural stone, batik and rattan industries in Cirebon Regency.
Keywords **:** geographic, information systems, geographic information systems.

1. INTRODUCTION

Cirebon Regency's Investment and One-Stop Service (DPMPTSP) is a government agency engaged in investment and licensing, one of which is an industrial business license. DPMPTSP is a bridge for investors to invest in the Cirebon Regency. Cirebon Regency is one of the regencies in West Java Province. Based on its geographical location, Cirebon Regency is in the position of 6 ° 30'-7 ° 00 'South Latitude and 108 ° 40'-108 ° 48' East Longitude. Area of Cirebon Regency, which is 990.36 Km2. Access to Cirebon Regency is very easy. There is easy access to Cirebon Regency, for example West Java International Airport, Cipali Toll Road, and International Ports which make investors interested in investing in Cirebon Regency.

According to data obtained from the Cirebon Regency Industry and Trade Office in 2016 concerning Small and Medium Industries, there were 41 products taken 3 products, namely natural stone, batik and rattan. The three products are superior products in Cirebon Regency. Rattan production develops in the Plumbon, Weru, Depok, Plered, Kedawung and Palimanan Subdistricts, with 1,305 business units currently recorded. Sentra The growing natural stone industry in Palimanan, Dukupuntang, Gempol, and Depok Districts with businessmen is currently recorded at 364 business units. While batik develops in Plered, Tengah Tani, Kedawung, and Ciwaringin Subdistricts with entrepreneurs currently carrying 558 business units. The three products are in great demand by investors. Not only domestic investors, foreign investors are also interested in these three products so that natural stone, batik and rattan are often exported abroad. To attract more investors, a system that holds information is needed to make it easier for investors to access information about the investment opportunities of the three products. At present, DPMPTSP does not have a tool or media to display geographical attribute data because the way carried out by Cirebon Regency DPMPTSP in providing information about investment opportunities is only based on counseling activities using power point assistance and participating in exhibitions held by third parties. This method resulted in information dissemination being uneven because investors did not have a description of the geographical environmental conditions of Cirebon Regency.

According to existing problems, it is necessary to create a Geographic Information System (GIS) mapping investment opportunities in the natural stone, batik, and rattan in Cirebon Regency so that

investors see the spread of investment opportunities in the natural stone, batik and rattan industries in Cirebon Regency and can it also makes it easier for the agency to monitor investment opportunities in the natural stone, batik and rattan industries in Cirebon Regency because the output from the GIS is in the form of a map that will be more informative so that it is expected to provide information to investors.

The purpose of this study was to analyze the industrial area of natural stone, batik and rattan in Cirebon Regency, as well as to build a geographical information system to map investment opportunities in the natural stone, batik and rattan industries in Cirebon Regency. The purpose of this research is to assist the agency in monitoring investment opportunities in the natural stone, batik and rattan industries and assist investors in providing investment opportunities in the natural stone, batik and rattan industries so that investors can invest in Cirebon Regency.

2. RESEARCH CONTENT

2.1 Geographic Information System

information system is defined as a tool or medium for entering, storing, retrieving, manipulating, analyzing, and displaying geographical attribute data (geospatial data) that is useful to support decision-making processes in resource planning and management nature, environment, transportation, urban problems, and administration.

Geographical Information System is also defined as a database system where almost all data is structured in a geospatial manner and there is a procedure that works to provide information about a geospatial object in the database. [1]

2.1.1 Spatial Data

data is a data that is geographically oriented and has a certain coordinate system as the reference basis. Most of the data to be handled in GIS is spatial data which is a data that is geographically oriented, has a certain coordinate system as the reference basis and has two important parts that make it different from other data, namely location (spatial) information and descriptive information (attributes) described below:

1. Location information (spatial) is information relating to a coordinate of both geographic coordinates (latitude and longitude) and XYZ Cartesian coordinates (abscissa, ordinate and altitude), including projection systems.
2. Descriptive information (attributes) or non-spatial information is information about a location that has some information related to the location, for example the type of vegetation, population, area, zip code, and so on. Attribute information is often used also to state the quality of a location.

2.1.2 Non Spatial Data

Non-spatial data is data that is presented in the form of a table that contains object information in spatial data and in the form of tabular data that is attached directly to spatial data.

2.2 Fuzzy Logic

logic is one of the right ways to map an input space into an output space based on the concept of fuzzy set. According to Lotfi A. Zadeh, fuzzy logic is good for solving problems that contain uncertainty. [2]

2.3 Investment

According to the Big Indonesian Dictionary (KBBI), the meaning of investment is the investment of money or capital in a company or project for the purpose of obtaining profits. People who invest capital or investors are called investors. Investors are parties who invest funds in continuity. Investors can be divided into individual or institutional investors and are also distinguished by the origin of the country, namely domestic or local investors and foreign investors. [3]

2.4 Geographic Information System Analysis

Analysis of geographic information systems is a stage in the development of a geographic information system mapping investment opportunities in the natural stone, batik and rattan industries in Cirebon Regency.

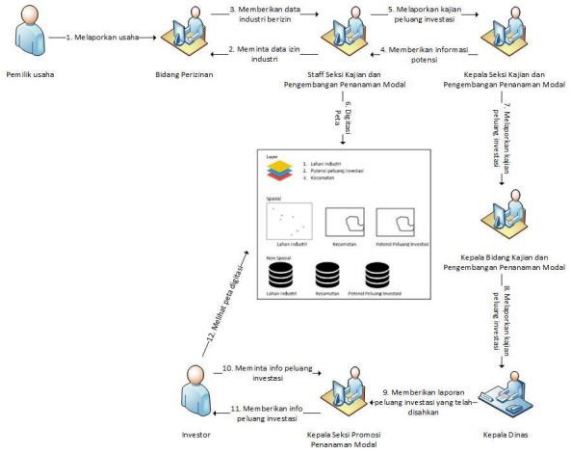


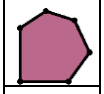
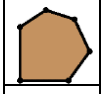
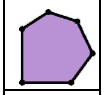
Figure 1. Geographic Information System Model

2.5 Spatial Data Analysis

data is one of the data needed in making a system. The spatial data to be built includes industrial land that has been licensed in the form of points and sub-district data and industrial area data in the form of polygons of different colors. The colors used for dyeing in accordance with the administrative map of Cirebon

Table 1. Spatial Data Analysis

No.	Digitizing Mapping	Description	Spatial Data	Example

1	Licensed Industrial Land	point coordinatesIndustrial Land Natural Stone Distribution	Point	
		Distribution Point coordinatesBatik Industrial Land		
		Point coordinatesIndustrial Land Distribution Rattan		
2	Subdistrict	Kecamatan Arjawinangun	Polygon	
		District Astanajapura		
		District Babakan		
		District Beber		
		District Ciledug		
		District Ciwaringin		
		District Depok		
		Subdistrict Dukupuntang		
		District Gebang		
		District Gegesik		
		District Gempol		
		District		
		Subdistrict Gumulung		
		Subdistrict Gunung Jati		
		Subdistrict Jamblang		
		Subdistrict Kaliwedi		
		District		
		Subdistrict District Karangsembung		
		Subdistrict Karangwareng		
		Subdistrict Kedawung		
		Subdistrict Klangenan		
		Subdistrict Lemahabang		
		Subdistrict Losari		
		District Mundu		

		Kecamatan Pabedilan		
		District Pabuaran		
		District Palimanan		
		District Pangenan		
		District Pasaleman		
		District Plered		
		District Plumbon		
		District Sedong		
		District Sumber		
		Suranenggala		
		Subdistrict Susukan		
		Subdistrict Susukan Lebak		
		Subdistrict Talun		
		Subdistrict Tengah Tani		
		Subdistrict Waled		
		Subdistrict Weru Subdistrict		
3	Industrial District	Natural	*Polygon*	
		Batik		
		Rattan		

2.6 Non Spatial Data Analysis

Non spatial data or attributes are data containing object information related to spatial data that will be used to build system.

Table 2. Non Spatial Data Analysis

No	Name	Description	Attribute
1	Subdistrict	Contains district data of Cirebon District	id subdistrict, sub-district name, and coordinates
2	Village	Contains village data Cirebon Regency	village id, village name
3	Industrial permitlicensed industry	data Containsdata	id industry, the owner's name, address, industry, company name, no license, date of license, validity period, status, type of industry, the investment value of
four	categories investment opportunities	Contains data categories of potential investment opportunities	id categories and the category name

2.7 Analysis of investment opportunities

Analysis of investment opportunities in this research uses fuzzy method. To solve a problem using fuzzy, several steps are needed. Stages in analyzing investment opportunities include determining theset *fuzzy*, determining the membership function, membership function and membership value, evaluation of rules or *rules*.

2.7.1 *Fuzzy Sets*

Variables from the formation of fuzzy sets are criteria of investment opportunities in Cirebon Regency. Table of the formation of fuzzy set can be seen in table 3.

Table 3. set *Fuzzy*

No	Variable	Set of Fuzzy	Universe Discussion	Domain
1	Suitability of RTRW	Not Suitable	[0..10]	[0-5]
		Suitable		[4-10]
2	Distance to Toll	Near	[0..20]	[0-7]
		Moderate		[6-13]
		Far		[12-20]
3	Number of Workers	Slightly	[0..35,000]	[0-15,000]
		Medium		[10,000-25,000]
		Many		[20,000-35,000]
4	Environmental conditions	Have no effect	[0..10]	[0-5]
		Influence		[4-10]

2.7.2 Determining Membership Function

This stage is used to determine the equation of the membership function based on each variable. Each variable is included in the formula contained in the theoretical basis of membership functions.

1. The suitability variable of the RTRW

$$\mu NotSuitable\,[x] = \begin{cases} 1, & x \le 3 \\ \dfrac{5-x}{5-3}, & 3 < x < 5 \\ 0, & x \ge 5 \end{cases}$$

$$\mu Suitable\,[x] = \begin{cases} 0, & x \le 4 \\ \dfrac{x-4}{10-4}, & 4 < x < 10 \\ 1, & x \ge 10 \end{cases}$$

2. The variable distance to the toll

$$\mu Near\,[x] = \begin{cases} 1, & x \le 4 \\ \dfrac{7-x}{7-4}, & 4 < x < 7 \\ 0, & x \ge 7 \end{cases}$$

$$\mu Moderate[x] = \begin{cases} 0, & x \le 6 \; atau \; x \ge 13 \\ \dfrac{x-6}{9-6}, & 6 < x \le 9 \\ \dfrac{13-x}{13-9}, & 9 < x < 13 \end{cases}$$

$$\mu Far[x] = \begin{cases} 1, & x \le 12 \\ \dfrac{x-12}{20-12}, & 12 < x < 15 \\ 0, & x \ge 15 \end{cases}$$

3. Variable number of workers

$$\mu Slightly[x] = \begin{cases} 1, & x \le 15.000 \\ \dfrac{15.000-x}{20.000-15.000}, & 15.000 < x < 20.000 \\ 0, & x \ge 15.000 \end{cases}$$

$$\mu Medium[x] = \begin{cases} 0, & x \le 10.000 \; atau \; x \ge 25.000 \\ \dfrac{x-10.000}{22.000-10.000}, & 10.000 < x \le 22.000 \\ \dfrac{25.000-x}{25.000-18.000}, & 18.000 < x < 25.000 \end{cases}$$

$$\mu Many[x] = \begin{cases} 0, & x \le 20.000 \\ \dfrac{x-20.000}{35.000-20.000}, & 20.000 < x < 35.000 \\ 1, & x \ge 35.000 \end{cases}$$

4. Variable environmental conditions

$$\mu HaveNoEffect[x] = \begin{cases} 1, & x \le 3 \\ \dfrac{5-x}{5-3}, & 3 < x < 5 \\ 0, & x \ge 5 \end{cases}$$

$$\mu Influence\,[x] = \begin{cases} 0, & x \le 4 \\ \dfrac{x-4}{10-4}, & 4 < x < 10 \\ 1, & x \ge 10 \end{cases}$$

2.7.3 Membership Function and Membership Value

function is a curve that shows the mapping of data input points into its membership value (membership degree) which has intervals between 0 to 1.

Case Example:

1. Dukupuntang District has a variable value of suitability RTRW 10 for natural stone, because Dukupuntang District is designated as natural stone area in PERDA No. 17 of 2011 concerning RTRW. The distance to the toll road from Dukupuntang District ± 9 Km and Dukupuntang District has ± 32,000 workers. Dukupuntang District, a rock mountain called mount kuda, so that it can be used as a source of basic material for making natural stones, this makes Dukupuntang District has a value of 10 in environmental conditions.
   a. Membership Function RTRW Conformity
      RTRW conformity value obtained, that is 10. The next step, the value is converted tovalue *fuzzy* by entering the value into the formula. A value of 10 is in the appropriate domain.

The degree of membership of the suitability of the RTRW obtained after it is entered into the formula is 1. The conclusion is the District of Dukupuntang in accordance with the provisions of PERDA RTRW No. 17 of 2011 for the natural stone industry area.

b. Membership Function Distance to Toll
Crisp value of distance to the obtained toll, which is 9 km. The next step, the value is converted tovalue *fuzzy* by entering the value into the formula. The value 9 is in the medium domain. The degree of membership from the distance to the toll obtained after entering the formula is 1. The results of the assessment can be concluded that the distance to the toll road from Dukupuntang Subdistrict is moderate. This means that the distance to the toll road from Dukupuntang District is not too far away.

c. Membership Function Number of Workers
The crisp amount of labor obtained is 32,000. The next step, the value is converted tovalue *fuzzy* by entering the value into the formula. The value of 32,000 is in many domains. The degree of membership from the amount of labor obtained after entering the formula is 0.8. It can be concluded that the number of workers in the Dukupuntang Sub-district includes many.

d. Membership Function Environmental Conditions
Crisp environmental conditions obtained, namely 10. The next step, the value is converted tovalues *fuzzy* by entering these values into the formula. A value of 10 is in the influential domain. The degree of membership of the environmental conditions obtained after entering the formula is 1. The conclusion is that the environmental conditions in Dukupuntang sub-district are influential because they are close to the location of Mount Kuda.

2. Plered Subdistrict has the RTRW 10 suitability variable value for batik, because Plered Subdistrict is designated as a batik area in PERDA No. 17 of 2011 concerning RTRW. The distance to the toll road from Plered District ± 3 Km and Plered District has ± 23,000 workers. Plered Subdistrict is designated as a batik area because the environmental conditions of Plered Subdistrict are batik craftsmen who have been handed down from generation to generation.
   a. Membership Function RTRW Conformity
   RTRW conformity value obtained, that is 10. The next step, the value is converted tovalue *fuzzy* by entering the value into the formula. A value of 10 is in the appropriate domain. The degree of membership of the suitability of the RTRW obtained after entering the formula is 1. The conclusion is that the District of Plered in accordance with the provisions of the PERDA RTRW No. 17 of 2011 for the batik industry area.
   b. Membership Function Distance to Toll
   Crisp value of distance to the obtained toll, which is 3 km. The next step, the value is converted tovalue *fuzzy* by entering the value into the formula. Value 3 is in a close domain. The degree of membership from the distance to the toll obtained after entering the formula is 0.57 and rounded to 0.6. It can be concluded that the distance to the toll road from Plered Sub-district is close.
   c. Membership Function Number of Workers
   The crisp amount of labor obtained is 23,000. The next step, the value is converted tovalue *fuzzy* by entering the value into the formula. The value of 23,000 is in the medium domain. The degree of membership of the amount of labor obtained after entering the formula is 0.29 which is rounded to 0.3. It can be concluded that the number of workers in the District of Plered is moderate.
   d. Membership Function Environmental Conditions
   The crisp environmental conditions obtained are 9. The next stage, the value is converted tovalues *fuzzy* by entering these values into the formula. A value of 9 is in the influential domain. The degree of membership of the environmental conditions obtained after entering the formula is 0.83 and rounded to 0.8. The conclusion is that the environmental conditions in Plered Subdistrict have an effect because the plered sub-district area is an area of batik craftsmen who have been handed down from generation to generation.
3. Weru Subdistrict has the RTRW 10 suitability variable value for batik, because Weru Subdistrict is designated as a rattan area in PERDA No. 17 of 2011 concerning RTRW. The distance to the toll road from Weru District is ± 1 Km and Weru District has ± 17,000 workers. Weru Subdistrict is designated as a batik area because the environmental conditions of Weru Subdistrict are rattan craftsmen who have been handed down from generation to generation.
   a. Membership Function RTRW Conformity
   RTRW conformity value obtained, that is 10. The next step, the value is converted tovalue *fuzzy* by entering the value into the formula. A value of 10 is in the appropriate domain. The degree of membership of the suitability of the RTRW obtained after entering the formula is 1. The conclusion is that Weru Subdistrict in accordance with the provisions of PERDA RTRW No. 17 of 2011 for the rattan industry area.
   b. Membership Function Distance to Toll

Crisp value of distance to the obtained toll, which is 1 km. The next step, the value is converted tovalue *fuzzy* by entering the value into the formula. Value 1 is in the close domain. The degree of membership from the distance to the toll obtained after entering the formula is 0.86 and rounded to 0.9. It can be concluded that the distance to the toll road from Weru Sub-district, which is close so that it is easy to reach.

c. Membership Function Number of Workers
The crisp amount of labor obtained is 17,000. The next step, the value is converted tovalue *fuzzy* by entering the value into the formula. A value of 17,000 is in the medium domain. The degree of membership from the amount of labor obtained after entering the formula is 0.88 and can be rounded up to 0.9. It can be concluded that the number of workers in Weru Subdistrict is moderate.

d. Membership Function Environmental Conditions
The crisp environmental conditions obtained are 9. The next stage, the value is converted tovalues *fuzzy* by entering these values into the formula. A value of 9 is in the influential domain. The degree of membership of the environmental conditions obtained after entering the formula is 0.83 and can be rounded up to 0.8. The conclusion is that the environmental conditions in Weru Subdistrict are influential.

2.7.4 Evaluation of Rules or *Rules*

This stage is a stage to determine whether the area has the opportunity to invest in natural stone, batik and rattan. How to calculate the number of rules by using the formula n-outputn-input = 24 = 16. N-output in the form of output from fuzzy logic results in the form of appropriate and not suitable. N-input is an input variable of fuzzy logic used. Examples of the rules include:

1. If the suitability of the RTRW is appropriate AND the distance to the toll road is close AND the number of workers is large AND environmental conditions are influential THEN has an opportunity.
2. If the suitability of the RTRW is appropriate AND the distance to the toll road is AND the number of workers is large AND the influential environmental conditions THEN has an opportunity.
3. If the suitability of the RTRW is appropriate AND the distance to the toll road is close AND the number of workers at the same time AND the influential environmental conditions THEN has an opportunity.

2.8 Database Analysis

Database analysis is an activity of analyzing data that will be processed to be stored in the database. This database analysis activity is done by creating ERD (Entity Relationship Diagram). ERD is one technique that aims to describe the information needed in the system and the relationship between all the data.

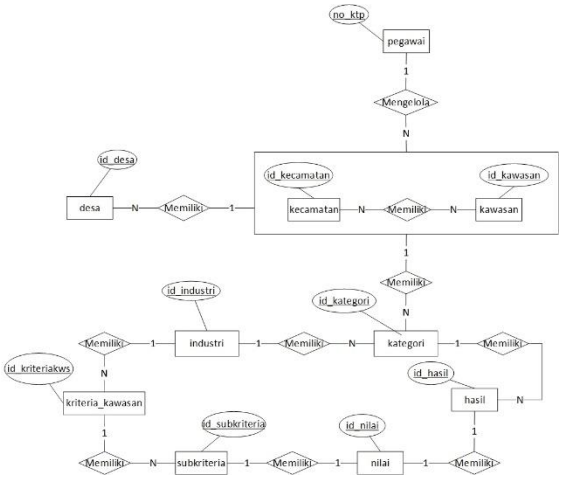


Figure 2. ERD Geographic Information System

2.9 Context Diagram Context

diagram is a diagram that consists of a process and describes the scope of a system. Context diagram contains an overview of the system to be made. Context diagram can only contain one process.

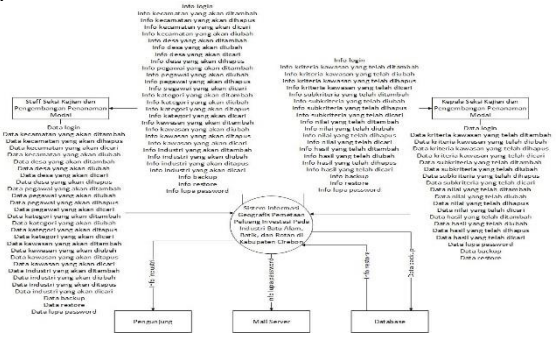


Figure 3. Context Diagram

2.10Data Flow Diagram

DFDis a data logic model or process that is created to describe where the data originates from and where data is coming from the system, where data is stored, what processes produce the data and the interaction between the data stored and the process imposed on the data.

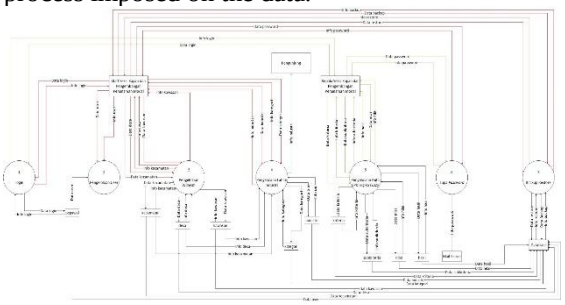


Figure 4. DFD Level 1 Geographic Information System

2.11 Interface Design

Interface is one of the services provided by the operating system as a means of interaction between users and the operating system. Interface Design aims to describe the interface of the system to be built.

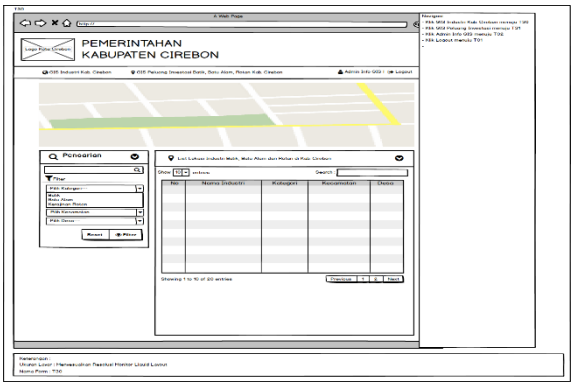


Figure 5. Designing Visitor Interfaces

2.12 System Testing System

testing aims to determine whether the system is built in accordance with the wishes or not. System testing also aims to determine errors or deficiencies in the system being tested. The testing plan that will be carried out is by testing the system built with Black Box testing, testing User Acceptance Testing (UAT), and beta testing.

2.12.1 Conclusion ofTesting *Black Box*

Based on the results of the Black Box test, the conclusion of a functionally constructed system has fulfilled the needs as expected and can be used.

2.12.2 Conclusion of Testing of *User Acceptance Test (UAT)*

Based on the results of the User Acceptance Test (UAT), the conclusion is that the system is feasible to proceed to the testing phase of end user acceptance.

2.12.3 Beta Testing The

Conclusion of the beta test that has been carried out is that the system has been able to assist the agency to monitor mapping of investment opportunities and help investors obtain information about investment opportunities in the natural stone, batik and rattan industries in Cirebon Regency.

3 CLOSING

3.1 Conclusion The

Conclusion of this study is that the system built can help Investment Services and One Stop Services in monitoring the area with investment opportunities and helping investors to obtain information about investment opportunities in the natural stone, batik and rattan industries.

3.2 Suggestions

Geographic information systems mapping investment opportunities in the natural stone, batik, and rattan industries in Cirebon Regency that are built still have shortcomings, so the advice that can be given by the author so that the system can be developed in the future is:

1. Developed systems become better in in terms of features and appearance.
2. The system can be developed into aapplication *mobile* and added several features that are compatible with mobile applications.
3. The commodities under study are even more added.

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