APPLICATION OF THE FAILURE MODE AND EFFECTS ANALYSIS METHOD ON THE PROJECT RISK MANAGEMENT INFORMATION SYSTEM PT. DELTRA WIJAYA CONSULTANT

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ABSTRACT

PT. DELTRA WIJAYA KONSULTAN is a company engaged in the field of construction. The company was founded in 2003, originally called Studio Cikaso, the company has handled various construction projects in Bandung and outside Bandung, especially government projects. The company has problems in managing project risk so that the Operational Personnel have difficulty determining the level of importance of the risk and do not know the impact of the risk is high or low for the project. The next problem is the Operational Responsible difficulty in planning risk management. There is a mismatch between the project cost budget from the planned and the ongoing. The solution to the risk management problem is using the Failure Modes and Effects Analysis (FMEA) method to determine the importance of the risk and the Expected Monetery Value (EMV) method to determine the cost of risk. Based on the problems above, a project risk management information system is needed at PT. DELTRA WIJAYA CONSULTANTS to assist the Operational Responsibility in determining the level of importance of risk and determining the cost of risk. Based on the test results, it can be concluded that the project's risk management system can assist the Operational Responsibility in determining the importance of risk and determining the cost of risk.

Kata kunci : Project Risk Management, Information Systems, Risk Management, Failure Modes and Effects Analysis, Expected Monetary Value.

1. INTRODUCTION

PT. DELTRA WIJAYA CONSULTANT is a company engaged in the field of construction. The company was founded in 2003 originally named Studio Cikaso, the company has handled various construction projects in the Bandung area and outside Bandung, especially government projects. The work includes planning, mapping, design, feasibility studies, buildings and construction. Based on the results of an interview with Mr. Agus Hari Santoso as the Person in Charge of Operations, stated that there are still difficulties in determining the level of importance of risk. The Operational Responsibility handles the risk based on which risk was reported first, so the Operational Responsibility does not know the impact of the risk, large or small for the project.

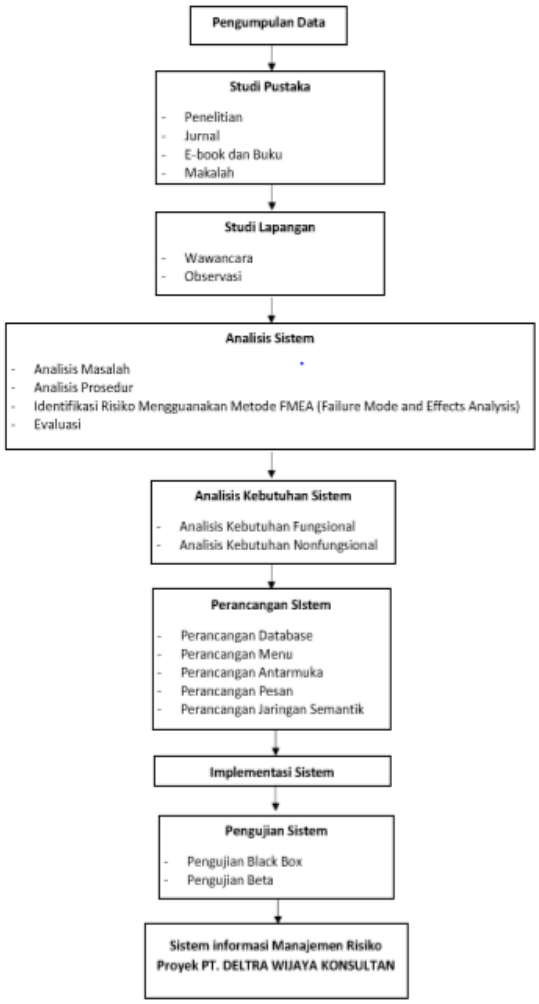
In the preparation of the Jagiobabang Border Area RDTR project and the Subang Artificial Element Earth Visual Verification project. In the Jagoibabang project there were several problems, namely, the presence of uneven land which caused additional purchases of equipment at the time of the project implementation, and the Subang project there was weather (rain) which did not support the completion of the work. Based on the weekly report on the second week by Mr. Agus Hari Santoso as the Person in Charge of Operations, the implementation of the project has several obstacles, namely, the addition of the purchase of work tools at the time the project will start. Then in the second week of project implementation, it rained so the weather did not support completing the work in accordance with the specified weights. Based on the project realization report, the company experienced an increase in the project cost budget. The company carries out risk management by using company cash to overcome additional costs that are not in accordance with the initial plan. But if using money the company will harm the company if the same risk occurs again. Based on the problems that occur, it can be concluded that there are difficulties in project supervision and the lack of good risk management arrangements undertaken by the company. From these problems, a website-based information system will be built to overcome the problems that exist in PT. DELTRA WIJAYA CONSULTANT.

Information systems are a number of components (human, computer, information technology, and work procedures), something is processed (data becomes information), and is intended to achieve a goal or goal [1]. PHP is sebuah bahasa pemograman berbasis web yang mempunyai banyak keunggulan dibandingkan dengan bahasa pemograman berbasis web yang lain [4].

2. RESEARCH CONTENTS

2.1 Research Methodology

The research methodology used in this study is to use a descriptive methodology.



Picture 1 Research Methodology

2.2 Analisis Project Planning

Vvv The project is a business / activity that is complex, non-routine, limited by time, budget, resources, and performance specifications that are designed to meet the needs of consumers [3]. As for the nature of the project that has clear and unique goals, takes place temporarily (has a date and starts to finish), requires diverse resources, has a sponsor or customer as a source of funding so that the project matches the goals and objectives set [2]. Project planning analysis consists of analysis including the Budget Plan (RAB), schedule, qualitative risk analysis using Failure Modes and Effects Analysis (FMEA), and quantitative risk analysis using Earned Monetary Value.

2.2.1 Risk Analysis Using *Failure Modes and Effects Analysis*

Qualitative risk analysis using the Failure Modes and Effects Analysis method serves to identify and determine the level of importance of risks that may occur in the project [5]. Risk analysis and identification activities are used as a basis for making decisions if a risk occurs by looking at the level of importance of the risk [6].

1. Risk Identification

The risk identification process is carried out to find out and list risks that have occurred in the project or that might occur in the project.

Table 1 Risk Identification

No.	type Risk	Risk Codes
1	**External Risk**	
1.1	Weather	R1
1.2	Material prices suddenly rise	R2
1.3	Traffic conditions	R3
1.4	extortion	R4
2	**Risk Tools and Materials**	
2.1	Delay materials	R5
2.2	Damage to the work tool	R6
2.3	Material damage	R7
2.4	The loss of material	R8
3	**Labor Risk**	
3.1	Work accident	R9
3.2	Labor pain	R10

3. Determine the Value of Severity, Occurence, and Detection

After getting a list of risks obtained from the risk identification process, the risk list is assessed based on Severity, Occurence, and Detection with parameters which can be seen in table 2, table 3, and table 4 [7].

Table 1 Severity Level

Effect	Criteria: Severity Effect	Ranked
Dangerous (Without Warning)	Testing not carried damage with damage that affects the system, but without warning tool	10
Dangerous (The Warning)	Testing not carried damage with damage that affects the system but there is still a warning tool	9
Very high	Testing can not be implemented due to severe damage	8
High	Testing can not be implemented because of significant damage to equipment	7
moderate	Testing can not dilakasanakan as little damage	6
Low	Testing can not run normally with or without damage	5
Very low	Tests can be carried out, but there is a significant decrease in performance	4
Minor	Testing can continue to be implemented, but there is a decrease in the performance of the tool	3
Very minor	The test continues to run, only a slight annoyance	2
Nothing	No effect	1

Table 3 Level Events

Effect	Criteria: Level Events	probability	Ranked
Almost always	Risk always happen	> 9	10
Very high	Very high risk of loss	> 8-9	9
High	High-risk occurring	> 7-8	8
rather high	The risk that occurs rather high	> 6-7	7
moderate	Risks that occur at a moderate level	> 5-6	6
Low	Risks that occur at low levels	> 4-5	5
a little	Risks that occur slightly	> 3-4	4
The least	The risk that occurs very little	> 2-3	3
Almost never	Risks are rare	> 1-2	2
Never	Risk never happened	0-1	1

Table 2 Level Detection

Detection	Criteria: Level Detection	Ranked
Not sure	Undetectable	10
Very small	difficult to detect	9
small	Relatively difficult to detect	8
Very low	Very rarely detected	7
Low	Relatively rarely detected	6
moderate	Quite easily detected	5
High enough	can be detected	4
High	easily detected	3
Very high	difficult to detect	2
almost definitely	definitely detected	1

The following are Severity, Occurence, and Detection values, one of which is the preparation & planning work that has been identified based on the results of an interview with the Operational Responsibility at PT. DELTRA WIJAYA CONSULTANT can be seen in table 5.

Table 5 Value *Severity*, *Occurance*, and *Detection*

Risk Code	Risk	*(Severity)*	*(Occurrence)*	*(Detection)*
	Preparation Work			
R1	Weather (Rain)	3	7	3
R2	Material prices have suddenly risen	7	6	4
R3	Traffics Condition	5	5	4
R4	Extortion	3	4	6
R5	Delay in materials	7	4	5
R6	Work tool damage	7	4	6
R7	Material Damage	7	4	6
R8	Loss of materials	7	4	7
R9	Work accident	4	2	7
R10	Sick laborers	4	2	7
	Planning Work			
R1	Weather	6	7	4
R2	Material prices have suddenly risen	1	6	1
R3	Traffics Condition	5	5	5
R4	Extortion	5	4	4
R5	Delay in materials	1	4	1
R6	Work tool damage	3	4	3
R7	Material Damage	1	4	1
R8	Loss of materials	1	4	1
R9	Work accident	6	2	7
R10	Sick laborers	4	2	7

After getting Severity, Occurence, and Detection values, the risk priority number (RPN) is calculated by multiplying the Severity, Occurence, and Detection values.

RPN = Severity x Occurence x Detection

RPN = value of the priority level of risk
Severity = severity value
Occurence = rate of occurrence
Detection = detection level value

The following is a table of the results of RPN calculations in the preparation & planning work using the FMEA method in table 6.

Table 3 Calculation Result RPN

Risk Code	Risk	(Severity)	(Occurrence)	(Detection)	RPN (Risk Priority Number)
	Preparation Work				
R1	Weather (Rain)	3	7	3	63
R2	Material prices have suddenly risen	7	6	4	168
R3	Trafficts Condition	5	5	4	100
R4	Extortion	3	4	6	
R5	Delay in materials	7	4	5	72
R6	Work tool damage	7	4	6	140
R7	Material Damage	7	4	6	168
R8	Loss of materials	7	4	7	168
R9	Work accident	4	2	7	112
R10	Sick laborers	4	2	7	56
	Planning Work				56
R1	Weather	6	7	4	
R2	Material prices have suddenly risen	1	6	1	168
R3	Trafficts Condition	5	5	5	6
R4	Extortion	5	4	4	125
R5	Delay in materials	1	4	1	80
R6	Work tool damage	3	4	3	4
R7	Material Damage	1	4	1	36
R8	Loss of materials	1	4	1	4
R9	Work accident	6	2	7	4
R10	Sick laborers	4	2	7	84

4. Determine Critical Value

After obtaining an RPN value for each risk, a critical value is then calculated. Critical value is used to determine the risk included in the high or low category. Risks are included in the high category if the RPN value is greater than the critical value (RPN value kritis critical value). If the RPN value is smaller than the critical value, the risk is included in the low category. Critical values can be calculated in a way:

$$critical\ value = \frac{total\ RPN}{jumlah\ daftar\ risiko}$$

Then obtained a critical value in the project 109 / HK.200? PPK-5538 / IV / 2018. Preparation of the State Border RDTR in Jagoibabang for the preparation & planning work.

Preparation work

$$Critical\ value = \frac{63+168+100+72+140+168+168+112+56+56}{10}.$$

$$= 110.3 \approx 110$$

Planning work

$$Critical\ Value = \frac{168+6+125+80+4+36+4+4+84+56}{10}$$

$$= 56.7 \approx 57$$

The critical values obtained for the preparation and planning work are 110 and 57 which means that if the RPN value for each risk is above 110 or equal to 110, then it is included in high risk and if it is below 80 or equal to 80, then it is included in low risk. The risk categories can be seen in table 7.

Table 4 Risk Category

Risk Code	Risk	RPN (Risk priority Number)	Category
	Pekerjaan Persiapan		
R1	Weather (Rain)	63	Low
R2	Material prices have suddenly risen	168	High
R3	Trafficts Condition	100	Low
R4	Extortion	72	Low
R5	Delay in materials	140	High
R6	Work tool damage	168	High
R7	Material Damage	168	High
R8	Loss of materials	112	High
R9	Work accident	56	Low
R10	Sick laborers	56	Low
	Planning Work		
R1	Weather	168	High
R2	Material prices have suddenly risen	6	Low
R3	Trafficts Condition	125	High
R4	Extortion	80	High
R5	Delay in materials	4	Low
R6	Work tool damage	36	Low
R7	Material Damage	4	Low
R8	Loss of materials	4	Low
R9	Work accident	84	High
R10	Sick laborers	56	Low

From the risk category data obtained, the Operational Responsibility can find out which risks must be addressed as soon as possible.

4. Risk Management

From the results of a series of risk analyzes that have been carried out then used as a reference for risk mitigation. Risk management actions are obtained from the results of coordination with the Operational Responsibility at PT. DELTRA WIJAYA KOSULTAN. The handling measures for each risk can be seen in table 8.

Table 5 Risk Management

Risk Code	Risk	RPN	Category	Risk Management Measure
	Preparation Work			
R7	Material damage	168	High	Buy new damaged material
R6	Work tools damage	168	High	Repair work tools or buy new work tools
R2	Material prices suddenly rise	168	High	Enter into agreement with material suppliers
R5	Delay in materials	140	High	Coordinate with material suppliers
R8	Material loss	112	High	Increases supervision of materials at the project site
R3	Traffic conditions	100	Low	Good traffic management
R4	Extrotion	72	Low	Request protection from local officials
R1	Weather	63	Low	Increase labor or increase work hours
R9	Work accident	56	Low	Provide direction regarding work safety
R10	Sick Laborers	56	Low	Conduct overtime to existing workers or increase labor
	Planning work			
R1	Weather	168	High	Increase labor or increase work hours
R3	Traffic conditions	125	High	Good traffic management
R9	Work accident	84	High	Provide direction regarding work safety
R4	Extrotion	80	High	Request protection from local officials
R10	Sick Laborers	56	Low	Mengadakan lembur kepada tenaga kerja yang ada atau menambah tenaga kerja
R6	Work tools damage	36	Low	Repair work tools or buy new work tools
R2	Material prices suddenly rise	6	Low	Enter into agreement with material suppliers
R5	Delay in materials	4	Low	Coordinate with material suppliers
R7	Material damage	4	Low	Buy new damaged material
R8	Material loss	4	Low	Increase supervision of materials at the project site

Based on the results of a risk analysis using FMEA, the results of the risk analysis are used to assist the Operational Responsible Officer in identifying the risks that might occur, so that if the risk occurs can be handled quickly based on the level of importance of the risk that can be seen from the risk priority value (RPN) at most height and predetermined risk management measures.

2.2.2 Risk Analysis using *Expected Monetary Value methode*

The Expected Monetary Value (EMV) method is used to calculate the cost of a risk if a risk occurs [7]. If the EMV value is positive then it is an opportunity and if the EMV value is negative it means it is a threat that can cause harm to the company. How to get the EMV value is as follows.

EMV = Probability x Consequence

EMV = expected money if risk occurs Probability = value of risk probability
Consequences = the value of the impact caused by the risk

Determination of the probability and frequency values obtained from an interview with Mr. Agus Hari Santoso as the Person in Charge of Operations at PT. DELTRA WIJAYA CONSULTANT. The probability value is determined based on the results of an interview with the Operational Person in charge of events in the field and the consequences based on the company's financial condition and the value of the project budget. EMV calculation results can be seen in table 9.

Table 9 EMV Calculation Result

Risk Code	Risk	Probability (%)	Consequnce (Rp)	EMV (Rp)
R1	Weather	60	-2.000.000	-1.200.000
R2	Material prices have suddenly risen	40	-3.000.000	-1.200.000
R3	Labor accident	30	-2.000.000	-1.400.000
R4	Extortion (illegal payments)	20	-600.000	-480.000
R5	Traffic conditions	30	-500.000	-150.000
R6	Material delays	30	-500.000	-150.000
Total (Rp)				-4.580.000

Obtained a total EMV value of Rp. 4,580,000. The minus value means the threat of loss to the company in terms of cost. In the system to be built that value can be included by the Operational Responsible Project in budget planning by allocating it to existing work so that if there is a risk in a job there is no need to use the company's cash funds because the Operating Responsible Person has his own allocation for risk costs.

2.2.3 Budget Plan

Making a budget plan is needed so that the project runs in accordance with the planned costs. RAB calculation at PT. DELTRA WIJAYA CONSULTANT is calculated by multiplying the volume of work and the unit price. The total price of the RAB will be added to the value of risk costs obtained from calculations using EMV. For details of the RAB calculation on each job description can be seen in table 10.

Table 6 Budget Plan

No.	Uraian							Satuan	Volume	Harga Satuan	Jumlah
A	BIAYA PERSONIL										Rp 18,500,000
	Tenaga Ahli										
	1	Team Lea	1	org	x	2	bln	OB	2	Rp 4,000,000	Rp 8,000,000
	2	Ahli	1	org	x	2	bln	OB	2	Rp 3,000,000	Rp 6,000,000
	Tenaga Pendukung										
	1	Operator	1	org	x	2	bln	OB	2	Rp 1,000,000	Rp 2,000,000
	2	Sekretaris	1	org	x	2	bln	OB	2	Rp 1,250,000	Rp 2,500,000
B	BIAYA NON PERSONIL										Rp 31,085,000
1	BIAYA SURVEY										
	Dalam Pengumpulan Data										
		Biaya Survey dan Pengumpulan Data				1	ls	LS	1	Rp 1,300,000	Rp 1,300,000
2	BIAYA PRODUK DAN LAPORAN										
	a	Laporan				5	bk	BK	5	Rp 85,000	Rp 425,000
	b	Maket				1	bh	BH	1	Rp 29,000,000	Rp 29,000,000
3	BIAYA LAIN-LAIN										
	a.	Biaya Alat Tulis Kantor dan Bahan									
		1) ATK dan Bahan Komputer						BL	2	Rp 180,000	Rp 360,000
	REKAPITULASI										
	A.	BIAYA PERSONIL									Rp 18,500,000
	B.	BIAYA NON PERSONIL									Rp 31,085,000
									JUMLAH		Rp 49,585,000

The total price of the RAB will be added to the value of risk costs obtained from calculations using EMV, so that the Operational Person has an allocation of costs if there is a risk in project implementation. The following is a recapitulation of the latest RAB after adding the risk cost value can be seen in table 11.

Table 7 New Budget Planning Recapitulation

No.	Uraian							Satuan	Volume	Harga Satuan	Jumlah
A	BIAYA PERSONIL										Rp 18,500,000
	Tenaga Ahli										
	1	Team Lea	1	org	x	2	bln	OB	2	Rp 4,000,000	Rp 8,000,000
	2	Ahli	1	org	x	2	bln	OB	2	Rp 3,000,000	Rp 6,000,000
	Tenaga Pendukung										
	1	Operator	1	org	x	2	bln	OB	2	Rp 1,000,000	Rp 2,000,000
	2	Sekretaris	1	org	x	2	bln	OB	2	Rp 1,250,000	Rp 2,500,000
B	BIAYA NON PERSONIL										Rp 31,085,000
1	BIAYA SURVEY										
	Dalam Pengumpulan Data										
		Biaya Survey dan Pengumpulan Data				1	ls	LS	1	Rp 1,300,000	Rp 1,300,000
2	BIAYA PRODUK DAN LAPORAN										
	a	Laporan				5	bk	BK	5	Rp 85,000	Rp 425,000
	b	Maket				1	bh	BH	1	Rp29,000,000	Rp 29,000,000
3	BIAYA LAIN-LAIN										
	a.	Biaya Alat Tulis Kantor dan Bahan									
		1) ATK dan Bahan Komputer						BL	2	Rp 180,000	Rp 360,000
	REKAPITULASI										
	A.	BIAYA PERSONIL									Rp 18,500,000
	B.	BIAYA NON PERSONIL									Rp 31,085,000
	C.	BAYA RISIKO									Rp 4,580,000
									JUMLAH		Rp 54,165,000

Based on the new RAB recapitulation data in table 11, shows that the previous budget amounted to Rp. 49,585,000 added risk costs of Rp. 4,580,000 to Rp. 54,165,000. (includes 10% VAT). The new RAB value will be used as the value of the SPK contract for the project.

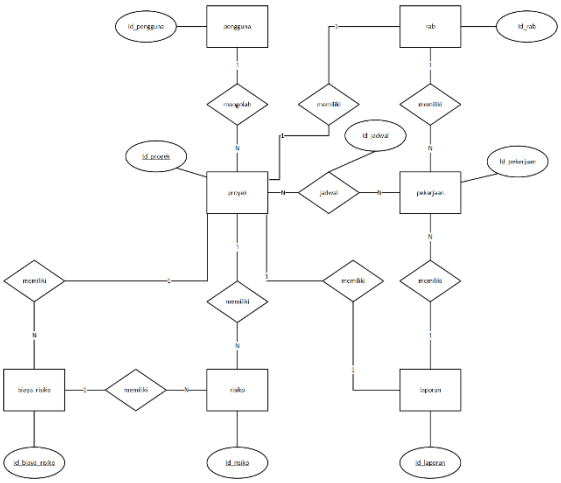
2.3 User Analysis

User analytics is the user that will use the system. Two user's access rights are:

1. Operational Responsibility: Manage risk management, view project evaluation data, view and manage work data, manage RAB data, Manage schedule data
2. Implementer: view project data, manage weekly reports, see evaluation data.
3. Admin: manage user

2.4 Database Analysis

Database analysis uses Entity Relationship Diagrams (ERD). Describe the relationships between databases [9].



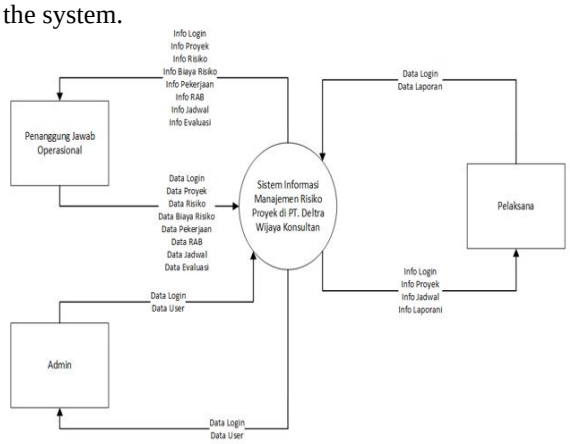
Gambar 2 ERD

Table 12 Explaination ERD

No	Nama Entitas	Atribut
1	user	{id_pengguna, *user*name, nama, password, jabatan}
2	proyek	{id_proyek, pemilik_proyek, nama_kontrak, no_kontrak, tanggal_mulai, tanggal_selesai, nilai_kontrak, durasi, status}
3	pekerjaan	{id_pekerjaan, nama_pekerjaan, volume, satuan,harga_satuan}
4	rab	{id_rab, jumlah_harga}
5	jadwal	id_jadwal, tgl_mulai_jadwal, tgl_selesai_jadwal, durasi_jadwal, ket_jadwal
6	risiko	id_risiko, nama_risiko, nilai_keparahan, keparahan, nilai_kejadian, kejadian, nilai_deteksi, deteksi, rpn, mitigasi
7	biaya_risiko	id_biaya_risiko, nama_risiko, probabilitas, konsekuensi, emv
8	laporan	id_laporan, minggu, kendala_laporan, penanganan_laporan, pengeluaran_laporan, ket_laporan

2.5 Diagram Context

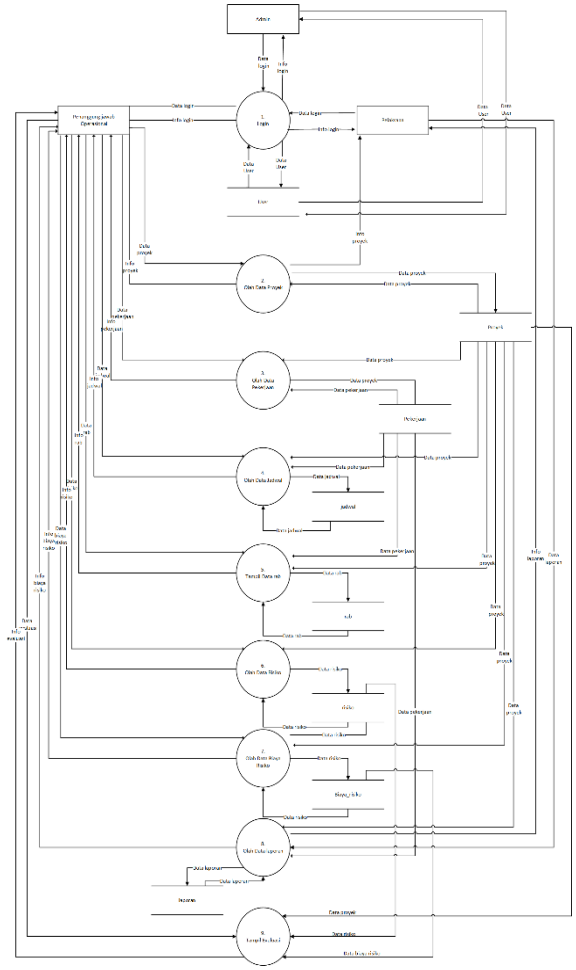
Context diagram illustrates the flow of data on the system.



Picture 3 Diagram Context

2.6 *Data Flow Diagram (DFD)*

DFD is a tool to show the flow of processes in a system. DFD consists of data stores, processes, data flow, and entities [10].



Picture 4 DFD

2.7 Testing

Testing is the process of evaluating the system to find faults and deficiencies in the system being tested [11].

2.7.1 *Blackbox* Testing

Based on the results of black box testing that has been done on the Project Risk Management Information System at PT. DELTRA WIJAYA CONSULTANTS, it can be concluded that the application being built has been tested by the system issuing output in accordance with the expected Operational Responsibility. The form of error display is easy enough to be understood in giving direction to the user to enter data that is correct and not convoluted. This system has produced the expected output.

2.7.2 *Beta Testing*

Based on the answers from the results of interviews with the Managing and Operational Managing Officer at PT. DELTRA WIJAYA CONSULTANT, the system can help the Operational Person in charge because the system makes it easy to determine the importance of risk, makes it easy to calculate risk costs, the evaluation feature can find out the recommended budget plans that have been included with risk costs, know the name of the risk, the risk priority value, and costs which of each risk and system can help the Implementer because he can know the list of existing projects, work on each project, schedule of each work, can manage project reports.

5. CLOSING

Based on the results of research and testing conducted on the Project Risk Management Information System at PT. DELTRA WIJAYA CONSULTANTS, the conclusion is that the project risk management information system can assist the Operational Responsibility in determining the importance of the risk by determining the priority value of the risk, so as to know the high or low level of risk that occurs and the project risk management information system can help the Guidance Operational in determining the cost of risk so that the company does not experience losses caused by risks that occur because the planned budget costs have been added to the risk costs.

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