International Journal of Civil Engineering and Technology (IJCIET)

ISSN Print : 0976 - 6308 ISSN Online: 0976 - 6316
Volume 10, Issue 6 (2019)

Bibliometrics		
DownLoad (3 Weeks)	:	403
DownLoad (6 Weeks)	:	817
DownLoad (6 Months)	:	1559
DownLoad (1 Year)	:	

S.No	Article ID	Title of the Paper	Authors	Pages	Downloads	How to cite this article
1	IJCIET_10_06_001	TRAFFIC ACCIDENTS, ANALYSIS AND COST MODELING New! Download PDF Abstract Reference	MAJED MSALLAM	1 - 14	246	View
2	IJCIET_10_06_002	STUDYING OF THE ROTATING HOUSE STRUCTURE, PART 1: EFFECT OF COULOMB FRICTION DAMPING New! Download PDF Abstract Reference	THE-HUNG DUONG	15 - 24	107	View
3	IJCIET_10_06_003	CONSTRUCTION WORKING USING FOAM CONCRETES THE STUDY OF LIGHTWEIGHT CONCRETE New! Download PDF Abstract Reference	WALAA MOHAMMED HAMZAH	25 - 34	79	View
4	IJCIET_10_06_004	MEASUREMENT OF LOCAL MECHANICAL CHARACTERISTICS OF MARBLE BY BROADBAND ULTRASONIC STRUCTUROSCOPY New! Download PDF Abstract Reference	A.N., KRAVCOV, I.A., SHIBAEV	35 - 42	34	View
5	IJCIET_10_06_005	WATER SCARCITY: A MAJOR CONCERN FOR CITIZENS New! Download PDF Abstract Reference	BIDYUT JYOTI GOGOI	43 - 53	38	View
6	IJCIET_10_06_006	ON THE USE OF MODE SHAPE CURVATURE FOR MULTI-CRACK DETECTION IN BEAM-LIKE STRUCTURES New! Download PDF Abstract Reference	THE-HUNG DUONG	54 - 65	23	View
7	IJCIET_10_06_007	THE APPLICATION OF QUALITY ASSURANCE CRITERIA IN LIGHT OF GOVERNANCE PRINCIPLES (THE MIDDLE EAST UNIVERSITY AS A MODEL) New! Download PDF Abstract Reference	MOHAMMAD M. AL HELIH, TAMARA YACOUB NASEREDDIN	66 - 79	18	View
8	IJCIET_10_06_008	THE DEVELOPMENT OF INTELLIGENT SYSTEMS FOR EARLY PREVENTION OF FIRE IN HIGH-RISE BUILDING BASED ON FUZZY LOGIC New! Download PDF Abstract Reference	YUSTINUS UPA SOMBOLAYUK, NADJAMUDDIN HARUN, HERMAN PARUNG, ZULFAJRI BASRI HASANUDDIN	80 - 88	33	View
9	IJCIET_10_06_009	SURVEY ON SKELETAL GAIT NORMALITY ASSESSMENT New! Download PDF Abstract Reference	HUU-HUNG HUYNH, VIET-HA HO, DUC-HOANG VO and VAN-SY NGO	89 - 96	21	View
10	IJCIET_10_06_010	SELECTIVE METHOD OF CALCULATING THE FLASH POINT TEMPERATURE USING THE PENSKY- MARTENS CLOSED CUP TESTER OF A PURE LIQUID New! Download	NGO TRUNG HOC, DANG THI BICH HOP, NGUYEN HUU DUNG,	97 - 102	21	View

		PDF Abstract Reference	TRUONG QUANG VINH			
11	IJCIET_10_06_011	MODELING ESTIMATED VS30 BASED ON TOPOGRAPHY AND GEOMORPHOLOGY FOR PADANG, INDONESIA Download PDF Abstract Reference	ASTRI RAHAYU, WIDJOJO A. PRAKOSO, IMAM A. SADISUN	103 - 111	16	View
12	IJCIET_10_06_012	USING MICROCONTROLLER FOR THE MONITORING WATER LEVEL IN JENEBERANG RIVER TO CONTROL OF FLOODING AND WATER CRISIS IN MAKASSAR CITY Download PDF Abstract Reference	MUHAMMAD AMIN, NADJAMUDDIN HARUN, MUHAMMAD SALEH PALLU, ZULFAJRI BASRI HASANUDDIN	112 - 120	22	View
13	IJCIET_10_06_013	THE EXISTENCE OF AGRICULTURAL ASSURANCE AGREEMENT ON NATIONAL FOOD RESILIENCE PROGRAM Download PDF Abstract Reference	ZAHRY VANDAWATY CHUMAIDA, HILDA YUNITA SABRIE, BAMBANG SUGENG ARIADI SUBAGYONO, ASRI WIJAYANTI	121 - 132	21	View
14	IJCIET_10_06_014	STUDYING OF THE ROTATING HOUSE STRUCTURE, PART 2: EFFECT OF NON-VISCOUS PARAMETER IN ELASTIC FORCE Download PDF Abstract Reference	THE-HUNG DUONG	133 - 142	22	View
15	IJCIET_10_06_015	STUDYING OF THE ROTATING HOUSE STRUCTURE, PART 3: EFFECT OF DUFFING NON-LINEAR ELASTIC FORCE Download PDF Abstract Reference	THE-HUNG DUONG	143 - 154	24	View
16	IJCIET_10_06_016	ESTIMATION OF RUNOFF COEFFICIENT USING SATELLITE IMAGERY IN WELANG WATERSHED PASURUAN DISTRICT INDONESIA Download PDF Abstract Reference	SUHARDI, GUSFAN., H, ENTIN., H	155 - 162	16	View
17	IJCIET_10_06_017	INFLUENCE OF COMMUNITY' PARTICIPATION, MOTIVATION, BEHAVIOR AND TECHNICAL SUPPORT ON THE ACHIEVEMENT OF THE RURAL INFRASTRUCTURE DEVELOPMENT PROGRAM IN NORTH GOWA AND TORAJA REGENCIES, SOUTH SULAWESI, INDONESIA Download PDF Abstract Reference	WATONO, ANTARIKSA, AGUNG MURTI NUGROHO, ANDI TAMSIL	163 - 180	15	View
18	IJCIET_10_06_018	INVESTIGATING THE POTENTIAL INCREASE IN SEA LEVEL AT THE EAST COAST OF PENINSULAR MALAYSIA: TERENGGANU BY UTILISING VARIOUS MACHINE LEARNING TECHNIQUES Download PDF Abstract Reference	V. LAI, A. NAJAH AHMED, M.A. MALEK, A. EL-SHAFIE, AMR EL-SHAFIE	181 - 193	7	View
19	IJCIET_10_06_019	THE VULGARIZATION FOR THE PATRIMONIALIZATION OF THE KETTARA GEODIVERSITY (CENTRAL JBILET), MOROCCO Download PDF Abstract Reference	KHADIJA KAID RASSOU, BOUCHRA RAZOKI, MOHAMED YAZIDI, SAÏD CHAKIRI, HASSAN EL HADI, ZOHRA BEJJAJI, FATIMA EL HMIDI and MOHAMED ALLOUZA	194 - 214	9	View
20	IJCIET_10_06_020	PATTERN OF COMMUNITY-BASED LAND USE IN SALU PAKU SUB-WATERSHED IN THE UPSTREAM PART OF RONGKONG WATERSHED, NORTH LUWU REGENCY, SOUTH SULAWESI, INDONESIA Download PDF Abstract Reference	ANNAS BOCENG, SUKOSO, SOEMARNO and AMIR TJONENG	215 - 229	12	View
21	IJCIET_10_06_021	FIELD EXECUTIVE LEADERSHIP MODEL IN ITS INFLUENCE ON IMPROVING THE PERFORMANCE OF CONTRACTOR'S WORKFORCE IN MODERATION MOTIVATION VARIABLES Download PDF Abstract Reference	DAFID IRAWAN, INDRASURYA B. MOCHTAR and CHRISTIONO UTOMO	230 - 239	15	View
22	IJCIET_10_06_022	E-GOVERNMENT LEGISLATIVE CONSTRAINTS Download PDF Abstract Reference	MOHAMMAD IBRAHIM ABU EL-HAIJA, SALEEM M-SHAREEF KARA, TAMARA Y. NASEREDDIN	240 - 244	112	View
23	IJCIET_10_06_023	CALCULATION MODEL OF THERMAL STRESSES IN SAPPHIRE - GLASS DIELECTRIC STRUCTURE FOR PRESSURE SENSOR Download PDF Abstract Reference	S.P. MALYUKOV, A.V. KOVALEV, D.A. BONDARCHUK, YU.V. KLUNNIKOVA, A.A. KULAKOVA	245 - 252	18	View
24	IJCIET_10_06_024	NOTARY HONORARY ASSEMBLY AS THE STATE ADMINISTRATIVE OFFICIAL AND ITS DECISIONS AS THE STATE ADMINISTRATIVE DECISION Download PDF Abstract Reference	HABIB ADJIE	253 - 262	7	View
		DIGITIZING HYDROLOGICAL PATTERNS FOR RIVER				

25	IJCIET_10_06_025	DIGITIZING HYDROLOGICAL PATTERNS FOR RIVER TRAFFIC SAFETY New! Download PDF Abstract Reference	DARRIEN YAU SENG MAH, M. A. MALEK and FREDERIK JOSEP PUTUHENA	263 - 271	32	View
26	IJCIET_10_06_026	RISK BASED CONTRACT MANAGEMENT TO CONTROL MATERIAL PRICE INCREMENT IN A POWER PLANT PROJECT New! Download PDF Abstract Reference	MUHAMAD RANGGA BARMANA, AYOMI DITA RARASATI and IMRAN HILMAN MOHAMMAD	272 - 281	22	View
27	IJCIET_10_06_027	OPTIMATION OF THE SELECTION OF LANDSLIDE MITIGATION METHODS IN ARJASA, JEMBER DISTRICT INDONESIA New! Download PDF Abstract Reference	RAHMAN A., FARID.,M, YENY.,D	282 - 290	17	View
28	IJCIET_10_06_028	WORLDWIDE WASTEWATER AND USE IN AGRICULTURE New! Download PDF Abstract Reference	PEDRO A. CÁRDENAS BEJARANO, JUAN P. RODRÍGUEZ MIRANDA and JHON J. FERIA DÍAZ	291 - 297	39	View
29	IJCIET_10_06_029	REMOVAL OF TURBIDITY OUT OF RAW WATER FOR IRRIGATION SYSTEMS BY MEANS OF FILTRATION IN MULTIPLE STAGES USING HIGH APPLICATION RATES New! Download PDF Abstract Reference	JHON J. FERIA DÍAZ, JUAN P. RODRÍGUEZ MIRANDA and MARINELA B. ÁLVAREZ BORRERO	298 - 305	26	View
30	IJCIET_10_06_030	ASSESSMENT OF OCEAN RENEWABLE ENERGY RESOURCES IN TERENGGANU, MALAYSIA New! Download PDF Abstract Reference	OMAR SULIMAN ZAROOG, NIGEL LEE CHIA LOCK, ALI. N. AHMED, AHMED EL-SHAFIE and AMR EL-SHAFIE	306 - 313	13	View
31	IJCIET_10_06_031	DAILY FORECASTING OF DAM WATER LEVELS USING MACHINE LEARNING New! Download PDF Abstract Reference	WONG JEE KHAI, MOATH ALRAIH, ALI NAJAH AHMED, CHOW MING FAI, AHMED EL-SHAFIE3 and AMR EL-SHAFIE	314 - 323	18	View
32	IJCIET_10_06_032	INFLUENCE OF INFLOW-OUTFLOW SYSTEMS FOR NATURAL MIXING IN A CIRCULAR TANK New! Download PDF Abstract Reference	ZAHIRANIZA MUSTAFFA, SYED MUZZAMIL HUSSAIN SHAH, MARLINDA ABDUL MALEK, WAN NORGAYAH WAN MOHD NOOR and EBRAHIM HAMID HUSSEIN AL-QADAMI	324 - 335	20	View
33	IJCIET_10_06_033	IMPACT OF CLIMATIC CHANGE ON RIYADH CITY RAINFALL New! Download PDF Abstract Reference	GAMAL M. ABDEL AAL, FAHMY S. ABDELHALEEM, TAREK H. NASR-ALLAH and ENG. HAYTHAM M. AFIFI	336 - 350	16	View
34	IJCIET_10_06_034	KEYPHRAS EXTRACTION FROM SCIENTIFIC ARABIC ARTICLES BY APPLYING A NEW STEAMING ALGORITHM FOR EXTRACTING ARABIC WORDS ON KEA ALGORITHM New! Download PDF Abstract Reference	YALMAZ NAJM ALDEEN TAHER, ABBAS HUSSEIN ALI, TAHA DARWASSH HANAWY HUSSEIN	351 - 363	11	View
35	IJCIET_10_06_035	ANALYSIS OF MARKET STRUCTURE, CONDUCT AND PERFORMANCE OF CORN (ZEA MAYS L.) IN KEDUNG MALANG VILLAGE, PAPAR DISTRICT, KEDIRI REGENCY, EAST JAVA New! Download PDF Abstract Reference	ABDUL WAHIB MUHAIMIN, LIS M YAPANTO AND VERINA WIJAYANTI	364 - 374	11	View
36	IJCIET_10_06_036	ROLE OF INDIVIDUAL CHARACTERISTICS AS A MODERATING EFFECTS OF AUDITOR PROFESSIONALISM ATTITUDE ON AUDIT QUALITY OF INSPECTORATE APPARATUS IN SOUTHEAST SULAWESI New! Download PDF Abstract Reference	ARIFUDDIN MASUD, FERDINAND AND ABDUL RAZAK	375 - 388	23	View
37	IJCIET_10_06_037	WAVE TRANSMISSION THROUGH CURTAINWALL PILE BREAKWATER (CPB) New! Download PDF Abstract Reference	SUBEKTI, DARSONO S AND YUWONO N	389 - 398	39	View
38	IJCIET_10_06_038	POSSIBILITY OF BIM TECHNOLOGY IN SITE SAFETY ANALYSIS AT IRAQI CONSTRUCTION INDUSTRY New! Download PDF Abstract Reference	HAYDER REZZAQ ABED, WADHAH AMER HATEM AND NIDAL ADNAN JASIM	399 - 410	27	View
39	IJCIET_10_06_039	A COMPARISON OF THE COMPRESSIVE STRENGTH OF CONCRETE BETWEEN NATURAL COARSE AGGREGATE AND RECYCLED COARSE AGGREGATE New! Download PDF Abstract Reference	PUNKORN CHEEWAWUTWATANAWIT, WARANON KONGSONG, SEREE TUPRAKAY, SATHIAN CHAROENRIAN, BOONTHAM HARNPHANICH AND CHAIWAT POOWORAKULCHAI	411 - 417	36	View
		CORRELATION ANALYSIS OF UNIAXIAL COMPRESSIVE				

40	IJCIET_10_06_040	STRENGTH (UCS) AND POINT LOAD INDEX (IS50) OF BANKET CONGLOMERATE WITHIN TARKWAIAN DEPOSITS OF GHANA Download PDF Abstract Reference	M. AFFAM, E.N. ASARE, D. AIKINS	418 - 434	12	View
41	IJCIET_10_06_041	EXPLORE POSSIBLE CLIMATE CHANGE IMPACTS ON SURFACE FLOODING IN KELANTAN Download PDF Abstract Reference	WONG JEE KHAI, NG JIEN HUN, ALI NAJAH AHMED, CHOW MING FAI, AHMED EL-SHAFIE and AMR EL-SHAFIE	435 - 443	13	View
42	IJCIET_10_06_042	CAUSES AND EFFECT OF ELECTION BRIBERY ANALYTICAL AND PRACTICAL STUDY Download PDF Abstract Reference	AHMAD M. ALLOUZI, ABDULLAH A. ALKHSEILAT and AYMAN Y. ALRFOO	444 - 452	8	View
43	IJCIET_10_06_043	PREPARATION AND CHARACTERIZATION OF OIL PALM EMPTY BUNCHES POWDER AS A FILLER OF POLYPROPYLENE / NATURAL RUBBER Download PDF Abstract Reference	EVA MARLINA GINTING, NURDIN BUKIT, MOTLAN, DEBORA GULTOM, ERNA FRIDA, BUNGA FISIKANTA BUKIT	453 - 464	26	View
44	IJCIET_10_06_044	ROOTING THE ROLE OF THE JUDGE IN FORMING THE LEGAL BASE A COMPARATIVE STUDY Download PDF Abstract Reference	RAQIYA ABDELJABAR ALI, MOHAMMED ALI ZAAL AL-SHABATAT	465 - 474	6	View
45	IJCIET_10_06_045	INVESTIGATING THE LOW UTILIZATION OF POZZOLANA CEMENT IN THE GHANAIAN CONSTRUCTION INDUSTRY Download PDF Abstract Reference	EDWARD AYEBENG BOTCHWAY, ALBERT MASOPERH	475 - 482	12	View
46	IJCIET_10_06_046	ANALYSIS OF FACTORS THAT AFFECT THE RISK OF IMPLEMENTATION OF UNDERPASS PROJECT CONSTRUCTION IN MAYJEN SUNGKONO SURABAYA Download PDF Abstract Reference	MIFTAHUL HUDA	483 - 493	8	View
47	IJCIET_10_06_047	PARTICIPATIVE AND INCLUSIVE COLLABORATIVE MANAGEMENT OF CONSERVATION AREAS IN KAYAN MENTARANG NATIONAL PARK NORTH KALIMANTAN INDONESIA Download PDF Abstract Reference	DOLVINA DAMUS, ZAENAL KUSUMA, BAGYO YANUWIADI, IMAM SANTOSO	494 - 507	10	View
48	IJCIET_10_06_048	URBAN FLOOD MANAGEMENT AND MONITORING IN VRISHABHAVATHI VALLEY New! Download PDF Abstract Reference	D H YASHASVINI, PRIYANKA S, VIDYASHREE, VINUTHA S	508 - 512	16	View
49	IJCIET_10_06_049	RISK ALLOCATION MODEL FOR INDONESIA'S ROAD MAINTENANCE PROJECT UNDER PERFORMANCE BASED CONTRACT SCHEME New! Download PDF Abstract Reference	DENI SETIAWAN, REINI WIRAHADIKUSUMAH, KRISHNA S. PRIBADI, HARUN AL RASYID LUBIS	513 - 527	8	View
50	IJCIET_10_06_050	TRAFFIC CONGESTION CONTROL FOR UNPLANNED CITIES New! Download PDF Abstract Reference	METWALLY G. M. ALTAHER, AHMED MOHAMADY ABDALLAH, MOHAMED ABDELGHANY ELSAYED, ABD EL-RAHMAN BAZ ABD EL-SAMII MAHFOUZ	528 - 540	62	View

Pages 1 | 2 |

International Journal of Civil Engineering and Technology (IJCIET)
Volume 10, Issue 06, June 2019, pp. 513-527, Article ID: IJCIET_10_06_049
Available online at http://www.iaeme.com/ijciet/issues.asp?JType=IJCIET&VType=10&IType=6
ISSN Print: 0976-6308 and ISSN Online: 0976-6316

RISK ALLOCATION MODEL FOR INDONESIA'S ROAD MAINTENANCE PROJECT UNDER PERFORMANCE BASED CONTRACT SCHEME

Deni Setiawan
Civil Engineering Doctoral Student, Faculty of Civil Engineering and Environmental
Institut Teknologi Bandung, Bandung, Indonesia

Reini Wirahadikusumah, **Krishna S. Pribadi**
Civil Engineering Professor, Faculty of Civil Engineering and Environmental
Institut Teknologi Bandung, Bandung, Indonesia

Harun Al Rasyid Lubis
Civil Engineering Associate Professor, Faculty of Civil Engineering and Environmental
Institut Teknologi Bandung, Bandung, Indonesia

ABSTRACT

The implementation of Performance Based Contracts (PBC) in Indonesia still has many challenges. In terms of risk allocation, PBC allocate more risk to the contractor. Certain risks are inherent in all construction projects. Shifting the risk onto one of the parties to a construction contract agreement is unfair and expensive. Equitable allocation of risks among parties is very important. The allocation of risk between road manager and contractor parties in a PBC contract is a critical element of success that should be based on an assessment of the party best able to manage it. Determining the parties that are most able to bear the risk has been generated from various studies both through qualitative and quantitative approaches. Martin Barnes (1983) in his research has proposed a risk allocation algorithm to determine which parties are most able to accept the risks qualitatively. The purpose of this paper is to provide a qualitative risk allocation model for road maintenance projects with PBC schemes in Indonesia.

The study took samples in several national roads in Pantura Lane Road. Risk allocation algorithm proposed by Martin Barnes (1983) is applied to determine the best able party to manage the risk by considering magnitude and cost of each risk factor. The results show that the risk of natural disasters and overloading vehicle risk should not bear by the contractors. Force Majeure risk should be allocated to the owner by creating an addendum contract for recovery works with unit price payment mechanism. If the contractor still bear overloading risk, then the owner must facilitate actual traffic volume data and actual total weight data for engineering designing *process. This condition indicates that there is a trade-off from the contractor party in the bid price as the impact of handling risks.*

Key words: Risk, allocation, performance, contract, roads, model.

Cite this Article: Deni Setiawan, Reini Wirahadikusumah, Krishna S. Pribadi, Harun Al Rasyid Lubis, Risk Allocation Model for Indonesia's Road Maintenance Project Under Performance Based Contract Scheme, *International Journal of Civil Engineering and Technology* 10(6), 2019, pp. 513-527.
http://www.iaeme.com/IJCIET/issues.asp?JType=IJCIET&VType=10&IType=6

1. INTRODUCTION

Performance-Based Contracts (PBC) are generally defined as types of contracts with payment mechanisms are based on outcomes. In contrast, traditional contract-based methods are based on input specifications that govern and determine when and how contractors need to carry out road maintenance activities (Stankevich et al., 2005; Zietlow, 2005). PBC allows contractors to choose their own methods, innovate, and potentially generate more profits as long as contractual performance criteria are met. The benefits of implementing a PBC for road maintenance work are as follows: there are cost savings for road maintenance work (savings in implementation costs range from 10 to 40%) (Stankevich et al., 2005), risk sharing and quality assurance by contractors, innovation, increased efficiency of road authorities and contractors, reducing administrative burdens, user satisfaction, achieving a sustainable road management system, increasing work flexibility, and increasing transparency and reducing the possibility of corruption (Pakkala, 2005; Sultana et al., 2012). PBC is a contract type with delivery methods Design-Build-Operate-Maintain (DBOM). At the PBC, design work, construction, through maintenance contracts are integrated into a single package and only to one contractor. PBC does not set the job specifications, but contractors are limited by the outcome. PBC uses lump sum fixed price and applies incentives and disincentives in the payment mechanism. From the design process until maintenance works can stimulate contractors to improve work methods to reduce the risk of increased financing (Olivier et al., 2010). The parties involved in the PBC project are certainly required to have the ability to manage and allocate risks so that they do not burden one party, for example: how to predict traffic growth and how to allocate the risk of unexpected costs that are beyond the contractor's control. The fact that if the risk allocation is not balanced between the parties involved in the contract, it will increase the total cost of the project and will also affect the relationship between the parties to the contract (Khazaeni et al., 2012). Risk allocation is defined as dividing or imposing risks that may occur in a project to the parties that are most able to manage it, where contracts and regulations are the basis of reference for the division. Setting well how to allocate risk between project owners and contractors significantly impacts the optimal cost of managing risks (Khazaeni et al., 2012; Lam et al., 2007). Availability of an optimal risk allocation model for PBC in Indonesia for decision makers in formulating an important risk allocation mechanism to be examined so that the benefits of this Performance Based Contract are achieved. The purpose of this research is to develop a risk allocation model for improvement and maintenance work with PBC schemes in Indonesia.

2. IMPORTANCE RISK ALLOCATION MODEL FOR INDONESIA PBC PROJECT

PBC projects in Indonesia allocates more risk that a significantly affects on the increase in the project cost to the contractor party. For example the contractor has to bear the risk of inflation and exchange rate fluctuations, which have to be compensated by increasing the bid price.

The contractor also has to bear risks beyond his or hers capability to deal with, such as traffic overloading, bad road user behavior and improper road side activities such as informal markets using part of the right of way including drainage channels. The road manager doesn't bear much risk that a significantly impacts on increase the project cost, because the payment mechanism used in PBC is lump sum fixed price (Susanti et al, 2014, Setiawan et al, 2015).The efficiency and effectiveness of contract clauses can only be understood when both parties have the same perception of risk allocation. The absence of clear contractual provisions which parties are the risk bearer will cause disagreement and mismanaged risk by assuming that the risks or consequences are not their responsibility (Andi, 2006). Mismanaged risks can cause project inefficiencies and have the potential to trigger conflicts, which in turn will lead to increased project costs (Hartman and Snelgrove, 1996). Based on the principle that the risk must be borne by those who can manage it, for this reason there is a need for risk allocation steps for PBC. The following is the experience of several countries in terms of risk sharing on road maintenance projects with PBC: In Virginia, United States, contractors risk unexpected costs, including inflation, rising material prices, accidents and force majeure events. In Argentina, contracts allow price adjustments in certain circumstances that are beyond the contractor's control, such as earthquakes, hurricanes and insufficient supply of asphalt. The government uses the bid price and schedule submitted in the auction process as a basis for consideration of the estimated cost of overruns. The risk of excess fees is limited to 25% of the price. In British Columbia, Canada, and Estonia the CBC includes an annual price adjustment process that takes into account changes in the prices of labor and fuel indexes (Stankevich et al., 2005). In Indonesia, Ministry of Public Works have implemented two PBC pilot projects in 2011, the Pantura Section Demak-Trengguli (7.68 kilometers) in Central Java Province and Section Ciasem-Pamanukan (18.5 kilometers) in West Java Province (both sections are categorized as national roads) with contract duration for both projects is four years and contract value of over 100 billion rupiah. In 2012, Ministry of Finance to agree on allocating four more PBC projects with 7 (seven) year contract duration. These are:

1. Section Semarang-Bawen, West Java (22 kilometers), contract period: 2012-2018
2. Section Bojonegoro-Padangan, East Java (11 kilometers), contract period: 2012-2018
3. Section Padangan-Ngawi, East Java (10.70 kilometers), contract period: 2012-2018
4. Section Sei Hanyu-Tb. Lahung, Central Kalimantan (50.60 kilometers), contract period: 2013-2020

Pilot project of PBC is needed before it is fully introduced to measure the feasibility, capability, cost and quality of work and establish a relationship between the contractor and the road authority (World Bank, 2012). The implementation of PBC in Indonesia still facing constrained in various issues. The audit report of the Audit Board of the Republic of Indonesia in semester 2 of 2013 indicated that the implementation of PBC worth IDR 106.96 billion in the Ciasem-Pamanukan Work Package in West Java Province contained many weaknesses and the results were not effective. One of the issues raised by the Audit Board was that contractors were unable to implement the PBC, the problem revealed was that there were significant design changes, the quality of the work was not good, and the reconstruction work. Based on the results of the audit, The Ministry of Public Works and Housing has temporarily suspended the PBC in Indonesia until efforts are made to improve PBC into the suit conditions in Indonesia.

3. RESEARCH METHOD

The PBC risk allocation model is expected to be able to answer problems that refer to the unavailability of PBC models based on the optimal risk allocation in Indonesia. The PBC model produced from this study uses a quantitative approach by using an iterative process on the risk allocation algorithm developed by Martin Barnes, so that it can assist national road managers in objectively making decisions related to allocating risks to the parties who are best able to manage risk at a cost cheaper risk. In general, this PBC model can be applied to the application of PBC to strategic national road networks with high traffic volume characteristics.

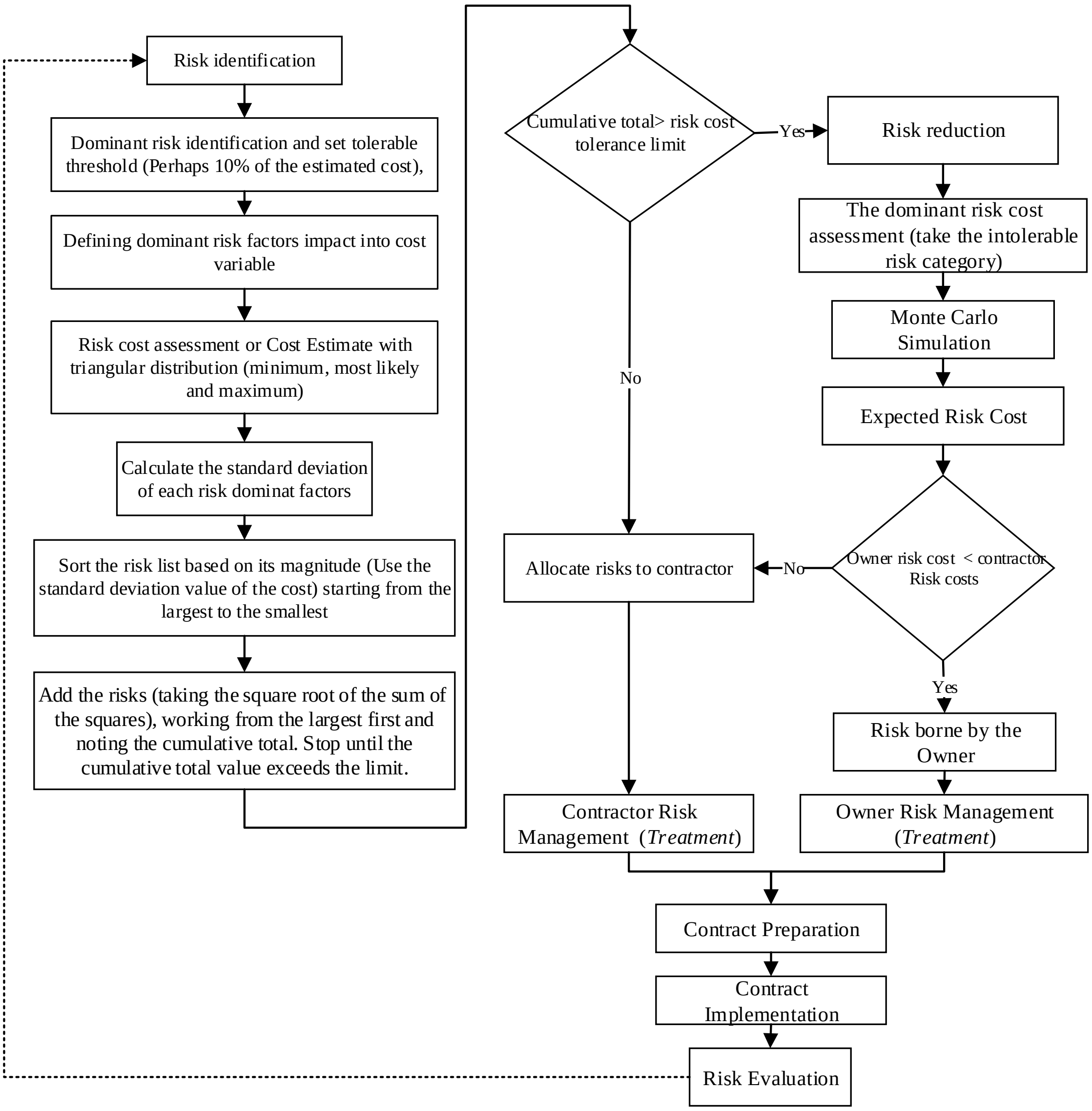

Figure 1 PBC Risk Allocation Model Framework

Stage 1: Risk Identification

The risk identification stage through the Risk Breakdown Structure (RBS) for PBC project. In Indonesia, PBC projects are divided into three, namely: (i) risks related to design activities, (ii) risks related to construction/rehabilitation activities and (iii) risks related to maintenance activities. Risk Breakdown Structure (RBS) was utilized to identify the risks at different stages of design, construction and maintenance phases. Some previous researchers have conducted a study on risk identification on Performance Based Contracts (Haas, et al,2001;

Pidwerbesky, B.D., 2004; Hyman., 2009; Mousavi et al, 2011, Zhu et al, 2011; Zietlow, G., 2013, Andhika et al, 2014, Susanti et al , 2014)). Table 1 shows a list of the various risks that could potentially occur at PBC road work projects.

Table 1 Risk Breakdown Structure

No	Risk Event	Risk Code
A	Design Phase	
1	Increased costs due to design change	A1
2	Increased costs due to design errors	A2
B	Construction Phase	
1	The project stalled due to changes in policy	B1
2	Cost changes due to rework to meet road performance standards	B2
3	Increased costs due to the scope and amount of work can not be predicted	B3
4	Losses due to price estimation error	B4
5	Disputes with contractors that have an impact on the delay in the construction process	B5
6	Changes in working methods caused by the lack of environmental documents	B6
7	Theft of materials and equipment	B7
8	Rework activities due to the weak ability of subcontractors	B8
9	Cost change due to work implementation errors	B9
10	Losses due to natural disasters (floods , landslides , etc.)	B10
11	Increased costs due to fluctuations in currency exchange rates	B11
12	Schedule delayed due to weather conditions	B12
13	Late payments to contractors	B13
14	The increasing volume traffic and overloading	B14
15	Losses due to price estimation error	B15
16	The dispute caused by lack of understanding of the contractual agreement	B16
17	Disputes due to performance measurement that does not reflect the performance requirements	B17
18	Contractor's Financial failure	B18
19	Cessation of schedule due to strike	B19
20	Losses due to price escalation	B20
C	Maintenance Phase	
1	Losses due to natural disasters (floods , landslides , etc.)	C1
2	Losses due to unavailability of materials, equipment , and labor	C2
3	Increased costs due to fluctuations in currency exchange rates	C3
4	Disputes due to the weak ability of supervisors	C4
5	Schedule delayed due to weather conditions	C5

No	Risk Event	Risk Code
6	Losses due to work accident	C6
7	The dispute caused by lack of understanding of the contractual agreement	C7
8	Late payments to contractors	C8
9	The increasing volume traffic and overloading	C9
10	The delay in the project due to the strife caused by the unclear legal framework	C10
11	Cessation of the project due to conflicts related to the legality	C11
12	Losses due to price estimation error	C12
13	Late payments due to work packages that are not included in the priority handling	C13
14	Late payments due to the budget that are not available or is available but less	C14
15	Contractor's Financial failure	C15
16	Costs for security payment	C16
17	Blockage of drainage channels due to market	C17
18	Losses due to price escalation	C18
19	Theft of materials and equipment	C19
20	Cessation of schedule due to strike	C20
21	Disputes due to performance measurement that does not reflect the performance requirements	C21

Stage 2: Dominant risk identification

Quantitative risk assessment consists of two main variables. The first variable is Risk Probability (P), measurement of the frequency of possible risks and the second variable is the Risk Impact (I), measuring the impact of risks that may occur. The final stage of the risk assessment is to measure how much the risk impacts on these costs with risk map. This stage identifies dominant risks and defines the relationship between risk factors and variable costs. The Pareto chart was made through a weight assignment to get risk dominant short list as shown in Fig. 2 and Table 2 for detailed cost breakdown structures. A questionnaire was then structured to get the contractors perceptions. The respondents were asked to choose between very low, low, moderate, high and very high. The second question refers to the impact on project objectives once the risk event occurs. The qualitative research includes expert interviews to validate risk identification and assist with the selection of the most significant/dominant risks (shown at Figure 2). Risk probability scale and risk impact scale shown at Table 1

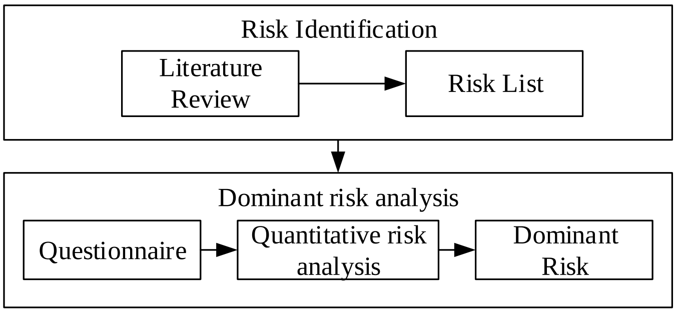

Figure 2 Risk Dominant Selection

Table 1 Risk probability Scale and Risk Impact Scale

Risk Probability Assessment	Explanation	Risk Impact Assessment	Explanation
1	Occur once in 10-15 years	1	The loss is less than 5% of the contract price
2	Occur once in 5-10 years	2	Losses between 5.1-10% of the contract price
3	Occur once in 2-5 years	3	Losses between 10.1-15% of the contract price
4	Occur once in 1-2 years	4	Losses between 15.1-20% of the contract price
5	Occurs throughout the contract	5	The loss is more than 20.1% of the contract price

Stage 3: Risk Allocation Process

The risk allocation algorithm suggested by (Barnes, 1983) is based on the measurement of risk. The probability distribution used to measure risk is a normal distribution. The principle suggested by Barnes is that risks arising out of the contractor's control must not be allocated to the contractor because it will cause the contractor to bear the risk at a cost that is too large. The contractor in an effort to mitigate risk will add costs to bear high risks because the contractor is basically the party who rejects/avoids risk. Thus it would be better if the owner who bears the risks that are beyond the contractor's control. The assumption of the risk allocation principle from Barnes is based on the idea that the owner is a party that has a risk neutral attitude so that the owner has the ability and willingness to bear certain risks, while the contracting party is a party with a risk adverse attitude. The risk allocation process stage is preceded by a project risk cost assessment used to review the variants of costs related to the project, such as uncertainty, risk and also opportunities that might have an impact on construction costs.

Risk Allocation

- Risk-allocation algorithm proposed by Martin Barnes has six step:
- Prepare a list of the unrelated risks that have to be carried by one or other of the parties.
- Identify the risks that are predominantly outside the contractor's control. Allocate these to the client and remove them from the list.
- Rank the list in order of magnitude (measured as the standard deviation of cost uncertainty).
- Add the risks (taking the square root of the sum of the squares), working from the largest first and noting the cumulative total. Stop when the cumulative total levels out.
- If the cumulative total exceeds a tolerable threshold (Perhaps 10% of the estimated cost), consider what steps could be taken either to reduce each risk or to share it between the two parties (e.g. by using ground reference conditions). Go back to step 3 and continue.
- If the cumulative total is less than the threshold, allocate the remaining large risks and ail the small risks to the contractor.

Risk Costs Assesment

Uncertainty in cost items is modeled with continuous distribution functions such as triangular distribution. If C_{dc} is the risk cost of the design and construction phase, C_m is the risk cost at the maintenance phase, C_g is the risk cost in the guarantee period and W_i is the weight of each risk to the cost, the total cost can be formulated as:

$$C_{tot} = \sum_{i=1}^{n} C_{dc} + \sum_{i=1}^{n} C_m + \sum_{i=1}^{n} C_g.$$

This research project uses probability analysis, specifically the Monte Carlo analysis, which is a computer simulation that is used to solve many uncertainty problems in various scientific disciplines. Monte Carlo analysis is “the discipline of designing a model of an actual or theoretical physical system, executing the model on a digital computer, and analyzing the execution output”. The risk cost of each risk factors in this research obtained from interview process, respondents asses the risk cost based on triangular distribution (min, most likely and max). The default risk values are then sorted from the largest to the smallest. The greater the standard deviation value then indicates a large uncertainty value. The standard deviation value of each of these risks is then cumulative and the maximum limit value is assumed to bear the risk. For that, then in this study developed the amount of maximum limit value borne by the contractor. The risk allocation model for PBC pilot project in Ciasem-Pamanukan section show in Table 3.

Table 3 Risk Allocation Process For Ciasem-Pamanukan Section

No	Risk Dominat Factors	Risk Code	Standard Deviation (IDR)		
			All Risks Allocated to Contractors	Natural Disaster Risk Allocated To Owners	Overloading Risk Allocated to the Owner
1	Losses due to natural disasters (floods , landslides , etc.)	CP1	4,742,040,304.81		
2	The increasing volume traffic and overloading	CP9	4,742,040,304.81	4,742,040,304.81	
3	The increasing volume traffic and overloading	C7	4,734,331,971.48	4,734,331,971.48	4,734,331,971.48
4	Changes in costs due to scope and number of jobs cannot be predicted	B3	4,374,589,085.31	4,374,589,085.31	4,374,589,085.31
5	The increasing volume traffic and overloading	CM3	3,202,025,479.73	3,202,025,479.73	3,202,025,479.73
6	Changes in costs due to errors in estimated prices	B4	2,461,389,846.61	2,461,389,846.61	2,461,389,846.61
7	Changes in costs due to rework activities due to the weak ability of subcontractors	B8	2,002,886,553.78	2,002,886,553.78	2,002,886,553.78
8	Changes in costs due to cost escalation	CP18	1,568,984,689.18	1,568,984,689.18	1,568,984,689.18
9	Changes in costs due to errors in estimated prices	CP12	1,561,135,061.17	1,561,135,061.17	1,561,135,061.17
10	Changes in costs due to reworks to achives road performance standards	B2	1,501,054,411.95	1,501,054,411.95	1,501,054,411.95
11	Changes in costs due to cost escalation	C15	1,469,140,695.15	1,469,140,695.15	1,469,140,695.15
12	Changes in costs due to errors in work	B9	1,262,382,652.26	1,262,382,652.26	1,262,382,652.26
13	Changes in costs due to errors in estimated prices	B14	1,203,422,054.78	1,203,422,054.78	1,203,422,054.78
14	Late payment to the contractor	B13	1,047,193,021.43	1,047,193,021.43	1,047,193,021.43
15	Changes in work methods due to	B6			

No	Risk Dominat Factors	Risk Code	Standard Deviation (IDR)		
			All Risks Allocated to Contractors	Natural Disaster Risk Allocated To Owners	Overloading Risk Allocated to the Owner
	unpreparedness of environmental documents		800,314,543.02	800,314,543.02	800,314,543.02
16	Late payment due to project packages that are not included in the priority treatmen	C11	327,984,192.49	327,984,192.49	327,984,192.49
17	The unavailability of materials, equipment and labor	C2	323,274,415.69	323,274,415.69	323,274,415.69
18	Changes in costs due to fluctuations in currency exchange rates	CP3	183,219,837.99	183,219,837.99	183,219,837.99
19	The unavailability of materials, equipment and labor	CP2	175,511,504.66	175,511,504.66	175,511,504.66
20	Late payment to the contractor	CP8	175,511,504.66	175,511,504.66	175,511,504.66
21	Late payment due to project packages that are not included in the priority treatmen	CP13	175,511,504.66	175,511,504.66	175,511,504.66
22	Late payment due to a budget that is not available	CP14	175,511,504.66	175,511,504.66	175,511,504.66
23	Disputes due to performance measurement do not reflect road performance requirements	CP21	175,511,504.66	175,511,504.66	175,511,504.66
24	Late payment due to a budget that is not available	C8	163,065,135.58	163,065,135.58	163,065,135.58
25	Late payment to the contractor	CM2	140,409,203.73	140,409,203.73	140,409,203.73
26	Disputes with supervisors due to misunderstandings regarding supervision of Performance Based Contracts that are different from traditional contracts (DBB)	CP4	70,204,601.86	70,204,601.86	70,204,601.86
27	Disputes due to weak understanding of contracts	CP7	70,204,601.86	70,204,601.86	70,204,601.86
28	Changes in costs due to design changes	A1	36,968,333.33	36,968,333.33	36,968,333.33
29	Changes in costs due to improper design	A2	36,818,333.33	36,818,333.33	36,818,333.33
30	Increased costs for payment of security costs	C13	35,102,300.93	35,102,300.93	35,102,300.93
31	Termination of the project due to the existence of conflicts related to legality	CM4	35,102,300.93	35,102,300.93	35,102,300.93
32	Increased costs for payment of security costs	CM6	35,102,300.93	35,102,300.93	35,102,300.93
Cumulative			**11,018,138,712.49**	**9,945,473,062.42**	**8,742,167,247.48**
Contract Cost			**97,406,765,972.24**	**97,406,765,972.24**	**97,406,765,972.24**
Tolerance Limit (10% of Contract Value)			**9,740,676,597.22**	**9,740,676,597.22**	**9,740,676,597.22**

The modeling results indicate that there are two risk factors that have an adverse impact and are beyond the contractor's ability to manage them. The risks are:

1. The risk of vehicle overloading.
2. The risk of natural disasters.

4. MODEL VALIDATION

The validation of the study was conducted through trials. The trial process is conducted to show that the results of the study can be applied to the situation reviewed and conclusions drawn apply generally to other contexts similar to the situation in the study. In this study, a trial of the risk allocation model is carried out by applying a contract model by testing the contract model for other PBC projects and then evaluating the risk allocation optimally based on the principle of risk allocation and comparing it with a contract that has been valid before. PBC project in Demak-Trengguli section and Semarang-Bawen section was choosen for validation process. The result show in Table 4

Table 4 Risk Allocation Model Validation Result

No	Risk Dominat Factors	Risk Code	Demak-Trengguli Section	Semarang-Bawen Section
			Overloading Risk Allocated to the Owner	Overloading Risk Allocated to the Owner
1	Losses due to natural disasters (floods , landslides , etc.)	CP1	2,459,574,000.00	7,010,510,000
2	Changes in costs due to scope and number of jobs cannot be predicted	B3	1,259,351,000.00	5,257,155,000
3	Changes in costs due to errors in estimated prices	B4	1,225,585,000.00	3,507,733,000
4	Changes in costs due to rework activities due to the weak ability of subcontractors	B8	1,064,181,000.00	3,498,989,000
5	Changes in costs due to cost escalation	CP18	1,044,572,000.00	3,492,130,000
6	Changes in costs due to errors in estimated prices	CP12	946,236,800.00	3,491,220,000
7	Changes in costs due to reworks to achives road performance standards	B2	930,430,800.00	3,112,730,000
8	Changes in costs due to cost escalation	C15	814,133,500.00	1,927,293,000
9	Changes in costs due to errors in work	B9	479,894,900.00	1,741,742,000
10	Changes in costs due to errors in estimated prices	B14	271,887,700.00	1,251,711,000
11	Late payment to the contractor	B13	256,854,600.00	1,239,357,000
12	Changes in work methods due to unpreparedness of environmental documents	B6	253,804,400.00	626,066,900
13	Late payment due to project packages that are not included in the priority treatmen	C11	243,544,300.00	620,987,100
14	The unavailability of materials, equipment and labor	C2	231,368,000.00	620,537,300
15	Changes in costs due to fluctuations in currency exchange rates	CP3	224,466,000.00	619,092,600
16	The unavailability of materials, equipment and labor	CP2	134,103,300.00	617,561,500
17	Late payment to the contractor	CP8	128,851,700.00	312,783,300
18	Late payment due to project packages that are	CP13	128,581,800.00	312,384,200

No	Risk Dominat Factors	Risk Code	Demak-Trengguli Section Overloading Risk Allocated to the Owner	Semarang-Bawen Section Overloading Risk Allocated to the Owner
	not included in the priority treatmen			
19	Late payment due to a budget that is not available	CP14	125,052,500.00	311,740,200
20	Disputes due to performance measurement do not reflect road performance requirements	CP21	124,455,700.00	308,644,600
21	Late payment due to a budget that is not available	C8	122,813,800.00	305,908,900
22	Late payment to the contractor	CM2	116,996,400.00	248,479,900
23	Disputes with supervisors due to misunderstandings regarding supervision of Performance Based Contracts that are different from traditional contracts (DBB)	CP4	112,583,000.00	123,838,300
24	Disputes due to weak understanding of contracts	CP7	84,820,340.00	123,405,600
25	Changes in costs due to design changes	A1	77,235,760.00	123,253,800
26	Changes in costs due to improper design	A2	54,817,700.00	62,306,160
27	Increased costs for payment of security costs	C13	26,715,590.00	61,081,920
28	Termination of the project due to the existence of conflicts related to legality	CM4	26,016,750.00	5,915,413
29	Increased costs for payment of security costs	CM6	24,077,860.00	5,884,049
	Cumulative		**3,811,127,143.15**	**12,156,461,745.51**
	Contract Cost		**54,001,036,177.18**	**175,350,416,482.14**
	Tolerance Limit (10% of Contract Value)		**5,400,103,617.72**	**17,535,041,648.21**

5. RISK ALLOCATION MODEL FOR INDONESIA'S PBC

The optimal risk allocation process proposed based on the results of the model trials for the PBC project for national road improvement and maintenance is as shown in Figure 2. The owner is the party that has full responsibility in terms of managing the project and includes allocating risk. Thus, the user of the risk allocation model produced in this study is the owner.

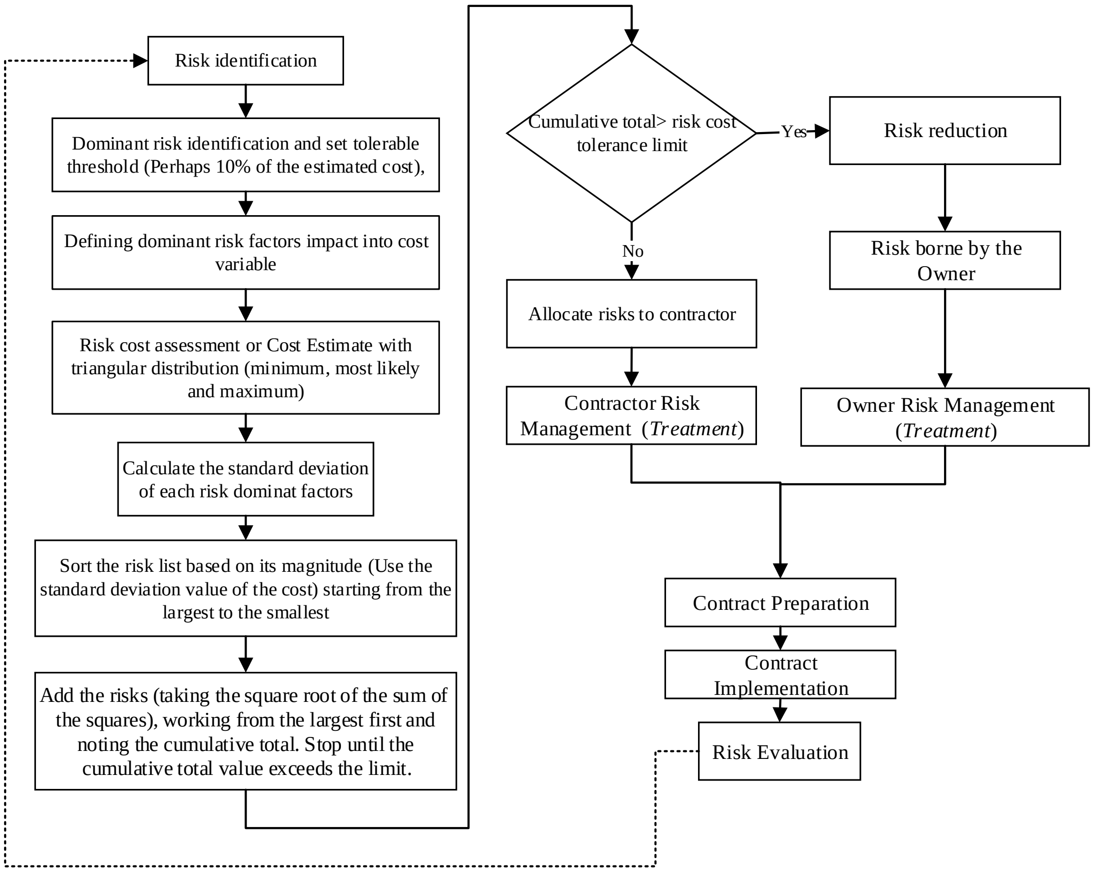

Figure 3 PBC Risk Allocation Model

The optimal risk allocation model for PBC for national road improvementand maintenance includes 3 (three) stages as follows:

Risk Allocation Stage

The risk allocation process in this study adopted and developed a risk allocation algorithm from Martin Barnes (1983). The risk allocation steps are as follows:

Risk Identification.

1. Perform a dominant risk analysis. (The results of the dominant risk analysis are presented in Table 2 in Setiawan et al, 2018)
2. Identify risks that are outside the contractor's control, then allocate those risks to the owner.
3. Calculate deviation standard of each risk dominat factors following triangular distribution formulation.
4. Sort the risk list based on its magnitude (Use the standard deviation value of the cost) starting from the largest to the smallest.
5. Add each risk (take the square root of the sum of the squares), do it from the largest value and add it cumulatively. Stop until the cumulative total value exceeds the limit.
6. If the cumulative total exceeds the tolerance limit (for example 10% of the contract cost), consider the next steps that must be taken to reduce risk or share them between the two parties (contractor and owner).
7. If the cumulative total is smaller than the threshold, allocate all risks to the contractor.

Contract Preparation Stage

The contracting phase is the stage to determine the party responsible for the risk which is then compiled into the contents of the clause on the general terms of the contract.

Contract Implementation Phase

The implementation phase of the contract is a process of realization of work to improve and maintain national roads that are contracted with the PBC scheme. This stage is also the implementation stage of the risk allocation that has been prepared previously. Recording of implementation related to the risks that occur throughout the implementation is important for the evaluation and development process in the future.

Evaluation Phase

The application of risk allocation to PBC needs to be evaluated to discuss aspects of learning both aspects that are successful and those that fail. Furthermore, the evaluation report needs to be managed as input material for other parties who will try to implement the PBC on the next national road improvement and maintenance project. The evaluation phase is carried out after the implementation stage of the PBC is completed, so that the risks that arise in each project location can be measured by probability and impact. This is important so that the development of PBCs based on optimal risk allocation to obtain best value for both owners and contractors can be achieved**.**

6. DISCUSSION

The risk allocation process in this study is to adopt and develop a risk allocation algorithm from Martin Barnes's research. The risk allocation model developed in this study has several limitations, namely:

Limitations of assumptions

The limited amount of data and respondents will certainly have an impact on determining distribution. This research uses triangular distribution as the approach. While the proposed Martin Barnes algorithm specifies normal distribution as a reference. For this reason, a comprehensive study is needed on determining the probability distribution for the Monte Carlo Simulation process. The probability distribution for risk costs is assumed to be a triangular distribution with a minimum cost assessment, the most likely cost and the maximum cost of each risk cost. Contracting respondents are reluctant to provide minimum fees so that minimum costs are equated with the most likely costs. This certainly will affect the standard deviation value as a measure to allocate risk. Risk allocation model with the risk allocation principle developed by Martin Barnes is able to produce optimal risk allocation with the assumption that the owner is the party that has the awareness to share risks.

Limitations of the survey process

Risk assessment to obtain the dominant risk is limited to the number of respondents. Each case study was chosen by two respondents, the contractor was represented by the Project Manager and the owner was represented by the Road Manager. The process of risk assessment with limited data causes its assessment to be biased, it should be to measure uncertainty requiring sufficient data. The constraints on the limited number of respondents were due to the termination of the project for the improvement and maintenance work with the PBC scheme by the related parties.

7. CONCLUSION

The contribution of this research is to provide a Performance-Based Contract model based on optimal risk allocation from the perceptions of owners and contractors. This risk allocation model can be used as a tool to determine which party is most appropriate to bear certain risks. The PBC risk allocation modeling stage along with the explanation has been prepared and presented in the form of a schematic optimal risk allocation process for PBC national road maintenance can be seen in Figure 2. The owner is the party that has responsibility in managing the project and includes allocating risk. The risk allocation process is the stage to determine which party is most appropriate to bear certain risks. This research has contributed to the practical aspects of implementing PBC for national road maintenance projects in Indonesia. The results of the identification of dominant risks indicate that the risk of overloading the vehicle becomes the most dominant risk and the contractor is not the right party to manage the risk. The risk allocation model that has been produced in this study has answered the problem of the process of allocating risk to those who are able to manage it with low risk costs. The use of this model can help road managers in the preparation and development of performance-based contract documents based on optimal risk allocation. The use of this allocation model for the Owner (Road Manager) is to compile the contents of the clause in the general terms of the contract based on optimal risk allocation.

REFERENCES

[1] Andi, 2006. The importance and allocation of risks in Indonesian construction projects. *Constr. Manag. Econ.* 24, 69–80. https://doi.org/10.1080/01446190500310338

[2] Barnes, M., 1983. How to allocate risks in construction contracts. *Int. J. Proj. Manag*. 1, 24–28.

[3] Hartman, F., Snelgrove, P., 1996. Risk allocation in lump-sum contracts—Concept of latent dispute. *J. Constr. Eng. Manag.* 122, 291–296.

[4] Khazaeni, G., Khanzadi, M., Afshar, A., 2012. Optimum risk allocation model for construction contracts: fuzzy TOPSIS approach. *Can. J. Civ. Eng.* 39, 789–800. https://doi.org/10.1139/l2012-038

[5] Lam, K.C., Wang, D., Lee, P.T.K., Tsang, Y.T., 2007. Modelling risk allocation decision in construction contracts. *Int. J. Proj. Manag.* 25, 485–493. https://doi.org/10.1016/j.ijproman.2006.11.005

[6] Olivier, P.A., Emery, S., Horak, E., Pretorius, P., 2010. Holistic pavement management–Experiences with performance based pavement management in Australia and South Africa, in: *Proceedings of the 2010 SARF/IRF Conference*, Somerset West, South Africa.

[7] Pakkala, P., 2005. Performance-based contracts—International experiences, in: Presentation at the TRB Executive Workshop" Performance-Based Contracting", April.

[8] Stankevich, N., Qureshi, N., Queiroz, C., 2005. *Performance-based Contracting for Preservation and Improvement of Road Assets* 11.

[9] Sultana, M., Rahman, A., Chowdhury, S., 2012. An overview of issues to consider before introducing performance-based road maintenance contracting. *World Acad. Sci. Eng. Technol.* 62, 350–355.

[10] Susanti, B., Reini, W., Biemo W. Soemardi, B.W., Sutrisno, “Kajian Risiko Penerapan Kontrak Berbasis Kinerja Pada Proyek Pekerjaan Jalan Nasional”. Seminar Nasional X – (2014) Teknik Sipil ITS Surabaya

[11] Setiawan, D., Reini, D.W., Krishna, S.P. Risk Allocation in Performance Based Contract Clauses For National Road Maintenance Project in Indonesia. *Proceedings SICEST 2016*, Bangka Island 2015.

[12] Setiawan, D., Reini, D.W., Krishna, S.P., Harun A. L. Risk Allocation for Indonesia's Performance Based Contract (PBC) for Road Rehabilitation and Maintenance Project. in Proceedings 42nd AUBEA Conference 2018. Singapore 2018

[13] Wirahadikusumah, R., Susanti, B., Coffey, V., Adighibe, C., 2015. Performance-based Contracting for Roads – Experiences of Australia and Indonesia. *Procedia Eng.* 125, 5–11. https://doi.org/10.1016/j.proeng.2015.11.002

[14] Zietlow, G., 2005. Cutting costs and improving quality through performance-based road management and maintenance contracts-the Latin American and OECD experiences. Sr. Road Exec. Programme Restruct. Road Manag. Ger. Dev. Coop. Birm.

IAEME Publication

(Publishers of High Quality Peer Reviewed Refereed Scientific, Engineering & Technology, Medicine and Management International Journals)

www.iaeme.com
editor@iaeme.com
iaemedu@gmail.com

INTERNATIONAL JOURNAL OF CIVIL ENGINEERING & TECHNOLOGY (IJCIET)

www.iaeme.com/ijciet/index.asp

Paper ID: IJCIET_10_06_049 **Date: 02-July-2019**

Certificate of Publication

This is to certify that the research paper entitled **"RISK ALLOCATION MODEL FOR INDONESIA'S ROAD MAINTENANCE PROJECT UNDER PERFORMANCE BASED CONTRACT SCHEME"** Authored by **"Deni Setiawan, Reini Wirahadikusumah, Krishna S. Pribadi, Harun Al Rasyid Lubis"** had been reviewed by the Editorial Board and published in **"International Journal of Civil Engineering & Technology (IJCIET), Volume 10, Issue 06, June 2019, pp. 513-527, ISSN Print: 0976-6308 and ISSN Online: 0976-6316; Journal Impact Factor (2019): 10.7810 Calculated by GISI (www.jifactor.com)".**

Chief Editor