Game Theory Based Partnership Modeling to Procure Construction MaterialBetween Suppliers and HousingDeveloper

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Abstract— **The demand of residential housing always keeps increasing throughout several decades in developing countries such as Indonesia. The population growth and economy upsurge speed up the housing demand. This situation results in glittering prospect in housing development. The developer together with its suppliers play significant roles in the success of this business. Hence the corresponding relationship between the two is critical to analyze in order to attain a certain level of effectiveness. At the time being, this relationship is commonly lead by the developer in a one-way approach. Developerdoes supplier selection based on lowest price, minimum quality requirement and lead time. This conventional approach is considered to be inadequate since the developer decision on supplier selection is very possible to be manipulated by those suppliers in opposite ways.The effective decision making process should be made on the basis of cooperation between developer and supplier. This study aims to model the relationshipbetween suppliers and developer based on cooperative game theory.Thepreliminary outcome isa set of models on relationship between suppliersanddeveloper.This model is later on utilized to providewin-win solution in term ofsatisfactory profit distribution within cooperative relationship.**

Keywords: developer-supplier relationship, cooperative game theory, win-win solution.

I. Introduction

Background

To many relationship between developer and supplier urges developer to thoroughlythreat its business operations with its suppliers.Supplieris alsoanimportant part to makeproductsandservices, butso fardevelopers oftendo nottry tomaintain good and sustainablerelationshipswith its suppliers.

At the time being,supplier selection is difficult and have a risk when a comprehensive criteria have not incorporated properly.Therefore, mutual relationship between suppliers – developer in assuring the business runs well is necessary.

Many teory and method can be used to make decision making, there are *Analytical Hierarchy Process* (AHP) dan*Fuzzy Analytical Hierarchy Process* (FAHP). Choosing a suitable strategy can help avaluator in analyzing and evaluating the best strategic alternatives [1]. In this research used *Game theory* method. *Game theory* is method that focus on dynamics process change strategy [2].

The advantage of *Game theory* method is all player were satisfied with the decisions taken (*win – win solution*). If *Game theory* not applied, the possibility of one player will gain loss. The game consists a set of rule that builds competing situation from two player or more in choosing stategy for maximize profits [3].

Game Theory have two kind that is *cooperative* dan*noncooperative*. *Cooperativegame theory*form joint commitment with attention relative strength of player. While *non cooperativegame theory*that means one of the player make own decisions without commitment between players.

In this research, proposed *cooperative game theory* that assumes a benchmark relationship between *decision maker* in making decisions.

Problem Formulation

Based on the background described above, the problem can be formulated as follows:
How to model a relationship between material suppliers - developers undercooperative game theory approach as well as analyse its possible equilibrium solution as a proposal for making the common goal of profit maximization in win-win solution way might be attained?

Research Objective

The purposeofthis research is to: Modelingcooperationbetween material suppliers - developers with cooperative game theory approach, so both of themsget optimum benefit.

II. Research Method

The purpose of this research is tomodelingcooperationbetween material suppliers - developers with cooperative game theory at PT. GrahaAgungKencana .
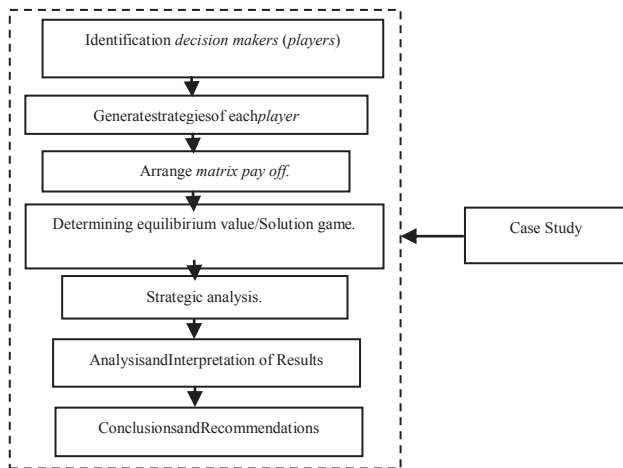Stages of the research described in the *flowchart* Figure 2.1 below.

Figure 2.1 Research Methods

Based on figure above the player for this case study is supplier and housing developer PT. GrahaAgungKencana. Each of player will be generate their strategy.

Toarrange apayoff matrixin this studyis by measuringorpredicting thespecificvaluefrom the strategyof eachplayerthat issuppliersanddevelopers ofGreen Semanggi Residence.Payoff betweensuppliers whose contested is maximizenetrevenue. Butpayoffbetweensupplierwith developerthe effectiveness ofcost orprice.The assumptionthat thepayoff matrixknown bothof players.

III. APPROACH AND DATA

Research Population

The populationofthis research is theproject leaderofseveraldeveloperswhouse the*SupplyBy Owner*methodin Surabayathat will be usedtocreate amodel ofmaterialprocurementcooperationbetweensuppliers - developers.Furthermore,casestudythepopulation of thisresearchisthe project leaderatGreen Semanggi Residence, unit of procurement PTGrahaAgungKencana, unit of logistics GreenSemanggiResidenceandmaterialsuppliersofPTGrahaAgu ngKencana.

Sampling Techniques

In this research, researc used a*purposive sampling* technique.This technique with have purpose ofcompletelysamplingaccording toresearch, so that chosepeoplewhounderstand wellthecooperationstrategyof relationship between supplier - developer.

Research Respondents

Respondents for this research isproject leaders, unitprocurementandlogistics departmentin severaldeveloperswhousethe method*SupplyBy Owner*in Surabaya andin the ProjectGreenSemanggiResidencewithdeveloper ofPT.

GrahaAgungKencana, andtwomaterialsuppliersownedbyPTGrahaAgungKencana.

Data CollectionPhase

In this phase, the data required is data about strategies of supplier and criteria of material suppliers include*quality* and*price*.The strategies and the criteria for the developer is *price*.

Methodof data collection was donein the following way:

- Interviewto find dataandinformationabout systemof weightingin decidingfor selection of material suppliers. Preparingmaterialsinterview/questionto the LeadershipProject, unitprocurementof PT. GrahaAgungKencana, andlogistics departmentinGreen Semanggi Residenceproject.The expected outcome forinterview isstrategy/criteriain selection material suppliers.

- Interviewtoobtain dataandinformationfrommaterialsuppliers.Dointerviewsw ithmaterial suppliersPT. GrahaAgungKencana. Expected resultsfrom thisinterviewswith material suppliersishowthe strategies they used,so thesuppliercan establisha relationshipwiththe developerinorder to procurematerialfor developers.

IV. RESULT

Before determine material supplier matrix payoff ,first stepdo a Paretoanalysis,there is a way of organizing data that visually highlights catagories for more detailed study.

The results of the calculation of the Pareto analysis of several material suppliers by developerdescribed in the Table4.1.

Table4.1 Results of calculation Pareto analysis

No	Name ofSupplier	Material	Vol. Transaction		Comulatif	
			(Rp.)	(%)	(Rp.)	(%)
1	PT. PrasadaHidupSentosa	Granit	1,520,142,500.00	0.472	1,520,142,500.00	0.472
2	PT. Monier	Roof tile	1,040,726,271.48	0.323	2,560,868,771.48	0.796
3	Toya Fiberglass	SeptictankBiofilter	373,500,000.00	0.116	2,934,368,771.48	0.912
4	Toto	Closet	283,362,000.00	0.088	3,217,730,771.48	1.000
			3,217,730,771.48			
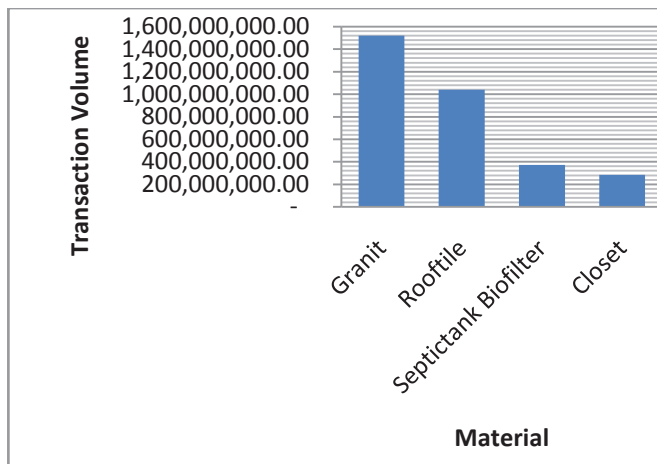
Basedonparetodiagrams, selected materialsupplier graniteandrooftile. But in this study, the materialto be analysed is a supplierof granite.There aretwomaterial suppliers ofgraniteto be analysed strategy, PT PrasadaHidupSentosaandTokoDuniaKeramik.

Supplier Payoff Matrix

In this study there are two material suppliers are used in determining the matrix payoffthere are Granite material suppliers.

Strategy material supplier A (PT PrasadaHidupSentosa) is maximize net income.

1. Strategy[I] materialsuppliersA
    a. Supplymaterialwith qualityisalways sameor fixed.
    b. Give discount 1-5% when makingreservationsin a certain amount.
2. Strategy[II] materialsuppliers A
    a. Abilityto provide materialwith good quality.
    b. Givingdiscounts 6-10% when makingreservationsin a certain amount.

Strategy material supplier B (TokoDuniaKeramik) is maximize net income.

1. Strategy[I] material supplierB
    a. Abilityto provideproducts withgood quality(no defects) basedstandardspecifications ofthe product.
    b. Give aslightly cheaperprice(6% -10%) than the other.
2. Strategy[II] material supplierB
    a. Abilityto provide productswith good quality.
    b. Give aslightly cheaperprice(above 11%) than the other.

The income of Supplier A for years Rp. 3.040.285.000,00. Supplier A get income from supply housing developer about 50%, so the income supplier A just from supply housing developer about Rp. 1.520.142.500,00.

The income Supplier Bfor years Rp. 21.600.000.000,00. Supplier B get income from supply housing developer just 5%, so the income supplier B just from supply housing developer about Rp. 1.080.000.000,00.

If supplier A dan supplier B using strategy [I], the income supplier A will decrease 5% for years and the income supplier B will increase until 8%. The calculation of Gaming if Supplier A and supplier B using strategy [I] can be described in Table 4.2.

Table 4.2Calculation of*Gaming*ifSupplierA andSupplierBUsingStrategy [I]

Player	PayoffValue (Rp.)	Note
Supplier A	1,444,135,375.00	Bruto income for years
Supplier B	1,166,400,000.00	Bruto income for years

Source: ProcessedResults(2014)

The described calculationof*Gaming*with *Pairwise*betweenSupplierA andSupplierBshown Table 4.3 until Table 4.5.

Table 4.3Calculation of*Gaming*ifSupplierA UsingStrategy [I] andSupplierBUsingStrategy [II]

Player	PayoffValue (Rp.)	Note
Supplier A	1,398,531,100.00	Bruto income for years
Supplier B	1,209,600,000.00	Bruto income for years

Source: ProcessedResults(2014)

Table 4.4Calculation of*Gaming*ifSupplierA UsingStrategy [II] andSupplierBUsingStrategy [I]

Player	PayoffValue (Rp.)	Note
Supplier A	1,520,142,500.00	Bruto income for years
Supplier B	1,080,000,000.00	Bruto income for years

Source: ProcessedResults(2014)

Table 4.5Calculation of*Gaming*ifSupplierAandSupplierBUsingStrategy [II]

Player	PayoffValue (Rp.)	Note
Supplier A	1,596,149,625.00	Bruto income for years
Supplier B	1,242,000,000.00	Bruto income for years

Source: ProcessedResults(2014)

Table 4.6 *Matrix Payoff*Interactions Supplier A and Supplier B

		Supplier B	
		Strategi [I]	Strategi [II]
Supplier A	Strategy [I]	1,444,135,375; 1,166,400,000	1,398,531,100; 1,209,600,000
	Strategy [II]	1,520,142,500; 1,080,000,000	1,596,149,625; 1,242,000,000

Source: ProcessedResults(2014)

Based on Matrix Payoff calculations above, individual choice of each player is to use strategies [II] (1,596,149,625; 1,242,000,000). This condition is called the *nashequilibrium* is a condition where none of players who not benefit by changing his strategy while the other players do not change own strategy. This can be evidenced magnitude value

of pay-off between supplier A and supplier B there are at [row 2; column 2] (1,596,149,625; 1,242,000,000). If one of the players change their strategy, then the other player will get losses.

V. CONCLUSIONS

Based on the simulation, *game theory* can used as tools to choose procurement partnershipbetween suppliers and housing developer.
Based on the result from case study, *Game theory*it is only model that need to be developed in choosing a more varied strategy.

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