IMPLEMENTATION OF EVALUATION MODEL AND SUPPLIER PERFORMANCE SCORECARD IN SELECTING SUPPLIER

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ABSTRACT

Supplier selection is one of Multi-Criteria Decision Making (MCDM) and Multi-Person Decision Making (MPDM) problems. In order to determine the best supplier in sourcing process, the main factors involved are subjective and objective decision. The subjective decision is obtained from decision makers' preference. Meanwhile, the objective decision is gathered from actual data. Thus, the integration between both factors is needed in selecting the best supplier. An evaluation model is designed to choose the best supplier. Besides it, the supplier performance scorecard is developed to present supplier performance data. Both evaluation model and supplier performance scorecard are applied to a case study in PT. ABCD.

Key words*: Supplier Selection, Evaluation Model, Supplier Performance Scorecard.*

1. INTRODUCTION

Decision makers on conducting supplier selection must select the best supplier among candidates by considering several criteria required. Assessment of each supplier is implemented to determine the selected supplier. Actually, the assessment consists of subjective decision and objective decision. The intangible element called subjective decision is data gathered from decision makers' preference on assessing alternative based on each criterion. Each decision maker has their own preference toward alternative. The preference of each decision maker can be different. Therefore, decision makers as assessor can have different decision or opinion in order to select the best supplier. Meanwhile, the tangible element called objective decision is actual data that presents alternative performance and ability. Thus, data recorded is fixed and definite. Therefore, the result must be same no matter who assessor is. Integration between subjective and objective decision will present the best supplier as supplier who deserves to have that predicate. There are many methods used as media to determine the best supplier. Sometimes methods used in supplier selection are not suitable enough.

According to background above, this paper aims to presents the best supplier which can be an integration result between subjective and objective decision in supplier selection. Evaluation model and supplier performance scorecard are implemented to a case study in order to select the best one. AHP, TOPSIS, and OWA method are utilized on designing evaluation model. Decision makers' preference about priority level of alternative and criteria required is collected as data for this model. In order to represent supplier measurement, supplier performance scorecard is developed based on Balanced Scorecard approach. This scorecard will be fulfilled by assessor based on actual data recorded. As objective data, scorecard result is assumed can be information data for decision maker in order to determine the selected supplier.

In this paper author presents implementation of evaluation model and supplier scorecard in order to select the best supplier. The rest of paper is structured as follow. In section 2 the literature study about evaluation model and supplier performance scorecard is described. Section 3 accommodates model and scorecard framework. Meanwhile, section 4 implementation results of a case study in PT. ABCD. Finally, section 5 provides the conclusion and recommendation.

2. LITERATURE STUDY

2.1 Analytical Hierarchy Process

Analytical Hierarchy Process (AHP) can be defined as a decision making method to prioritize alternative by considering several criteria and visualize the problem hierarchical in term of criteria and sub-criteria (Thomas Lorie Saaty, 1993). AHP is designed for situation in which ideas, opinions, preferences, behaviors and beliefs affecting decision making process in order to providing a numeric scale in deciding the best alternative. In AHP a problem is structured as a hierarchy.

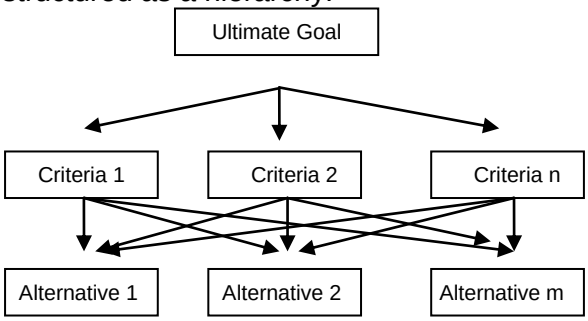

Figure 1. AHP Structure

Calculating Pairwise Comparison Matrix

If consistency in judgement requires that a_{ij} = k automaticcally implies that a_{ji} = 1/k. Then, the all diagonal element a_{ii} of A must equal 1. In ideal case, the comparison matrix (***A***) is fully consistent, the rank (***A***) = 1 and λ□**= *n*** (*n* **=** number of criteria). In this case, the following equation is valid:

$$\boldsymbol{A} \,.\, \boldsymbol{x} = \boldsymbol{x} \,.\, \boldsymbol{n} \qquad (1)$$

(***x*** is the *eigen vector* of ***A*** that represents the weight of alternative or criteria)

Analysis level of Inconsistency Matrix Pairwise Comparison

It was proved that Consistency Index (CR) from matrix n can be obtained by the formula:

$$CI = \frac{n_{max} - n}{n-1} \qquad (2)$$

The limit lack of consistency measured by using Consistency Ratio (CR) that is comparison Consistency Index (CI) with Random Index (RI) is shown in the formula below:

$$RI = \frac{1.98\,(n-2)}{n} \qquad (3)$$

$$CR = \frac{CI}{RI} \qquad (4)$$

Table 1. Random Index (RI)

N	1	2	3	4	5	6	7	8
RI	0	0	0,58	0,9	1,12	1,24	1,32	1,14

If the calculation is less than 10% (CR < 0.1), lack of consistency opinions still considered acceptable. The calculation above can be continued in order to obtain main eigenvector value and CI at each level are obtained. The measurement among criteria or alternatives can be used a relative measurement scale one until nine, as below:

Table 2. The Saaty Rating Scale

Intensity of Importance	Definition	Explanation
1	Equal Importance	Two factors contribute equally to the objective
3	Moderate Importance	Experience and judgment slightly favor one over the other
5	Strong Importance	Experience and judgment strongly favor one over the other
7	Very strong Importance	Experience and judgment very strongly favor one over the other. Its importance is demonstrated in practice
2,4,6,8	For compromise between the above value	When compromise is needed

2.2 TOPSIS

TOPSIS (Technique for Ordered Preference by Similarity to an Ideal Solution) is a decision making method to identify the ideal solutions from a set of alternatives (Chen and Hwang, 1991). The basic principle of this method is the chosen alternative should have the shortest distance from the positive ideal solution and the farthest distance from negative ideal solution.

The positive and negative ideal solution is given as:

$$c^+ = \{c_1^+, \dots, c_n^+\} = \left\{\left(max_i c_{ij} | j \epsilon I\right), \left(min_i c_{ij} | j \epsilon J\right)\right\} \qquad (5)$$

$$c^- = \{c_1^-, \dots, c_n^-\} = \left\{\left(min_i c_{ij} | j \epsilon I\right), \left(max_i c_{ij} | j \epsilon J\right)\right\} \qquad (6)$$

The separation from the positive ideal solution is given as:

$$d_i^+ = \sqrt{\sum_{j=1}^{n} \left(c_{ij} - c_j^+\right)^2}, i = 1, \dots, m \qquad (7)$$

Otherwise, the separation from the negative ideal solution is given as:

$$d_i^- = \sqrt{\sum_{j=1}^{n}\left(c_{ij} - c_j^-\right)^2},\ i = 1 \ldots, m \quad (8)$$

The relative closeness of alternative is defined as:

$$C_i = \frac{d_i^-}{d_i^+ - d_i^-} \quad (9)$$

2.3 OWA

Ordered Weighted Averaging (OWA) is a generalization method of the WA (weighted average) to aggregate decision makers' opinion in decision making (Yager, 1988). OWA operator is commutative, continue, monotone, neutral, and stabile operator in linear transformation. Operator OWA is defined as function f : $[0,1]^n$ [0,1] that related to weighted vector. This method uses $\{p_1, \ldots, p_m\}$, has function to aggregate the value that have been made before. Operator OWA is defined as:

$$Pc = fw(p_1, \ldots, p_n) = W.PT = \sum_{i=1}^{n} w_i \cdot p_{\sigma i} \quad (10)$$

Where, $\underset{W}{\rightarrow} = (w_1, .., w_n)^T$ is weighted vector with $w_i \in [0,1]$ and $\sum^n_{i=1} w_i = 1$. PT is value vector. Every element $p_{\sigma i} \in$ PT is sequence of the biggest value i of sequence value that group is made $\{p_1, \ldots, p_m\}$. If it is given n criteria as fuzzy subset of alternative X set, operator OWA is used to implement fuzzy majority method with fuzzy linguistic quantifier. If fuzzy quantifier f is used to count weight on OWA, then operator f is notated by f_w. There are three categories in fuzzy quantifier on operator OWA that can be used: "at least half", "as many as possible", and "most".

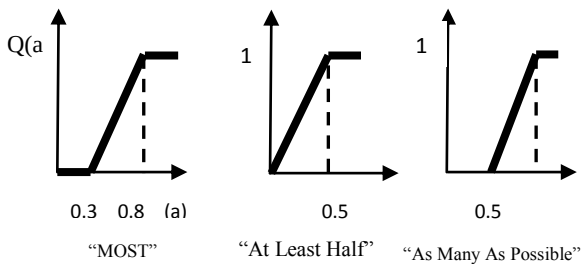

Figure 2. Proportional Fuzzy Quantifier

Q is the regular quantifier in proportional fuzzy quantifier. Based on fuzzy quantifier above, Q(a) can be given as:

Table 3. Limitation Q(a) in Fuzzy Quantifier

No.	Fuzzy Quantifier	Definition
1.	MOST	$Q(a)=\begin{cases}0 & \text{if } a<0.3\\ \frac{a-0.3}{0.8-0.3} & \text{if } 0.3\le a\le 0.8\\ 1 & \text{if } a>0.8\end{cases}$
2.	At Least Half	$Q(a)=\begin{cases}0 & \text{if } a<0\\ \frac{a-0}{0.5-0} & \text{if } 0\le a\le 0.5\\ 1 & \text{if } a>0.5\end{cases}$
3.	As Many As Possible	$Q(a)=\begin{cases}0 & \text{if } a<0.5\\ \frac{a-0.5}{1-0.5} & \text{if } 0.5\le a\le 1\\ 1 & \text{if } a>1\end{cases}$

The weighted vector of Q can be defined as:

$$w_i = Q\left(\frac{i}{n}\right) - Q\left(\frac{i-1}{n}\right) \quad (11)$$

Where, n is total of alternatives and i is the sequence of alternative levels of w_i.

2.4 QGDD

The two fuzzy majorities guided choice degrees that defined as multiplicative preference relations are Quantifier Guided Dominance Degree and Quantifier Guided Non-Dominance Degree. QGDD quantifies dominance choice of one criterion toward other criteria on fuzzy majority in:

$$QGDD = F_q\left(P_{ij}^c, j = 1, \ldots, n,\ j \neq 1\right) \quad (12)$$

Meanwhile, QGNDD quantifies comparison between criteria that is non-dominance on fuzzy majority in:

$$QGNDD = F_q\left(1 - P_{ji}^{integration}, j = 1, \ldots, n,\ j \neq 1\right) \quad (13)$$

Where: $P_{ij}^c = max\left\{P_{ij}^c - P_{ij}^c, 0\right\}$

2.5 Balanced Scorecard

The Balanced Scorecard method is a management framework that evaluates corporate performance from four different perspectives: the financial, the internal business process, the customer, and the learning and growth (Kaplan and Norton, 1992). This scorecard has been modified and applied by hundreds of organizations. Actually, the balanced scorecard has obtained evolution through three generation. At the first developed, the scorecard was positioned as performance-measurement framework, which providing management with useful information related to financial performance, internal processes, customer perceptions and internal learning and

growth. Then, the second generation, the scorecard allows individuals and teams to define what they must do in order to achieve the goal. They can combine Total Quality Management (TQM) and determining Key Performance Indicators (KPIs) in order to generate the measurement of supplier performance. In third generation scorecard, the causality concept has been introduced into the framework. There is identification of causality in action and resultant impact between and within scorecard perspectives in order to provide strategic framework. It is marked as a significant development in scorecard understanding and application.

3. EVALUATION MODEL AND SUPPLIER PERFORMANCE SCORECARD FRAMEWORK

3.1 Evaluation Model Framework

The evaluation model framework will be design based on table below.

Table 4. Evaluation Model Analysis

No.	Method	Data	Result
1	Analytical Hierarchy Process (AHP)	Questionnaire Result	The weight of alternatives and criteria
2	Technique for Order Preference by Similarity to an Ideal Solution (TOPSIS)	AHP Result	Relative Closeness Matrix
3	Ordered Weighted Averaging (OWA)	TOPSIS Result	Ranking of Alternatives by using Quantifier Guided Dominance Degree (QGDD)

Step 1: AHP Analysis

The first step is developing pairwise comparison matrices of alternative and criteria. Based on questionnaire result, the importance or priority level of each comparison result will be inputted to pairwise comparison matrices. *The second step* is normalizing the pairwise comparison matrices for alternatives and criteria. By dividing each value in pairwise comparison matrices with the total value of each column, the normalized matrices of alternatives and criteria can be conducted. The next action is averaging each row in normalized matrices. This average value is called eigen vector. Eigen vector is used as the weighted vector for alternatives and criteria by using AHP approach (Refer to Table 6.). *The third step* is examining inconsistency test. The purpose of this test is finding Consistency Ratio (CR) for alternative and criteria data. By determining the maximum eigen (λ max), Consistency Index (CI), and Random Index (RI), inconsistency test can be conducted (Refer to Table 7).

Step 2: TOPSIS Analysis

The first step is developing normalized decision matrix by multiplying the weighted vector between alternative and criteria based on AHP result (Refer to Table 8.). *The second step* is determining the positive and negative ideal solution from normalized decision matrix. The positive ideal solution is the maximum value of a set of alternative based on each criterion. Otherwise, the negative ideal solution is the minimum value of a set of alternative based on each criterion (Refer to Table 9.). *The third step* is determining relative closeness to the ideal solution by calculating the separation measures first. The separation measures consist of separation from the positive ideal solution and separation from the negative ideal solution (Refer to Table 10.).

Step 3: OWA Analysis

The first step is designing fuzzy preference relation matrix based on TOPSIS result. The relative closeness for each alternative is used to determine the matrix (Refer to Table 11.). *The second step* is aggregating fuzzy preference relation matrix by using OWA operator. This aggregation phase utilizes fuzzy majority concept by using fuzzy proportional quantifier "MOST". Fuzzy quantifier "MOST" is chosen because the interval decision is between 0.3 – 0.5. It means quantifier will select the dominance alternative. Then, the weighted vector will be obtained by integrating OWA operator and fuzzy quantifier "MOST" (Refer to Table 12.). *The third step* is selecting the best supplier based on ranking of alternative. The choice concept used is Quantifier Guided Dominance Degree (QGDD) because it will quantify the dominance of alternative in fuzzy relation set in order to select the best one (Refer to Table 13.).

3.2 Supplier Performance Scorecard Template using Balanced Scorecard Approach

The first step is determining the strategic focus areas as performance perspectives and the associated Key Performance Indicators (KPIs) of company. The performance perspectives area is defined as criteria required in company. *The second step* is suggesting weighting scheme in order to find perspective score. The assessment of this scorecard will implement maximum total score of 100 points. The weight for each perspective is obtained by AHP result for criteria weighted score. In order to obtain 100 points as maximum score, the criteria weighted score will be multiplied by 100 points. Thus, the total score for each perspective can be determined. *The third step* is determining the weight for each KPI on each perspective. According to 5-points Likert Scale concept, there is rating of 1-5 points to assess supplier performance. The maximum score of Likert Scale is 5 points. Thus, each focus perspective score must be divided by 5 points to obtain perspective weight. The total KPIs for each perspective is 3 indicators. Therefore, the KPIs weight can be measured by dividing perspective weight with 3 as the total indicator. *The fourth step* is designing the template and procedure of supplier performance scorecard. The procedure of scorecard fulfillment is given as:

1. Assessing supplier performance by giving ratings of 1-5 based on Likert Ratings scale (1= Unacceptable, 2= Needs Improvement, 3= Average, 4= Above Average, and 5= Excellent) toward each KPIs within perspective.
2. Multiplying the given Ratings with the KPIs Weight in order to determine the Score.
3. Calculating the Subtotal of each focus perspective area.
4. Calculating the Total Score for whole focus perspectives.
5. Determining the Overall Rating of the supplier performance based on Total Score obtained.
6. Decision maker might provide additional information about their assessment in “COMMENTS” column.

4. CASE STUDY AND ANALYSIS

In this section, evaluation model and supplier performance scorecard are implemented to a case study in PT. ABCD, an automotive industry. Supplier selection or sourcing process here provides SDS (Sourcing Decision Sheet) as sourcing process result. Buyer as a decision maker who is responsible on creating SDS, must evaluate each supplier quotation in order to determine the selected supplier. SDS can be issued if CIT (Cost Index Target) is less than 1. CIT is a comparison index between supplier part cost and target cost. SDS is done if it is approved and signed by all decision makers. The focus problem on conducting this research is Cover Room Partition case in Resin and Rubber Parts Section. Cover Room Partition is one of parts which has CIT <1. It means SDS for this part can be processed. Three suppliers have been chosen as candidate for this part. They are *AO, TS, and ST.* The criteria required in order to determine the best supplier are *Supplier Experience (SE), Supplier Capability (SC), Product Performance (PP), Cost (CS), and Delivery and Service (DS).* There are three decision makers *(BY1, BY2, and SH)* who are involved as assessor of this supplier selection. Based on Saaty’scale, each decision maker is asked to assess the priority level of alternative and criteria by fulfilling questionnaire.

4.1 Evaluation Model Result

Step1: AHP Analysis

Table 5. Questionnaire Result

No.	Criteria		Result	Point
	I	II		
1	SE	SC	SE	6
2	SE	PP	SE	5
3	SE	CS	CS	7
4	SE	DS	DS	3
5	SC	PP	SC	4
6	SC	CS	CS	5
7	SC	DS	SC	2
8	PP	CS	CS	4
9	PP	DS	PP	3
10	CS	DS	CS	5

No.	Criteria	Alternative		Result	Point
		I	II		
1	Supplier Experience	AO	TS	AO	3
		AO	ST	AO	3
		ST	TS	TS	2
2	Supplier Capability	AO	TS	TS	5
		AO	ST	AO	2
		ST	TS	TS	5
3	Product Performance	AO	TS	TS	3
		AO	ST	ST	3
		ST	TS	TS	2
4	Cost	AO	TS	AO	5
		AO	ST	AO	6
		ST	TS	TS	2
5	Delivery and Service	AO	TS	TS	4
		AO	ST	ST	3
		ST	TS	ST	2

Table 6. The Relative Weight of Alternative and Criteria

Alternative	Weighted Vector				
	SE	SC	PP	CS	DS
AO	0,589	0,182	0,142	0,723	0,142
TS	0,252	0,703	0,525	0,174	0,334
ST	0,159	0,115	0,334	0,103	0,525

Criteria	Weighted Vector
SE	0,203
SC	0,132
PP	0,102
CS	0,457
DS	0,105

Table 7. Inconsistency Test

Inconsistency Test	ALTERNATIVE					CRITERIA
	SE	SC	PP	CS	DS	
λ max	3,07	3,088	3,065	3,099	3,065	5,161
CI	0,035	0,044	0,033	0,05	0,033	0,04
RI	0,58	0,58	0,58	0,58	0,58	1,12
CR	0,061	0,076	0,056	0,086	0,056	0,036

Step 2: TOPSIS Analysis

Table 8. Normalized Matrix

Alternative	Criteria				
	SE	SC	PP	CS	DS
AO	0,12	0,024	0,014	0,33	0,015
TS	0,051	0,093	0,054	0,08	0,035
ST	0,032	0,015	0,034	0,047	0,055

Table 9. Positive and Negative Ideal Solution

	SE	SC	PP	CS	DS
C^+	0,12	0,093	0,054	0,33	0,055

	SE	SC	PP	CS	DS
C^-	0,032	0,015	0,014	0,047	0,015

Table 10. Relative Closeness to Ideal Solution

Alternative	d^+	d^-	Relative Closeness (C_i)
AO	0,089	0,296	0,769
TS	0,261	0,097	0,271
ST	0,307	0,045	0,128

Step 3: OWA Analysis

Table 11. Fuzzy Preference Relation Matrix

	AO	TS	ST
AO	-	0,89	0,973
TS	0,11	-	0,818
ST	0,027	0,182	-

Table 12. Fuzzy Quantifier "MOST"

Alternative Supplier(i)	Q(i/n)	Q((i-1)/n)	Weighted Vector(i)
1	0,067	0	0,067
2	0,733	0,067	0,667
3	1	0,733	0,267
		Total	1

Table 13. The Ranking of Suppliers by using QGDD

Alternative	Sequence of FPRM			QGDD	Rank
AO	0,973	0,89	-	0,658	1
TS	0,818	0,11	-	0,128	2
ST	0,027	0,182	-	0,123	3

4.2 Supplier Performance Scorecard Result

Table 14. AO Performance Scorecard

No.	Perspective Area	KPIs Area	Rating	Weight	Score
1	SE	Reputation for integrity	4	1,33	5,32
		Supplier competence	3	1,33	3,99
		Ease of doing business	3	1,33	3,99
2	SC	Plant area facility	3	0,87	2,61
		Production facility	4	0,87	3,48
		Supplier Infrastructure	3	0,87	2,61
3	PP	Quality acceptance	3	0,67	2,01
		Responsiveness to impro	4	0,67	2,68
		Product defect and custo	3	0,67	2,01
4	CS	Competitive part cost	3	3,07	9,21
		Competitive tooling cost	2	3,07	6,14
		Net profit	3	3,07	9,21
5	DS	On-time arrival delivery	3	3,67	11,01
		Lead time	3	3,67	11,01
		Warranty and claim	3	3,67	11,01
			Total Points		86
			Overall Rating		4

Table 15. TS Performance Scorecard

No.	Perspective Area	KPIs Area	Rating	Weight	Score
1	SE	Reputation for integrity	3	1,33	3,99
		Supplier competence	3	1,33	3,99
		Ease of doing business	2	1,33	2,66
2	SC	Plant area facility	4	0,87	3,48
		Production facility	3	0,87	2,61
		Supplier Infrastructure	3	0,87	2,61
3	PP	Quality acceptance	4	0,67	2,68
		Responsiveness to impro	3	0,67	2,01
		Product defect and custo	3	0,67	2,01
4	CS	Competitive part cost	3	3,07	9,21
		Competitive tooling cost	2	3,07	6,14
		Net profit	3	3,07	9,21
5	DS	On-time arrival delivery	3	3,67	11,01
		Lead time	2	3,67	7,34
		Warranty and claim	3	3,67	11,01
			Total Points		80
			Overall Rating		4

Table 16. ST Performance Scorecard

No.	Perspective Area	KPIs Area	Rating	Weight	Score
1	SE	Reputation for integrity	4	1,33	5,32
		Supplier competence	3	1,33	3,99
		Ease of doing business	3	1,33	3,99
2	SC	Plant area facility	3	0,87	2,61
		Production facility	3	0,87	2,61
		Supplier Infrastructure	3	0,87	2,61
3	PP	Quality acceptance	4	0,67	2,68
		Responsiveness to impro	3	0,67	2,01
		Product defect and custo	3	0,67	2,01
4	CS	Competitive part cost	2	3,07	6,14
		Competitive tooling cost	2	3,07	6,14
		Net profit	3	3,07	9,21
5	DS	On-time arrival delivery	3	3,67	11,01
		Lead time	3	3,67	11,01
		Warranty and claim	3	3,67	11,01
			Total Points		82
			Overall Rating		4

4.3 Supplier Selection Result

In order to consider multi criteria that company required, evaluation model is designed to select the best supplier. Decision maker as assessor must determine priority level of each alternative based on criteria required. This data will be processed by AHP method. The eigen vector as a weight of alternative and criteria is generated. In criteria, the priority of SE is 20.3%, SC is 13.2%, PP is 10.2%, CS is 45.7%, and DS is 10.5 %. It means that the highest importance level is gained by CS. Otherwise, the smallest priority is DS.

Then, AHP result will be processed by TOPSIS approach in order to find out the distance of negative and positive ideal solution. In this phase, AO is obtained 0,089 points as the farthest distance from negative ideal solution and 0.296 points as the closest distance from positive ideal solution. Hence, the relative closeness of AO is 0.769, TS is 0.271, and ST is 0.128.

TOPSIS result will be processed by OWA. By utilizing fuzzy quantifier “MOST” as OWA operator, the weighted vector of alternative is obtained. The sequence of weighted vector is 0.067, 0.667, and 0.267. This weighted vector will be used for QGDD as a choice method to rank the alternatives. Finally, the QGDD result is AO as the first

ranks with 0.658, TS as the second ranks with 0.128, and ST as the third ranks with 0.123. Therefore, by implementing this model in supplier selection, AO is selected as the best supplier.

Evaluation model above is designed by utilizing decision makers' preference on assessing each supplier toward each criterion. Supplier selection is always influenced by subjective decision and objective decision. Subjective decision is gathered from decision makers' preference. Meanwhile objective decision is collected based on actual data recorded. Supplier performance scorecard is designed in order to measure supplier performance during their collaboration with company. By using Balanced Scorecard approach, the focus perspectives and KPIs is determined. Criteria and sub- criteria required are represented as the focus perspective and KPIs of company. Weighting process for each perspective and KPIs is developed based on criteria weight of AHP result. By implementing Likert ratings scale, scorecard template is designed. According to cover room partition case, this scorecard is implemented to AO, ST, and TS. Based on actual data recorded, the scorecard result is AO obtains ratings of 4 with 86 points, TS reaches ratings of 4 with 80 points, and ST achieves ratings of 4 with 82 points. Thus, the highest point is pointed to AO, the second place is ST, and TS is the third place. Through this scorecard, performance measurement of supplier can be shown and represented. As objective decision, this scorecard can be information needed by decision maker in order to select the best supplier. Thus, the supplier performance scorecard can support and complement evaluation model in supplier selection.

5. CONCLUSION

Based on evaluation model and supplier scorecard result, AO is chosen as the best supplier for cover room partition case in PT. ABCD. Hence, AO is considered as an integration result that combines two factors in supplier selection which are subjective decision and objective decision. The subjective decision called intangible element because the information of supplier assessment is gathered from each decision makers' preference. Each decision maker has their own opinion toward alternative. Meanwhile, the objective decision is represented by company data which consists of supplier performance measurement. The data is fixed and actual. Therefore, evaluation model and supplier performance scorecard can be utilized to select the best supplier in sourcing process.

Future research can be extended by considering the weight of each decision maker in assessing supplier candidate. They have their own background, skills, knowledge, abilities, culture and also different preference on assessing each supplier. Besides it, determining the strategic perspective and KPIs in order to improve supplier performance is recommended on developing a new supplier scorecard for future research.

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7. APPENDICES

Appendix 1. Supplier Performance Scorecard Template

SUPPLIER PERFORMANCE SCORECARD

SUPPLIER NAME : _____

	PERSPECTIVE AREA	RATING	WEIGHT	SCORE	COMMENTS
	SUPPLIER EXPERIENCE PERSPECTIVE				
1	*REPUTATION FOR INTEGRITY* (Building good cooperation in order to integrating company-supplier relation in future project)		*1,33*		
2	*SUPPLIER COMPETENCE* (Supplier performance in handling and conducting production during company's project)		*1,33*		
3	*EASE OF DOING BUSINESS* (Figuring out profesional business of supplier (i.e: requesting quotation,response to change, or supplier attitude))		*1,33*		
	SUBTOTAL (20 POINTS)				
	SUPPLIER CAPABILITY PERSPECTIVE				
1	*PLANT AREA FACILITY* (Supplier evaluation based on plant area facility especially in safety commitment (uniform, safety shoes, operation line mark, etc)		*0,87*		
2	*PRODUCTION FACILITY* (Supplier ability based on production facility such as ability in machine or tooling operation and sufficient operator)		*0,87*		
3	*SUPPLIER INFRASTRUCTURE* (Supplier assessment based on infrastructure area (i.e: manufacturing, administration, systems))		*0,87*		
	SUBTOTAL (13 POINTS)				
	PRODUCT PERFORMANCE PERSPECTIVE				
1	*QUALITY ACCEPTANCE* (Confirmation to company requirements specified on Quotation, Drawing, and associated Standards or Specifications)		*0,67*		
2	*RESPONSIVENESS TO IMPROVEMENT* (Expectation in order to produce better performance in product quality and variance for		*0,67*		
3	*PRODUCT DEFECT AND CUSTOMER* (Responces about decreasing product defect and reducing customer complaint)		*0,67*		
	SUBTOTAL (10 POINTS)				
	COST PERSPECTIVE				
1	*COMPETITIVE PART COST* (Providing competitive part cost for material and process cost in order to obtain company target achievement)		*3,07*		
2	*COMPETITIVE TOOLING COST* (Reducing cost by reassessing tooling cost based on molding price and depreciation cost)		*3,07*		
3	*NET PROFIT* (Agreement of net profit (overhead cost) that supplier achives based on company's condition)		*3,07*		
	SUBTOTAL (46 POINTS)				
	DELIVERY AND SERVICE PERSPECTIVE				
1	*ON-TIME ARRIVAL DELIVERY* (Confirmation to on-time arrival delivery based on lead time on production planning plan)		*3,67*		
2	*LEAD TIME* (Implementing production according to lead time on company agreement)		*3,67*		
3	*WARANTY AND CLAIM* (Ease of proposing waranty and claim of product as one of after sales support to company)		*3,67*		
	SUBTOTAL (11 POINTS)				
	TOTAL POINT (MAX. 100 POINTS)				
	OVERALL RATING				

Note:

RATINGS (points)	***1= Unacceptable***	***2= Need Improvement***	***3= Average***	***4= Above Average***	***5= Excellent***
	0 - 39	***40 - 59***	***60 -79***	***80 - 89***	***90 - 100***

Appendix 2. Control Board

CONTROL BOARD

Section: Resin and Rubber Parts
Total Parts: 406 parts
Batch: 5
Period: Mei 25 - June 29 '2012
Subtotal: 53 parts

No.	CANDIDATE	PROPOSED SUPPLIER	P/N	SDS STATUS
1	AO,TS,IC	TS	50912-809AL/M/N-2	SDS APPROVED
2	AO,IR,TB	IR	51243-809AL/M/N-1	IN PROCESS
3	AO,IR,TB	IR	51243-810AL/M-1	IN PROCESS
4	AO,TS,ST	AO	51634-809AL/M-1	SDS APPROVED
5	AO,TS,ST	AO	51634-810AL/M-2	SDS APPROVED
6	AO,IC,TB	TB	51783-810AL/M-2	SDS APPROVED
7	SG,TB,IR	IR	52180-809AL-1	IN PROCESS
8	SG,TB,IR	IR	52180-810AL-1	IN PROCESS
9	TB,SG,IC	TB	54561-809AL/M-1	PENDING
10	ST,IC,TB	ST	54562-809AL/M-1	SDS APPROVED
11	TB,SG,IC	IC	54561-810AL/M-1	PENDING
12	ST,IC,TB	ST	54562-810AL/M-1	SDS APPROVED
13	AO,TS,ST	AO	55120-810AL-1	IN PROCESS
14	IC,TB,SG	TB	56320-809AL-2	PENDING
15	TS,IR,IC	TS	58724-809AL/M-1	PENDING
16	TS,IR,IC	TS	58724-810AL/M-1	PENDING
17	AO,ST,SG	ST	61024-809AL/M-1	PENDING
18	AO,ST,SG	ST	61024-810AL/M-1	PENDING
19	TB,TS,SG	TS	61209-809AL/AM-1	PENDING
20	AO,TS,IR	AO	63450-809AL/M/N-1	SDS APPROVED
21	AO,TS,IR	AO	63450-810AL/M-1	SDS APPROVED
22	AO,TS,IC	IC	64230-809AL/M-1	SDS APPROVED
23	AO,TS,IC	IC	64230-810AL/M-1	SDS APPROVED
24	AO,TS,ST	AO	64275-809AL/M-1	SDS APPROVED
25	AO,TS,ST	AO	64275-810AL/M-1	SDS APPROVED
26	TS,ST,IR	TS	65086-809AL/M-1	IN PROCESS
27	TS,ST,IR	TS	65086-810AL/M-1	IN PROCESS

SUMMARY:

SDS STATUS		
APPROVED	26	PARTS
IN PROCESS	12	PARTS
PENDING	15	PARTS

Appendix 3. Auditing Results

COMPLETELY CHECK COMPLETELY FIND OUT

PERIOD: JUN 2011- JAN 2012

NO.	SUPPLIER NAME	PRODUCT	AREA	CATEGORIES	RESULT OF VISIT			
					SAFETY GEMBA CHECK	PRODUCTION CHECK		
						EFC-B	640A	800A
1	AO	Resin and Rubber Parts	Bogor	Resin	Good	Excellent	Excellent	Good
2	TS	Resin and Rubber Parts	Tanggerang	Resin	Excellent	Excellent	Excellent	Good
3	ST	Resin and Rubber Parts	Cikarang	Resin	Good	Excellent	Good	Excellent

INDICATOR

Level	Description
90-100	Excellent
75-89	Good
50-74	Fair
0-49	Poor

PHYSICAL CHECK ASSET

PERIOD: FEB 2012

NO.	SUPPLIER NAME	AREA	TOTAL ASSET	RESULT OF VISIT			REMARKS
				ASSET EXISTANCE	MISSING PLATE LABEL	ASSET MAP	
1	AO	Bogor	27 units	27	3	24	3 units without plate label and asset map
2	TS	Tanggerang	8 units	8	-	8	2 pieces sticker label is needed for small tooling
3	ST	Cikarang	13 units	13	-	13	7 units located in supplier 2nd-tier plant at PT. SK

Appendix 4. Supplier Cost Breakdown

AO

Material

Type: PP AZ 564 G COMP	Gross Usage (kg)	Rate (USD/kg)	Rate (Rp/kg)
	0,422	2,020	17.645
Resin Material Cost (Rp)			7.446
Material Cost (Rp)			**7.446**

Process

Type: 850 T	Cavity	C/T (sec.)	Rate (Rp/sec.)
	1	90	47.00
Resin Process Cost (Rp)			4.230
Process Cost (Rp)			**4.230**
Manufacturing Cost (Rp)			**11.676**

FOH

Overhead	15%	1.751
Part Cost (w/o tooling) (Rp)	CIT:	**13.430** 0,59

Tooling Amount	Rp	804.000.000
Tooling Depre (6 years)		2.060,00
Part Cost (w/ tooling)	**Rp**	**15.490**

ST

Material

Type: TSM5514G-2L	Gross Usage (kg)	Rate (USD/kg)	Rate (Rp/kg)
	0,422	2,060	17.994
Resin Material Cost (Rp)			7.595
Material Cost (Rp)			**7.595**

Process

Type: 850 T	Cavity	C/T (sec.)	Rate (Rp/sec.)
	1	55	105,00
Resin Process Cost (Rp)			5.775
Process Cost (Rp)			**5.775**
Manufacturing Cost (Rp)			**13.370**

FOH

Overhead	15%	2.006
Part Cost (w/o tooling) (Rp)	CIT:	**15.380** 0,67

Tooling Amount	Rp	1.600.500.000
Tooling Depre (6 years)	Rp	4.109
Part Cost (w/ tooling)	**Rp**	**19.490**

TS

Material

Type: TSM5514G-2	Gross Usage (kg)	Rate (USD/kg)	Rate (Rp/kg)
	0,438	2,210	19.304
Resin Material Cost (Rp)			8.455
Material Cost (Rp)			**8.455**

Process

Type: 650 T	Cavity	C/T (sec.)	Rate (Rp/sec.)
	1	60	68,34
Resin Process Cost (Rp)			4.100
Process Cost (Rp)			**4.100**
Manufacturing Cost (Rp)			**12.556**

FOH

Overhead	15%	1.883
Part Cost (w/o tooling) (Rp)	CIT:	**14.440** 0,63

Tooling Amount	Rp	935.500.000
Tooling Depre (6 years)	Rp	2.402
Part Cost (w/ tooling)	**Rp**	**16.840**