Categorization of Indicators for Performance of Small and Medium Enterprises

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Abstract

Better understanding of the factor that influences performance at business process level is the requirement for an effective performance measurement system (PMS). Many countries develop a local PMS based on the characteristics of their Small and Medium Enterprises (SMEs). It becomes important tool to measure SMEs performance, so the business maintains in a good track. Therefore, this study aims the development of performance indicator for Malaysian SMEs. This research applied DEMATEL technique to confirm the relationship among the performance indicators besides identifying and categorize the key indicators. The result is beneficial for SME managers and advisors.

Keywords
Performance Measurement System (PMS), Small and Medium Enterprises (SMEs), DEMATEL technique.

1. Introduction

Small and Medium Industries (SMEs) play an important role in world economic development. As confirmed by Veskaisri, Chan, and Pollard (2007), SMEs have contributed to the Gross Domestic Product (GDP) and create job opportunities for a large number of community members. The Statistics Department quoted that SMEs recorded a GDP growth of 5.2% compared with the national GDP of 4.2%, indicating SMEs' interest in the deterioration of the national economy growth (Department of Statistics Malaysia, 2013). SMEs are said to form the base of industrial structures as SMEs facilitate the process of industrialization in most countries regardless of the level of their development (Balasundaram, 2009) and it is critical to achieve economic and social growth especially in developing countries (Nkwe, 2012). SMEs contribute to the elimination of poverty, job creation, and create new generation of entrepreneurs. It also plays a major role as it is a major source of innovation, entrepreneur skills, and job employment opportunities (Ahmad & Muhammad Arif, 2015).

Globally, organizations evaluate the performance to identify how well a process activity achieves its purpose. A number of researches has been done on this issue (Sushil, 2010; Yadav, Sushil, & Sagar, 2015), and different authors

translate each word in their respective understandings. However, the meaning of performance measurement is still debatable. According to Neely (1998), performance measurement is a process where they quantifying efficiency and effectiveness of actions that have been taken in the past through acquisition, collation, sorting, analysis, interpretation, and also the dissemination of appropriate data. On the other hand, Amaratunga and Baldry (2002) has provided a more specific definition of performance measurement, which is the performance measurement is fundamental that organizations need to assess to see what extent the predetermined targets will be achieved, as well as identifying organizational advantages and limitation, as well as defining organizational activities in the future, with the main objective of bringing the organization move forward. However, Moullin (2003) argued that Neely (1998) gives the definition without giving a complete guidance to organizations about what it is significant all about. Moullin (2003) defines it as the process of identifying how well the organization has been managing, as well as the value that has been given to customers and stakeholders. Moullin (2003) defended that his definition clearly demonstrates the reasons of measuring the performance and highlights the values that organization delivers to its various stakeholders and the way the organization is overseen. This definition demonstrates the role and the procedure of performance measurement clearly from a very distinctive viewpoint.

In particular, performance measurement plays an influential role in identifying progress in relation to achieving the company's current objective (Jensen, 2017). According to Afshan and Motwani (2018), customer satisfaction is one of the important objectives of a business. Then, if the firm detects error during the process of achieving these objectives, the firm would be willing to do improvement to ensure customer satisfactions and their requirement is fulfilled. In addition, the firm can identify opportunities to increase productivity, for example, have employees who skilfully manage a situation can save the cost of using external employee's source. Through the measurement of performance, the firm has knowledge about differences between external and internal performance standards. More important is, pay attention on the weaknesses and strength in the company is a critical action to helps management to devise strategies in order to promote the company to efficiently utilize the available resources without creating additional unnecessary changes to the system. The management should emphasize the main challenges to be solved immediately to avoid any future losses.

2. Research Background

Achieving success and avoiding failure is a critical issue for all organizations to continue to survive today, as the economic crisis is increasingly challenging especially SMEs, as SMEs have become the largest contributor to the country's economy, as well as worldwide. However, evaluating performance in the SME industry is not as easy as it seems, as it is variable over the business background itself. It involves many parties in its value chain. Traditionally, the perception of the success performance of the company is merely financial. Because of this, many previous PMS are focus on financial factors only. However, the world has changed; many other subjective factors need to be studied, influencing the performance of an organization as a whole. Financial factors are temporary, while the success performance of an organization should be look at the future aspect as well. Thus, the dynamics performance factor contributes to SMEs performance success remain largely undisclosed. Given the body of evidence, this paper presents an effort to explore the critical performance indicators for SMEs by considering the gap in previous research. Logically, identifying these factors can help SMEs achieve their goals effectively. (Hofstrand, 2015) states that successful entrepreneurs must have complete knowledge about key success performance.

Theoretically, this paper focuses on the theoretical underpinning performance indicators from business process perspective for SMEs. As noted by many scholars, SMEs considered as an important in achieving economic and social development goals. Thus, the fundamental research question was formulated for the authors' current [PhD] study(Mustapha, 2019); What are the performance indicators for SMEs? Based on the identified of performance indicators from performance measurement systems, and an extensive literature review, a structured questionnaire was developed. The questionnaire was then piloted for readability, content, ease of answering and the rating scale used. The questionnaire was refined based on the suggestions and feedbacks received. The questionnaire which was confirmed then sent electronically via email two (2) rounds of the Delphi procedure to a panel of forty two (42) purposely selected SMEs experts together with the initial invitations. The initial invitations consisted of introductory questionnaires that provide the introduction to the study include an explanation of the theory underpinning the study. It also explained the responsibilities of the respondent in participating in the study. At the end of the introductory questionnaire, the 'Participation Consent Declaration' was also included in this questionnaire. Participants who return the questionnaires considered agreed to participate in study.

A recent study in 2019 [14] by the same research team as this study, a Delphi study used for offering participants three major perspectives of business process consisted of twenty-seven questions in the format of structured and open-

ended for feedback was applied. The Delphi process was in two rounds of the iteration process. The content in each section of questionnaires has been described in detail including brief description for each indicator. Every expert was instructed to rate the importance of the indicators affecting the performance of SMEs. The questionnaires use the importance scale based on the five point Likert-scale which, 0 means no judgment, 1 means very unimportant, 2 means unimportant, 3 means important and 4 means very important. Additionally, each participant is given the opportunity to list and describe other indicators that are not in the list that may be considered important and necessary in assessing SMEs performance in the provided column. After receiving subjects' responses, the data was analyzed in term of group mean and median. In the second round, every participating Delphi panelist received second questionnaires including the additional indicators suggested by participants in the first round. The results of the previous round in term of group mean and median of each factor were included in the questionnaire. Also, the individuals' response to the previous round was also included. In this round, panelists were asked to revise his/her judgments provided in the previous round. This second round gave Delphi panelists an opportunity to make further clarification about both information and their judgment against relative importance of the factors. After receiving subjects' responses, the data was analyzed to determine the consensus. The aim of the study [14] was to abstract a set of relevant performance indicators for SMEs in Malaysia by gathering the expert's opinions. Using the finding of the past study [14], in this study DEMATEL technique is used to achieve the defined objective of the current study.

The DEMATEL technique is applied to confirm quantitatively the interdependent relationships between the abstracted twenty-two indicators (as shown in Table 1), which had achieved consensus in the beginning stage. The questionnaire was designed based on direct influence of factors in column A on factors in column B. It included a pairwise scale. The scores of 0, 1, 2, and 3 represent no influence, weak direct influence, moderate direct influence, and strong direct influence.

Table 1: Performance Indicators (Mustapha, 2019)

Item	Perspectives/ Indicator
F1	Leadership Proficiency
F2	Strategy Formulation
F3	Vision Development
F4	Future Excellence
F5	Organizational structure
F6	Customer Orientation
F7	Mass production
F8	Strategic Partner Relationship
F9	Resources Utilization
F10	Process Oriented Structure
F11	Quality Assess
F12	Competitive Aggressiveness
F13	Delivery Assess
F14	Efficiency Level
F15	Sales and marketing orientation
F16	Financial Management
F17	Time Utilization
F18	Human Resource Competencies
F19	Educational and Training
F20	Significant Improvement
F21	Operation Excellence
F22	Government program support
*F for factor	

3. Research Method

DEMATEL has been used scientifically by many studies involving complex issues to enhance understanding of specific problems. DEMATEL is a tool to solve the problem involves an important decision in clarify the important feature of the problem and help make counter measures. (Tzeng, Chiang, & Li, 2007) and (C.-W. Li & Tzeng, 2009) have used this method to transform attributes of the application and evaluate it into non-independent multi-criteria evaluation problems. Then, DEMATEL validates reliance and the relationship that exists between each factor involved and the constraining in relation based on specific features of the subjects. Through this way, it reflects the important features and the evolving trend in the system. Next, the calculation steps of DEMATEL is discusses in details.

Step 1: In the first step of DEMATEL technique, a group of experts has been asked to state the level of value they believe a factor effects on other factors. In this study, the integer 0 means no influence, 1 means weak influence, 2 means moderate direct influence, 3 means strong direct influence, and 4 means very strong direct influence, has been used to evaluate the relationship between different factors. Assuming a group of total m experts and n factors, each expert is required to give a view of the degree of direct influence between two factors based on pairwise comparisons (Zahidy, Azizan, & Sorooshian, 2018). Pairwise comparison between the ith factor and the jth given by kth expert is indicated as x_{ij}^k, makes the n x n non-negative matrix is constructed as $X^k = [x_{ij}^k]_{nxn}$ where k is the number to which participant is in the evaluation process with $1 \leq k \leq m$. The mathematical formula is as follows;

$$X = \begin{bmatrix} 0 & x12 & \cdots & x1n \\ x21 & 0 & \cdots & x2n \\ \vdots & \vdots & \ddots & \vdots \\ xn1 & xn2 & \cdots & 0 \end{bmatrix}$$

Thus, we have X^1, X^2, X^3..., X^m matrices are from *m* experts, and each element of X^k is an integer that has been set in a range of influence scale, which indicates the degree of factor *i* influencing factor *j*, and denoted by X_{ij}. The key diagonal of the element is that each answer matrix X_{ij} will be set to zero because DEMATEL does not assess the self-influence of each factor.

To aggregate of all judgment that has been granted by m experts, then an average matrix $Z = [Z_{ij}]$ has been constructing by calculating the average influence quantification as shows at below:

$$z_{ij} = \frac{1}{m} \left(\sum_{i=1}^{m} x_{ij}^k \right)$$

The matrix Z also known as initial direct relation matrix. It shows the initial direct effects that factor exerts on and receives from other factors. Direct relation matrix can also be used for translating the output to influence map.

Step 2: The second step is to calculate the normalized direct relation matrix D from the average matrix Z. It can be calculated by dividing each element with the largest number of row or column of average matrix (Zahidy et al., 2018), as shown in the original DEMATEL technique. Some studies use this method were using the largest number of row or columns as standard for normalization.

Factor $\max_{1 \leq i \leq n} (\sum_{j=1}^{n} Zij)$ represent total direct influence on the scale of influence of the indicator with the most direct influence on other factors.

The steps for this normalization are made as a preparation for the next step in DEMATEL, where the indirect influences are calculated and provided the aligned scale for all the factors for these calculations. Normalized initial direct relation matrix D is equal to $[d_{ij}]$ where the value for each element in the matrix D is in the range between [0,1]. The calculation is shown below:

$$D = \frac{Z}{S}$$

Where, $$S = \max_{1 \leq i \leq n} \left(\sum_{j=1}^{n} Zij \right)$$

Step 3: In this step, direct relationships and indirect relationships are calculated, means total relationships matrix is calculated (Zahidy et al., 2018). However, in the research study, the experts give a rating only on effects. It shows that indirect effects on influencing factors (factor a influences factor b and factor b influences factor c, thus factor a also indirectly influences factor c) are lower than the direct effects. The increasing indirections the indirect influence matrix converges to the null matrix as shown below:

$$\lim_{k \to \infty} D^k = [0]_{nxn}$$

Where 0 is the null matrix, and with I is an n x n identity matrix, the following hold true;

$$\lim_{k \to \infty} (I + D + D^2 + \cdots + D^k) = (I - D)^{-1}$$

The total relation matrix T is, therefore, defined as:

$$T = D(I - D)^{-1}$$

Step 4: In the total-relation matrix T, the sum of rows and the sum of columns are represented by vector R and D, respectively (Hsu, Kuo, Chen, & Hu, 2013). Let R and D be n x 1 and 1 x n vectors representing the sum of rows and the sum of columns in the total-relation matrix T. Now, if D_i is the sum of the *i*th row of the matrix T, then:

$$(D_1 \ldots D_n) \ with \ D_j = \sum_{i=1}^{n} t_{ij}$$

Where, $(j = 1, 2, \ldots, n)$

It summarizes both the direct and indirect effects that factor i exerts on the other factors. Similarly, if R_j is the sum of the *j*th column in the matrix T, then;

$$\begin{bmatrix} D^1 \\ \vdots \\ D^n \end{bmatrix} \qquad D_i = \sum_{j=1}^{n} t_{ij}$$

Where, $(i = 1, 2 \ldots, n)$

It summarizes the direct and indirect effects that factor j receive from the other factors. When i = j, the sum ($D_i + R_i$) shows the total effects given and received by factor i, thus:

$$(D_i + R_i) = \sum_{j=1}^{n} t_{ij} + \sum_{k=1}^{n} t_{ik}$$

It represents the degree of importance of factor i in the entire system. The difference indicates the net effects that factor i contributes to the system and is shown below:

$$(D_i - R_i) = \sum_{j=1}^{n} t_{ij} - \sum_{k=1}^{n} t_{ik}$$

Specifically, if $(D_i - R_i)$ is positive, the influence factor i is a net cause, while if $(D_i - R_i)$ is negative, factor *i* is a net receiver.

Step 5: The threshold value, α was computed by the average of the elements in matrix T. (Y. Li & Mathiyazhagan, 2018). This calculation aimed to eliminate some minor effects elements in matrix T and is shown below:

$$\alpha = \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} [t_{ij}]}{N}$$

where N is the total number of elements in matrix T.

Step 6: The cause and effect diagram are constructed by mapping all coordinate sets of $(D_1 + R_1, D_1 - R_1)$ to visualize the complex interrelationship. It provides information to judge which the most important factors are and how influence affected factors (Tsai et al., 2015). The factors that t_{ij} is greater than α are selected and shown in cause and effect diagram (Chu & Choi, 2000). Based on the coordinate positions of $(D_k + R_k)$ and $(D_k - R_k)$, the factors can be divided into the following four types (Chu & Choi, 2000):

$(D_k - R_k)$ is positive and $(D_k + R_k)$ is large: This indicates that the factors are causes, which are also driving factors for solving problems.

$(D_k - R_k)$ is positive and $(D_k + R_k)$ is small: This indicates that the factors are independent and can only influence a few other factors.

$(D_k - R_k)$ is negative and $(D_k + R_k)$ is large: This indicates that the factors are the core problems that must be solve, however, these are effect-type attributes which cannot be directly improved.

$(D_k - R_k)$ is negative and $(D_k + R_k)$ is small: This indicates that the factors are independent and can be influenced by only a few other factors.

4. Results

The questionnaires were sent electronically to the thirty-four respondents who responded the Round 2 of the Delphi study. For the matrix calculation, the indicators were numbered accordingly, as shown in Table 1. Respondents were asked to indicate the level to which they believe that any of the indicators influence each other using the integer score 0 (no influence), 1 (weak direct influence), 2 (moderate direct influence), and 3 (strong direct influence). Based on the influence scale, a higher score represents stronger direct influence. They ranked them based on their experience and expertise that they hold with regard to the importance of indicators to the SMEs performance.

Of the thirty-four respondents, thirteen responded the questionnaires representing 38.24% response rate. One of the experts noted that the time restriction and the difficulty in developing the relationship of variables as the reasons for not participate in the DEMATEL round. While the other experts who did not respond provided no grounds for doing so. According to Nilashi et al. (2015), within 5 to 15 experts are sufficient for a group decision-making to be appropriate. In a DEMATEL study in China, Routroy and Sunil Kumar (2014) solicited data from fifteen respondents to analyze the impact factors of the project interface management. Meanwhile, Nasiripour, Bahadori, Tofighi, and Gohari (2010) engaged twelve Malaysian construction industries practitioners to identify the critical success factors of a project. Similar, in a recent DEMATEL study, Gharakhani (2012) also employed twelve experts to analyzed supplier development program enablers. Tsai et al. (2015) used ten experts to analyze the relationships between the determinants influential in performance of prehospital emergency system and in another study, Cooper and Schindler (2006) also used ten experts to evaluated the supplier selection criteria. Hence, the data generated from thirteen respondents for this DEMATEL round were considered of sound quality that would enable to draw a valid and generalized conclusion.

Thirteen sets of 22 x 22 non-negative matrices were obtained from the thirteen respondents. Microsoft Excel 2016 has been used to analyze data. All judgments of all experts were aggregated. After that, we construct an initial direct-relation matrix Z by calculating the same arithmetic mean of the accumulated matrices obtained from the panelist. The computation was performed according to the specific equation as described in section 3. In table 1, it demonstrated the initial direct effect that the factor affects other factors and receives effects from other factors. After that, normalized

initial direct-relation matrix X is created by normalized initial direct-relation matrix Z, which is calculated using equation 3.2, then used for computation according to equation 3.3. In this study, the largest number in a row or column is used as a normalization indicator as shown in table 1. The value is 55.846 (column 14, F14). The normalization process is made by dividing each element in matrix Z with 55.846. Table 2 shows the result matrix X.

   The next process is a total matrix T relation was constructed to calculate the direct and indirect effects of each indicator. The calculation used the formula 3.7, using the normalized initial direct relation matrix D. In the beginning, the matrix I must first be developed, where the essential diagonal element is equal to 1 and the rest element is equal to 0. After that, the (I – X) matrix was constructed by subtracting every element of the matrix X with the corresponding element of the matrix I before constructing the inverse matrix (I – X)-1. Further, the resulting matrix T was calculated by multiplying the normalized initial direct-relation matrix X with the inverse matrix (I – X)-1 as shown in Table 3. The sum of rows and the sum of columns in the total relation matrix T was calculated according to Equation (3.5) and Equation (3.6). In Table 4, the sum of rows and the sum of columns were presented by D and R, respectively.

Table 2: Initial Direct Relation

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16	F17	F18	F19	F20	F21	F22	∑Zj
F1	0.000	2.923	2.846	2.769	2.846	2.692	1.923	2.615	1.846	2.923	1.769	2.692	1.846	1.769	1.692	1.769	1.846	2.923	1.923	2.000	3.000	0.077	46.692
F2	2.692	0.000	2.923	2.846	0.846	0.923	1.923	0.923	0.154	2.000	1.923	2.923	0.846	2.923	2.846	3.000	2.923	1.692	1.000	2.923	2.923	0.000	41.154
F3	1.923	2.846	0.000	2.923	0.846	2.846	1.769	0.769	1.846	2.769	2.615	2.846	1.923	2.923	2.923	1.923	0.923	2.769	2.846	3.000	2.923	0.077	46.231
F4	2.000	2.077	2.923	0.000	0.846	2.846	2.769	2.000	1.000	2.923	2.692	2.769	1.692	2.769	2.846	3.000	2.000	1.923	2.692	2.923	3.000	0.000	47.692
F5	2.077	0.231	2.154	1.846	0.000	2.000	2.077	1.077	2.308	2.231	2.154	1.077	0.769	2.846	0.846	1.000	1.923	2.846	2.000	1.923	2.846	0.000	36.231
F6	1.154	1.923	2.923	2.692	1.231	0.000	2.846	2.923	2.615	2.692	2.692	2.769	3.000	2.769	2.692	2.923	2.923	1.154	2.846	2.538	2.692	0.154	50.154
F7	1.462	2.154	2.231	2.154	1.154	2.615	0.000	2.692	2.385	2.615	3.000	2.154	2.615	2.538	2.769	2.538	2.923	1.231	2.154	2.077	2.154	0.000	45.615
F8	1.154	1.000	1.000	2.000	0.000	3.000	3.000	0.000	3.000	2.769	2.000	2.923	2.615	2.692	2.000	2.000	2.000	1.000	0.000	2.000	3.000	0.000	39.154
F9	1.231	1.077	1.000	2.154	1.000	2.923	2.846	3.000	0.000	3.000	2.692	2.000	2.154	3.000	1.000	3.000	2.077	1.000	0.000	2.000	2.000	0.077	39.231
F10	1.308	2.077	2.000	3.000	2.000	2.846	2.923	2.000	2.000	0.000	3.000	2.000	2.000	2.923	1.000	2.154	2.000	1.000	2.000	2.000	3.000	0.000	43.231
F11	2.077	2.769	2.923	3.000	2.000	3.000	2.692	3.000	3.000	2.615	0.000	3.000	2.077	2.000	1.000	3.000	3.000	1.000	2.000	3.000	3.000	1.000	51.154
F12	2.923	2.923	3.000	2.923	2.077	2.692	2.769	2.077	2.923	2.615	2.769	0.000	1.923	2.923	2.846	2.923	2.846	3.000	2.000	3.000	3.000	0.077	54.231
F13	0.923	1.385	1.231	2.077	1.231	2.615	2.077	2.154	2.846	2.769	2.692	2.615	0.000	2.923	2.000	2.077	2.923	1.000	1.000	2.000	2.000	0.000	40.538
F14	2.846	3.000	2.923	2.846	3.000	2.692	2.615	2.000	2.692	2.462	2.846	2.923	2.692	0.000	2.000	2.923	2.615	1.923	2.000	2.923	2.923	0.077	52.923
F15	2.154	2.846	2.923	2.846	1.385	2.692	2.923	2.077	2.923	2.846	2.769	2.692	2.154	1.923	0.000	2.923	2.077	1.154	1.923	2.923	1.923	1.000	49.077
F16	1.077	2.846	3.000	3.000	1.000	3.000	2.000	3.000	3.000	1.000	3.000	3.000	2.000	2.000	3.000	0.000	2.000	3.000	3.000	3.000	2.000	2.000	50.923
F17	2.077	2.000	1.000	2.000	1.000	3.000	3.000	2.000	1.000	3.000	3.000	3.000	3.000	3.000	2.000	2.000	0.000	2.000	2.000	2.000	3.000	1.000	46.077
F18	2.923	1.154	2.000	3.000	3.000	3.000	1.000	1.000	1.000	2.000	2.000	2.000	1.000	3.000	1.000	3.000	2.000	0.000	2.000	3.000	3.000	0.077	42.154
F19	2.846	1.923	2.923	2.846	2.000	3.000	1.154	1.308	1.077	2.077	2.154	2.923	2.077	3.000	2.000	2.000	2.000	3.000	0.000	3.000	3.000	0.000	46.308
F20	2.923	2.846	3.000	3.000	2.000	3.000	2.000	1.000	2.000	3.000	3.000	3.000	2.000	2.923	2.846	2.615	2.154	1.000	3.000	0.000	2.000	2.000	51.308
F21	2.769	2.923	2.846	2.923	1.846	1.923	2.231	2.077	2.000	2.154	2.077	2.154	2.000	2.923	1.846	1.923	2.000	2.000	3.000	3.000	0.000	1.000	47.615
F22	0.154	1.154	3.000	2.923	1.000	1.154	0.000	0.000	0.077	0.000	1.000	2.154	0.231	2.077	2.077	1.923	0.154	0.000	3.000	2.000	2.000	0.000	26.077
∑Zj	40.692	44.077	50.769	55.769	32.308	54.462	46.538	39.692	41.692	50.462	51.846	53.615	40.615	55.846	43.231	50.615	45.308	36.615	42.385	53.231	55.385	8.615	0.000

Table 3: Normalized initial direct-relation

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16	F17	F18	F19	F20	F21	F22
F1	0.0000	0.0523	0.0510	0.0496	0.0510	0.0482	0.0344	0.0468	0.0331	0.0523	0.0317	0.0482	0.0331	0.0317	0.0303	0.0317	0.0331	0.0523	0.0344	0.0358	0.0537	0.0014
F2	0.0482	0.0000	0.0523	0.0510	0.0152	0.0165	0.0344	0.0165	0.0028	0.0358	0.0344	0.0523	0.0152	0.0523	0.0510	0.0537	0.0523	0.0303	0.0179	0.0523	0.0523	0.0000
F3	0.0344	0.0510	0.0000	0.0523	0.0152	0.0510	0.0317	0.0138	0.0331	0.0496	0.0468	0.0510	0.0344	0.0523	0.0523	0.0344	0.0165	0.0496	0.0510	0.0537	0.0523	0.0014
F4	0.0358	0.0372	0.0523	0.0000	0.0152	0.0510	0.0496	0.0358	0.0179	0.0523	0.0482	0.0496	0.0303	0.0496	0.0510	0.0537	0.0358	0.0344	0.0482	0.0523	0.0537	0.0000
F5	0.0372	0.0041	0.0386	0.0331	0.0000	0.0358	0.0372	0.0193	0.0413	0.0399	0.0386	0.0193	0.0138	0.0510	0.0152	0.0179	0.0344	0.0510	0.0358	0.0344	0.0510	0.0000
F6	0.0207	0.0344	0.0523	0.0482	0.0220	0.0000	0.0510	0.0523	0.0468	0.0482	0.0482	0.0496	0.0537	0.0496	0.0482	0.0523	0.0523	0.0207	0.0510	0.0455	0.0482	0.0028
F7	0.0262	0.0386	0.0399	0.0386	0.0207	0.0468	0.0000	0.0482	0.0427	0.0468	0.0537	0.0386	0.0468	0.0455	0.0496	0.0455	0.0523	0.0220	0.0386	0.0372	0.0386	0.0000
F8	0.0207	0.0179	0.0179	0.0358	0.0000	0.0537	0.0537	0.0000	0.0537	0.0496	0.0358	0.0523	0.0468	0.0482	0.0358	0.0358	0.0358	0.0179	0.0000	0.0358	0.0537	0.0000
F9	0.0220	0.0193	0.0179	0.0386	0.0179	0.0523	0.0510	0.0537	0.0000	0.0537	0.0482	0.0358	0.0386	0.0537	0.0179	0.0537	0.0372	0.0179	0.0000	0.0358	0.0358	0.0014
F10	0.0234	0.0372	0.0358	0.0537	0.0358	0.0510	0.0523	0.0358	0.0358	0.0000	0.0537	0.0358	0.0358	0.0523	0.0179	0.0386	0.0358	0.0179	0.0358	0.0358	0.0537	0.0000
F11	0.0372	0.0496	0.0523	0.0537	0.0358	0.0537	0.0482	0.0537	0.0537	0.0468	0.0000	0.0537	0.0372	0.0358	0.0179	0.0537	0.0537	0.0179	0.0358	0.0537	0.0537	0.0179
F12	0.0523	0.0523	0.0537	0.0523	0.0372	0.0482	0.0496	0.0372	0.0523	0.0468	0.0496	0.0000	0.0344	0.0523	0.0510	0.0523	0.0510	0.0537	0.0358	0.0537	0.0537	0.0014
F13	0.0165	0.0248	0.0220	0.0372	0.0220	0.0468	0.0372	0.0386	0.0510	0.0496	0.0482	0.0468	0.0000	0.0523	0.0358	0.0372	0.0523	0.0179	0.0179	0.0358	0.0358	0.0000
F14	0.0510	0.0537	0.0523	0.0510	0.0537	0.0482	0.0468	0.0358	0.0482	0.0441	0.0510	0.0523	0.0482	0.0000	0.0358	0.0523	0.0468	0.0344	0.0358	0.0523	0.0523	0.0014
F15	0.0386	0.0510	0.0523	0.0510	0.0248	0.0482	0.0523	0.0372	0.0523	0.0510	0.0496	0.0482	0.0386	0.0344	0.0000	0.0523	0.0372	0.0207	0.0344	0.0523	0.0344	0.0179
F16	0.0193	0.0510	0.0537	0.0537	0.0179	0.0537	0.0358	0.0537	0.0537	0.0179	0.0537	0.0537	0.0358	0.0358	0.0537	0.0000	0.0358	0.0537	0.0537	0.0537	0.0358	0.0358
F17	0.0372	0.0358	0.0179	0.0358	0.0179	0.0537	0.0537	0.0358	0.0179	0.0537	0.0537	0.0537	0.0537	0.0537	0.0358	0.0358	0.0000	0.0358	0.0358	0.0358	0.0537	0.0179
F18	0.0523	0.0207	0.0358	0.0537	0.0537	0.0537	0.0179	0.0179	0.0179	0.0358	0.0358	0.0358	0.0179	0.0537	0.0179	0.0537	0.0358	0.0000	0.0358	0.0537	0.0537	0.0014
F19	0.0510	0.0344	0.0523	0.0510	0.0358	0.0537	0.0207	0.0234	0.0193	0.0372	0.0386	0.0523	0.0372	0.0537	0.0358	0.0358	0.0358	0.0537	0.0000	0.0537	0.0537	0.0000
F20	0.0523	0.0510	0.0537	0.0537	0.0358	0.0537	0.0358	0.0179	0.0358	0.0537	0.0537	0.0537	0.0358	0.0523	0.0510	0.0468	0.0386	0.0179	0.0537	0.0000	0.0358	0.0358
F21	0.0496	0.0523	0.0510	0.0523	0.0331	0.0344	0.0399	0.0372	0.0358	0.0386	0.0372	0.0386	0.0358	0.0523	0.0331	0.0344	0.0358	0.0358	0.0537	0.0537	0.0000	0.0179
F22	0.0028	0.0207	0.0537	0.0523	0.0179	0.0207	0.0000	0.0000	0.0014	0.0000	0.0179	0.0386	0.0041	0.0372	0.0372	0.0344	0.0028	0.0000	0.0537	0.0358	0.0358	0.0000

Table 4: The total relation

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16	F17	F18	F19	F20	F21	F22	D
F1	0.171	**0.234**	**0.253**	**0.270**	0.182	**0.267**	**0.229**	0.212	0.206	**0.259**	**0.244**	**0.262**	0.203	**0.255**	0.206	**0.236**	**0.221**	0.203	0.205	**0.250**	**0.274**	0.038	4.880
F2	0.203	0.172	**0.238**	**0.253**	0.137	**0.219**	0.212	0.169	0.163	**0.226**	**0.228**	**0.249**	0.172	**0.253**	0.212	**0.239**	**0.222**	0.170	0.177	**0.248**	**0.253**	0.036	4.451
F3	0.207	**0.238**	0.208	**0.276**	0.151	**0.272**	**0.228**	0.183	0.208	**0.259**	**0.261**	**0.268**	0.206	**0.276**	0.229	**0.243**	0.208	0.202	**0.223**	**0.270**	**0.274**	0.040	4.931
F4	0.213	**0.231**	**0.264**	**0.233**	0.154	**0.280**	**0.251**	0.210	0.201	**0.268**	**0.269**	**0.274**	0.209	**0.280**	0.235	**0.266**	**0.232**	0.193	**0.227**	**0.276**	**0.283**	0.040	5.091
F5	0.171	0.151	0.198	0.208	0.107	0.210	0.190	0.152	0.178	0.204	0.206	0.190	0.150	**0.226**	0.154	0.180	0.182	0.170	0.171	0.204	**0.225**	0.030	3.855
F6	0.204	**0.235**	**0.270**	**0.287**	0.164	**0.241**	**0.261**	**0.233**	**0.235**	**0.273**	**0.278**	**0.283**	0.238	**0.290**	0.239	**0.273**	**0.255**	0.185	**0.234**	**0.277**	**0.286**	0.044	5.285
F7	0.193	**0.221**	**0.239**	**0.257**	0.151	**0.264**	0.195	0.213	0.215	**0.252**	**0.263**	**0.252**	0.216	**0.264**	0.223	**0.247**	**0.238**	0.171	0.206	**0.249**	**0.257**	0.038	4.824
F8	0.165	0.178	0.192	**0.226**	0.115	**0.242**	0.222	0.147	0.204	**0.228**	0.219	**0.236**	0.194	**0.238**	0.187	0.213	0.199	0.147	0.148	**0.219**	**0.241**	0.033	4.194
F9	0.166	0.178	0.192	**0.228**	0.131	**0.240**	0.218	0.198	0.152	**0.231**	**0.230**	0.221	0.186	**0.242**	0.170	**0.228**	0.199	0.147	0.148	**0.219**	0.225	0.034	4.181
F10	0.183	0.210	**0.227**	**0.260**	0.159	**0.257**	**0.235**	0.193	0.200	0.197	**0.252**	**0.239**	0.197	**0.260**	0.185	**0.231**	0.213	0.161	0.196	**0.237**	**0.260**	0.036	4.586
F11	**0.221**	**0.250**	**0.273**	**0.294**	0.178	**0.293**	**0.260**	0.235	0.242	**0.273**	0.233	**0.288**	0.224	**0.279**	0.213	**0.276**	0.258	0.184	**0.222**	**0.286**	**0.294**	0.059	5.336
F12	**0.249**	**0.266**	**0.289**	**0.310**	0.191	**0.304**	**0.275**	**0.232**	**0.253**	**0.289**	**0.296**	0.253	**0.233**	**0.310**	0.255	**0.290**	**0.269**	**0.229**	0.235	**0.303**	**0.310**	0.046	5.687
F13	0.166	0.189	0.201	**0.232**	0.139	**0.241**	0.211	0.188	0.205	**0.233**	**0.236**	**0.237**	0.153	**0.248**	0.191	**0.219**	**0.218**	0.151	0.169	**0.225**	**0.231**	0.034	4.318
F14	**0.242**	**0.262**	**0.281**	**0.301**	0.202	**0.297**	**0.267**	**0.225**	**0.245**	**0.280**	**0.291**	**0.296**	0.240	**0.254**	0.236	**0.283**	**0.260**	0.207	**0.229**	**0.294**	**0.302**	0.044	5.539
F15	0.215	**0.245**	**0.265**	**0.283**	0.163	**0.279**	**0.256**	0.213	**0.234**	**0.269**	**0.272**	**0.275**	0.218	**0.269**	0.188	**0.267**	**0.235**	0.180	0.214	**0.277**	**0.267**	0.057	5.143
F16	0.204	**0.250**	**0.273**	**0.293**	0.161	**0.291**	**0.246**	**0.232**	**0.240**	**0.244**	**0.282**	**0.287**	0.220	**0.277**	0.245	**0.225**	**0.239**	0.215	**0.237**	**0.286**	**0.275**	0.076	5.300
F17	0.205	**0.220**	**0.222**	**0.257**	0.151	**0.272**	**0.246**	0.203	0.193	**0.259**	**0.264**	**0.267**	0.223	**0.274**	0.211	**0.240**	0.189	0.185	0.206	**0.249**	**0.272**	0.055	4.864
F18	0.208	0.192	**0.224**	**0.257**	0.176	**0.256**	0.198	0.173	0.179	**0.227**	**0.231**	**0.234**	0.176	**0.257**	0.181	**0.240**	0.208	0.143	0.195	**0.250**	**0.257**	0.037	4.501
F19	**0.222**	**0.222**	**0.257**	**0.274**	0.170	**0.275**	**0.217**	0.192	0.196	**0.247**	**0.252**	**0.269**	0.209	**0.277**	0.214	**0.243**	**0.225**	0.207	0.175	**0.270**	**0.276**	0.038	4.927
F20	**0.236**	**0.253**	**0.277**	**0.297**	0.181	**0.294**	**0.249**	0.202	**0.226**	**0.280**	**0.285**	**0.290**	0.222	**0.295**	0.244	**0.271**	**0.244**	0.186	**0.241**	**0.237**	**0.279**	0.076	5.366
F21	**0.222**	**0.240**	**0.258**	**0.278**	0.168	**0.259**	**0.237**	0.206	0.212	**0.251**	**0.253**	**0.259**	0.209	**0.278**	0.213	**0.243**	**0.227**	0.191	**0.227**	**0.271**	**0.227**	0.056	4.984
F22	0.104	0.131	0.174	0.181	0.095	0.149	0.113	0.096	0.103	0.122	0.142	0.165	0.104	0.166	0.142	0.154	0.112	0.092	0.155	0.162	0.164	0.023	2.849
R	4.369	4.767	5.277	5.756	3.425	5.705	5.016	4.308	4.491	5.373	5.488	5.595	4.402	5.769	4.570	5.309	4.854	3.918	4.438	5.560	5.731	0.969	105.091

The total effects given and received by each indicator were also calculated according to Equation (3.7) and Equation (3.8). The determinants of the sum of the row (D) and the sum of column (R) were added together to obtain the centrality (D + R). The higher the centrality (D + R), the higher was the importance of the indicator. The determinants of the sum of the row were subtracted from the sum of column to obtain the degree of cause and effect (D – R). The higher the positive degree of cause and effect (D – R), the easier item directly influencing the other indicators, whereas the higher the negative degree of cause and effect, the easier was the indicator to be influenced by other indicators. Table 4 summarized the total effects given and received by each indicator.

The threshold value (α) was computed by the average of the elements in the total relation matrix T in order to eliminate some minor effects elements. It was calculated according to Equation (3.9) and revealed that the threshold value (α) was 0.217, i.e. 105.091 divided by 484. The boldfaced elements in the total relation matrix T, shown in Table 3, represent values greater than the threshold value (α).

Table 5:Total Effect of the Overall Influence

Performance Indicators	Rate of the effect on another indicator D	Rate of the effect from another indicator R	D+R	D-R
Leadership Proficiency	4.880	4.369	9.249	0.511
Strategy Formulation	4.451	4.767	9.218	-0.316
Vision Development	4.931	5.277	10.208	-0.346
Future Excellence	5.091	5.756	10.847	-0.664
Organizational Structure	3.855	3.425	7.280	0.430
Customer Orientation	5.285	5.705	10.990	-0.420
Mass Production	4.824	5.016	9.840	-0.192
Strategic Partner Relationship	4.194	4.308	8.502	-0.114
Resources Utilization	4.181	4.491	8.673	-0.310
Process Orientation	4.586	5.373	9.959	-0.787
Quality Assess	5.336	5.488	10.824	-0.153
Competitive Aggressiveness	5.687	5.595	11.281	0.092
Delivery Assess	4.318	4.402	8.719	-0.084
Efficiency Level	5.539	5.769	11.308	-0.230
Sales and Marketing Orientation	5.143	4.570	9.713	0.573
Financial Management	5.300	5.309	10.609	-0.010
Time Utilization	4.864	4.854	9.718	0.011
Human Resource Competencies	4.501	3.918	8.419	0.582
Educational and Training	4.927	4.438	9.365	0.489
Significant Improvement	5.366	5.560	10.926	-0.194
Operation Excellence	4.984	5.731	10.715	-0.747
Government Program Support	2.849	0.969	3.818	1.879

5. Discussion

The importance of the evaluation indicator was determined by (D + R) values. Greater centrality (D + R) value represents that the performance indicator is relatively important. Based on Table 4.15, it is obviously shown that ten indicators were above the average in overall centrality. In the descending order, the most important indicators were 'Efficiency Level', "Competitive Aggressiveness', 'Customer Orientation', 'Significant Improvement', 'Future Excellence', 'Quality Access', 'Operation Excellence', 'Financial Management', 'Vision Development', 'Process Orientation', and 'Mass Production' which representing the (D + R) values of 11.308, 11.282, 10.989, 10.926, 10.847, 10.824, 10.715, 10.609, 10.208, 9.959, respectively.

The symbol of causality value D - R represents whether the performance indicator affects or is affected by others. Based on values of D - R, the indicators have been classified in two groups namely the cause group and effect group. If the value of D - R was positive or net cause, the indicators involved were classified in the cause group, and directly to affect other indicators. In addition, the indicators which have the highest value of D - R had the greatest direct impact on the others. On the other hand, if the value of D - R was negative or net receive, the indicators involved were classified in the effect group, and largely influenced by the others.

From column (D – R) in Table 4, it was found that eight indicators, namely 'Leadership Proficiency', 'Organizational Structure', 'Competitive Aggressiveness', 'Marketing Competencies', 'Time Utilization', 'Human Resource Competencies', 'Educational and Training', and 'Government program support' which have positive (D – R) values of 0.511, 0.430, 0.092, 0.573, 0.011, 0.582, 0.489, and 1.879 respectively, were classified in the cause group. The other fourteen indicators, namely 'Strategy Formulation', 'Vision Development', 'Future Excellence', 'Customer Orientation', 'Mass Production', 'Strategic Partner Relationship', 'Resources Utilization', 'Process Orientation', 'Quality Assess', 'Delivery Assess', 'Efficiency Level', 'Financial Management', 'Significant Improvement', and 'Operation Excellence' which have negative (D – R) values of -0.316, -0.346, -0.664, -0.420, -0.192, -0.114, -0.310, -0.787, -0.153, -0.084, -0.230, -0.010, -0.194, -0.747 respectively, were classified in the effect group.

In summarizing the aforementioned analyses, the importance of the evaluation indicator was determined by (D + R) and (D – R) values. According to the prominence (D + R) and relation (D – R), the twenty-two indicators can be group under four categories to understand the degrees and directions of the interactive influence (Cooper & Schindler, 2006) as follows:

Indicators with high relation and high prominence representing by positive (D –R) value, and higher (D + R) value. This category comprised Leadership Proficiency, Marketing Competencies, Competitive Aggressiveness, Time Utilization, and Educational and Training.

Indicator with high relation and low prominence representing by negative (D –R) value, higher (D + R) value. This category consisted Efficiency Level, Customer Orientation, Significant Improvement, Future Excellent, Quality, Operation Excellence, Financial Management, Vision Development, Process Orientation, Mass Production, and Strategy Formulation.

Indicator with low relation and high prominence representing by positive (D –R) value, and lower (D + R) value. This category included Human Resource Competencies, Organizational structure, and Government program support.

Indicator with low relation and low prominence representing by negative (D –R) value, and lower (D + R) value. This category consisted Strategic Partner Relationship, Resources Utilization, and Delivery Assess.

To be clearer, based on the coordinate position of (D + R) and (D – R), the indicators can be divided into four quadrants as shown in the following Figure 1.
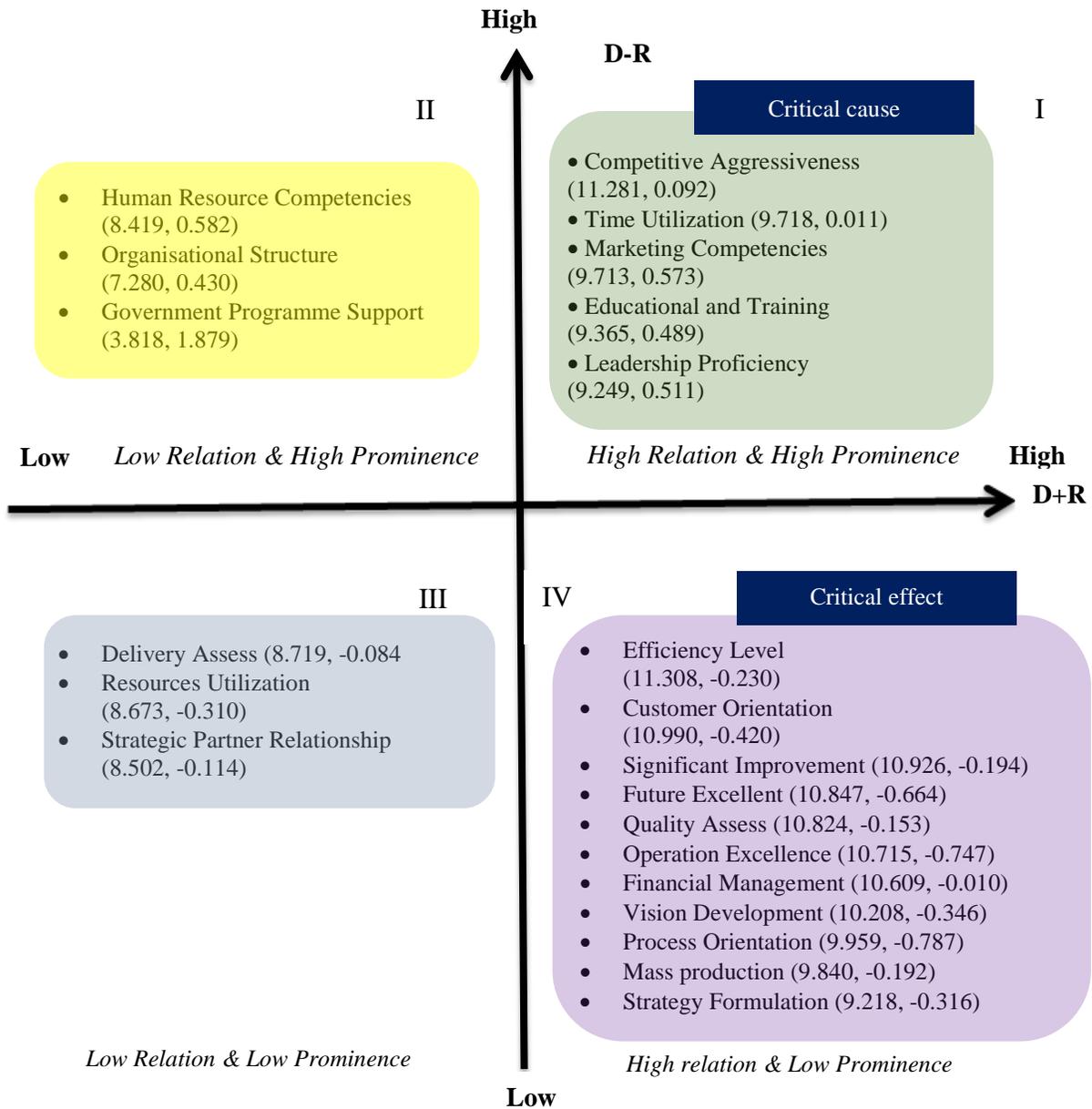
High

D-R

II

Critical cause   I

• Competitive Aggressiveness
(11.281, 0.092)
• Time Utilization (9.718, 0.011)
• Marketing Competencies
(9.713, 0.573)
• Educational and Training
(9.365, 0.489)
• Leadership Proficiency
(9.249, 0.511)

• Human Resource Competencies
(8.419, 0.582)
• Organisational Structure
(7.280, 0.430)
• Government Programme Support
(3.818, 1.879)

Low   *Low Relation & High Prominence*   *High Relation & High Prominence*   **High**

D+R

III   IV   Critical effect

• Delivery Assess (8.719, -0.084
• Resources Utilization
(8.673, -0.310)
• Strategic Partner Relationship
(8.502, -0.114)

• Efficiency Level
(11.308, -0.230)
• Customer Orientation
(10.990, -0.420)
• Significant Improvement (10.926, -0.194)
• Future Excellent (10.847, -0.664)
• Quality Assess (10.824, -0.153)
• Operation Excellence (10.715, -0.747)
• Financial Management (10.609, -0.010)
• Vision Development (10.208, -0.346)
• Process Orientation (9.959, -0.787)
• Mass production (9.840, -0.192)
• Strategy Formulation (9.218, -0.316)

Low Relation & Low Prominence   *High relation & Low Prominence*

Low

Figure 1. Categorization of the indicators

6. Conclusion

This study discusses the strategy for the development of critical performance indicator in SMEs through DEMATEL. At present, SMEs in Malaysia has very high contribution toward Malaysian economy, however, they are facing high failure rate. It can be seen from the literature that SMEs needs well-developed performance measurement system as a tool to evaluate the performance for effective development and avoid failure in the future. Consequently, from the study results, experts suggest that SMEs in Malaysia should actively focus on five performance indicators which are Leadership Proficiency, Marketing Competencies, Competitive Aggressiveness, Time Utilization, and Educational and Training because they were in cause group, the critical and core indicators influencing other indicators. They are the driving indicators of the problem solving. Any actions taken on these indicators will have wide-ranging impact on other indicators. On the other hand, from the effect group, Efficiency Level, Customer

Orientation, Significant Improvement, Future Excellent, Quality, Operation Excellence, Financial Management, Vision Development, Process Orientation, Mass Production, and Strategy Formulation were the core problems that must be solved. They are highly affected by the other indicators and require more attention. The results suggest that the SMEs should also give more attention to improve these indicators because they are highly affected by other indicators. Research on performance measurement in SMEs in Malaysia is still inadequate, and this study is still in preliminary stage. More detailed discussion and further research on sub-indicators may be able to complete overall study. This will lead to a continuous development towards SMEs industry in Malaysia. Although this study only explores performance indicators in SMEs from Malaysian's background, the results of the study still contribute to the update of literature in the performance measurement, making it a great reference value to decision makers from other countries that interested in developing performance measurement system.

Acknowledgement

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