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Performance evaluation model for project managers using managerial practices

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Abstract

There are many studies address the issues of finding the critical success factors of projects. In this study, we focus on the performance of the people who manage projects. A performance evaluation model for project managers is constructed on the basis of managerial practices. This model incorporates leadership behaviors that lead to managerial practices with some essential factors that may affect them. An analytic network process that borrows the idea of stochastic transiting process is employed to identify the interdependence between these two groups of elements. The model first calculates the relative importance of the leadership behaviors for the performance evaluation of project managers with respect to each of those influence factors. In the analytic network process approach, the relative importance of those leadership behaviors as well as the relative intensity of the factors that influence them is determined simultaneously. As for the relative weights of the managerial practices in each leadership behavior is determined in a similar way. Finally, the relative importance of those leadership behaviors and weights of their corresponding managerial practices will be involved to the model for evaluating the performance of project managers. The intensities of those influence factors will be used to aid the understanding of how the influence factors affect the leadership behaviors.

Keywords: Human resource management; System approach; Performance; ANP

1. Introduction

Since the 1950s most of the research in project management has focused on project scheduling problems, assuming that better scheduling techniques would result in better management and thus the successful completion of projects. However, there are many factors could determine the success or failure of a project. Many researchers consequently devote themselves to the studies of trying to figure out the critical success or failure factors in a project [1–8]. In these literatures, factors are mostly related to the types of projects that the researchers addressed. Each list of factors varies in its scope and purpose. The issues that related to project managers are less concerned needless to say how to evaluate their performance. Huemann et al. [8] argued that due to the specific characteristics of the project-oriented company, there exist specific challenges for HRM in such companies and appealed to the researchers that research on HRM in project-oriented company must take the perspective of the individual employee as well as the organization. To go with the stream of discussion, in this research, we try to address the issue of project manager's performance. It is inappropriate to evaluate the performance of project managers using conventional measures of productivity because projects pose somewhat entirely unique kinds of properties. Unfortunately, measuring their performance only by the profit associated with the projects they handled is also unfair because some projects with their specific nature are more profitable than the others. Chang and Leu [9] employed data mining technique to identify the project profitability variables, and found that some types of projects in an engineering design company are more profitable than other projects. If a company adopts

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the evaluation system on the basis of profit only, project managers will stick to those projects that are profitable and ward off those are not. However, unprofitable projects may bring intangible benefits such as enhancing the technology level or boosting the reputation of the company. Such undue emphasis on short-term profit may undermine the sustainability of the company in the long run. Every company has its focus on some special types of projects that can generate the greatest profits for the company while maintaining its success and sustainability. On the other hand, trying new types of projects may extend the business territory of the company and promise future profits. Therefore, it is important to encourage employees or project managers of the middle or higher level of a company to take the challenge of new types of projects. A suitable performance evaluation system that can foster the atmosphere of aggressiveness is essential.

For to achieve the management purpose, a more sophisticated performance evaluation system that not only based on the quantified data of accounting but also on some qualitative indices of the performance of managerial practices has to be considered. In this paper, we focus on the discussion of the latter one. The performance of a project manager is associated with whether he or she can elaborate the managerial practices of the leadership behavior effectively and efficiently. These leadership behaviors are related to making decisions at some critical points, influencing people in the project team, building relationships with other departments in the company for obtaining necessary support, and giving or seeking information while conducting the project. Evaluating the performance of project managers by these leadership behaviors requires their relative importance to be determined beforehand. It is suitable to determine the relative importance after considering the factors that may affect them rather than just allocating a number subjectively. According to the studies of Hyvari [10] and Adenfelt and Lagerstrom [11], the factors that affect the implementation of the managerial practices are not only the project types mentioned above, but include also the technical competence of the company, enterprise organization, and the position level of the project manager in the company. The performance evaluation model should take into consideration all these factors to ensure that the evaluation process is impartial.

It is obvious that there exists different degree of interdependence between the factors and the leadership behaviors. For instance, the technical competence of a company will affect the managerial practices in the behavior of decision-making more significantly than in the behavior of influencing people. On the other hand, from the viewpoint of conducting the managerial practices in the leadership behavior of building relationship, the position level of the project manager and the enterprise organization should be emphasized more than the other two influencing factors. Consequently, the relationship between them are interdependent and recursive. This paper considers the interdependence between the influencing factors and the leadership behaviors, and employs the Analytical Network Process (ANP) approach to construct the performance evaluation system. This approach has been applied to many similar problems. Sarkis and Sundarraj [12] showed how the ANP model combined with another optimization model could be utilized to conduct a comprehensive evaluation of the factors affecting job location at a digital equipment corporation. Another application can be found in the paper by Sarkis [13] in which he used the ANP technique to integrate the elements and attributes of corporate environmental management into a strategic assessment system.

2. Performance evaluation model for project managers

Previous studies have shown that there are many factors influencing the performance of leadership behavior of managerial practices implemented by project managers. It is inevitable that the researches conducted with different sampling data will lead to inconsistency. For example, the ranks of the 14 managerial practices of the leadership behavior in the studies of Kim and Tukl [14] and Hyvari [10] derived from different questionnaire surveys are different. For this reason, factors affecting the performance of implementing managerial practices must be included in the performance evaluation model.

3. Factors influencing leadership behavior

Many factors related to the skills and characteristics of project managers' leadership behaviors. Pinto and Slevin [15] demonstrated the importance of selecting project managers who possess the necessary technical and administrative skills such as commitment and competence for successful project termination. The survey of White and Fortune [4] shown that the most frequently mentioned factors relate to successful project were clear goals/objectives delivered from project manager, support from senior manager and adequate funds/resources. The results are similar to the studies in [2,16,17]. Pinto and Slevin [16] emphasized the provision of adequate communication channels and control mechanism for acquiring information and supports. From these literatures review, we would conclude that the factors may influence the leadership behavior of project manager are as follows:

(1) Technical competence: This factor includes the familiarity of project management tools used [18,19], quality of employees, on-job training, and experiences learnt from previous successes or failures, which affect the performance of subsequent projects undertaken.
(2) Enterprise organization: The organization structure of an enterprise will affect the performance of specific projects. The study of Gray et al. [20] indicated that architectural projects prefer matrix structure of organization. Chuad [21] examined the use of different types of project management structure from different

industrial sectors. Generally, the enterprise organization can be presented as functional, functional matrix, balanced matrix, project matrix, and project team type of organization [22].

(3) Project properties: The properties include project types, duration [23], amount of contracts, consignor, manpower and budget involved, and the relation to other projects that have bee finished.
(4) Position level: What kinds of resources can be used, what level of people are responsible for negotiation, and what commanding and dispatching channels can be applied are all related to the position level of the project manager in a company.

These four influencing factors are included in the performance evaluation model that will be constructed.

4. Leadership behaviors of managerial practices

In this study, the 14 managerial practices of leadership behaviors that were employed in the studies of Yukl et al. [24], Yukl [25], Kim and Yukl [14] will be adopted as the performance evaluating factors. The validity and effectiveness of these managerial practices on the performance of project management have been studied by Yukl et al. [24]. Hyvari [10] further classified these 14 managerial practices into four clusters as follows. In this research, we refer them as four leadership behaviors:

(1) Making decision: This cluster includes the managerial practices of planning/organizing, problem-solving, consulting, and delegating.
(2) Influencing people: Motivating/inspiring, recognizing, and rewarding are classified into this cluster.
(3) Building relationships: This cluster comprises the managerial practices of networking, conflict management/team building, supporting, and developing.
(4) Giving–seeking information: They are monitoring, informing, and clarifying.

Fig. 1 depicts the performance evaluation model that takes into consideration the interdependence of influencing factors and the leadership behaviors. The general management goal can work upon both types of factors simultaneously. The two bold curves between the levels of influencing factors and the leadership behaviors represent their interdependent and recursive relationship. The managerial practices in each of the leadership behavior are assumed to have unidirectional influence.

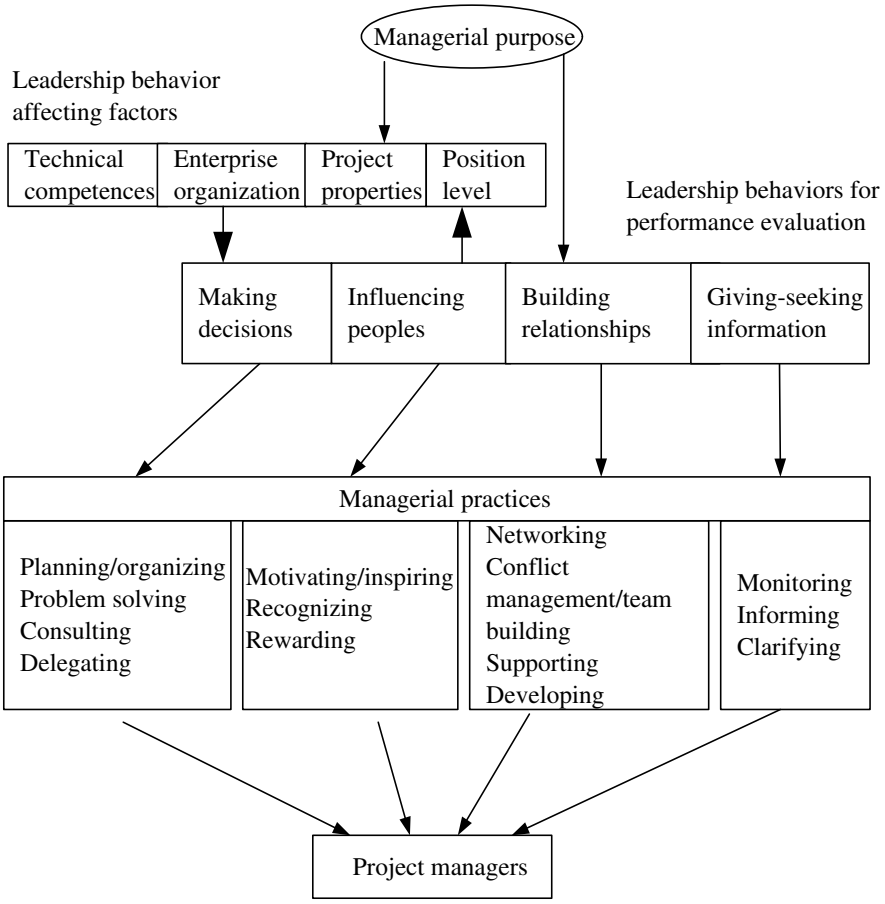

Fig. 1. The relationship between influence factors and managerial practices for performance evaluation.

5. The ANP approach for constructing the performance evaluation model

The relative weights of the 14 managerial practices must be determined before they can be employed to evaluate the performance of project managers. Hyvari [10] classified these 14 practices into four clusters, which we interpret as four leadership behaviors for performance evaluation. In this research, we determine the relative weights of the managerial practices in each leadership behavior after we had determined the relative importance of the four leadership behavior.

As mentioned above, the two groups of influencing factors and leadership behaviors are interdependent. It is not adequate to apply the traditional analytical hierarchical process (AHP) that neglects mutual effects on different layers of the evaluation model. The analytical network process (ANP) [26] approach is employed to deal with this interactive environment. It is capable of handling interdependence among different layers of elements by obtaining the composite weights for developing a "supermatrix". Traditional Analytical Hierarchy Process (AHP) assumes that the system elements are not correlated and are unidirectionally influenced by a hierarchical relation. However, the ANP approach eliminates these limitations and allows a feedback relationship between the elements at different layers and interdependence between elements at the same layer through the development of a "supermatrix" [27]. To elicit preferences of various elements, the respondent compares two elements at a time with respect to the "control" element residing at another layer.

The fundamental requirement for developing the supermatrix in the ANP is the control element for these pairwise comparisons that can be the element at the upper or lower layers of the network structure. For ANP, like AHP, pairwise comparisons of the elements at each layer are conducted with respect to their relative importance towards their control element.

For the purpose of pairwise comparison, we construct the scale of measure from 1 to 7, denoting indifferent to absolutely important, respectively. Reasonably, the reciprocal scale of measure from 1 to 1/7 will denote indifferent to absolutely unimportant, respectively.

We now conduct the pairwise comparison of the leadership behaviors with respect to some specific control factors that influence them. We wish to find their relative weights of importance (w), on each of the specific control factors. Ideally, we can make a perfect comparison provided that the relative weights of importance for these behaviors are already known. That means the number $c_{ij} = w_i/w_j$ indicating the strength of behavior i when compared with behavior j. But practically, the evolve process is exactly the reverse. The relative weights of importance of these behaviors are unknown and will be derived from the subjective judgement of pairwise comparison. For example, Table 1 depicted the results of comparison of leadership behavior of decision-making, influencing people, building relationships and giving–seeking information with respect to the influence factors of technical competence.

Once the pairwise comparisons are completed, we noted that the diagonal of this comparison matrix C consists of ones. The relative weight vector must satisfy the equation $Cw = nw$ provided that we can make a perfect comparison and create a $n \times n$ comparison matrix. Once again, in practical situation, the comparison is made by subjective judgement. Based on the theory of matrix, the small variations of the comparison of c_{ij} will keep the largest eigenvalue close to n, Consequently, the relative vector of weight w is computed as the unique solution of

$$Cw = \lambda_{\max} w$$

where C is the comparison matrix and $\lambda_{\max}$ is the largest eigenvalue of C. There are several algorithms available for approximating vector w [26]. However, in this paper, a two-stage algorithm proposed by Meade and Sarkis [28] is used in the process for averaging over normalized columns and is employed to approximate vector w. This is represented as

$$w_i = \frac{1}{n} \sum_{j=1}^{n} \left(\frac{c_{i,j}}{\sum_{i=1}^{m} c_{i,j}} \right) \tag{1}$$

From the data in Table 1, the decision-maker gives more relative weight of importance to the behavior of decision-making than other behaviors with respect to the performance influencing factor of technical competence of the company.

The pairwise comparisons of leadership behaviors with respect to other three influencing factors are conducted in a similar way. The results of these comparisons are summarized in Table 2. As we can see, the relative weights of importance of those behaviors are inconsistent when different performance influencing factors are considered.

Similarly, the pairwise comparisons of these influencing factors with respect to each specific control leadership

Table 1
Pairwise comparison for leadership behaviors with respect to the technical competence

Technical competences	Making decision	Influencing peoples	Building relationships	Giving–seeking information	Relative weights
Making decision	1	6	5	3	0.55
Influencing peoples	1/6	1	1/3	1/6	0.06
Building relationships	1/5	3	1	1/2	0.13
Giving–seeking information	1/3	6	2	1	0.26

Table 2
Relative weights of leadership behaviors with respect to different performance influence factors

Evaluating factors	Affecting factors			
	Technical competences	Enterprise organization	Project properties	Position level
Making decisions	0.55	0.19	0.32	0.19
Influencing peoples	0.06	0.15	0.23	0.31
Building relationships	0.13	0.37	0.18	0.27
Giving–seeking information	0.26	0.29	0.27	0.23

Table 4
Relative weights of influencing factors with respect to each of the behaviors

Affecting factors	Evaluating factors			
	Making decisions	Influencing peoples	Building relationships	Giving–seeking information
Technical competences	0.45	0.26	0.22	0.20
Enterprise organization	0.12	0.31	0.33	0.29
Project properties	0.11	0.15	0.18	0.28
Position level	0.32	0.28	0.27	0.23

behavior are conducted. The comparison of the influencing factors that affect performance with respect to the behavior of decision-making is illustrated in Table 3. The relative weight vector of the influencing factors are obtained from applying Eq. (1) is written in the rightmost column of Table 3. The data show great intensity of the factors of technical competence and giving–seeking information when considering the behavior of decision-making in performance evaluation. The pairwise comparisons of influencing factors with respect to other three leadership behaviors for performance evaluation are conducted in a similar way. The results of these comparisons are summarized in Table 4. As can be seen, the relative weights of intensity of the influencing factors that interpret the strength of impact on the performance of leadership behaviors are also inconsistent when different behavior are considered.

The next step is to form the "supermatrix" which allows a solution for the effects of interdependence between the elements at different layers of the model. Tables 2 and 4 are now combined to form the initial "supermatrix" as shown in Table 5. As the model represented in Fig. 1, the relationships of elements in the same layer are assumed to be insignificant. The corresponding area in the "supermatrix" is assigned a value of zero. The initial "supermatrix" transits 13 periods of time, and according to the stochastic process, it would mean that the matrix multiplies itself 13 times. In the long run, the "supermatrix" converges to the stable values given in Table 6, which will be used in further application.

As seen in Table 6, the relative weights of the importance of the leadership behaviors are in the order: making decision (0.320), giving–seeking information (0.261), building relationships (0.237), and influencing people (0.182). The relative weights of the influencing factors that can be interpreted as the intensity of impact on performance of the leadership behaviors are in the order: technical competence (0.296), position level (0.277), organization of enterprise (0.249), and project properties (0.178). This data reveal that the evaluator considers the capability of making decision and giving–seeking information are the most important leadership behaviors to a project manager. This is because project managers are usually a delegate to handle projects assigned to them. They are asked to handle or acquire the information or solutions for solving the problems of their projects autonomously. At the same time, the technical competence and the manager's position level in a company are considered to be the two most significant factors that may influence the performance the project managers as they implement the leadership behaviors of managerial practices. Therefore, to introduce or develop some novel and powerful technologies or tools to aid project managers for carrying out their jobs and establish the project matrix and project team-based organizations with convenience for communication are the essentials of a company.

To evaluate the performance of project managers, the relative weights of the managerial practices in each leadership behavior also have to be determined in advance. The similar process as determining the weights of those behaviors, the pairwise comparisons of the managerial practices in each leadership behavior are conducted with respect to the behavior itself. As described in Fig. 1, there exists only a unidirectional relationship between managerial practices and the corresponding leadership behavior they reside. Evaluators only have to conduct the comparison with respect to the behavior and the transition operation is unnecessary. The pairwise comparisons of planning/

Table 3
Pairwise comparison for influence factors with respect to behavior of decision-making

Making decision	Technical competences	Enterprise organization	Project properties	Position level	Relative weights
Technical competences	1	5	3	3/2	0.45
Enterprise organization	1/5	1	1	1/2	0.12
Project properties	1/3	1	1	1/4	0.11
Position level	2/3	2	4	1	0.32

Table 5
Initial supermatrix for ANP approach

	Making decisions	Influencing peoples	Building relationships	Giving–seeking information	Technical competences	Enterprise organization	Project properties	Position level
Making decisions					0.55	0.19	0.32	0.19
Influencing peoples					0.06	0.15	0.23	0.31
Building relationships					0.13	0.37	0.18	0.27
Giving–seeking information					0.26	0.29	0.27	0.23
Technical competences	0.45	0.26	0.22	0.20				
Enterprise organization	0.12	0.31	0.33	0.29				
Project properties	0.11	0.15	0.18	0.28				
Position level	0.32	0.28	0.27	0.23				

Table 6
Long-term supermatrix for ANP approach

	Making decisions	Influencing peoples	Building relationships	Giving–seeking information	Technical competences	Enterprise organization	Project properties	Position level
Making decisions	0	0	0	0	0.320	0.320	0.320	0.320
Influencing peoples	0	0	0	0	0.182	0.182	0.182	0.182
Building relationships	0	0	0	0	0.237	0.237	0.237	0.237
Giving–seeking information	0	0	0	0	0.261	0.261	0.261	0.261
Technical competences	0.296	0.296	0.296	0.296	0	0	0	0
Enterprise organization	0.249	0.249	0.249	0.249	0	0	0	0
Project properties	0.178	0.178	0.178	0.178	0	0	0	0
Position level	0.277	0.277	0.277	0.277	0	0	0	0

organizing, problem-solving, consulting, and delegating with respect to the leadership behavior of decision-making are depicted in Table 7. Eq. (1) is again applied. The rightmost column indicates their relative weights in the order of planning/organizing (0.42), problem-solving (0.30), delegating (0.17), and consulting (0.11). The relative weights of managerial practices in the other three leadership behaviors can be obtained by the same process. Finally, the relative importance of each leadership behavior and the relative weights of its associated managerial practices are summarized in Table 8. The numerals in parentheses are the product of the relative weight of the managerial practice with the relative importance of its associated leadership behavior.

Table 7
Pairwise comparison of managerial practices with respect to decision-making

Making decision	Planning/organizing	Problem solving	Consulting	Delegating	Relative weight
Planning/organizing	1	2	3	3	0.42
Problem solving	1/2	1	2	4	0.30
Consulting	1/3	1/2	1	1/3	0.11
Delegating	1/3	1/4	3	1	0.17

Table 8
Relative importance of leadership behaviors and their associated managerial practices

Making decision		Influencing peoples		Building relationships		Giving–seeking information	
0.320		0.182		0.237		0.261	
Planning/organizing	0.42 (0.134)	Motivating/inspiring	0.48 (0.087)	Networking	0.11 (0.026)	Monitoring	0.41 (0.107)
Problem solving	0.30 (0.096)	Recognizing	0.24 (0.044)	Conflict mgt./team building	0.38 (0.090)	Informing	0.22 (0.057)
Consulting	0.11 (0.035)	Rewarding	0.28 (0.051)	Supporting	0.27 (0.064)	Clarifying	0.37 (0.097)
Delegating	0.17 (0.054)			Developing	0.24 (0.057)		

There is only one evaluator that performs the above pairwise comparisons. In some cases, multiple evaluators such as higher-level managers, peer workers and some down stream employees could be invited to attend the evaluation process. In such cases, the average comparisons of those evaluators have to be calculated before transplanting the data to Tables 2 and 4. Other operations are the same as the above process except data preprocessing.

6. Example for illustration

A clean room and integrated air-conditioned engineering design and construction company in Taiwan, ROC, will be used as an example for illustration. There are about 70 engineers and 15 staffs in this company. For this company, all projects come from private or public (government) consigners. The budgets and durations of the projects are significantly different. An experiential engineer will be assigned to be a project manager whenever a project is formed. The project manager then has to handle all details for the project that are rough evaluation for the project, constructing and organizing a project team, engineering design, assessing the cost and price, constructing a control mechanism, acquiring authentication, construction, and make a final report. Considering the variety of durations of projects, sometimes each project manager may handle more than one project at the same time. On the other hand, each project manager is passively assigned to handle the projects. It is unsuitable for evaluating their performance only based on the data presented by accounting. This company decided to amend the possible bias by proposing another performance evaluation system that not only considers the manager's capability of acquiring profit of the projects that he handled but also his or her performance of managerial practices. The model that we discussed in the previous sections will be applied to aid the purpose achieving. There are seven senior engineers with different education background and expertise to be as the candidate project managers whenever a project is formed. Each end of a year, the general manager of this company has to evaluate the seven project managers' performance for appraising their bonus. Here, we describe the proposed model that may aid the general manager to make a more impartial judgement though the evaluation of the capability of acquiring profits that based on accounting data has been applied previously in this company.

The general manager has to compare the relative performance for these seven projector manager with respective to each of the managerial practices proposed in our model. For doing so, we define a scale from 1 to 7 as

Table 9
The performance comparison of the seven managers with respected to managerial practice of planning/organizing

Planning/organizing	M1	M2	M3	M4	M5	M6	M7	Relative score
M1	1	1/5	3	1	1/5	1/3	5	0.09
M2	5	1	3	3	5	1/3	7	0.24
M3	1/3	1/3	1	1/3	1/5	1/7	3	0.05
M4	1	1/3	3	1	1/3	1/5	3	0.08
M5	5	1/5	5	3	1	1/3	5	0.16
M6	3	3	6	5	3	1	7	0.33
M7	5	1/7	1/3	1/3	1/5	1/7	1	0.06

Table 10
The performance indices for the seven project managers

Behavior	Item	M1		M2		M3		M4		M5		M6		M7	
		Score	Score (w)	Score	Score (w)	Score	Score (w)	Score	Score (w)	Score	Score (w)	Score	Score (w)	Score	Score (w)
MD 0.320	PO 0.42	0.09	0.012	0.24	0.032	0.05	0.007	0.08	0.011	0.16	0.022	0.33	0.044	0.06	0.008
	PS 0.30	0.11	0.011	0.21	0.02	0.02	0.002	0.05	0.005	0.24	0.023	0.15	0.014	0.22	0.021
	Con 0.11	0.07	0.002	0.19	0.007	0.07	0.002	0.06	0.002	0.04	0.001	0.54	0.019	0.03	0.001
	Del 0.17	0.16	0.009	0.14	0.008	0.11	0.006	0.14	0.008	0.13	0.007	0.26	0.014	0.06	0.003
IP 0.182	MI 0.48	0.07	0.006	0.22	0.019	0.02	0.002	0.07	0.006	0.22	0.019	0.37	0.032	0.02	0.002
	Rec 0.24	0.12	0.005	0.05	0.002	0.12	0.005	0.07	0.003	0.1	0.004	0.32	0.014	0.22	0.01
	Rew 0.28	0.1	0.005	0.13	0.007	0.06	0.003	0.08	0.004	0.17	0.009	0.4	0.02	0.06	0.003
BR 0.237	Net 0.11	0.14	0.004	0.23	0.006	0.11	0.003	0.09	0.002	0.16	0.004	0.23	0.006	0.05	0.001
	CT 0.38	0.07	0.006	0.19	0.017	0.05	0.005	0.07	0.006	0.25	0.023	0.35	0.032	0.02	0.002
	Sup 0.27	0.07	0.004	0.21	0.013	0.06	0.004	0.06	0.004	0.14	0.009	0.43	0.028	0.03	0.002
	Dev 0.24	0.09	0.005	0.19	0.011	0.03	0.002	0.12	0.007	0.18	0.01	0.33	0.019	0.06	0.003
GI 0.261	Mon 0.41	0.16	0.017	0.22	0.024	0.14	0.015	0.08	0.009	0.14	0.015	0.23	0.025	0.03	0.003
	Inf 0.22	0.11	0.006	0.21	0.012	0.06	0.003	0.05	0.003	0.22	0.013	0.15	0.009	0.21	0.012
	Cla 0.37	0.14	0.014	0.18	0.017	0.05	0.005	0.14	0.014	0.21	0.02	0.26	0.025	0.02	0.002
		0.107		0.195		0.063		0.083		0.179		0.301		0.074	

Note: Score (w) means the weighted score.

indifferent to extremely excellent and its reciprocal 1 to 1/7 to be indifferent to extremely bad. The comparison process is similar to the one described in previous section. Table 9 depicts the result of the comparison of the performance for the seven managers with respected to the managerial practice of planning/organizing. After this comparison, the Eq. (1) is applied again to calculate their normalized relative performance as presented in the most right column in Table 9. The general manager has to conduct 14 7×7 comparison matrices owing to there are 14 managerial practices in the model. Combine the results with the relative weights of these managerial practices and their correspondent managerial behaviors that obtained in the previous sections. Consequently, the performance index for each of these seven project managers based on the managerial practices can be available by using the following equation (2),

$$P_k = \sum_i \sum_j w_i w_{ij} r_{ijk} \tag{2}$$

in which,

w_i: the relative weight of factor i.
w_{ij}: the relative weight of managerial practice j that resides in evaluating factor i.
r_{ijk}: the performance evaluation for project manager k of the managerial practice j that resides in factor i.

Higher values of P_k indicate that the project manager is doing a better job on implementing these managerial practices. The data in Table 10 described the calculating results for this case company. The order of the performance index for the seven project managers with respected to managerial practice is M6, M2, M5, M1, M4, M7, M3. Finally, the general manager can combine this information with other quantitative profitability evaluation to make a more impartial judgment.

7. Conclusion

The performance of a project manager is not only associated with his capability of acquiring profit but also dependent on whether he or she can implement the managerial practices of the leadership behavior effectively and efficiently. A performance evaluation model incorporates leadership behaviors with some essential factors that may affect them are proposed. From the literature review, there are many factors affecting the performance of project implementation. The relative importance of those behaviors is inconsistent when different performance influencing factors are considered. An analytic network process that borrows the idea of stochastic transiting process is employed to identify the interdependence between these two groups of factors. The model first determinates the relative importance of the leadership behaviors for the performance evaluation of project managers as well as the relative intensity of the factors that influence them. The relative weights of the managerial practices in each leadership behavior are determined in a similar way.

The data in this research reveal that the evaluator considers the capability of making decision and giving–seeking information are the most important leadership behaviors to a project manager. This is because project managers are usually asked to handle or acquire the information or solutions for solving the problems of their projects autonomously. At the same time, the technical competence and the manager's position level in a company are considered to be the two most significant factors that may influence the performance the project managers. Therefore, to introduce or develop some novel and powerful technologies or tools to aid project managers for carrying out their jobs and establish the project matrix and project team-based organizations with convenience for communication are the essentials of a company.

Finally, we suggest that the project managers' performance evaluation model comprise the following five phases. They are (1) determine the relative importance of the leadership behaviors considering the influence factors; (2) determine the relative weights of managerial practices derived from leadership behaviors; (3) compare the performance of managers with respect to each of those managerial practices; (4) calculate the performance index for each project manager; (5) combine the performance indices on managerial practice with other information based on quantified data for project managers to evaluate their performance.

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