International Journal of Innovative Computing, Information and Control
Volume **8**, Number **10(B)**, October **2012**

ISSN 1349-4198
pp. 7451–7465

EVALUATING INTERTWINED EFFECTS OF TEAM INTERNAL FACTORS ON PROJECT SUCCESS: A HYBRID METHOD COMBINING EXPLORATORY FACTOR ANALYSIS AND THE DEMATEL TECHNIQUE

Don Jyh-Fu Jeng

Institute of International Management
National Cheng Kung University
No. 1, University Road, Tainan City 70101, Taiwan
jeng@mail.ncku.edu.tw

Received April 2011; revised September 2011

Abstract. *Technology projects typically carry a high rate of failure. Project management refers to disciplines that enhance management of inherent strengths and weaknesses of a project. In contrast to external factors, project management frequently ignores internal factors. Such factors, involving internal services within the team, focus on working with people, ensuring customer satisfaction, and creating a conducive environment for the project team to deliver high quality products, which meet stakeholder expectations. This research investigated the intertwined effects of project team internal factors, and proposes a hybrid method that combines exploratory factor analysis and the Decision Making Trial and Evaluation Laboratory (DEMATEL) technique to solve an empirical case. Exploratory factor analysis was applied for extracting the dimension and criteria structure of internal factors. The DEMATEL technique was then used to analyze the intertwined effect. This research found, in the dimensional level, attitude highly influences other internal factors towards project success, while work loading is a key factor in criteria level that greatly influences all others. The proposed method has proven to be effective for analyzing the complex interrelation of human psychological concerns.*
Keywords: Decision making trial and evaluation laboratory (DEMATEL), Exploratory factor analysis, Internal service, Project critical success factors, Project management

1. **Introduction.** Project management is important to control projects throughout the entire project life cycle for successful and enhanced project performance. Management can also have "strategic value when a clear connection is made between how efficiently and effectively a project is done and how the project's products and services provide business value" [26] (p.19). Understanding controllable factors and the intertwined effects that affect performance of the project team is necessary to properly manage a project.

A significant amount of research has been conducted on project success factors within Western cultural settings (e.g., [1, 6, 43, 44]). However, most of these researches have focused on external factors of the team and rarely discuss how internal factors may influence overall project success. External factors relate to factors which individual project group members cannot control, while internal factors relate to teamwork and interpersonal skills. Previous studies have frequently neglected internal factors; however, they play a significant role in project success.

Because of the effect of culture on values and norms [17, 22], research needs to consider the cultural setting when investigating impact factors in non-Western settings. Research has not investigated the effect of internal factors within a Chinese cultural setting on project performance, and the literature on internal factors of project management is rare.

Understanding the intertwined effect of internal factors on project success is critical to managers conducting projects. These criteria affecting project success are numerous and exhibit mutual influence.

This paper first reviews and identifies the hierarchical structure of internal factors that influence project success and then analyzes intertwined effects between the criteria. Exploratory factor analysis is applied to extract the independent factors/criteria. Then, the DEMATEL technique [11, 12] is adopted to generate the impact relation map. The DEMATEL technique is commonly used to illustrate the interrelations among criteria, which avoid "overfitting" in the Structural Equation Modeling (SEM) method of quantitative research [55]. The hybrid method proposed in this study uses a top-down approach that evades the mis-assumption of hypothesis development in social science studies.

The remainder of this paper is organized as follows. The research background and literature review on factors that affect project performance are presented in Section 2. Section 3 briefly introduces exploratory factor analysis and the DEMATEL technique. Section 4 presents an empirical study of internal factors on project success, and proposes a hierarchy structure with dimension and criteria and analyzes its intertwined effects by DEMATEL. Section 5 discusses the analysis result and draws implications. Finally, Section 6 presents concluding remarks.

2. **Internal Factors Affecting Project Performance.** Project performance metrics are key attributes and objectives which must be met or reached to consider a project successful [30]. Most researchers (i.e., [1, 6, 7, 30, 33, 43, 54]) agree that time, cost, and quality should be used as performance metrics and key determinants of project success. However, many scholars agree that success criteria should not be limited to time, cost, and quality [1, 30, 32, 54]. For instance, internal factors, cultural involved, highly influence the project performance of a team.

2.1. **Cultural context.** Culture, both national and corporate, can be defined as "the collective programming of the mind which distinguishes the members of one group or society from those of another" [18] (p.82). Each nation consists of dominant and non-dominant groups. All groups possess their own, and sometimes similar group-ideologies, beliefs, and values, but the national culture will resemble the largest or more influential dominant group. Therefore, understanding the underlying views of the dominant group is vital to understanding the views of people within that culture [51]. The findings of previous studies conducted in Western cultural settings have not been adequate when applied to the Chinese cultural context, which is highly influenced by the teachings of Confucius. "Confucian social theory is concerned with the question of how to establish a harmonious secular order in the man-centered world" [28] (p.65). The term guanxi (role-relationship) [21] is deeply embedded in Confucian social theory and King [28] uses the term architect to refer to Confucian individuals who build guanxi throughout their lifetime, creating their own social networks outside their family structure.

In terms of Taiwan, the study of Hofstede [17] found that Confucianism regarding unequal relationships ranked on the higher end of power distance, meaning hierarchal structures are common. For Confucianism concerning the importance of upholding 'he', or harmony, Hofstede [17] showed that the Taiwanese culture leans toward collectivism rather than individualism, meaning that individuals focus on group interest rather than their individual self. This is further supported by the findings of Gao [13], who conducted a study to understand Chinese speaking practices, and found that the self in Chinese culture, involves and is made up of multiple relationships. The last two dimensions (i.e., uncertainty avoidance and masculinity) in the Hofstede study [17] indicate that Taiwanese prefer to avoid uncertainty and demonstrate both masculine and feminine characteristics, as the masculinity score is modest. Further studies have confirmed that the work ethic of Taiwanese employees reflects both Confucian values and cultural dimensions [18, 19].

2.2. **Internal impact factors.** The project performance of a team depends heavily on how well the team works together. The factors that affect these dynamics are the relationships between team members, and the perceived quality of "internal services" between team members as workflows between them. The scope of internal-team factors for this study is limited to interactions and relationships between project group members.

In terms of workflow, the McGrath [37] paper on the theory of the group assumes groups to be "complex, intact social systems... that engage in purposeful activity at three partially nested levels: projects, tasks, and steps" (p.151). Work may flow from one team member to the next at the steps and tasks level. This workflow is an internal service between team members, and the interaction related to the work passed on to the next step is the service encounter. The service encounter is the "dyadic interaction between an internal customer and an internal service provider" [14] (p.35).

An internal customer evaluates the perceived quality of the service encounter by assessing individual internal service quality attributes to gain an overall perception of its quality [14]. Improving and managing perceived quality is important for organizations. Researchers have found connections between high levels of internal service quality and higher productivity, improved relationships between departments and groups, lower employee turnover, increased external customer satisfaction, and increased profits [14, 23, 41, 42, 45, 49].

Previous studies have mainly applied Western internal service quality attributes to the Taiwanese setting (e.g., [8, 9, 31, 36]), as organizational culture. However, culture, which is based largely on national culture, has a direct effect on internal service providers and internal customer values, norms, behavior, and thinking [4, 22, 47]. Applying Western attributes to an Eastern cultural setting could produce inadequate results, because cultural differences create unique workplaces with diverse views, values, and practices [18]. To overcome this limitation, Stanworth et al. [50] developed the Taiwanese based internal service quality (ISQ) attribute, derived from 29 service quality attributes.

Confucianism has shown to have an undisputable impact on the national and organizational culture of Taiwan, where it is important to maintain harmony within relationships [18]. Studies related to group project performance within the Chinese context have shown that focusing on creating friendly relationships within organizations and groups can positively affect project performance by increasing their odds of success [25, 27]. Bromiley and Cummings [2] found that a harmonious relationship based on trust lowers costs and shortens the time spent conducting business. Thus, relationships play a major role within Taiwan due to Confucian influence. Katz [27] found that high levels of internal communication between all project members lead to higher project performance.

Based on the above literature reviews, this research adopted and slightly modified the ISQ structure of Stanworth et al. [50] as follows. Two items were removed when changing attributes from negative to positive (Incomplete Professional Knowledge and Quarrel), because they were polar opposites of positives already present (Detailed Professional Knowledge and Consensus), and one item was expanded into two separate items (Work Loading to Work Loading and Accessible) to better capture attribute complexity. This left 26 remaining attributes. Two trouble-shooting attributes from Pinto and Prescott [43] (trouble-shooting and handle deviations), and seven relationship attributes from Jin and Ling [25] were added to our list. Thus, the final scale investigated in this study was composed of 35 team internal factors, including friendly (chin-chieh), polite (ke-chi), patient, positive/proactive (jiji), responsible, trouble-shooting, able to handle deviations, please supervisor, competent, effective, detailed and professional knowledge, consensus, show empathy, shared objective, considerate, reliable, internal efficiency, external efficiency, harmony, personnel connection, emotionally stable, internal communication, litigation, risk exposure, change orders and claims, mutual understanding, client satisfaction, learning culture, help each other, cooperation, coordination, work loading, accessible, bureaucracy, and exchange thoughts.

3. **Building a Hybrid Model for Intertwined Effects Analysis.** This section introduces the concepts for establishing the intertwined effects structural model, combined factor analysis, and the DEMATEL technique. Quantifying a precise value in human psychological emotion is difficult. However, the complex phenomenon can be divided into many criteria to more easily judge differences or measure scores. The exploratory factor analysis method is commonly used to divide criteria into groups. These criteria may have interdependent relationships; therefore, the DEMATEL technique was used to construct interrelations between criteria.

3.1. **Finding independent factors for building a hierarchical system.** Based on a suitable measuring method, the criteria can be categorized into distinct aspects. When the evaluated criteria are too large to determine the dependent or independent relation with others, factor analysis can verify independent factors.

Exploratory factor analysis is a dimension reduction method of multivariate statistics, which explores the latent variables from manifest variables to uncover the underlying structure of a relatively large set of variables. This method explicitly breaks down the variability of criteria into a part attributable to the dimensions and shared with other criteria, while the other part is specific to a particular unrelated criterion to the dimensions. With the feature of exploratory factor analysis, a clear hierarchical structure in dimension and criteria can be extracted. The main procedure of exploratory factor analysis can be described in the following steps:

Step 1: Find the correlation matrix ($\boldsymbol{R}$) or variance-covariance matrix for the objects to be assessed.

Step 2: Find the eigenvalues ($\lambda_k, k = 1, 2, \cdots, m$) and eigenvectors ($\beta_k = [\beta_{1k}, \cdots, \beta_{lk}, \cdots, \beta_{pk}]$) for assessing the factor loading ($a_{lk} = \sqrt{\lambda_k}\beta_{lk}$) and the number of factors (m).

Step 3: Consider the eigenvalue ordering ($\lambda_1 > \cdots > \lambda_k > \cdots > \lambda_m; \lambda_m > 1$) to decide the number of common factors, and select the number of common factors to be extracted by a predetermined criterion.

Step 4: To facilitate the interpretation of factors, choose a rotation method. In this study, the promax rotation method was applied, which allows the factors to be correlated.

Step 5: Name the factor referring to the combination of manifest variables.

When a large set of variables is factored, the method first extracts the combinations of variables, explaining the greatest amount of variance, and then proceeds to combinations that account for progressively smaller amounts of variance. Two types of criteria are used for selecting the number of factors: latent root criterion and percentage of variance criterion. The former criterion is that any individual factor should account for the variance ($Var(Y_k) = \lambda_k$) of at least a single variable if it is to be retained for interpretation. In this criterion, only the factors having eigenvalues greater than 1 (i.e., $\lambda_k \geq 1$, $k = 1, 2, \cdots, m$) are considered significant. The latter criterion is based on achieving a specified cumulative percentage of total variance extracted by successive factors. Its purpose is to ensure the extracted factors can explain at least a specified amount of variance. Practically, to be satisfactory, the total amount of variance explained by factors should be at least 95% in the natural sciences, and 60% in the social sciences. However, no absolute threshold has been adopted for all applications [15].

3.2. **DEMATEL technique for building the structural model.** DEMATEL [11, 12] is a comprehensive method for building and analyzing a structural model involving causal relationships between complex factors. The method was developed with the assumption that properly used scientific research methods could facilitate comprehension of the specific problematique, the cluster of intertwined problems, and contribute to recognition of practical solutions by a hierarchical structure. The methodology, according to the characteristics of objective affairs, can verify the interdependence among the variables/attributes/criteria and confine the relation that reflects the characteristics with an essential system and evolution trend [5, 20]. The method is a practical and useful tool, especially for visualizing the structure of complex causal relationships with matrices or digraphs. The matrices or digraphs show a contextual relation between the elements of the system, in which a numeral represents the strength of influence of each element. Thus, the DEMATEL technique converts the relationship between the causes and effects of criteria into an intelligible structural model of systems [55]. Recently, DEMATEL technique has been widely applied in a number of disciplines, including airline safety [34], e-learning [53], decision-making [16, 33], knowledge management [48], operations research [39], technology and innovation management [20], marketing and consumer behavior [55], theory validation [24], and others. The structure of DEMATEL and the calculation steps are described as follows.

Step 1: Calculate the direct-influence matrix by scores (depending on the views of experts) and evaluate the relationship among elements (called variables/attributes/criteria) of mutual influence, using the scale ranging from 0 to 4 (indicating "no influence (0)," to "very high influence (4)"). Subjects are asked to indicate the direct effect they believe each element i exerts on every other element j, as indicated by d_{ij}. The matrix $\boldsymbol{D}$ of direct relations is thus obtained, which shows the pairwise comparison of causal relationship. Assume there are n variables that impact the system, the direct-influence matrix $\boldsymbol{D}$ is illustrated as follows.

$$\boldsymbol{D} = \begin{bmatrix} 0 & d_{12} & \cdots & d_{1n} \\ d_{21} & 0 & \cdots & d_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ d_{n1} & d_{n2} & \cdots & 0 \end{bmatrix}$$

Step 2: Normalize the direct-influence matrix: based on the direct-influence matrix $\boldsymbol{D}$, the normalized direct-relation matrix $\boldsymbol{N}$ is acquired using Equations (1) and (2).

$$\boldsymbol{N} = \boldsymbol{D}/u \tag{1}$$

$$u = \max_{i,j}\left\{\max_i \sum_{j=1}^{n} d_{ij}, \max_j \sum_{i=1}^{n} d_{ij}\right\}; \quad i, j \in \{1, 2, \cdots, n\} \tag{2}$$

Step 3: Attain the total-influence matrix: once the normalized direct-influence matrix $\boldsymbol{N}$ by summation for i or j is obtained, the total-influence matrix $\boldsymbol{T}$ is arrived at through Equation (3), in which the $\boldsymbol{I}$ is denoted as the identity matrix.

$$\begin{aligned} \boldsymbol{T} &= \boldsymbol{N} + \boldsymbol{N}^2 + \cdots + \boldsymbol{N}^q \\ &= \boldsymbol{N}\left(\boldsymbol{I} + \boldsymbol{N} + \boldsymbol{N}^2 + \cdots + \boldsymbol{N}^{q-1}\right)\left[(\boldsymbol{I} - \boldsymbol{N})(\boldsymbol{I} - \boldsymbol{N})^{-1}\right] \\ &= \boldsymbol{N}(\boldsymbol{I} - \boldsymbol{N}^q)(\boldsymbol{I} - \boldsymbol{N})^{-1} \end{aligned} \tag{3}$$

If $q \to \infty$, then $\lim_{q\to\infty} \boldsymbol{N}^q = [0]_{n\times n}$, where $\boldsymbol{N} = [d_{ij}]_{n\times n}$, $0 \le d_{ij} < 1$, $0 < (\sum_{j=1}^n d_{ij}, \sum_{i=1}^n d_{ij}) \le 1$, and either $\sum_{j=1}^n d_{ij}$ or $\sum_{i=1}^n d_{ij}$ equals 1, but not all. Based on Equation (3), we may obtain

$$\boldsymbol{T} = \boldsymbol{N}(\boldsymbol{I} - \boldsymbol{N})^{-1} \tag{4}$$

Step 4: Analyze the results: in the stage, the sum of rows (given influence) and the sum of columns (received influence) are separately expressed as influential vector $d = (d_1, \cdots, d_i, \cdots, d_n)'$ by factor j ($j = 1, 2, \cdots, n$) and influential vector $r = (r_1, \cdots, r_j, \cdots, r_n)'$ by factor i ($i = 1, 2, \cdots, n$) using Equations (5)-(7). Then, when $i, j \in \{1, 2, \cdots, n\}$ and $i = j$ the horizontal axis vector $(\boldsymbol{d} + \boldsymbol{r})$ is made by adding vector $\boldsymbol{d}$ to vector $\boldsymbol{r}$, which exhibits total important influence of each criterion. Similarly, the vertical axis vector $(\boldsymbol{d} - \boldsymbol{r})$ is built by deducting vector $\boldsymbol{d}$ from vector $\boldsymbol{r}$, which may separate criteria into a cause group and an effect group. In general, when the value of $d_i - r_i$ is higher, the criterion belongs to the cause group. On the contrary, if the value of $d_i - r_i$ is lower, the criterion belongs to the effect group. Therefore, the impact relation map can be achieved by plotting the data set of $\{(d_i + r_i, d_i - r_i) | i = 1, 2, \cdots, n\}$, which provides a valuable approach for decision-making.

$$\boldsymbol{T} = [t_{ij}]_{n\times n}, \quad i, j \in \{1, 2, \cdots, n\} \tag{5}$$

$$\boldsymbol{d} = \left[\sum_{j=1}^n t_{ij}\right]_{n\times 1} = [t_i]_{n\times 1} = [d_i]_{n\times 1} \tag{6}$$

$$\boldsymbol{r} = \left[\sum_{i=1}^n t_{ij}\right]_{1\times n}' = [t_j]_{n\times 1} = [r_j]_{n\times 1} \tag{7}$$

where vector $\boldsymbol{d} = (d_1, \cdots, d_i, \cdots, d_n)'$ and vector $\boldsymbol{r} = (r_1, \cdots, r_j, \cdots, r_n)'$ express the sum of rows and the sum of columns based on total-influence matrix $\boldsymbol{T} = [t_{ij}]_{n\times n}$, separately.

4. **Empirical Study: Case of Project Success.** The empirical experiment focused on firms that composed the project group. The study included two parts, the exploratory factor analysis, and DEMATEL analysis, described below.

4.1. **Exploratory factor analysis to obtain independent criteria groups.** The questionnaire was sent to several Taiwanese companies that have project groups consisting of Taiwanese working professionals, and it was explained that through the study, they can receive a clearer understanding of which factors are perceived to lead to greater project performance, which ultimately increases the probability of project success. Totally 224 questionnaires were collected for this study; 16 questionnaires were invalid, making 208 useable feedbacks.

In exploratory factor analysis, a clear structure emerged on the third iteration using a kappa rotation of 7. The Kaiser-Meyer-Olkin (KMO) and the Bartlett test are both acceptable on each iteration, with the lowest KMO being 0.949 and the highest Bartlett being 0.000. The Cronbach's α and Pearson Correlation were also both acceptable on each iteration with the lowest α being 0.851 and the lowest correlation being 0.618. After iterations one and two, the original 35-item list reduced to a final 26 items, categorized into eight dimensions. Eigenvalues were all greater than 1 and all item-to-total correlations of items were above the cutoff value 0.5. Table 1 shows the exploratory factor analysis final iteration result, which lists the dimension and criteria extracted from our original 35 internal factors.

Table 1. Dimension and criteria extracted

Extracted Dimensions	Items/Criteria	Factor Loading	Eigenvalues (Rotated)	Item-to-Total Correlation
Synergy (D_1)	Work Loading (C_{11})	1.22	14.27	0.79
	Accessible (C_{12})	0.95		0.84
	Reliable (C_{13})	0.90		0.79
	Considerate (C_{14})	0.87		0.83
	Coordination (C_{15})	0.83		0.87
	Help each other (C_{16})	0.81		0.84
	Cooperation (C_{17})	0.74		0.86
	Consensus (C_{18})	0.68		0.83
	Shared objective (C_{19})	0.63		0.75
Competence (D_2)	Trouble-shooting (C_{21})	0.95	12.08	0.80
	Handle deviations (C_{22})	0.93		0.86
	Positive/proactive (jiji) (C_{23})	0.86		0.85
	Responsible (C_{24})	0.80		0.81
Attitude (D_3)	Polite (ke-chi) (C_{31})	1.08	9.93	0.77
	Friendly (chin-chieh) (C_{32})	0.86		0.79
	Patience (C_{33})	0.69		0.70
Relationship (D_4)	Learning culture (C_{41})	1.04	11.62	0.69
	Client satisfaction (C_{42})	0.81		0.79
	Bureaucracy (C_{43})	0.59		0.68
Consideration (D_5)	Shows empathy (C_{51})	0.85	10.43	0.75
	Competent (C_{52})	0.84		0.73
	Effective (C_{53})	0.53		0.69
Risk Exposure (D_6)	Risk exposure (C_{61})	0.86	4.92	N/A
	Change orders and claims (C_{62})	0.80		N/A
Litigation (D_7)	Litigation (C_{71})	0.91	3.71	N/A
Personnel Connection (D_8)	Personnel connection (C_{81})	0.84	2.49	N/A

4.2. **DEMATEL method to find the interrelation between entwined criteria.** According to the factor analysis results, 50 experts were invited to discuss the relationship and influence level of criteria under the same factor, and to score the relationship among criteria based on the DEMATEL method. These experts were the certified Project Management Professional (PMP) of the Project Management Institute (PMI) with at least ten years' project management experience.

The initial direct-influence matrix $\boldsymbol{D}$ was then produced as shown in Table 2. Based on the direct-influence matrix, according to Equation (2), $u = 60.64$. The normalized direct-influence matrix $\boldsymbol{N}$, as shown in Table 3, was then retrieved based on Equation (1). Subsequently, the total-influence matrix $\boldsymbol{T}$ was calculated as displayed in Table 4. The degree of influence in dimension level and criteria level are presented in Table 5 and Table 6, respectively. Based on the above analysis, the comprehensive impact relation map can be generated as illustrated in Figure 1.

5. **Discussion and Implication.** The proposed hybrid method combining exploratory factor analysis and the DEMATEL technique has proven to be an effective model for evaluating complex psychological intertwined effects. Based on our empirical experiments, exploratory factor analysis was used to classify each element/criteria into eight independent factors/dimensions. Those criteria under the same dimension had some interrelations with each other. The direct/indirect influential relationship of criteria was figured using the DEMATEL technique.

TABLE 2. Direct-influence matrix $\boldsymbol{D}$

	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{18}	C_{19}	C_{21}	C_{22}	C_{23}	C_{24}	C_{31}	C_{32}	C_{33}	C_{41}	C_{42}	C_{43}	C_{51}	C_{52}	C_{53}	C_{61}	C_{62}	C_{71}	C_{81}
C_{11}	0	3.38	1.32	3.18	2.96	3.56	3.22	2.16	0.98	2.5	3.2	1.04	1.9	2.68	2.56	3.64	0.78	1.64	2.8	2.92	1.52	3.52	3.38	2.58	2.74	0.48
C_{12}	0.96	0	1.44	1.92	1.62	2.84	1.66	2.52	1.44	0.68	0.62	0.78	0.7	0.48	0.6	0.5	2.96	3.38	0.08	0.58	0.42	0.46	0.2	0.1	0.18	3.76
C_{13}	2.1	0.98	0	0.38	0.4	0.44	0.4	0.3	0.36	0.68	0.86	1.02	3.6	1.64	1.9	1.46	0.52	3.58	0.04	0.96	2.5	0.78	0.06	0.04	0.08	3.08
C_{14}	0.4	3.18	0.62	0	1.04	3.52	2.9	2.54	0.78	0.48	1.02	0.44	0.4	1.04	1.9	1.32	0.4	2.78	0.06	3.6	0.38	0.36	0.18	0.04	0.02	3.24
C_{15}	2.12	0.74	0.42	1.04	0	3.34	2.68	3.02	2.84	3.14	3.2	1.1	0.76	1.26	0.84	2.78	0.78	3.32	0.06	1.52	2.3	2.82	0.04	0.04	0.1	1.58
C_{16}	2.62	3.26	1.22	3.44	0.92	0	3.58	0.94	0.66	0.92	0.68	1	0.7	0.72	1.52	0.78	1.58	1.38	0.04	0.82	0.5	0.8	0.22	0.08	0.12	3.38
C_{17}	0.78	0.6	0.3	0.4	0.68	3.18	0	3.36	3.5	0.72	0.48	0.26	0.84	0.44	0.34	0.24	2.54	1.72	0.06	0.2	0.38	2.88	0.12	0.06	0.84	2.76
C_{18}	0.62	0.4	0.32	0.7	0.8	0.66	0.84	0	3.12	0.62	0.72	0.06	0.32	0.28	0.1	0.08	2.24	2.58	0.08	0.22	0.2	2.86	0.1	0.06	0.04	0.66
C_{19}	0.32	1.46	0.48	0.26	1.06	1.38	1.46	2.38	0	0.74	0.96	0.1	0.68	0.1	0.06	0.08	0.9	2.94	0.1	0.06	0.12	3.1	0.06	0.08	0.02	0.32
C_{21}	1.9	0.26	0.4	0.28	2.36	0.86	0.56	0.38	0.28	0	1.14	0.5	0.58	0.38	0.32	3.32	0.32	2.88	0.1	0.42	3.36	1.46	0.08	1.32	0.26	0.38
C_{22}	0.48	0.52	0.3	0.98	2.56	0.46	0.82	0.74	1.38	2.26	0	0.9	0.44	0.94	0.66	1.28	0.56	2.78	0.04	0.36	3.06	0.94	0.06	0.08	0.96	0.5
C_{23}	2.46	0.56	0.38	0.34	0.32	1.04	0.68	0.44	0.32	0.16	0.36	0	1.76	0.44	0.4	0.26	2.18	2.7	0.04	0.2	2.54	1.9	0.22	0.04	0.78	1.84
C_{24}	1.98	0.4	0.46	0.32	0.34	0.42	0.36	0.34	0.3	0.22	0.24	0.96	0	0.26	0.24	0.12	1.06	1.58	0.06	0.16	0.52	0.3	0.08	0.06	0.2	0.66
C_{31}	0.9	3.18	0.42	0.64	2.96	0.78	0.48	0.5	0.38	0.16	0.66	0.42	0.28	0	2.1	0.74	2.28	3.34	0.04	0.26	0.14	0.4	0.1	0.06	0.04	3.52
C_{32}	0.94	3.62	0.86	0.74	0.64	0.82	0.86	0.6	0.64	0.38	0.42	0.54	0.58	1.34	0	0.64	1	3.3	0.04	1.06	0.5	0.7	0.1	0.06	0.02	3.78
C_{33}	0.96	1.18	0.54	0.4	1.38	0.36	0.24	0.2	0.16	0.1	1.84	0.2	0.4	0.3	0.26	0	1.52	2.36	0.08	0.42	0.36	1.22	0.06	0.04	0.04	2.58
C_{41}	0.4	0.62	0.3	0.2	0.96	1.58	1.82	1.7	2.02	0.32	0.66	0.1	0.2	0.18	0.14	0.06	0	2.12	1	0.1	0.16	1.38	1.34	1.4	0.86	0.5
C_{42}	2.16	0.26	0.1	0.14	1.84	0.72	1.76	0.48	2.58	0.56	0.62	0.4	0.28	0.38	0.5	0.36	2.16	0	0.04	0.28	0.54	0.7	0.06	0.04	0.04	2.7
C_{43}	3.36	0.02	0	0	0.22	0	0.32	0.38	0.1	0.22	0.2	0	0.04	0	0	0	0.7	0	0	0	0	0.02	1.64	3.7	3.8	0
C_{51}	0.58	2.3	0.38	3.58	0.44	3.12	1.04	0.62	0.48	0.26	0.44	0.5	0.38	1.16	1.32	0.74	1.44	2.1	0.04	0	0.3	0.56	0.12	0.06	0.04	3.12
C_{52}	1.92	0.22	0.12	0.08	0.18	0.92	0.68	0.24	0.32	2.26	1.96	0.38	0.52	0.08	0.08	0.1	1.44	2.92	0.04	0.12	0	1.78	0.06	0.04	0.06	0.56
C_{53}	0.66	0.38	1.02	0.28	0.62	0.22	0.54	0.64	0.44	0.32	1.42	1.36	0.38	0.12	0.1	0.4	1.62	2.4	0.04	0.18	1.08	0	0.1	0.04	0.06	0.2
C_{61}	2.12	0.08	0.06	0.08	0.06	0.04	0.06	0.04	0.04	0.16	0.06	0.04	0.06	0.04	0.02	0.04	0.8	0	2.38	0.06	0.04	0.04	0	3.52	3.62	0
C_{62}	3.54	0	0	0.16	1.58	0.12	1.38	1.32	1.16	2.16	2.1	0	0.06	0	0	0.3	1.1	0	0.3	0.1	0.04	0.2	3.6	0	3.5	0
C_{71}	0.1	0	0	0	0	0	0	0	0	0.06	0	0	0	0	0	0	0	0	0.88	0	0	0	3.9	3.4	0	0
C_{81}	1.06	3.16	1.38	1.28	3.6	1.7	1.52	2.92	1.3	1.18	1.58	0.84	0.64	2.58	2.06	0.4	1.46	3.02	0.04	1.16	0.5	0.86	0.1	0.06	0.04	0

TABLE 3. Normalized direct-influence matrix $\boldsymbol{N}$ $(\times 10^{-4})$

	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{18}	C_{19}	C_{21}	C_{22}	C_{23}	C_{24}	C_{31}	C_{32}	C_{33}	C_{41}	C_{42}	C_{43}	C_{51}	C_{52}	C_{53}	C_{61}	C_{62}	C_{71}	C_{81}
C_{11}	0	557	218	524	488	587	531	356	162	412	528	172	313	442	422	600	129	270	462	482	251	580	557	425	452	79
C_{12}	158	0	237	317	267	468	274	416	237	112	102	129	115	79	99	82	488	557	13	96	69	76	33	16	30	620
C_{13}	346	162	0	63	66	73	66	49	59	112	142	168	594	270	313	241	86	590	7	158	412	129	10	7	13	508
C_{14}	66	524	102	0	172	580	478	419	129	79	168	73	66	172	313	218	66	458	10	594	63	59	30	7	3	534
C_{15}	350	122	69	172	0	551	442	498	468	518	528	181	125	208	139	458	129	547	10	251	379	465	7	7	16	261
C_{16}	432	538	201	567	152	0	590	155	109	152	112	165	115	119	251	129	261	228	7	135	82	132	36	13	20	557
C_{17}	129	99	49	66	112	524	0	554	577	119	79	43	139	73	56	40	419	284	10	33	63	475	20	10	139	455
C_{18}	102	66	53	115	132	109	139	0	515	102	119	10	53	46	16	13	369	425	13	36	33	472	16	10	7	109
C_{19}	53	241	79	43	175	228	241	392	0	122	158	16	112	16	10	13	148	485	16	10	20	511	10	13	3	53
C_{21}	313	43	66	46	389	142	92	63	46	0	188	82	96	63	53	547	53	475	16	69	554	241	13	218	43	63
C_{22}	79	86	49	162	422	76	135	122	228	373	0	148	73	155	109	211	92	458	7	59	505	155	10	13	158	82
C_{23}	406	92	63	56	53	172	112	73	53	26	59	0	290	73	66	43	359	445	7	33	419	313	36	7	129	303
C_{24}	327	66	76	53	56	69	59	56	49	36	40	158	0	43	40	20	175	261	10	26	86	49	13	10	33	109
C_{31}	148	524	69	106	488	129	79	82	63	26	109	69	46	0	346	122	376	551	7	43	23	66	16	10	7	580
C_{32}	155	597	142	122	106	135	142	99	106	63	69	89	96	221	0	106	165	544	7	175	82	115	16	10	3	623
C_{33}	158	195	89	66	228	59	40	33	26	16	303	33	66	49	43	0	251	389	13	69	59	201	10	7	7	425
C_{41}	66	102	49	33	158	261	300	280	333	53	109	16	33	30	23	10	0	350	165	16	26	228	221	231	142	82
C_{42}	356	43	16	23	303	119	290	79	425	92	102	66	46	63	82	59	356	0	7	46	89	115	10	7	7	445
C_{43}	554	3	0	0	36	0	53	63	16	36	33	0	7	0	0	0	115	0	0	0	0	3	270	610	627	0
C_{51}	96	379	63	590	73	515	172	102	79	43	73	82	63	191	218	122	237	346	7	0	49	92	20	10	7	515
C_{52}	317	36	20	13	30	152	112	40	53	373	323	63	86	13	13	16	237	482	7	20	0	294	10	7	10	92
C_{53}	109	63	168	46	102	36	89	106	73	53	234	224	63	20	16	66	267	396	7	30	178	0	16	7	10	33
C_{61}	350	13	10	13	10	7	10	7	7	26	10	7	10	7	3	7	132	0	392	10	7	7	0	580	597	0
C_{62}	584	0	0	26	261	20	228	218	191	356	346	0	10	0	0	49	181	0	49	16	7	33	594	0	577	0
C_{71}	16	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	145	0	0	0	643	561	0	0
C_{81}	175	521	228	211	594	280	251	482	214	195	261	139	106	425	340	66	241	498	7	191	82	142	16	10	7	0

Table 4. Total-influence matrix $\boldsymbol{T}$ ($\times 10^{-4}$)

	C_{11}	C_{12}	C_{13}	C_{14}	C_{15}	C_{16}	C_{17}	C_{18}	C_{19}	C_{21}	C_{22}	C_{23}	C_{24}	C_{31}	C_{32}	C_{33}	C_{41}	C_{42}	C_{43}	C_{51}	C_{52}	C_{53}	C_{61}	C_{62}	C_{71}	C_{81}
C_{11}	367	875	360	755	800	930	856	671	459	635	790	314	464	608	605	802	488	838	539	647	468	880	702	587	628	530
C_{12}	344	211	324	453	467	680	495	623	444	242	258	211	215	201	225	198	686	885	53	205	188	282	92	73	89	863
C_{13}	517	346	80	182	256	250	235	206	208	230	285	247	673	377	421	343	273	882	45	248	517	290	65	57	69	723
C_{14}	259	754	204	187	383	818	696	635	344	209	318	163	165	300	445	330	312	817	39	691	178	263	75	48	55	846
C_{15}	582	370	181	352	265	801	693	728	700	685	729	290	247	341	280	618	400	982	58	370	556	737	78	78	97	570
C_{16}	608	766	304	716	374	275	811	404	320	290	282	256	229	258	392	266	485	602	56	273	213	347	109	79	96	845
C_{17}	275	264	129	182	276	677	183	717	734	222	209	114	212	159	146	125	588	564	44	107	155	650	76	64	185	626
C_{18}	198	163	101	177	240	224	258	120	620	173	208	59	103	98	71	76	478	609	37	86	103	588	51	45	42	228
C_{19}	163	326	130	117	282	340	358	500	134	197	247	71	165	71	66	80	282	671	35	60	99	626	39	42	37	193
C_{21}	469	170	125	142	530	290	244	193	181	128	339	147	167	142	132	644	206	714	53	145	652	397	76	264	106	237
C_{22}	228	207	104	240	554	228	278	255	360	478	133	207	140	224	181	310	240	708	32	130	606	312	54	60	196	256
C_{23}	534	224	125	150	192	313	257	202	179	127	179	63	355	152	148	125	497	661	51	105	496	448	102	67	186	450
C_{24}	398	145	110	111	138	158	147	133	123	93	108	191	45	93	91	76	253	383	38	73	139	135	54	47	72	200
C_{31}	302	691	151	224	662	324	267	272	241	147	249	144	125	109	446	225	549	837	39	137	127	227	64	54	54	800
C_{32}	300	757	221	242	287	319	310	273	262	164	193	159	174	321	108	195	347	815	35	258	173	258	59	49	47	838
C_{33}	260	302	141	145	354	183	162	153	142	103	397	87	120	124	115	73	363	579	38	130	140	306	46	40	45	553
C_{41}	192	193	94	104	262	368	415	395	451	134	198	61	83	81	76	70	125	516	195	63	90	348	278	289	212	206
C_{42}	464	184	79	118	441	278	433	239	554	194	223	122	114	147	163	149	481	232	44	118	174	276	63	56	60	579
C_{43}	645	69	28	57	120	79	138	138	81	113	119	26	43	45	43	64	178	84	64	47	43	84	404	714	734	49
C_{51}	246	582	148	715	251	706	369	289	237	144	197	155	140	296	336	216	414	633	34	112	138	237	63	48	50	761
C_{52}	418	128	66	86	153	257	225	136	157	447	411	113	138	74	74	103	340	648	38	74	93	402	55	54	58	204
C_{53}	198	131	199	96	187	125	178	184	163	117	302	259	113	66	64	119	356	542	27	70	247	96	47	36	44	139
C_{61}	443	62	31	55	76	64	79	68	56	88	78	25	37	39	35	53	182	63	435	44	38	63	128	680	698	38
C_{62}	702	105	48	114	385	157	351	338	305	458	458	49	71	71	67	160	287	188	129	87	108	184	701	137	688	102
C_{71}	95	12	6	12	30	16	28	27	23	44	34	5	8	8	8	15	31	18	182	10	11	17	698	624	95	10
C_{81}	380	735	322	368	803	529	484	701	443	347	434	234	216	544	469	214	480	891	45	306	233	371	73	64	68	315

TABLE 5. Influence of concern factors in the dimension level

	d_i	r_i	$d_i + r_i$	$d_i - r_i$
D_1	0.2676	0.2185	0.4861	0.0492
D_2	0.1748	0.1462	0.3210	0.0287
D_3	0.2083	0.1409	0.3493	0.0674
D_4	0.1723	0.2468	0.4191	−0.0746
D_5	0.1576	0.1567	0.3143	0.0009
D_6	0.1895	0.1765	0.3660	0.0131
D_7	0.0917	0.1575	0.2492	−0.0659
D_8	0.2473	0.2660	0.5133	−0.0187

TABLE 6. Influence of concern factors in the criteria level

	d_i	r_i	$d_i + r_i$	$d_i - r_i$
C_{11}	1.6598	0.9587	2.6185	0.7011
C_{12}	0.9005	0.8771	1.7776	0.0234
C_{13}	0.8021	0.3812	1.1833	0.4210
C_{14}	0.9532	0.6098	1.5630	0.3434
C_{15}	1.1789	0.8766	2.0555	0.3024
C_{16}	0.9657	0.9388	1.9045	0.0269
C_{17}	0.7684	0.8949	1.6633	−0.1266
C_{18}	0.5156	0.8601	1.3757	−0.3446
C_{19}	0.5330	0.7920	1.3250	−0.2589
C_{21}	0.6893	0.6211	1.3105	0.0682
C_{22}	0.6722	0.7378	1.4100	−0.0656
C_{23}	0.6389	0.3773	1.0162	0.2616
C_{24}	0.3556	0.4563	0.8118	−0.1007
C_{31}	0.7468	0.4947	1.2415	0.2521
C_{32}	0.7163	0.5205	1.2368	0.1957
C_{33}	0.5101	0.5650	1.0751	−0.0548
C_{41}	0.5497	0.9320	1.4817	−0.3824
C_{42}	0.5986	1.5364	2.1350	−0.9378
C_{43}	0.4211	0.2386	0.6597	0.1824
C_{51}	0.7515	0.4594	1.2109	0.2921
C_{52}	0.4952	0.5986	1.0938	−0.1034
C_{53}	0.4106	0.8824	1.2930	−0.4718
C_{61}	0.3657	0.4253	0.7910	−0.0596
C_{62}	0.6449	0.4351	1.0801	0.2098
C_{71}	0.2067	0.4713	0.6781	−0.2646
C_{81}	1.0068	1.1162	2.1230	−0.1093

A clear structure of the team-internal impact factors for project performance within the Taiwanese cultural context was created through exploratory factor analysis (see Table 1). By combining the 26 attributes of ISQ from Stanworth et al. [50], two trouble-shooting attributes from Pinto and Prescott [43], and the seven relationship attributes from Jin and Ling [25], the final scale investigated in this study comprised 35 attributes. Exploratory factor analysis was then conducted to extract a final structure of eight dimensions and 26 criteria: Synergy (9 criteria), Competence (4 criteria), Attitude (3 criteria), Relationship

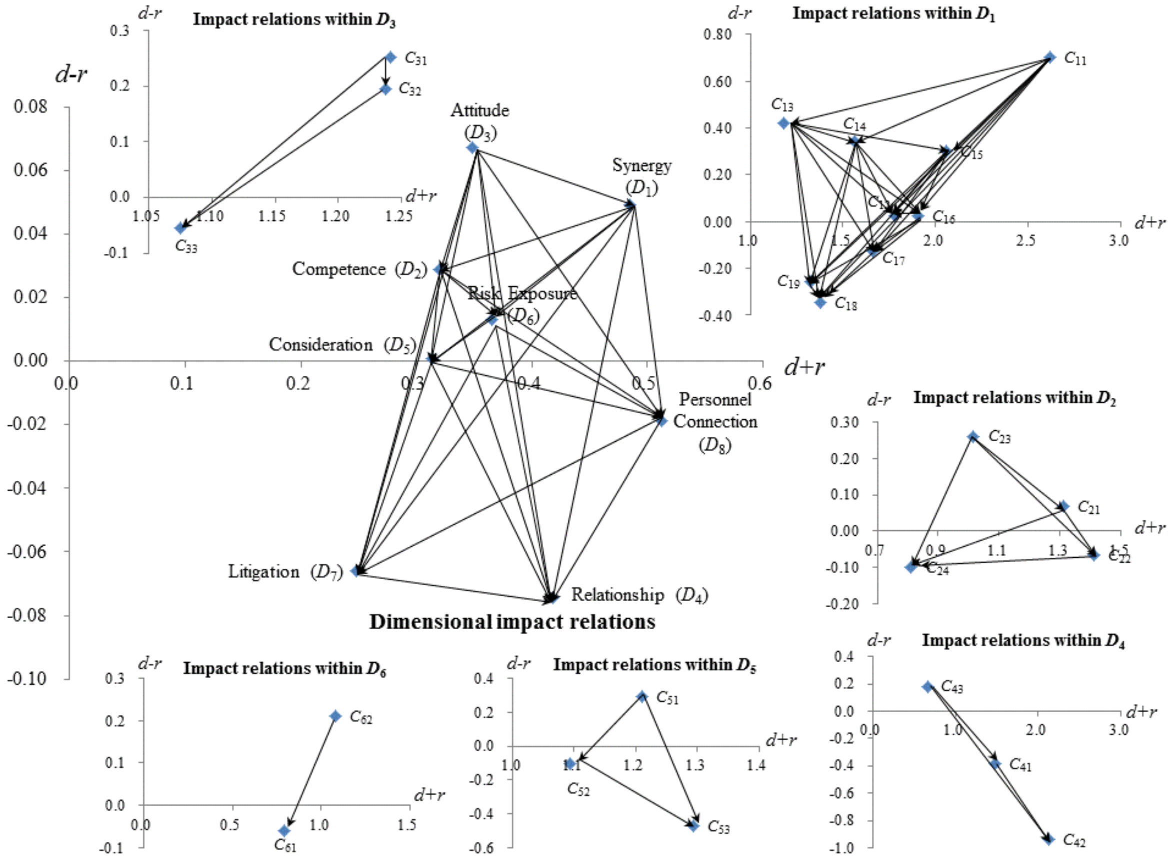

FIGURE 1. Comprehensive dimension and criteria impact relation map

(3 criteria), Consideration (3 criteria), Risk Exposure (2 criteria), Litigation (1 criterion), and Personnel Connection (1 criterion) (see Table 1).

According to DEMATEL analysis, the factors showing greater values of d_i+r_i intensely affect the others, the factors showing lesser values of d_i-r_i are intensely affected by the others. Figure 1 shows a clear picture of intertwined effect between dimensions and criteria.

Based on Figure 1, in the dimensional level, attitude (D_3) plays a significant role that highly influences other internal factors towards project success. However, relationship (D_4) is impacted by all dimensions. Personal connection (D_8) highly relates with other dimensions. Furthermore in cross-dimensional, work loading (C_{11}) is a key factor that greatly influences all other criteria, while ultimately meeting customer satisfaction (C_{42}). Bureaucracy (C_{43}) and litigation (C_{71}) show less relationship with other factors.

Project leadership requires more than mere technical competence and encompasses the ability to manage a team. Kloppenborg and Petrick [29] stated that skills in managing relationships are critical to satisfy stakeholders through all stages of the project. Creating right relationships between team members is one of the largest challenges project managers face [3, 40, 52]. Whitty [56] mentioned, "projects are simply a synthesis of human sensations and expectations about how multiple resources are to be used" (p.577). Ropponen and Lyytinen [46] indicated that personnel management is one of the major risk components in software development projects. The above evidences highlight the importance of understanding the interrelation of project team internal factors. Operationally, Okuhara et al. [38] proposed a genetic algorithm method to the worker and workload assignment problem in project management. However, the approach omits the human factors internally within the project team which may eventually impact the success of project.

The result of this study clearly shows the intertwined effects of team internal factors on project success. Because workloading is a key influencer, when more resources such as people, are needed than are available, the project manager needs to reschedule tasks concurrently or even sequentially to manage the constraint. The project manager should apply resource leveling to resolve schedule conflicts instead of overloading work to a single resource. The project team should emphasize positive attitude to create a harmonious working environment to further build team synergy. From the internal service point of view, Jeng [23] stated that rewards and recognition can be the best strategy to enhance internal service operation of a team.

6. **Concluding Remarks.** This research proposed a hybrid method combining factor analysis and the DEMATAL technique. Supported by previous qualitative studies, exploratory factor analysis was applied to extract a clear factor structure consisting of dimension and criteria. Then, the DEMATEL technique was utilized to analyze the intertwined effect between the extracted dimension and criteria. The proposed method is capable of analyzing the interrelation of complex human factors in social science research.

The impact relation map provides the project manager a clear picture on the affect of internal factors on project performance. A project manager may set strategies to better manage the working environment and team atmosphere. The result provides directions to enhance team synergy, increase relationships, and ultimately achieve project success. This study also provides information for a company to further adopt an effective training agenda and employee assistance programs (EAPs) to improve the working atmosphere of a project team. Future research may extend the proposed hybrid method with multiple criteria decision-making (MCDM) on managing project portfolio, for instance, fuzzy MCDM algorithm [10, 23], and grey relational analysis (GRA) [20].

Acknowledgement. The author would like to thank the anonymous reviewers for their valuable comments and suggestions to improve the quality of the paper. He is also grateful to Dr. James Stanworth for introducing the ISQ problem, along with discussion; and to Johanna Owen and Logan Reittinger for their assistance and literature survey.

REFERENCES

[1] R. Atkinson, Project management: Cost, time and quality, two best guesses and a phenomenon, its time to accept other success criteria, *International Journal of Project Management*, vol.17, no.6, pp.337-342, 1999.

[2] P. Bromiley and L. L. Cummings, Transactions costs in organizations with trust, *Research on Negotiation in Organizations*, vol.5, pp.219-250, 1995.

[3] A. Bucero, Smart emotions, *PM Network*, vol.18, no.11, pp.22, 2004.

[4] D. M. Cable and T. A. Judge, Person-organization fit, job choice decisions, and organizational entry, *Organizational Behavior and Human Decision Processes*, vol.67, no.3, pp.294-311, 1996.

[5] Y. J. Chiu, H. C. Chen, G. H. Tzeng and J. Z. Shyu, Marketing strategy based on customer behaviour for the LCD-TV, *International Journal of Management and Decision Making*, vol.7, no.2-3, pp.143-165, 2006.

[6] T. Cooke-Davies, The "real" success factors on projects, *International Journal of Project Management*, vol.20, no.3, pp.185-190, 2002.

[7] A. De Wit, Measurement of project success, *International Journal of Project Management*, vol.6, no.3, pp.164-170, 1988.

[8] W. Deng, S. Chiang, C. Tsai and S. Tsai, The relationship of internal service quality, external service quality and overall customer satisfaction, *Quality Monthly*, vol.43, no.10, pp.52-58, 2007.

[9] W. Deng, M. Lin and C. Tsai, Employee satisfaction as the foundation for assessing internal service quality: An international hotel example, *Quality Monthly*, vol.41, no.11, pp.79-83, 2005.

[10] J.-F. Ding, Fuzzy MCDM approach for selecting strategic partner: An empirical study of a container shipping company in Taiwan, *International Journal of Innovative Computing, Information and Control*, vol.5, no.4, pp.1055-1068, 2009.

[11] E. Fontela and A. Gabus, The DEMATEL observer, *DEMATEL 1976 Report*, Battelle Geneva Research Center, Geneva, Switzerland, 1976.

[12] A. Gabus and E. Fontela, Perceptions of the world problematique: Communication procedure, communicating with those bearing collective responsibility, *DEMATEL Report No. 1*, Battelle Geneva Research Center, Geneva, Switzerland, 1973.

[13] G. Gao, "Don't take my word for it." – Understanding Chinese speaking practices, *International Journal of Intercultural Relations*, vol.22, no.2, pp.163-186, 1998.

[14] D. D. Gremler, M. J. Bitner and K. R. Evans, The internal service encounter, *International Journal of Service Industry Management*, vol.5, no.2, pp.34-56, 1994.

[15] J. S. Hair, R. E. Anderson, R. L. Tetham and W. C. Black, *Multivariate Data Analysis*, 5th Edition, Prentice Hall, NJ, 1998.

[16] M. Hajime and I. Kenichi, Systematic decision making process for identifying the contradictions to be tackled by TRIZ to accomplish product innovation, *Journal of Automation, Mobile Robotics & Intelligent Systems*, vol.1, no.4, pp.21-29, 2007.

[17] G. Hofstead, Cultural dimensions in management and planning, *Asia Pacific Journal of Management*, vol.1, no.2, pp.81-99, 1984.

[18] G. Hofstede and M. H. Bond, The Confucius connection: From cultural roots to economic growth, *Organizational Dynamics*, vol.16, no.4, pp.4-21, 1988.

[19] G. Hofstede, B. Neuijen, D. D. Ohayv and G. Sanders, Measuring organizational cultures: A qualitative and quantitative study across twenty cases, *Administrative Science Quarterly*, vol.35, no.2, pp.286-316, 1990.

[20] C. Y. Huang and G. H. Tzeng, Reconfiguring the innovation policy portfolios for Taiwan's SIP mall industry, *Technovation*, vol.27, no.12, pp.744-765, 2007.

[21] K.-K. Hwang, The deep structure of Confucianism: A social psychological approach, *Asian Philosophy: An International Journal of the Philosophical Traditions of the East*, vol.11, no.3, pp.179-204, 2001.

[22] B.-S. Jaw, Y.-H. Ling, C. Y.-P. Wang and W.-C. Chang, The impact of culture on Chinese employees' work values, *Personnel Review*, vol.36, no.5, pp.763-780, 2007.

[23] D. J.-F. Jeng, Selection of an improvement strategy in internal service operations: The MCDM approach with fuzzy AHP and nonadditive fuzzy integral, *International Journal of Innovative Computing, Information and Control*, vol.8, no.8, pp.5917-5933, 2012.

[24] D. J.-F. Jeng and G. H. Tzeng, Social influence on the use of clinical decision support systems: Revisiting the unified theory of acceptance and use of technology by the fuzzy DEMATEL technique, *Computers & Industrial Engineering*, 2012.

[25] X.-H. Jin and F. Y. Y. Ling, Key relationship-based determinants of project performance in China, *Building and Environment*, vol.41, no.7, pp.915-925, 2006.

[26] K. Jugdev and R. Muller, A restropective look at our evolving understanding of project success, *Project Management Journal*, vol.36, no.4, pp.19-31, 2005.

[27] R. Katz, The effects of group longevity on project communication and performance, *Administrative Science Quarterly*, vol.27, no.1, pp.81-104, 1982.

[28] A. Y.-C. King, Kuan-hsi and network building: A sociological interpretation, *Daedalus*, vol.120, no.2, pp.63-84, 1991.

[29] T. Kloppenborg and J. Petrick, Leadership in project life cycle and team character development, *Project Management Journal*, vol.30, no.2, pp.8-13, 1999.

[30] A. Lester, *Project Management, Planning and Control*, 5th Edition, Butterworth-Heinemann, Oxford, 2007.

[31] J. F. Liao, C. H. J. Wu, Y. H. Jou and Y. Y. Huang, A study of the relationship between of internal marketing, job satisfaction and customer-oriented behaviors, *Sun Yat-Sen Management Review*, vol.12, no.5, pp.181-201, 2004.

[32] C. S. Lim and M. Z. Mohamed, Criteria of project success: An exploratory re-examination, *International Journal of Project Management*, vol.17, no.4, pp.243-248, 1999.

[33] F.-T. Lin, Time-cost tradeoff problem based on confidence-interval estimates and level (1-α) fuzzy numbers, *International Journal of Innovative Computing, Information and Control*, vol.4, no.10, pp.2551-2564, 2008.

[34] J. J. H. Liou, L. Yen and G. H. Tzeng, Building an effective safety management system for airlines, *Journal of Air Transport Management*, vol.14, no.1, pp.20-26, 2008.

[35] C. J. Lin and W. W. Wu, A causal analytical method for group decision-making under fuzzy environment, *Expert Systems with Applications*, vol.34, no.1, pp.205-213, 2008.

[36] I. Y. Lu and Y. H. Cheng, The study on the relationships among the factors of internal service quality, service ability, job satisfaction and external service quality: The case of nurse, *Journal of Quality*, vol.14, no.2, pp.161-179, 2007 (in Chinese).

[37] J. E. McGrath, Time, interaction, and performance (TIP): A theory of groups, *Small Group Research*, vol.22, no.2, pp.147-174, 1991.

[38] K. Okuhara, J. Shibata and H. Ishii, Adaptive worker's arrangement and workload control for project management by generic algorithm, *International Journal of Innovative Computing, Information and Control*, vol.3, no.1, pp.175-188, 2007.

[39] Y. P. Ou Yang, H. M. Shieh, J. D. Leu and G. H. Tzeng, A novel hybrid MCDM model combined with DEMATEL and ANP with applications, *International Journal of Operational Research*, vol.5, no.3, pp.160-168, 2008.

[40] I. Pant and B. Baroudi, Project management education: The human skills imperative, *International Journal of Project Management*, vol.26, no.2, pp.124-128, 2008.

[41] A. Paraskevas, Internal service encounters in hotels: An empirical study, *International Journal of Contemporary Hospitality Management*, vol.13, no.6, pp.285-292, 2001.

[42] A. Parasuraman, L. L. Berry and V. A. Zeithaml, Perceived service quality as a customer-based performance measure: An empirical examination of organizational barriers using an extended service quality model, *Human Resource Management*, vol.30, no.3, pp.335-364, 1991.

[43] J. K. Pinto and J. E. Prescott, Variations in critical success factors over the stages in the project life cycle, *Journal of Management*, vol.14, no.1, pp.5-18, 1988.

[44] J. K. Pinto and D. P. Slevin, Critical factors in successful project implementation, *IEEE Transactions on Engineering Management*, vol.34, no.1, pp.22-27, 1987.

[45] J. Reynoso and B. Moores, Towards the measurement of internal service quality, *International Journal of Service Industry Management*, vol.6, no.3, pp.64-83, 1995.

[46] J. Ropponen and K. Lyytinen, Components of software development risk: How to address them? A project manager survey, *IEEE Transactions on Software Engineering*, vol.26, no.2, pp.98-112, 2000.

[47] S. H. Schwartz and L. Sagiv, Identifying culture-specifics in the content and structure of values, *Journal of Cross-Cultural Psychology*, vol.26, no.1, pp.92-116, 1995.

[48] Y. Shi, Y. Peng, G. Kou and Z. Chen, Classifying credit card accounts for business intelligence and decision making: A multiple-criteria quadratic programming approach, *International Journal of Information Technology and Decision Making*, vol.4, no.4, pp.581-599, 2005.

[49] L. L. Stanley and J. D. Wisner, Internal service quality in purchasing: An empirical study, *Journal of Supply Chain Management*, vol.34, no.3, pp.50-60, 1998.

[50] J. Stanworth, S. Chen and R. Hsu, *Understanding Chinese Employees' (Dis)Satisfaction in the Internal Service Encounter*, Unpublished Research Article, National Changhua University of Education, Changhua, Taiwan, 2009.

[51] E. F. Stone-Romero and D. L. Stone, Cognitive, affective, and cultural influences on stigmatization: Impact on human resource management processes and practices, *Research in Personnel and Human Resources Management*, vol.26, pp.111-161, 2007.

[52] H. J. Thamhain, Linkages of project environment to performance: Lessons for team leadership, *International Journal of Project Management*, vol.22, no.7, pp.533-544, 2004.

[53] G. H. Tzeng, Y. P. Ou Yang, C. T. Lin and C. B. Chen, Hierarchical MADM with fuzzy integral for evaluating enterprise intranet web sites, *Information Sciences*, vol.169, no.3-4, pp.409-426, 2005.

[54] X. Wang and J. Huang, The relationships between key stakeholders' project performance and project success: Perceptions of Chinese construction supervising engineers, *International Journal of Project Management*, vol.24, no.3, pp.253-260, 2006.

[55] P. L. Wei, J. H. Huang, G. H. Tzeng and S. I. Wu, Causal modeling of web-advertising effects by improving SEM based on DEMATEL technique, *International Journal of Information Technology & Decision Making*, vol.9, no.5, pp.799-829, 2010.

[56] S. J. Whitty, A memetic paradigm of project management, *International Journal of Project Management*, vol.23, no.8, pp.575-583, 2005.