AN ASSESSMENT MODEL – THE EFFICIENCY OF CONSULTANTS WHEN DEALING WITH DELAYS IN CONSTRUCTION PROJECTS IN LIBYA

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The consultant plays an important role in monitoring and checking project time schedules and protecting the owner from any claims -which are the most problematic tasks. There is no existing scale with which to determine the consultant's efficiency, therefore developing an assessment technique is crucial. This research has been conducted by obtaining opinions from a field survey of Libyan experts in construction project supervision during the execution phase. The main objective is to develop a model to assess consultant's efficiency relating to construction projects delays. By applying this model to Libyan consultants, their level of efficiency can be measured. This model will also help the owner in selecting a consultant organization, and will help the consultant to improve their human resource management and professional development.

Keywords: Assessment model, Consultant offices, Delays, Efficiency, Supervision.

INTRODUCTION

All the studies that have been made relating to problems of delays in construction projects agree that most of these projects – if not all – are subject to delays. The construction industry throughout the world faces a variety of challenges concerning delays. Of course, Libyan construction projects have the same challenges and sometimes to a greater degree. This has been proven by the reports of The Public Committee of Projects Monitoring and Follow-up 2004, and also by most of the court cases between contractors and owners; the government mainly is the owner of all large construction projects in Libya, therefore it has to carry the massive additional costs caused by any delays.

The project life cycle goes through three main stages. These are; design, construction, and operation and maintenance period (defect liability period).

The construction stage is the execution of the work in accordance with the contractual agreement. Delay in Libya mainly occurs at this stage (Abounahia, 1998).

To maintain the project stages, the owner in Libya usually makes three contracts for the project. This traditional approach is the general rule in Libya. These contracts are between the:

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- Owner and contractor, who implements the project.
- Owner and consultant, who carries out design stage.
- Owner and supervisor (consultant office), who monitors the contractor's performance during construction stage within the agreed contract. The supervision contract may be made with the existing design consultant or a separate body, or, in rare cases, supervision is carried out by a team of engineers who are existing employees in the owner organization.

In spite of importance role of the consultant many consultants performance are not at satisfactory level, Change and Ibbs (1998) pointed out, and very little have been written about the arrangement between owner and consultant (Berggren et al, 2001), also very few have been written about their performance that are mainly not at construction stage in particular, such as Ling et al (2003) who constructed a model to assist the contractors to select design consultant for Design-Build projects, Change and Ibbs (1999) who design levels for Architecture/Engineer consultant performance measures.

The owner's supervisor (consultant office) represents the owner on the construction site, plays an important role in monitoring the implementation of consultant plans according to owner's requirements, monitors the performance of the contractor and protects the owner from any liability or contractor claims. He also assures that the owner's three main goals; (Time, Cost and Quality) are achieved (Meredith and Mantell,1989).The supervisor has clearly defined guidelines and procedures to monitor quality and budget, but monitoring and checking the time schedule and protecting the owner from any claims is the most difficult and problematic task.

The consultant office's efficiency is affected by several factors. The human resource management of the supervising organization (consultant office) for whom the supervisor works has a great effect on his efficiency (Krima, 2005). They should have good techniques to choose, assess and monitor, select the supervisor engineer and project manager (Hauschildt, 2000), provide clear procedures to be followed by supervising engineers and apply a good Management Information and Documentation System to monitor work processes (S.Assadi, 1997), (S.Scott, 1991). The consultant office should also plan to train their supervisors, keep them motivated and help to keep their knowledge up-dated and encourage them to apply the related state of art tools and techniques (N.Krima 2001) (Krima, 2005).

As mentioned above, the construction stage is a highly risky period for the owner of large projects in Libya (often the government). The efficiency of the consultant is very important and lack of efficiency will prevent him from protecting the owner's interests. Therefore this research is concerned with the consultant offices (supervisory organizations), their efficiency and their requirements to control delays on construction sites.

OBJECTIVE

The main objective is to develop a technique (model) to assess the degree of efficiency of consultant offices relating to delay in construction projects, determine

the efficiency degree of Libyan consultant offices and determine the area of subject deficiency.

METHODOLOGY

Data Collection

The data was obtained by a field-survey of Libyan experts and their opinions on construction project supervision. Interviews were conducted with a questionnaire.

Sample and population of the study:

From the 'Public Committee of Monitoring and Follow-up' a list was made with the Consultant Offices (supervision organizations), with whom the government has had contracts for the last ten years. Contact was made with the above organizations to make a list of their experts. A sample of fifty experts was then selected at random and used in this study.

Study variables:

To determine efficiency criteria (Factors) and list the subject variables, a review of previous related literature has been carried out and an exploratory study and investigation were conducted by interviewing some experts in the field of supervision. The variables of the consultant office were determined, as shown in Table 1.

Questionnaire development:

After the variables list was made, these variables were made into questions and a questionnaire with interview was designed. The questionnaire was about *the existing* and *the ideal* efficiency degree of the consultant office. A pilot study was conducted and, in accordance with its results and with the data analysis plan, some adjustments were made to produce the final questionnaire that was used to collect the data. More details about data collection, sample and population of the study, supervision variables and the development of the questionnaire are provided in (Krima, 2005)

Data Analysis

There is no existing standard scale with which to determine the degree of the consultant's efficiency. Therefore, a standard scale must be developed. This scale is developed through a specific question in the questionnaire about the level of the importance of the efficiency variables. This scale is a common standard of measurement enabling comparisons between the ideal situation proposed by the experts, and the existing efficiency which was ascertained through a certain part in the questionnaire.

A data analysis plan was made (see table 2 and 3) as explained below in *Variable weights and score calculations***,** and a data analysis system was developed. Both data analysis plan and system were tested, reviewed and assessed by specialists in Mathematics, Statistics and IT, then submitted to a computer programmer together with a copy of the questionnaire with questions, codes, marks (values) and instructions, to be programmed in Visual Basic.

After the programmed analysis system was designed, it was tested by comparing its results using the pilot study data, with the results when the same data was analysised by using Excel.

Variable weights and score calculations

As above mentioned, there is no existing standard scale (ideal) with which to determine the degree of the supervisor efficiency. The following paragraphs explain how this scale was developed, how measuring the existing efficiency was determined and the comparison between the ideal situation proposed by the experts and the existing degree of efficiency.

To develop the ideal standard *of the factors, variables and the total efficiency degree of the consultant office the following steps were taken:*

- First section in the questionnaire asks the experts about the importance and weights of each variable on a scale of 1-10. In Table 2, the column of variable weight (L) represents the average of the variable importance considered by the interviewee. For example the variable no.1.1 which is L (1) -Existence of quality objectives, policy and plan- is the average of all weights suggested by the experts.
- The weight of questions K(s) is minimal and can be assumed as shown in the column "Ideal question score" in Table 2. For example; K (1) the weight of the ideal answer of the question no. (1) in the questionnaire is 100% (equal) of the variable weight L(1).
- The factor weights (M) can be found by calculating the average of the variables weights L(s) related to the same factor. For example: M(1) - Quality system - this factor's weight is the average of its variables' weights; ie: it's the average of L(1), (2), (3), (4) and L(5).
- Normalization has also been made for the Factors. This is to change it from factor weight M(s) in the column "Factor weight" to normalized factor weight N(s) in the column "Normalized factor weight" in the same table.
- The summation of all normalized factors N(s) forms the whole ideal efficiency degree of the consultant office (O) which is equal to 100. The normalization step was taken to make it easy to scale and compare.

To calculate and gather scores of the existing efficiency degree of the factors, variables and the total existing efficiency degree of the supervising engineer, the following steps were taken:

- Second section of the questionnaire asks about the existing performance of the consultant office – those questions form the variables - relating to delay. When existing question's scores were calculated the variable weights were taken into consideration to make the comparison between ideal and existing efficiency possible.
- Each question value was calculated relating to the weight of the ideal answer as shown in table 3. For example; the ideal weight of the answer of the question no. (1) in the questionnaire is K(1)=1*L(1) -from table 2. This question in the questionnaire has four options from 0 to 3, so if the answer was the ideal which is the forth one, the score would be equal to the question weight, k(1)=r(225)*K(1)/3 = K(1), where r(225) is the answer code of the same question (see table 3).
- The answers of the questions form the existing efficiency of the variables, so scores of the answers of each variable were gathered and their summation is their

variable score. For example in table no.3, the column "Variable existing efficiency", the existing efficiency degree of the consultant office in variable no. 1.1 which is l(1) -Existence of quality objectives, policy and plan- is equal to the summation weighted scores a(1),2,3,4 and 5.

- Each factor's existing score (m) was obtained by gathering its variables' score in the column "Factor existing efficiency". Then normalization to these scores was made to get n(s).
- The summation of all normalized factors n(s) forms the whole existing efficiency degree of the supervising engineer (o).

To find out whether the consultant office as a whole is efficient or not, we can compare its existing efficiency degree (o) from table 2, with the ideal (O) in table 3. To check each Factor, we can compare the existing n(s) in table 3, with the ideal factors N(s) in table 2. We can do the same for each variable by comparing their existing efficiency l(s) with the ideal L(s).

Table 1 :Factors and variables of the consultant office

Factor No.	Factors	Variable No.	Variables
1	**Quality system**	1.1	-Existence of quality objectives, policy and plan
		1.2	-Existence of organization chart, manual, work instruction and job description
		1.3	-A clear procedure to follow and apply
		1.4	-A quality improvement system
		1.5	-Updating the aforementioned
2	**Information System at the consultant office**	2.1	-Applying and updating Management Information Systems
		2.2	-Applying and updating Documentation Systems
		2.3	-Applying and updating IT techniques
		2.4	-Using documents from previous projects
3	**Selection of supervisors and staff**	3.1	-Existence of certain criteria to choose supervisors for each project
		3.2	-Existence of professional, financial, administrative and legal staff at the consultant office
4	**Monitoring and follow up**	4.1	-Monitoring and follow-up of work process on site
		4.2	-Monitoring and follow-up of supervision on site
5	**Performance assessment**	4.3	-Assessment of supervisor engineers
		4.4	-Assessment of engineers at consultant office
		4.5	-Assessment of administrative, financial and legal staff at consultant office
6	**The improvement of skills and training**	6.1	-Making training plans
		6.2	-Providing internet access, related books, journals and magazines
		6.3	-Encouraging employees to participate and attend conferences and workshops
7	**Study of project contract and contract documents**	7.1	-Study of supervision contract
		7.2	-Study and analysis of the contract between the contractor and the owner
8	**Study of project program**	8.1	-Determines type of schedule that contractor should submit
		8.2	-Study of schedule before the start of supervision
9	**Motivation**	9.1	-Moral motivation for supervisors
		9.2	-Financial motivation

Table 2 : The ideal efficiency degree of the consultant

Question weight (K)	Variable N°	Variable weight (Ideal Efficiency) (L)	Factor N°	Factor weight (M)	Normalized factor weight (N)	Ideal efficiency degree (O)
K(1) = 1*L(1)	**1.1**	$L(1)=\sum_{j=1}^{n} R(200,j) / n$	**1**	$M(1)=\sum_{j=1}^{5} L(j)/ 5$	N(1)=[100*M(1)]/M	$O=\sum_{i=1}^{9} N(i)$
K(2) = 1*L(2)	**1.2**	$L(2)=\sum_{j=1}^{n} R(201,j) / n$				
K(3) = 1*L(3)	**1.3**	$L(3)=\sum_{j=1}^{n} R(202,j) / n$				
K(4) = 1*L(4)	**1.4**	$L(4)=\sum_{j=1}^{n} R(203,j) / n$				
K(5) = 0.25*L(5)	**1.5**	$L(5)=\sum_{j=1}^{n} R(204,j) / n$				
K(6) = 0.25*L(5)						
K(7) = 0.25*L(5)						
K(8) = 0.25*L(5)						
K(9) = 1*L(6)	**2.1**	$L(6)=\sum_{j=1}^{n} R(205,j) / n$	**2**	$M(2)=\sum_{j=6}^{9} L(j)/ 4$	N(2)=[100*M(2)]/M	
K(10) = 0.75*L(7)	**2.2**	$L(7)=\sum_{j=1}^{n} R(206,j) / n$				
K(11) = 0.25*L(7)						
K(12) = 1*L(8)	**2.3**	$L(8)=\sum_{j=1}^{n} R(207,j) / n$				
K(13) = 1*L(9)	**2.4**	$L(9)=\sum_{j=1}^{n} R(208,j) / n$				
K(14) = 0.5*L(10)	**3.1**	$L(10)=\sum_{j=1}^{n} R(209,j)/ n$	**3**	$M(3)=\sum_{j=10}^{11} L(j)/ 2$	N(3)=[100*M(3)]/M	
K(15) = 0.5*L(10)						
K(16) = 0.4*L(11)	**3.2**	$L(11)=\sum_{j=1}^{n} R(210,j)/ n$				
K(17) = 0.4*L(11)						
K(18) = 0.2*L(11)						
K(19) = 1*L(12)	**4.1**	$L(12)=\sum_{j=1}^{n} R(211,j)/ n$	**4**	$M(4)=\sum_{j=12}^{13} L(j)/ 2$	N(4)=[100*M(4)]/M	
K(20) = 1*L(13)	**4.2**	$L(13)=\sum_{j=1}^{n} R(212,j)/ n$				
K(21) = 1*L(14)	**5.1**	$L(14)=\sum_{j=1}^{n} R(213,j)/ n$	**5**	$M(5)=\sum_{j=14}^{16} L(j)/ 3$	N(5)=[100*M(5)]/M	
K(22) = 1*L(15)	**5.2**	$L(15)=\sum_{j=1}^{n} R(214,j)/ n$				
K(23) = 1*L(16)	**5.3**	$L(16)=\sum_{j=1}^{n} R(215,j)/ n$				
K(24) = 0.25*L(17)	**6.1**	$L(17)=\sum_{j=1}^{n} R(216,j)/ n$	**6**	$M(6)=\sum_{j=17}^{19} L(j)/ 3$	N(6)=[100*M(6)]/M	
K(25) = 0.25*L(17)						
K(26) = 0.25*L(17)						
K(27) = 0.25*L(17)						
K(28) = 0.5*L(18)	**6.2**	$L(18)=\sum_{j=1}^{n} R(217,j)/ n$				
K(29) = 0.5*L(18)						
K(30) = 0.5*L(19)	**6.3**	$L(19)=\sum_{j=1}^{n} R(218,j)/ n$				
K(31) = 0.5*L(19)						

From L(1) to L(25) = level of importance of each variable (from the questionnaire)

Continue Table 2 : The ideal efficiency degree of the consultant

Question weight (K)	Variable N°	Variable weight (Ideal Efficiency) (L)	Factor N°	Factor weight (M)	Normalized factor weight (N)	Ideal efficiency degree (O)
K(32) = 0.4*L(20) K(33) = 0.6*L(20)	**7.1**	$L(20)=\sum_{j=1}^{n} R(219,j)/n$	**7**	$M(7)=\sum_{j=20}^{21} L(j)/2$	N(7)=[100*M(7)]/M	$O=\sum_{i=1}^{9} N(i)$
K(34) = 1*L(21)	**7.2**	$L(21)=\sum_{j=1}^{n} R(220,j)/n$				
K(35) = 1*L(22)	**8.1**	$L(22)=\sum_{j=1}^{n} R(221,j)/n$	**8**	$M(8)=\sum_{j=22}^{23} L(j)/2$	N(8)=[100*M(8)]/M	
K(36) = 1*L(23)	**8.2**	$L(23)=\sum_{j=1}^{n} R(222,j)/n$				
K(37) = 1*L(24)	**9.1**	$L(24)=\sum_{j=1}^{N} R(223,j)/n$	**9**	$M(9)=\sum_{j=24}^{25} L(j)/2$	N(9)=[100*M(9)]/M	
K(38) = 1*L(25)	**9.2**	$L(25)=\sum_{j=1}^{N} R(224,j)/n$				
				$M=\sum_{i=1}^{9} M(i)$	$N=\sum_{i=1}^{10} M(i)100$	

Development of the consultant assessment model

The above mentioned final questionnaire and analysis system was adjusted and improved to produce the assessment model of the consultant office. This model could also be applied outside Libya by gathering the level of importance of the variables (table 1) as the efficiency standard might be different, then the model could be used, as the whole calculation structure is same.

The assessment of Libyan consultant offices

When an assessment of Libyan consultant offices was made, the results in table 4 were obtained. This table shows that the total efficiency degree of the Libyan consultant offices is 48.9% of the ideal efficiency degree. Most of their shortages are in their motivation (36.853%), there are also lack in their Quality Systems (42.272%), Information Systems(47.856), methods and techniques to select their supervisors and staff (47.045) and their study of project program (49.88).

Verification of Solution Model

After the assessment model has been produced, its validation will be checked. Testing the developed model was done by designing a questionnaire about solution model validity, submitting it with the model and the results (when it applies to the Libyan consultant offices) to some consultant offices and getting their opinion through this questionnaire.

Table 3: Existing efficiency degree of the consultant

Existing Question score (k)	Variable N°	Variable (existing efficiency) (l)	Factor N°	Factor existing efficiency (m)	Normalized factor (n)	Existing efficie-ncy (e)
k(1)=r(225)*K(1)/ 3	**1.1**	l(1) = k(1)				
k(2)=r(226)*K(2)/ 3	**1.2**	l(2) = k(2)				
k(3)=r(227)*K(3)/ 3	**1.3**	l(3) = k(3)				
k(4)=r(228)*K(4)/ 3	**1.4**	l(4) = k(4)				
k(5)=r(229)*K(5)/ 3			**1**	$m(1)=\sum_{j=1}^{5} l(j) / 5$	n(1)=[100*m(1)]/M	
k(6)=r(230)*K(6)/ 3	**1.5**	$l(5)=\sum_{j=5}^{8} k(j)$				
k(7)=r(231)*K(7)/ 3						
k(8)=r(232)*K(8)/ 3						
k(9)=r(233)*K(9)/ 3	**2.1**	l(6) = k(9)				
k(10)=r(234)*K(10)/ 3	**2.2**	$l(7)=\sum_{j=10}^{11} k(j)$				
k(11)=r(235)*K(11)/ 2			**2**	$m(2)=\sum_{j=6}^{9} l(j) / 4$	n(2)=[100*m(2)]/M	
k(12)=r(236)*K(12)/ 3	**2.3**	l(8) = k(12)				
k(13)=r(235)*K(13)/ 2	**2.4**	l(9) = k(13)				
k(14)=r(237)*K(14)/ 3						
k(15)=r(238)*K(15)/ 4	**3.1**	$l(10)=\sum_{j=14}^{15} k(j)$				
k(16)=r(239)*K(16)/ 12			**3**	$m(3)=\sum_{j=10}^{11} l(j) / 2$	n(3)=[100*m(3)]/M	
k(17)=r(240)*K(17)/ 4	**3.2**	$l(11)=\sum_{j=16}^{18} k(j)$				
k(18)=r(241)*K(18)/ 4						
k(19)=r(242)*K(19)/ 4	**4.1**	l(12) = k(19)				
k(20)=r(243)*K(20)/ 4	**4.2**	l(13) = k(20)	**4**	$m(4)=\sum_{j=12}^{13} l(j) / 2$	n(4)=[100*m(4)]/M	$o=\sum_{i=1}^{9} n(i)$
k(21)=r(244)*K(21)/ 4	**5.1**	l(14) = k(21)				
k(22)=r(245)*K(22)/ 4	**5.2**	l(15) = k(22)	**5**	$m(5)=\sum_{j=14}^{16} l(j) / 3$	n(5)=[100*m(5)]/M	
k(23)=r(246)*K(23)/ 4	**5.3**	l(16) = k(23)				
k(24)=r(247)*K(24)/ 3						
k(25)=r(248)*K(25)/ 4	**6.1**	$l(17)=\sum_{j=24}^{27} k(j)$				
k(26)=r(249)*K(26)/ 4						
k(27)=r(250)*K(27)/ 4						
k(28)=r(251)*K(28)/ 3						
k(29)=r(252)*K(29)/ 4	**6.2**	$l(18)=\sum_{j=28}^{29} k(j)$	**6**	$m(6)=\sum_{j=17}^{19} l(j) / 3$	n(6)=[100*m(6)]/M	
k(30)=r(253)*K(30)/ 4						
k(31)=r(254)*K(31)/ 4	**6.3**	$l(19)=\sum_{j=30}^{31} k(j)$				
k(32)=r(255)*K(32)/ 2						
k(33)=r(256)*K(33)/ 3	**7.1**	$l(20)=\sum_{j=32}^{33} k(j)$				
k(34)=r(257)*K(34)/ 4	**7.2**	l(21) = k(34)	**7**	$m(7)=\sum_{j=20}^{21} l(j) / 2$	n(7)=[100*m(7)]/M	
k(35)=r(258)*K(35)/ 5	**8.1**	l(22) = k(35)				
k(36)=r(259)*K(36)/ 20	**8.2**	l(23) = k(36)	**8**	$m(8)=\sum_{j=22}^{23} l(j) / 2$	n(8)=[100*m(8)]/M	
k(37)=r(260)*K(37)/ 4	**9.1**	l(24) = k(37)				
k(38)=r(261)*K(38)/ 4	**9.2**	l(25) = k(38)	**9**	$m(9)=\sum_{j=24}^{25} l(j) / 2$	n(9)=[100*m(9)]/M	

K & M from table 2

From r(225) to r(261) = answers from the questionnaire.

Table 4 : The efficiency degree of the Libyan consultants

Factors and Variables	Ideal	Existing	%
Quality system	**11.101**	**4.69**	**42.272**
Existence of quality objectives, policy and plan	8	2.95	36.842
Existence of organization chart, manual, work instruction and job description	7.969	4.61	57.895
A clear procedure to follow and apply	8.281	4.36	52.632
A quality improvement system	8.094	3.12	38.596
Updating the aforementioned	7.553	1.82	24.123
Information System at the consultant office	**10.837**	**5.19**	**47.856**
Applying and updating Management Information Systems	7.438	3.26	43.86
Applying and updating Documentation Systems	8.188	4.31	52.632
Applying and updating IT and techniques	7.938)	3.34	42.105
Using documents from previous projects	7.594	4	52.632

Selection of supervisors and staff	**10.695**	**5.03**	**47.045**
Existence of certain criteria to choose supervisors for each project	7.5	4.06	54.167
Existence of professional, financial, administrative and legal staff at the office	7.875	3.17	40.263
Monitoring and follow up	**11.543**	**7.06**	**61.173**
Monitoring and follow-up of work process on site	8.344	4.94	59.211
Monitoring and follow-up of supervision on site	8.25	5.21	63.158
Performance assessment	**10.971**	**5.68**	**51.792**
Assessment of supervisor engineers	8.125	4.38	53.947
Assessment of engineers at consultant office	7.844	4.03	51.316
Assessment of administrative, financial and legal staff at consultant office	7.688	3.84	50
The improvement of skills and training	**10.724**	**5.43**	**50.593**
Making training plans	7.781	3.54	45.504
Providing internet access, related books, journals and magazines	7.656	4.32	56.36
Encouraging employees to participate and attend conferences and workshops	7.688	3.84	50
Study of project contract and contract documents	**11.63**	**6.01**	**51.671**
Study of supervision contract	8.25	4.52	54.737
Study and analysis of the contract between the contractor and the owner	8.469	4.12	48.684
Study of project program	**11.5**	**5.74**	**49.88**
Determines type of schedule that contractor should submit	8.281	4.62	55.789
Study of schedule before the start of supervision	8.25	3.63	43.947
Motivation	**11**	**4.05**	**36.853**
Moral motivation for supervisors	7.844	2.79	35.526
Financial motivation	7.969	3.04	38.158
TOTAL EFFICIENCY DEGREE OF THE CONSULTANT	**100**	**48.9**	

CONCLUSION

There is no existing standard scale to assess the efficiency of Libyan consultant when dealing with delays during construction stage. To establish this ideal scale; criteria of consultant efficiency was determined and a survey was conducted, using a questionnaire with interviews, to obtain opinions of experts in supervision. This scale is a common standard of measurement enabling comparisons between the ideal situation proposed by the experts, and the existing efficiency which was ascertained through a certain part in the questionnaire. When an assessment of Libyan consultant offices was made by applying the initial model, the results shows that the total efficiency degree of the Libyan consultant offices is less than 50% of the ideal efficiency degree. There is lack in their Quality Systems, Information Systems, motivation, methods and techniques used to select their supervisors and staff and their study of project program.

The initial model will be adjusted and improved, and will be validated by either designing a questionnaire to elicit the opinions of some consultant offices or by presenting the model to decision makers in consultant offices to get their opinions on how it could help consultant organizations to assess their human resource management, relating to supervisor performance on site in dealing with delays. It is expected that the model would help both the owner in selecting a consultant, and the consultants to improve their human resource management.

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