PERGAMON

International Journal of Project Management 20 (2002) 385–400

INTERNATIONAL JOURNAL OF PROJECT MANAGEMENT

www.elsevier.com/locate/ijproman

Factors and procedures used in matching project managers to construction projects in Bangkok

Stephen Ogunlana [a], Zafaar Siddiqui [a], Silas Yisa [b], Paul Olomolaiye [b,*]

[a] *School of Civil Engineering, Asian Institute of Technology, PO Box 4, Klong Luang, Pathum Thani 12120, Thailand*
[b] *Built Environment Research Unit, School of Engineering and the Built Environment, University of Wolverhampton, Wulfruna Street, Wolverhampton WV1 1SB, UK*

Received 18 January 2000; received in revised form 1 June 2000; accepted 26 January 2001

Abstract

A number of factors and associated sub-factors influencing the matching of project managers to construction projects were identified after a thorough review of related literature and interviews of management personnel involved in the selection of project managers. There appears to be a consensus among the construction industry management in Bangkok on the factors, which influence the selection of construction project managers. A detailed survey of the top 100 construction companies in Thailand was conducted, to determine what factors are used in the industry to assign project managers to projects. A total of 73 completed questionnaires were received from 36 companies. It was established that influencing factors attract some degree of relative importance irrespective of the construction project category. The data showed no statistical difference between the three project categories in the weights given to the various factors considered for project manager assignment. Personal characteristics are considered least important for effective project management. It is argued that, at least in the Thai context, contractors are careful in assigning Project Managers that are capable of meeting external customers' needs. A matching model was developed based on the identified influencing factors and the relative importance they attached in the process of selecting the construction project managers. The model requires input in terms of the project requirements and evaluation of candidates' characteristics with respect to the influencing factors.

Keywords: Projects; Project managers; Assignment; Customer satisfaction; Factors

1. Introduction

Construction projects have always been a very important part of human civilization. The rapid technological developments of the last hundred or so years have resulted in a growing number of construction projects of enormously complex nature. The last decade has seen a steep rise in the quantity and complexity of construction projects in Asia as a result of spectacular economic development of the whole region.

Finding the right project manager for a construction project is therefore a major task in project implementation. Different projects require different skills and capabilities on the part of the project manager. Every owner, consultant, and contractor is on the look-out for the few good project managers available. They are indeed hard to find and even a search firm is unable to turn up much of a matching even though the target candidate (a good project manager) can practically write his own pay-cheque. This paper addresses the major factors considered by managers in assigning project managers to projects.

2. Role and responsibility of a project manager

A typical project can be described as complex system of a large number of interrelated and interconnected elements, various organisational units and a wide variety of people. It is due to this diverse and complex nature of the project system, that Goodwin [1] suggests project integration as "one of the key functions of the project manager." He defined project integration as the process of ensuring that all elements of the project — its

* Corresponding author. Tel.: +44-1902-322765; fax: +44-1902-322743.
E-mail address: P.Olomolaiye@wlv.ac.uk (P. Olomolaiye).

0263-7863/02/$22.00
PII: S0263-7863(01)00017-5

tasks, subsystems, components, parts, organisational units, and people — fit together in an integrated whole that functions according to plan.

The responsibility of project integration requires the project manager to perform three key tasks [1]. Firstly, the project manager has to implement an effective planning and control system for all the project activities. Secondly, all communication links within and outside the project need to be established and maintained. Dias [2] has emphasised this point by suggesting that the project manager's major role is to be "a good facilitator especially regarding the flow of information." Various researchers have also established that a very large proportion of the project manager's time, more than 70% according to Goodwin [1], is spent communicating with people. Such communication activities normally include clarification of project team's role and responsibilities, collection and dissemination of information, conflict resolution and agreement negotiations. Finally, effective project integration requires the project manager to act quickly to resolve internal and external conflicts before they start to threaten project budget, scheduling and performance specification. Kerzner [3] sees project management as being the same as conflict management. Walton [4] believes the most important responsibilities of a project manager are project evaluation, setting up the team, setting up systems, planning, monitoring, control, negotiating contract conditions, training and communication. Oberlender [5] also identifies five basic roles for a project manager as planning, organising, staffing, directing and controlling.

3. Essential skills of a project manager

In order to meet the objectives of modern projects, with an increasingly complex nature, it is essential for the project managers to be able to use variety of managerial skills. It is necessary for today's project managers not only to organise technologies but also to be capable of organising individuals and co-ordinating work flow between functional specialists in a typical project team [6,7]. Some of these essential skills include: conceptual skills, human skills, negotiation skills and technical skills.

Conceptual skill is the ability to see the enterprise as a whole and recognise how the various functions of the organisation depend on one another and how changes in any one part affects the other [8]. The diversity of the project system and the need to ensure that all the elements function together as an integrated whole requires a high degree of conceptual skill on the part of the project manager [1,9].

In order to meet the project objectives, the project manager is dependent on other people to accomplish project tasks within the frame work of the project schedule, budget, and performance specification. *Human skill* is in fact, the ability to work with and through other people [8]. A project manager uses human skills in influencing other people's behaviour to achieve project objectives through the recourse he/she has to various sources of power and corresponding methods by which to influence others. Handy [10] identified five sources of power and four methods of influence.

Negotiation skills are an integral part of any project. Many of the tasks comprising project implementation process are governed by agreement, either formal or informal. All these agreements need to be negotiated and the project manager will certainly be involved in the negotiation for major agreements. Extensive research has been carried out on the negotiation process and various strategies that can be adopted [1,8,11].

Technical skill is defined by Katz [8] as an understanding of and proficiency in, a specific kind of activity, particularly one involving methods, processes, procedures, or techniques. It involves specialised knowledge, analytical ability within speciality, and facility in the use of tools and techniques of a specific discipline. Gaddis [12] also suggests that a successful project manager is one who possesses technical competence, which has been gained through a career in advanced technology environment. A number of other skills have since been suggested as the essential skills required in project managers. There is, however, overwhelming consensus among researchers that while there is no compelling necessity for project managers to be a technical specialist, they should have some degree of technical skill encompassing the technological discipline on which the project is based.

4. Leadership and project management

Leadership has many definitions. Mintzberg [13] defines it as the process of influencing others to behave in preferred ways to accomplish organisational objectives. Katz and Kahn [14] suggest that leadership is an incremental influence over and above that which is formally prescribed in the work unit. Kezsbom and Donnelly [15] describe leadership as a social influence process in which the leader seeks the participation of individuals in an effort to obtain organisational objectives.

Given the fact that there is no universal agreement on the definition of leadership, it is not surprising that there is no universally accepted theory of leadership. Leadership theories range from classical [16] to contemporary [17]. Researchers have described what leaders normally do [18] as well as what leaders ought to do [19–21]. Some researchers have focused on the behaviour of effective leaders [22], while others have attempted to model social behaviour [23,24].

One of the most popular of leadership theories as proposed by Fielder [25], suggests that successful leadership depends on a good match between the style of the leader and the demands of the situation. Fielder suggested that neither task-oriented nor relationship-oriented leadership style can be predicted to be most effective at all time. Instead, each style is effective when used in the right situation. A detailed explanation of Fielder's theory can be found in a number of texts on organisational behaviour [26–28].

Leadership in the context of construction industry is a complex issue and understanding of what constitutes it and how it functions is somewhat incomplete [29]. Little attention has been paid to the role of the construction project manager as a leader in fostering and maintaining good relationship [30,31]. Only a few studies have been carried out to investigate the impact of leadership in the context of construction industry. One of such studies, [32], examined the patterns of leadership styles in the construction industry and investigated the relationship between leadership style and organisational structure and their impact on effectiveness. The study concluded that poor performance was associated with low task and low people consideration, while high performance was primarily associated high-task orientation. [33] studied the influence of leadership styles of project managers on organisational structure and project performance and found that leaders who were high in task and low people consideration, produced an acceptable level commercial performance. Bresnen et al. [34,35] considered the importance of contextual factors upon the relationship between leadership styles and effectiveness on a construction project. A positive association between the construction project manager's leadership orientation and effectiveness was established. This association, however, was contingent upon the duration of the project, the size of the project and labour force composition.

5. Past experience

It is quite common practice to analyse one's previous experience and performance before a job is offered. Given the importance and demands of the project manager's job, it is understandable that the employers will be very keen to know the performance of the projects previously managed by the prospective candidates. However, given the complex nature of the projects, a detailed evaluation of a project's success or failure is a difficult task. In fact the concept of project success has remained ambiguously defined in the project management literature [36].

Ashley et al. [37] identified six basic criteria commonly used for measuring project performance, namely: budget performance; schedule performance; client satisfaction; functionality and quality; contractors' satisfaction; and project team satisfaction. Earlier, Sidwell [38] had come up with a similar list of criteria which are generally accepted to evaluate project performance. These are time, cost, aesthetics, function and quality, client satisfaction, and team members relationships.

6. Research methodology

There are two common problems in matching project managers to construction projects. Firstly, it is difficult to come up with a list of all the factors that need to be considered for selecting and matching a project manager for a particular construction project. Secondly, most of the selection procedures currently in us are based on subjective assessment of the potential candidates. In this study an attempt is made to alleviate, or at best, minimise their adverse effects.

As a solution to the first problem, the matching factors are selected in such a manner that they not only take into account the general qualities and abilities identified but also consider the opinion and judgement of the people who regularly hire and assign project managers for a particular industry. Therefore the matching factors used in this study for a typical construction project are based on an exhaustive literature review and pilot survey of various factors commonly used by a number of construction companies in Bangkok city. The element of subjectivity in assessing the suitability of a candidate against the matching factors can be reduced by using the a method of ''multiple level weightage factors''. An approach used in the field of value engineering.

7. Data collection

The matching factors to be considered and the outline of the questionnaire were developed after exhaustive study and review of relevant literature. This was followed by a pilot survey. The pilot survey consisted of personal interviews of 10 professionals involved in the selection of project managers. The knowledge gained from the pilot survey was incorporated into the final revision of the factors list and questionnaire. It was concluded that there were 14 main factors needed to be considered for matching project managers to construction projects. There were several mutually exclusive sub-factors associated with each of the 14 main factors which would significantly influence the selection and matching process for the project manager.

The questionnaire has three parts. The first part includes questions to collect the basic information about the companies to which the respondent managers belonged. The second part of the questionnaire includes all the sub-factors associated with the main factors that

affect the matching/selection of the project managers of construction projects. A normalised scale of 1–10 was assigned to each sub-factor, where 1 is "not important", 5 is "average and 10 is " very important". The respondents were asked to indicate the importance they give to each of these sub-factors while selecting a project manager, using a scale of 1–10. In the third part, only the 14 main factors were included without being further divided into sub-factors. Each main factor was assigned the same normalised scale of 1–10, as their sub-factors were assigned in the second part of the questionnaire.

Construction industry in Bangkok was selected as a typical representation of the construction industry as a whole. Data collection was carried out using various communication methods available, i.e. mail, telephone, facsmile, e-mail messages and personal interviews. High ranking officials of various construction companies operating in Bangkok needed to be contacted as the information sought for this study was related to a sensitive and high profile issue. These officials had been involved with the selection of project managers for various construction projects undertaken by their companies. A total of 90 construction companies operating in Bangkok were approached for data collection purpose for this study. Ten of these companies were multinational construction companies. Twenty were joint venture and the remaining 60 were local companies. Top ranking managers involved in matching/selection of project managers at these companies were asked to fill in the research questionnaire.

It could be argued that various types of construction projects may require a different order magnitude of importance to be assigned to the same matching factor. To take this into account, the various construction projects were classified into three different categories, namely: residential and commercial projects; industrial projects; and heavy engineering projects. The data collected through questionnaire was first organised as three different samples, one for each category of construction project as defined above.

A total of 36 managers responded, giving a response rate of about 35%. It is common knowledge that management personnel are generally reluctant to provide any company specific information. They also have suspicious attitude towards researchers and do not normally give any information that may reveal their faults or shortcomings. It was therefore no surprise that significant convincing was required to obtain the data for this study.

The language problem was also faced during the data collection phase of this study. Many relevant personnel contacted at construction companies in Bangkok found it difficult to understand and respond to the questionnaire in English. In order to solve this problem, the questionnaire was translated into Thai language. This resulted in more meaningful responses and a higher participation rate. Information provided by the AIT Alumni Association also proved useful in contacting various potential respondents in Bangkok construction industry.

8. Data analysis

Thirty-six senior managers who have been involved with the selection of project managers for construction projects, returned a total of 73 completed questionnaires. Some respondents only completed a single questionnaire for just one category of construction projects. In other cases, a single respondent completed separate questionnaires for more than one project category. Those who completed questionnaires for more than one project category were told that they must consider the questionnaire for each project category in complete isolation and totally independent of questionnaire for other categories. Similarly, all the respondents were told that all the questions on the questionnaire should be treated totally independent of any other question on the questionnaire. It was explained that all the factors (and sub-factors) are mutually exclusive and the weightage assigned to one factor (or sub-factor) should not affect the weightage assigned to any other factor (or sub-factor).

A total of 24 completed questionnaires were received for *residential/commercial* project category. The number of completed questionnaires for *industrial and heavy engineering* categories were 22 and 27, respectively. An audit of the completed questionnaires revealed that not all the factors and sub-factors were assigned a weightage on all the questionnaires. It means that the sample size for each factor and sub-factor in any particular project category was not a constant number.

The data collected was analysed at two different levels: the main factors (14 in all) level and the sub-factors (55 in all) level. The number of "valid answers" against each main factor is also given in the table and is used as the sample size for calculating the central tendency (mean) and the dispersion (standard deviation) for that factor. Table 1 shows the comparison of three sample means at the main factor level. The three values in brackets indicate the mean weightage for a particular factor or sub-factor for *residential/commercial*, *industrial* and *heavy engineering* project categories, respectively. It must be noted that the purpose of using the mean weightage values for various factors (and sub-factors) is to study the relative trends rather than unnecessarily emphasising one particular numerical value against the other.

The 14 mean weightage values (i.e. one for each main factor) in the three project categories vary considerably, showing the relative importance given to these factors in

Table 1
Sub-factors weightages for the three project categories

Factors	Residential			Industrial			Heavy engineering		
	Sample	Mean	S.D.	Sample	Mean	S.D.	Sample	Mean	S.D.
A. Sex									
A.1 Male	24	8.082	2.121	22	7.909	2.880	27	8.148	2.931
A.2 Female	21	2.716	1.848	21	2.239	1.870	21	2.880	2.421
B. Age									
B.1 25 to 35 Years	23	6.957	1.848	22	6.591	2.282	28	6.111	2.289
B.2 35 to 45 Years	24	7.533	1.781	22	9.045	1.812	27	7.811	2.218
B.3 Above 45 Yeans	23	6.478	2.110	22	6.264	2.172	28	8.423	2.711
C. Marital Status									
C.1 Married	24	3.292	3.043	22	3.882	2.998	28	4.038	3.460
C.2 Single	23	2.912	2.844	22	3.182	2.889	27	3.370	2.837
D. Educational Qualification									
D.1 B.Sc. or B.Eng.	24	8.250	1.711	22	8.812	2.112	26	8.381	1.981
D.2 M.Sc. or M.Eng.	24	6.417	1.863	22	7.138	2.455	27	7.222	2.375
D.3 Ph.D.	22	1.995	1.704	22	2.409	2.016	28	3.100	2.627
E. Experience									
E.I Specialised Experience	23	7.753	2.181	21	8.124	1.961	21	8.880	1.810
E.2 Construction Industry Experience	23	1.879		21	8.238	1.841	25	7.409	2.788
E.3 Other Applicable Experience	23			21	6.1348	2.081	21	6.080	2.040
E.4 Overall Experience	24	8.250	2.132	23	8.818	1.532	27	9.111	1.281
F- Past Performance									
F.1 Performance within Budget	24	9.250	0.887	21	9.286	0.958	25	9.160	0.898
F.2 Performance within Time	24	9.082	1.018	21	9.238	0.944	28	9.231	0.951
F.3 Performance within Quality Spec.	24	8.533	1.404	21	8.144	1.181	21	8.960	1.274
G. Duties and responsibilities of Project Manager									
G. 1 During Planning Stage	24	8.821	1.348	21	8.142	1.082	21	9.160	0.807
G.2 During Design Stage	24	4.125	3.587	21	4.801	3.832	21	4.960	3.725
G.3 During Tendering Stage	24	7.375	1.813	21	7.238	2.188	28	8.348	1.656
H. Procurement Activities									
H.1 Procurement of Equipment	24	7.533	1.810	22	8.138	1.612	28	8.381	1.444
H.2 Procurement of Labour	24	8.500	1.382	22	8.388	1.442	28	8.208	1.288
H.3 Procurement of Materials	24	7.752	1.744	22	8.000	1.633	27	8.558	I.488
I. Management Abilities									
1.1 Planning	24	8.708	1.233	21	9.238	0.944	28	9.273	0.151
1.2 Organising	24	8.708	1.013	21	8.819	0.921	28	9.000	0.638
1.3 Staffing	24	8.417	1.283	21	8.429	1.326	28	8.462	1.334
1.4 Directing	24	8.292	1.301	21	8.619	1.024	28	8.731	1.079
1.5 Controlling	24	9.000	0.178	21	9.239	0.944	27	9.444	0.892
J. Leadership Capabilities									
J.1 Task-Oriented leadership style	24	6.142	2.000	20	6.958	2.460	28	7.391	2.111
J.2 Relationship-Oriented Style	23	8.435	1.237	20	8.435	1.974	27	8.407	1.824
K. Human Relations									
K.1 Relationship with Top Management	24	8.292	1.805	21	6.333	1.742	28	8.814	1.856
K. 2 Relationship with Project Team	24	8.208	1.171	21	8.524	1.289	28	8.577	1.238
K.3 Relationship with Clients	24	8.919	1.122	21	8.957	1.195	28	8.912	1.938
K.4Relationship with other Depts &Co	23	8.871	2.510	21	7.150	2.205	27	7.259	2.159
L. Administrative and Technical Credibility									
L.1 Technical Credibility	24	8.419	1.888	22	8.8114	1.167	26	9.077	1.129
L.2 Administrative Credibility	24	7.458	1.889	22	8.000	1.822	27	8.148	1.810
M. Personality of the Project Manager									
M.1 Physical Condition	24	7..292	1.932	21	7.416	1.882	25	7.160	1.904
M.2 Intelligence	24	8.873	1.154	21	9.095	0.889	26	9.077	1.017
M.3 Maturity	24	7.000	1.888	21	7.124	1.887	21	7.480	1.856
M.4 Sensitivity	24	7.375	I.193	21	3.281	1.658	21	7.140	1.889
M.5 Emotional Stability	24	7.083	2.653	21	8.511	2.785	21	8.840	2.734
M.6 Warmth	24	8.251	2.251	21	1.714	2.777	21	5.760	2.891
N. Traits and Abilities of the Project Manager									
N.1 Judgement	24	9.292	0.959	22	9.455	0.854	27	9.444	0.110
N.2 Creativity	24	8.042	1.122	22	8.137	0.889	27	7.911	1.141
N.3 Sense of Responsibility	24	8.917	1.349	22	9.318	0.894	27	9.256	0.912
N.4 Dependability	24	7.093	1.863	22	7.131	1.728	27	8.728	2.192
N.5 Pride in Performance	24	7.625	1.511	22	7.591	1.301	27	7.519	1.691
N.6 Alertness	24	6. 333	2.595	22	6.909	2.580	27	8.962	2.738
N.7 Initiative	24	7.667	1.239	22	7.905	1.221	28	8.289	1.282
N.8 Self Confidence	24	8.758	1.452	22	9.041	1.213	27	9.037	1.091
N.9 Long Range Perspective	24	8.883	1.181	22	8.955	1.174	27	9.074	1.207
N.10 Willingness to Change	24	7.146	1.546	22	7.045	1.296	27	7.370	1.5
N.11 Motivation	24	8.455	1.318	22	8.455	1.142	26	8.592	1.158
N.12 Communication	24	7.758	1.700	22	7.814	1.142	27	7.563	1.531
N.13 Negotiations	24	8.871	1.955	22	6.855	1.939	27	7.481	2.064

matching the project managers to construction projects. For each factor, the three mean weightage values (i.e. one from each project category) are quite similar, i.e. they are in the same order of magnitude (Table 2).

"Experience" has the highest mean weightage among the 14 factors in all the three project categories (9.33, 9.64, 9.42). In order words, the construction industry considers experience to be the most important factor for selection of project mangers. "Marital status" is considered as the least important factor with the lowest mean weightage in all the three project categories.

"Sex" has been considered as a factor having above average importance with mean weightage values of 6.67; 6.86, 6.78 for the three project categories. This trend is consistent with the Asian cultural practices where the construction work is usually considered too "rough and tough" requiring preference for the male gender.

Managerial skills in terms of "managerial abilities", "leadership capabilities" and "human relationship" are all considered as significantly important factors as indicated from the high mean weightage values across the three project categories. Ability to procure resources for the project ("procurement abilities") are also found to be important (7.43, 7.76, 7.73), but they are considered relatively less important than the experience, educational qualification and managerial skills. The same can be concluded for "personality of the project manager" (7.08, 7.67, and 7.42).

Table 3 shows the sample mean and standard deviation for the weightage for the three project categories at the sub-factor level. Like the data at the main factor level, the number of "valid answers" against each sub-factor is used as sample size for calculating the central tendency (mean) and the dispersion (standard deviation) for that particular sub-factor.

The three mean weightage values for each sub-factor (i.e. one from each project category) are quite similar, i.e. they are in the same order of magnitude. As expected, when it comes to becoming a project manager, being a male is significantly more important than being a female (8.08, 7.9, 8.15 against 2.71, 2.24, 2.88). This trend reflects the socio-cultural set up of Asian societies. The relative importance of these two sub-factors will be significantly different even for different Asian regions, let alone for the western societies.

The age group of 35–45 years is considered more important (7.83, 8.04, 7.82) than the 25–35 years age group (6.96, 6.59, 6.12) and the above 45 years age group (6.48, 6.36, 6.42). The likely reason for this trend is the desire to strike a balance between skill/experience and human energies needed to cope with the challenge of the project manager's job.

Consistent with the trend for the main factor related to "marital status", it does not seem to attract much importance. Relatively speaking being a married person was considered a little more important than being a single person (3.29, 3.68, 4.04 against 2.91, 3.18, 3.37). This, perhaps, reflects the perception that a married person is likely to have a more mature and stable personality than a single person. However, as the lower weightage values show, the selectors are unlikely to attach any importance to a candidate's marital status while selecting a construction project manager.

It was considered significantly important for a project manager to have a degree (8.25, 8.81, 8.39). The importance of a postgraduate degree (6.42, 7.14, 7. 22),

Table 2
Factors' weightages for the three project categories

Factors	Residential/commercial			Industrial projects			Heavy engineering		
	Sample size (valid answers)	Weightage (1–10 scale)		Sample size (valid answers)	Weightage (1–10 scale)		Sample size (valid answers)	Weightage (1–10 scale)	
		Sample mean	Standard deviation		Sample mean	Standard deviation		Sample mean	Standard deviation
A	24	6.667	1.786	21	6.857	2.372	27	8.778	2.517
B	24	6.875	1.393	22	7.273	1.386	27	7.593	1.716
C	24	4.042	3.127	22	3.500	2.773	27	3.815	3.101
D	24	8.958	1.233	22	8.364	2.105	27	8.704	1.877
E	24	9.333	1.435	22	9.636	0.902	26	9.423	1.270
F	24	8.625	1.952	22	9.000	1.662	27	8.889	1.625
G	24	8.500	1.504	22	9.182	1.220	27	9.037	1.480
H	23	7.435	1.502	21	7.762	1.375	26	7.731	1.485
I	24	8.583	1.692	22	9.136	1.263	27	9.000	1.359
J	24	8.500	1.668	22	9.000	1.309	27	8.926	1.358
K	24	9.000	1.216	22	9.136	1.125	27	9.111	1.219
L	24	8.208	1.141	22	8.113	1.152	27	8.481	1.424
M	24	7.083	1.932	21	7.687	1.653	26	7.423	1.901
N	24	8.042	1.459	22	8.727	1.279	27	8.539	1.366

Table 3
Standardised global weights for sub-factors

Factors and sub-factors	RMS weightages	Global weightages
A. Sex		
A.1 Male	8.469	10.000
A.2 Female	3.305	1.000
B. Age		
B.1 25 to 35 Years	6.873	1.293
B.2 35 to 45 Years	8.12	10.000
B.3 Above 45 Years	6.831	1.000
C. Marital Status		
C.1 Married	4.82	10.000
C.2 Single	4.213	1.000
D. Educational Qualification		
D.1 B.Sc. or B.E.	8.498	10.000
D..2 M.Sc. or M.Eng.	7.281	7.700
D.3 Ph.D.	3.735	1.000
E. Experience		
E.1 Specialised Experience for Specific Projects	8.649	9.184
E.2 Construction Industry Experience	7.98	6.991
E.3 other Applicable Experience	6.152	1.000
E.4 Overall Experience	8.898	10.000
F. Past Performance		
F.1 Performance within Allocated Budget	9.272	10.000
F.2 Performance within Allocated Time	9.232	8..294
F.3 Performance within High Standard of Quality	9.061	I.000
G. Duties & Responsibilities of Project Manager		
G.1 During Planning Stage	9.114	10.000
G.2 During Design Stage	6.051	1.000
G.3 During Tendering Stage	7.54	5..375
H. Procurement Activities		
H.1 Procurement of Equipment	8.287	4.634
H.2 Procurement of Labour	8.479	10.000
H.3 Procurement of Material	8.157	1.000
I. Management Abilities		
1.1 Planning	9.283	10.000
1.2 Organising	8.685	2.643
1.3 Staffing	8.527	1.000
1.4 Directing	8.676	2.774
1.5 Controlling	9.283	10.000
J. Leadership Capabilities		
J.1 Task-Oriented Style of Leadership	7.351	1.000
2 Relationship-Oriented Style of Leadership	8.228	10.000
K. Human Relations		
K.1 Relationship with Top Management	6.557	1.000
K.2 Relationship with Project Team	8.616	8.799
K.3 Relationship with Clients	8.933	10.000
K.4 Relationship with other Departments & Companies	7.505	4..591
L. Administrative and Technical Credibility		
L. 1 Technical Credibility	8.936	10.000
L.2 Administrative Credibility	8.163	1.000
M. Personality of Project Manager		
M.1 Physical Condition	7.65	5.244
M.2 Intelligence	9.136	10.000
M.3 Maturity	7.745	5.548
M.4 Sensitivity	7.556	4.943
M.5 Emotional Stability	7.111	3.519
M.6 Warmth	6.324	1.000
N. Trait and Abilities of Project Manager		
N.1 Judgement	9.446	10.000
N.2 Creativity	8.182	5.033
N.3 Sense of Responsibility	9.359	9.658
N.4 Dependability	7.332	1.688
N.5 Pride in Performance	7.731	3.257
N.6 Alertness	7.354	1.775
N.7 Initiative	8.000	4.315
N.8 Self Confidence	9.127	8.746
N.9 Long Range Perspective	9.027	8.353
N.10 Willingness to Change	7.175	1.000
N.11 Motivation	8.528	6.391
N.12 Communication	8.025	4.413
N.13 Negotiation	7.207	1.197

although above average, is considered lower than the graduate degree. The PhD qualification attracted the least importance (1.95, 3.4, 3.5), especially for residential and commercial projects, when it comes to becoming a construction project manager. As mentioned earlier, experience is considered as the most important factor in selecting a construction project manager. The weightage trends for the sub-factors associated with experience indicate that the "overall experience" is considered most important (8.25, 8.82, 9.11), closely followed by the "specialised experience for specific projects" (7.78, 8.52, 8.88) and the "construction industry experience" (7.43, 8.24, 7.40). The "other applicable experience" is given only average importance (5.45, 6.05, 6.08). Again, the high importance given to overall experience shows the preference for a project manager of "generalist" nature.

All the three sub-factors relating to a candidate's past performance in terms of completing a job within budget, time and high quality standard are given very high weightage with only a slight variation for the three project categories. The results show 9.25, 9.29, and 9.16 for performance within budget; 9.08, 9.24, 9.23 for performance within time, and 8.83, 9.14, 8.96 for performance within high standard of quality.

Duties and responsibilities of the project manager during the planning stages attracted quite high mean weightage (8.63, 9.14, 9.16), as compared to the duties and responsibilities during the tendering stage (7.37, 7.24, 8.35). Duties and responsibilities of construction project managers during the design stages of the project are considered to have just about average importance. Good work at the planning stages will help in completing the project successfully. A successful construction project manager is expected to be equally good in procuring equipment, labour and material, as similar values for mean weightage against these sub-factors demonstrate.

Management skills in terms of planning, organising, staffing, directing, and controlling have been identified by many researchers as the key to successful completion. It is therefore no surprise to see very high values for mean weightage against all these five sub-factors.

Relationship-oriented leadership style is considered to be more important for the construction project managers than the task-oriented style (8.44, 8.44, 8.41 against 6.54, 6.96, 7.38). Although the ability of the project manager to build relationships with top management and other departments and companies are given significant weightage (mean weightage in an order of 6–7 on a 1–10 scale). It was considered relatively less important than the ability to build relationship with the project team members and the clients (mean weightage in an order of 8–9 on a 1–10 scale).

Both administrative and technical credibility are considered significantly important factors in selecting the construction project managers. Technical credibility was given a little more importance than administrative credibility (8.46, 8.86, 9.08 against 7.46, 8.00, 5.76).

All the six sub-factors associated with the personality of construction project mangers obtained significant mean weightage, but of varying order. Intelligence is considered the most important personality attribute (8.87, 9.09, 9.08), followed by physical condition, maturity, sensitivity, emotional stability, and finally the warmth (6.25, 5.71, 5.76).

9. Matching model

Corporate objectives provide direction, allow synergy, aid in evaluation, establish priorities, reduce uncertainty, minimise conflict, stimulate exertion, and aid in both allocation of resources and design of jobs [39]. Without long-term objectives an organisation will drift aimlessly towards some unknown.

Matching resources with strategic requirements focuses on aligning key external with internal factors to achieve corporate objectives. There are five well-known matching techniques that have been widely used in strategic framework and matching process: the *TOWS Matrix*; the *SPACE Matrix*; the *BCG Matrix*; the *IE Matrix*; and the *Grand Strategy Matrix*. They all rely upon information derived from the input stage to match external opportunities and threats with internal strength and weakness. Matching external and internal critical factors is the key to effectively generating feasible alternative strategies [39].

The *Threats-Opportunities-Weakness-Strength* (TOWS) *Matrix* is an important matching tool that helps managers to use a firm's internal strength to take advantage of external opportunities; improve upon internal weakness by taking advantage of external opportunities; use a firm's strength to avoid or reduce the impact of external threats; and finally reduce internal weakness and avoid environmental threats.

The *Strategic Position and Action Evaluation* (SPACE) Matrix is another important matching tool. It uses a four-quadrant framework to indicate whether aggressive, conservative, defensive, or competitive strategies are appropriate for a given organisation. Depending upon the type of organisation, numerous variables could comprise of each of the dimensions represented on the axes of the SPACE matrix. The axes of the SPACE Matrix represent two internal dimensions (*financial strength* and *competitive advantage*) and two external dimensions (*environmental stability* and *industry strength*).

The third of these tools is the *Boston Consulting Group* (BCG) Matrix. The BCG and the Internal–External (IE) matrices are designed specifically to enhance a multidivisional firm's efforts to formulate strategies. Although the BCG matrices have a number

of obvious attractions, they do not represent the ultimate management panacea that many of their advocates in the early days argued [42]. Practical values of portfolio analysis are influenced significantly both by the quality of the basic data inputs, many of which are difficult to define and measure, and the broader political and social environments within which decisions are made.

The results are sensitive to the ratings and weights and can be manipulated to produce a desired location in the matrix. Furthermore, since an averaging process is occurring, two or more businesses may end up in the same cell position but differ in the underlying ratings and weights. Finally, the models fail to accommodate the synergies between two or more businesses, and this means that marketing decisions for one business at any time may be risky.

Other than ranking strategies to achieve the prioritised list, there is only one analytical technique in the literature designed to determine the relative attractiveness of feasible alternative actions. This technique is the *Quantitative Strategic Planning Matrix* (QSPM). QSPM objectively indicates which alternative is the best. It uses input and the matching results to decide objectively amongst all the alternatives. It allows decision-makers to evaluate alternative decisions objectively, based on previously identified external and internal critical success factors.

The factors and sub-factors influencing the matching and selection of project managers have been identified in the earlier sections of this paper. Each of these factors and sub-factors is assigned a global weightage on a 1–10 scale, including their relative importance. The global weightage for a particular factor (or sub-factor) is estimated to be the combined sample's RMS weightage for that factor (or sub-factor). These factors and their global importance weightage can now be considered as the matching model parameters (Table 4).

9.1. Formulation of a single data sample

It was observed that although the three data samples (representing three project categories) are independent of each other, the central tendencies (sample mean) and dispersion (standard deviation) of the three data samples exhibit remarkable similarities at each individual factor and sub-factor level. This observation for 14 factors and 55 sub-factors gave an indication that the three samples may have belonged to the same population of construction projects. If correct, this conclusion would mean that a particular factor (or sub-factor) should attract the same (as represented by a weightage on a 1–10 scale) for selecting construction project manager, irrespective of the project category. It would also mean that the three different samples, one for each project category, can be combined into a single sample. This single sample can then be used to estimate the population means of weightages for each factor and sub-factor. The population means thus estimated for each individual factor and sub-factor's weightage can then be taken as typical wightage that should be assigned to that particular factor or sub-factor while selecting the construction project manager.

The candidates' profile can then be matched against the project requirement profile to determine the best fit, as shown in the matching model in Fig. 1. In order to confirm that similar weightages are assigned to a particular factor (sub-factor) in all the three project categories, statistical method of hypothetical testing is used. The data from all three samples can now be combined into a single sample, representing all construction projects.

Once it has been established that the three project categories can be considered as a single population of construction project, the next step was to estimate the mean values for weightage assigned to each factor and sub-factor which can be estimated using the combined sample of the three project categories.

The sample sizes for each factor and sub-factors for the three project categories data taken together are either 73 or slightly less than 73, depending on the number of invalid answers to a particular factor or sub-factor. It means that all factors and sub-factors have large sample sizes (i.e. $n > 30$) and therefore, according to the Central Limit Theorem, the population can be considered as the normal population. Accordingly, the hypothesis test for the statistical decision rule for 2-tailed tests about a population mean can be used to estimate the population mean for each factor and sub-factor.

Table 4 also summarises the calculations for testing the hypothesis that the population mean weightage for each factor and sub-factor can be estimated as the "root mean square" (RMS) value of the weightage for that particular factor and sub-factor, as obtained from the combined sample.

The RMS value of a function over a given interval is defined as the square root of the mean value of the square of the function over that interval. If we are to determine the RMS value of the function $y = \mathrm{f}\ (x)$ between $x = a$ and $x = b$, then we need to evaluate the mean value of the square of the function and take the square root of this value. Hence the RMS value of $y = \mathrm{f}(x)$ between $x = a$ and $x = b$ is:

$$\mathrm{RMS} = \sqrt{\left[\left(\sum x_i\right)^2 / n\right]}$$

The RMS value gives rudimentary information on the intensity (or magnitude) of the tendency of the quantity. This tendency could be +ve or −ve, but generally it

Table 4
Ranking of matching factors and sub-factors for combined project categories ($n = 73$)

Rank	Factors	Sub-factors	Weightage (1–10 Scale)			
			Valid answers	Sample mean	Standard deviation	Root mean square (rms)
1. E Experience						
	1.1	E.4 Overall Experience	73	8.740	1.683	8.898
	1.2	E.1 Specialist Experience for Specific Project	69	8.406	2.053	8.849
	1.3	E.2 Construction Industry Experience	69	7.657	2.234	7.980
	1.4	E.3 Other Applicable Experience	69	5.855	1.904	6.162
2. K Human Relations						
	2.1	K.3 Relationship with Clients	71	8.930	1.130	8.933
	2.2	K.2 Relationship with project team	71	8.437	1.227	8.818
	2.3	K.4 Relationship with other Department and Companies	71	7.113	2.265	7.605
	2.4	K.1 Relationship with Top Management	71	6A37	1.833	6.557
3. I Management Abilities						
	3.1	1.1 Planning	71	9.127	1.068	9.283
	3.2	1.5 Controlling	72	9.236	0.942	9.183
	3.3	1.4 Directing	71	8.649	1.144	8.676
	3.4	1.2 Organising	71	8.876	0.982	8.665
	3.5	1.3 Staffing	71	8.437	1.295	8.527
4. G Duties and Responsibilities of Project Managers						
	4.1	G.1 During Planning Stage	73	9.043	1.148	9.114
	4.2	G.3 During Tendering Stage	71	7.690	1.924	7.640
	4.3	G.2 During Design Stage				
5. F Past Performance						
	5.1	F. I Performance with Allocated Budget	73	9.229	0.904	9.272
	5.2	F.2 Performance within Allocated Time	71	9.183	0.961	9.232
	5.3	F.3 Performance within High Standard of Quality	70	8..971	1.265	9.081
6. J Leadership Capabilities						
	6.1	J.2 Relationship-Oriented Style of Leadership	70	8.300	1.888	8.228
	6.2	J.1 Task-Oriented Style Leadership	70	8.971	2.328	7.351
7. D Educational Qualification						
	7.1	D.1 B.Sc. or B.Eng.	72	8.278	1.937	8.496
	7.2	D.2 M.Sc or M. Eng.	73	8.932	2.244	7.281
8. L Administrative and Technical Credibility						
	8.1	L.I Technical Credibility	71	8.833	1.359	8.938
	8.2	L2 Administrative Credibility	72	7.861	1.655	8.163
9. N Trait and Abilities of Project Manager						
	9.1	N.1 Judgement	73	9.364	0.876	9.448
	9.2	N.3 Sense of Responsibility	73	9.178	1.072	9.359
	9.3	N.8 Self Confidence	73	8.946	1.257	9.127
	9.4	N.9 Long Range Perspective	73	8.966	1.172	9.027
	9.5	N.11 Motivation	72	8.542	1.198	8.528
	9.6	N.2 Creativity	73	7.986	1.061	6.182
	9.7	N. 12 Communication	73	7.8611	1.601	8.025
	9.8	N.7 Initiative	72	7.968	1.251	8.300
	9.9	N.5 Pride in Performance	73	7.575	1.572	7.731
	9.10	N.6 Alertness	73	6.740	2.625	7.354
	9.11	N.4 Dependability	73	6.986	1.933	7.232
	9.12	N.13 Negotiation	73	7.123	1.993	7.207
	9.13	N.10 Willingness to Change	73	7.164	1.463	7.157
10. H Procurement Activities						
	10.1	H.2 Procurement of Labour	72	8.389	1.338	8.479
	10.2	H. 1 Procurement of Equipment	72	8.125	1.618	8.287
	10.3	H.3 Procurement of Material	73	8.137	1.619	8.157
11. M Personality of Project Manager						
	11.1	M.2 Intelligence	71	9.014	1.021	9.136
	11.2	M.3 Maturity	70	7.329	1.878	7.745
	11.3	M.1 Physical Condition	70	7.588	1.838	7.650
	11.4	M.4 Sensitivity	70	7.257	1.742	7.556

(*continued on next page*)

Table 4 (*continued*)

Rank	Factors	Sub-factors	Weightage (1–10 Scale)			
			Valid answers	Sample mean	Standard deviation	Root mean square (rms)
	11.5	M.5 Emotional Stability	70	6.843	2.693	7.111
	11.6	M.6 Warmth	70	5.914	2.625	6.324
12. B Age						
	12.1	B.2 35 to 45 Years	73	7.890	1.933	8.120
	12.2	B.1 25 to 35Yeare	71	6.535	2.144	6.873
	12.3	B.3 Above 45 Years	71	6.423	2.348	6.831
13. A Sex						
	13.1	A.1 Male	73	8.055	2.635	8.469
	13.2	A.2 Female	67	2.821	2.021	3.305
14. C Marital Status						
	14.1	C.1 Married	72	4.181	3.135	4.820
	14.2	C.2 Single	72	3.667	2.798	4.213

reflects the +ve tendency. Given the fact that the weighatage scale used for all factors and sub-factors has a positive range (1–10), it is considered appropriate to use the RMS values. The RMS value not only provides a number representing the central tendency of the weightages assigned to a particular factor or sub-factor, it also gives an indication of respondents' trend in assigning the weightage to that factor or sub-factor.

The population mean weightages for all factors and sub-factors, estimated to be sample RMS weightages through hypothesis testing, can now be used in the matching model to develop profiles of potential candidates for construction project manager's job. These candidates can be ranked in order of the scores based on how well their profiles fit with the project requirements profile.

9.2. Project requirements

A total of 14 groups and 55 associated sub-factors were identified as the most likely influencing items while selecting a construction project manager. However, the specific requirements of a particular project determine the degree of relevance of these sub-factors to that project. The degree of relevance for the influencing sub-factors can also be different even for the same project, depending on which particular party to the project is evaluating the project requirements. For example, the sub-factor(s) related to labour management for a particular construction project would have more relevance to the project requirement from the contractor's perspective than from the client's perspective. The degree of relevance of each of the influencing sub-factor to the project requirements from that party's point of view who is searching for the project manager, needs to be defined in order to be able to match the candidates profiles in terms of the same influencing sub-factors.

A computer software is developed based on the matching model for use by the management personnel selecting the construction project manager. The important input to the matching model software are the specific requirements of the particular projects and the skills and capabilities of the potential candidate. To incorporate these inputs into the matching process, the project requirements index and candidate's evaluation sheet and the project requirement index is shown in Fig. 2. Various components of the model are explained below.

One important consideration in the matching model software is to reduce the subjectivity and bias of the candidate evaluator. The global relative importance assigned to each influencing factor and sub-factor is hidden from the evaluator during the evaluation process. Also, the project requirement index id defined by the organisation as a matter of policy and is not visible to the evaluator. Even on the computerised evaluation sheet, the evaluator is only permitted to choose one of the multi-choice answers relating to each influencing sub-factor without actually knowing the score associated with that answer. This way, the evaluator can only focus on the capabilities of the potential candidates and the matching model software takes care of the process of matching these capabilities to the project requirements, taking into consideration the relative importance of each capability in the overall project management scope.

The first step in the matching model computer software is to specify how much a particular influencing sub-factor is relevant to the project by assigning a Project Requirement Index using an ordinary scale of 0 (for not relevant at all) to 5 (for very relevant). These Project Requirement Indices specified in the matching model software are stored in one of the input files for later processing and are kept hidden from the evaluator.

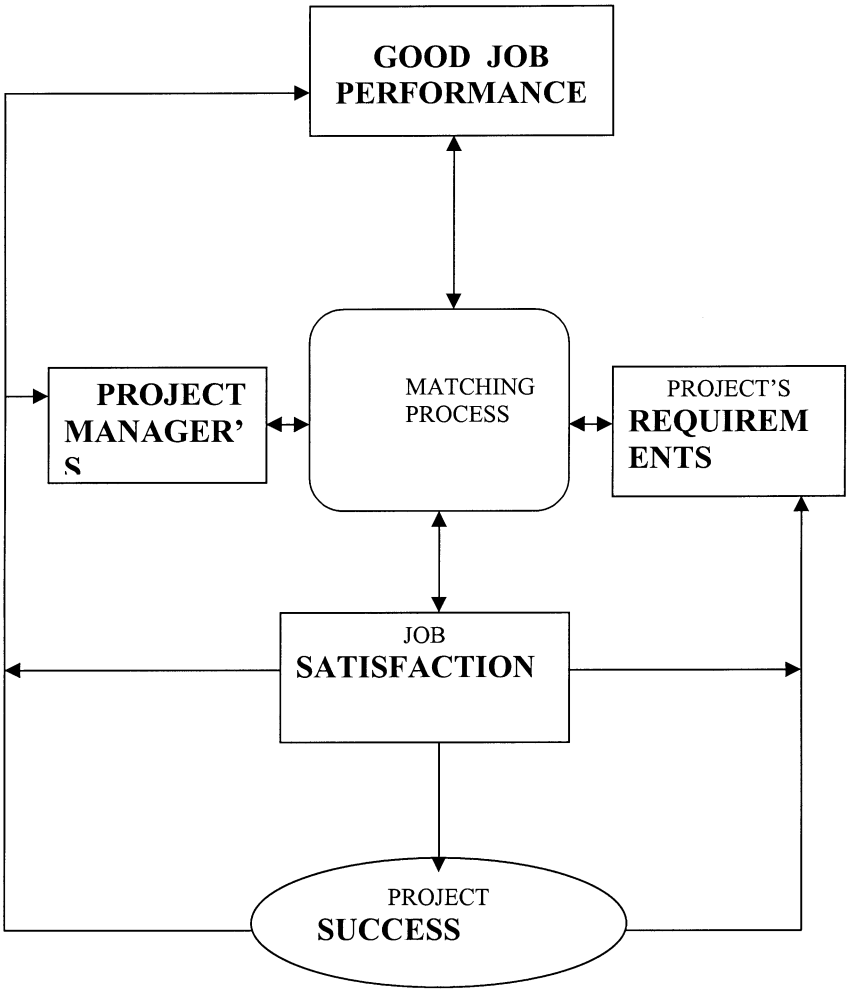


Fig. 1. Matching model flow chart.

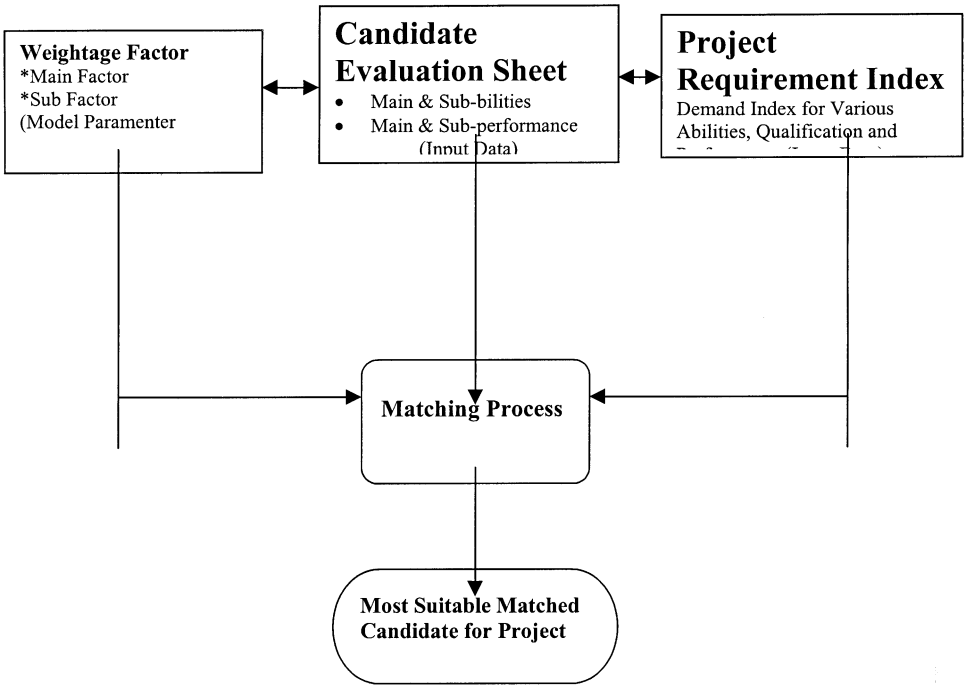


Fig. 2. Basic model concept.

9.3. Candidates evaluation

At the start of the matching exercise, the matching model software provides the user with an evaluation sheet to be filled in for each candidate interested in project manager's job. In addition to some basic information on the candidate (e.g. name, application number, etc.), the evaluation sheet requires the user to choose one of the multi-choice answers to the variety of questions. These questions on the evaluation sheet are associated with the influencing sub-factors identified earlier. The candidate's evaluation sheets should be filled in based on the information obtained from his/her resume, reference, interview and any other reliable source. Depending on the answer ticked by the user, the program assigns a score on an ordinal scale of 1–5 to the candidate against that particular question (or in other words, against the associated sub-factor). This evaluation score represents the degree to which the candidate possesses the characteristic related to the influencing sub-factor. The evaluation scores, for individual questions remain unknown to the user.

9.4. Selection and match processing

The global importance ranking for each influencing factor and sub-factor, as determined by the population mean weightage on a 1–10 scale, are stored in two data files as the database for the matching model software. The matching model software performs two types of processing and provides two sets of results to the user. Firstly, it calculates the total weighted value of the candidate's characteristics related to each influencing sub-factor only in terms of the global importance of that sub-factor, without considering the relevance of it to the project requirements. This is done by multiplying the global importance weightage of each sub-factor to the evaluation score of the candidate against that sub-factor (as obtained from the evaluation sheet).

These individual weighted scores at sub-factor level are then aggregated as the average weighted scores to the respective main factor levels. The 14 weighted scores thus obtained at the factor level are added together to provide a total weighted score of the candidate without considering the specific project requirements. This done by multiplying the global importance weightage of each sub-factor to the evaluation score of the candidate against that sub-factor (as obtained from the candidate's evaluation sheet). These individual weighted scores at sub-factor level are then aggregated as the average weighted scores to the respective main factor levels. In case of those main factors where only one of the associated sub-factor is applicable to any candidate (i.e. factor groups A, B, C, and J), the weighted score for the applicable sub-factor becomes the average weighted score at the respective factor level. For all other factor groups, all the associated sub-factors are applicable to every candidate, (although some may have 0 evaluation score). In these cases the average weighted score for the factor sup is calculated by adding the weighted scores at sub-factor levels in that group and diving it the number of sub-factors in that factor group (Fig. 3).

Each of the average weighted score, obtained at factor level, is then multiplied by the total weightage of the corresponding main factor to take into account the relative importance of main factors. The 14 weighted scores thus obtained at the factor level are added. The same process is performed for each candidate and the total weighted scores of all candidates are provided to the user. These scores provide an indication of the best candidate in terms of characteristics relating to the influencing factors. However, the "absolute best" candidate may not necessarily be the most suitable person to be the project manager on that particular project.

It is therefore necessary that a total "weighted matching score" for each candidate is calculated based on the matching of the candidate's characteristics to the project requirements. This objective is accomplished by multiplying the weighted score at each sub-factor level by the corresponding Project Requirement Index. The scores after considering the project requirements will provide an indication to the selectors of the candidate whose characteristics are best fitted to the project needs. In other words, the "most suitable" candidate for the project manager's job can now be based on a match of his/her characteristics and the project requirements. The matching model software can also provide the out put of candidates average weighted matching scores at the main factor level for detailed comparison and analysis purposes.

An alternative approach for the matching model is to standardise the global weightages of all the sub-factors within each main factor on a 1 to 10 scale, using the combined sample's RMS weightage for these sub-factors. In order to standardise the global weightage, the highest and lowest rank sub-factors within a particular main factor group will be assigned a value of 10 and 1, respectively. The standardised global weightages of the sub-factors ranked in between the lowest and highest rank sub-factors will then be interpolated between the values 1 and 10 maintaining the same ratio as that for the global weightages. For example if the global weightages for three sub-factors within a particular main factor group are 8, 7 and 6, respectively, then their standardised global weightages will become 10, 5 and 1, respectively.

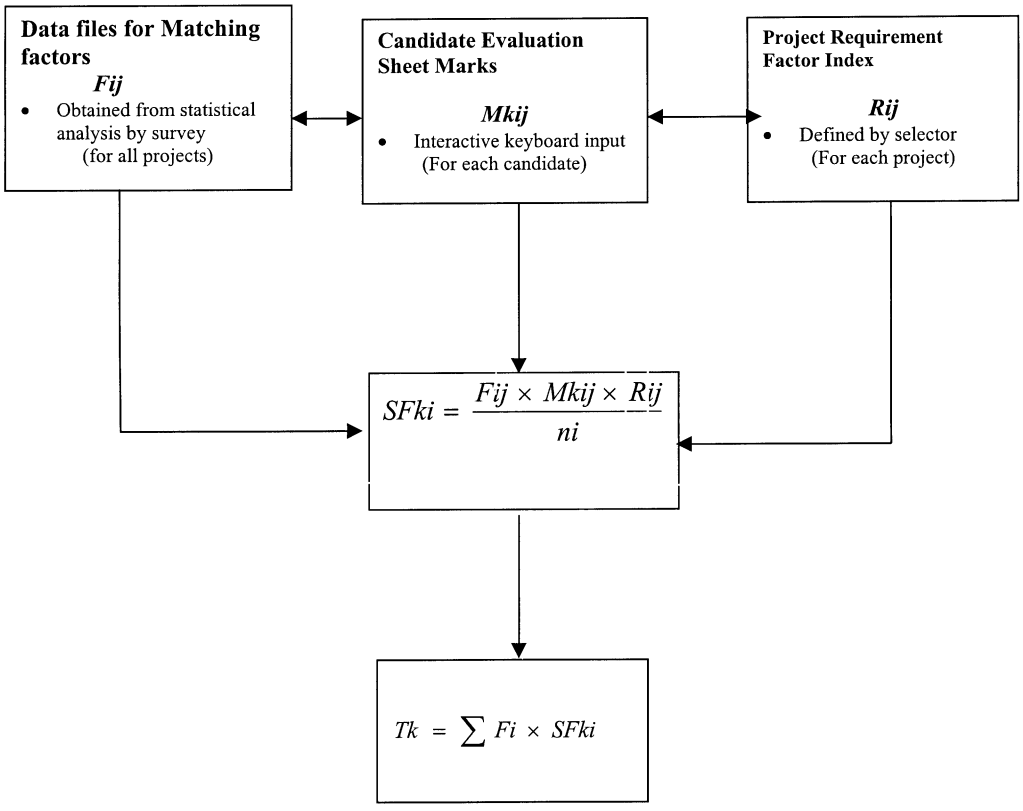
The effect of standardising the global weightages is to "stretch" the relative ranking of sub-factors within a main factor group to the extreme values of 1 (not important) to 10 (very important). However, it must be noted that the sub-factors ranking based on the global weightages, is only to show the "relative" importance of

these sub-factors. The lowest ranked sub-factor has the lowest RMS weightage in its group. But it does not necessarily mean that the lowest ranked sub-factor is not important in the selection of construction project managers. In fact, it can be seen from Table 4 that most of the lowest ranked sub-factors within various main factors still have values in the range of 7 to 9 on a 1–10 weightage scale, suggesting that they were near the "very important" mark. Standardisation of the global weightages considers these factors to be "not important" by assigning them the lowest value of 1. Similarly, it could be possible that the highest ranked sub-factor within a particular main factor group only marginally important among even less important sub-factors.

This process is shown in Fig. 3 along with the equation governing the matching process. As can be seen in the equation, a three-dimensional candidate matrix, a two-dimensional weightage factor matrix and a two-dimensional project requirement index matrix yield a two dimensional sub-marks matrix. This matrix when multiplied with global factors vector, yields a vector of final candidate scores. The model matching software is written in the BASIC computer language and effort has been made to make it user friendly.

10. Model implementation and staffing principles

The primary focus of the implementation model is on establishing the best match between the skills and abilities of prospective candidates for project manager's job against the requirements of the project. It does not take into account some of the issues related to project staffing which can possibly influence the selection of construction project manager.



Where;

F	= Factors
SF	= Sub-factor Score
K	= Candidate
M	= Evaluation Sheet Score for Candidate
R	= Requirement Project Index
T	= Total Score
i	= Sub-factors
j	= Main Factors
ni	= Total Number of Sub-factor

Fig. 3. Implementation of matching process.

One of the most prominent examples of such project staffing issues is the situation where the relatively inferior ability in one particular area of an otherwise excellent candidate can be adequately compensated by superior ability in that area of another member of the project team. Alternatively, the weaker capability in a particular area can be improved quickly and effectively through training etc. These types of situations can be accommodated in the implementation model by modifying the project requirement profile. The value of project requirement index for any particular area can be decreased to reflect the fact that strong capabilities of some other project team member(s) in that area will make it less critical for the project manager to have strong capabilities in the same area. In fact, the matching of candidates' profiles can be done both ways, i.e. with and without modifying the project requirement profile to incorporate these types of situations. The two sets of matching results thus obtained can be compared to draw more appropriate conclusions.

Another common project staffing issue is to take into account wider consideration beyond the particular project in question while selecting a project manager. For example, sometimes the "most suitable" candidate for the current project may be ignored in favour of another candidate with broader long-term advantages, such as his/her suitability for a more important project to be followed by the current project, etc. The implementation model is also capable of accommodating these "non project specific" requirements. The requirement indices for such "non project specific" factors can be defined in the model in addition to the project requirements indices. The candidates can then be scored against these additional factors and the matching can be performed. In summary, the implementation model is flexible enough to accommodate some of the common staffing principles. However, it is felt that there is some scope for future research on enhancing the implementation model to incorporate a wide variety of staffing principles.

In summary, the implementation model is flexible enough to accommodate some of the common staffing principles. However, it is felt that there is some scope for future research on enhancing the implementation model to incorporate a wide variety of staffing principles.

11. Conclusion

This study was only limited to the construction companies in Bangkok city. Given the subjective nature of the selection process for the project managers, it is inevitable that the cultural practices and values will be reflected in the importance given to various factors. The results of this study must therefore be considered in this perspective. A society with significantly different values is likely to give different importance to various factors, especially factors such as sex, marital status, etc. In fact, it is quite possible that a radically different society will propose a significantly different set of factors to be considered while selecting the project managers.

Initial observations of the basic statistical parameters (mean and standard deviation), for three project categories revealed that the importance given to any particular factor (or sub-factor), as indicated by a weightage on a 1–10 scale, was of the same order of magnitude. Consequently, the samples for three project categories were combined into a single sample representing all types of construction projects.

A ranking of the main influencing factors based on the population mean weightage of these factors, estimated to be the combined sample's RMS weightage, revealed that *experience* is given the highest importance when choosing a construction project manager. *Marital Status*, on other hand, is considered to be the least important factor in the selection of construction manager.

A matching model computer software is developed for use by the management personnel responsible for selecting the construction project managers. The matching model software is based on the influencing factors and their global importance weightage, as determined previously. The software input consists of the project requirement index and the potential candidates' evaluation scores in terms of the influencing subfactors.

The matching model software was also tested by matching the capabilities profiles of four candidates to the project requirements profiles of three hypothetical projects.

References

[1] Goodwin RSC. Skills required of effective project managers. Journal of Management in Engineering, ASCE, 1993;9:217–26, 3, July 1993.
[2] Dias WPS. Circular organisational structure for project team. Journal of Management in Engineering, ASCE 1990;6(4):471–8.
[3] Kerzner H. Project management: A system approach to planning, scheduling and controlling. New York: Van Nostrand Reinhold, 1979.
[4] Walton H. The project manager- a capite ad calcem, Journal of Project Management, 1984;22:11–21, March, 11.
[5] Oberlender. Project management for engineering and construction. Hightstown, New Jersey: McGraw Hill, 1993.
[6] Chan A. Matrix organisational structure, UNIBEAM Journal, national university of Singapore, Vol. XIX:60–63, 1990/1991.
[7] Chan, A. The role of project managers, Proceedings of the Project Management International Conference, Guangzhou, China, November, 1992.
[8] Katz R. Skills of an effective administrator. Harvard Business Review, September/October:90–102
[9] Burke R. Project management: planning and control techniques, 3rd ed. Capetown: Promatec Int, 1999.
[10] Handy C. Understanding organisations. Middlesex, UK: Penguin Books, 1985.

[11] Zartment W. The 50% solution. New York: Anchor Press/Doubleday, 1976.
[12] Gaddis P. The project manager, Harvard Business Review, May/June, 1959.
[13] Mintzberg H. The nature of managerial work. New York: Harper Row, 1972.
[14] Katz D, Kahn RL. The social psychology of organisation. New York: Wiley, 1978.
[15] Kezsbom DS, Donnelly RG. Managing the project organisation of the nineties: a survey of practical qualities of effective project leadership. Pittsburgh: PMI Symposium, 1992.
[16] Fayol H. General and industrial management. London: Pitman, 1949.
[17] Drucker PF. The effective executive. New York: Harper Row, 1966.
[18] Peters TJ. Liberation management. New York: Knopf, 1992.
[19] Blake RR, Mouton JS. The managerial grid. Houston: Gulf, 1964.
[20] Hershey P, Blanchard KH. Management of organisational behaviour: utilising human resources, 5th ed. New Jersey: Prentice-Hall, 1988.
[21] Vroom VH, Jago AG. New leadership: managing participation in organisations. New Jersey: Prentice-Hall, 1988.
[22] Fleishman EA, Hunt TG. Current developments in the study of leadership. Carbondale: Southern Illinois University Press, 1973.
[23] Graen G. Role making processes within complex organisations. In: Dunnette MD, editor. Handbook of industrial & organisational psychology. Skokie, Ill: Rand McNally, 1976.
[24] Likert R. Past and future perspectives on system 4 and appendices A & B. Ann Arbor, MI: Renis Likert Association, 1977.
[25] Fiedler FE, Chemers MM, Leadership and effective management, New York: Scott, 1974.
[26] Schriesheim C, Ker, S. Theories and measures of leadership: A critical appraisal of current and future directions. Hunt JG, Larson LL, editors. Leadership: the cutting edge. Southern Illinois University Press, 1976. p. 9–45.
[27] Strub MJ, Garcia JE. A meta-analytic investigation of Fiedler's contingency model of leadership effectiveness. Psychological Bulletin 1976;90:307–21.
[28] Schermerhorn JR. Management, 6th ed. New York: John Wiley, 1999.
[29] Bryman AE, Bresnen MJ, Ford JR, Beardsworth AD, Keil ET. Leader orientation and organisational transience: an investigation using Fielder's LPC scale. Journal of Occupational Psychology 1987;60:13–19.
[30] Harper D. The extending limits of site responsibility. In Harlow PA, editor. The practice of site management, 2, lOB, 1978.
[31] Lemarie M. Insight into management. Building Technology and Management 1975;13:5–8.
[32] Lansley P, Sadler P, Webb T. Organisation structure, management style and company performance. The International Journal of Management Science 1974;2:467–85.
[33] Monaghan TJ. An investigation of leadership styles and organisational structure, and their influence on the conduct of construction projects, MSc thesis, Heriot-Watt University, 1981.
[34] Bresnen MJ, Bryman AE, Ford JR, Beardsworth AD, Keil ET. The leader orientation of construction site managers. Journal of Construction Engineering & Management, ASCE 1986;112(3):370–80.
[35] Bresnen MJ, Bryman AE, Beardsworth AD, Keil ET. Effectiveness of site management. Technical Information Service, CIOB 1987;85:1–6.
[36] Chan A, Tam CM. Impact of management style on project performance, Proceedings of the First International Conference on Construction Project Management, January, 1995, Singapore. p. 115–122.
[37] Ashley DB, Lurie CS, Jaselskis EJ. Determinants of construction project success, Project Management Journal, Vol.18, No. 2, June 1987.
[38] Sidwell AC. A critical study of project team, organisational forms within the building process, PhD Thesis, 1983.
[39] Wheelen TL, Hunger JD. Strategic management and business policy, 7th ed. London: Prentice Hall International, (UK) Ltd, 2000.
[42] Hill CWL, Jones GR. Strategic management: an integrated approach, 4th Edn. Boston: Houghton Mifflin Company, 1998.