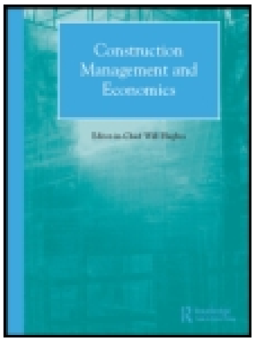

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Factors constraining successful building project implementation in South Africa

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The prevalence of client dissatisfaction in the South African building industry is a consequence of non-achievement of set project objectives due to identifiable constraints. The paper presents the results of investigations into the nature, magnitudes and frequencies of occurrence of these constraints. The descriptive survey method was used with qualitative data gathering through semi-structured interviews, and quantitative data gathering using structured questionnaires. Multi-attribute methods and rank correlation tests were used in the data analyses. A set of consultants' and contractors' acts of omission or commission is shown as the most influential and most frequently occurring factor constraining successful project delivery in the South African building industry. The controllable factors account for 67% of the perceived discrepancies between expected and actual outcomes of project development. An Influence–Frequency matrix was developed and applied as a conceptual framework for establishing the risk levels of the identified project constraints. The application of this framework is recommended as an effective approach to risk analysis and risk response development in project management.

Keywords: Development constraints, Influence–Frequency matrix, project management, project success criteria, risk management

Introduction

How do companies compete, build and maintain viable businesses in a rapidly changing global marketplace and business environment? A major part of the answer is 'a commitment to creating and retaining satisfied customers' (Kotler, 1997, p. 63).

To create and retain satisfied clients, service providers in the construction industry must meet the expectations and requirements of their clients in the delivery of projects. In terms of project development, clients' expectation is chiefly the delivery of the project within time, quality and cost targets (Luder, 1986; Raftery, 1999; Nkado, 1991).

Nkado and Mbachu (2001) argue that if clients' stated needs or developmental requirements could sufficiently address the real (which are usually latent) needs and objectives for investment, delivering the project within time, quality and cost targets could translate to clients' satisfaction. However, achievement of these project objectives proves to be elusive owing to some controllable and uncontrollable constraints. This is confirmed by the high incidence of client dissatisfaction reported in the literature (Kometa *et al.*, 1994; Bowen *et al.*, 1997; DPW, 1997).

The literature is replete with studies identifying factors constraining successful project implementation. For instance, NEDO (1978, 1983) and Kometa *et al.* (1994) argue that clients' attributes in particular, and their general approach towards project management could exert significant impact upon the achievement of project objectives. Morris and Hough (1986), and Kometa *et al.* (1994) identify 10 'success' factors, which should be present for any major project to be successfully executed. These include project definition and formulation, project finance, contracting, legal agreements, human factors, project implementation and management, politics and social factors, schedule and urgency, schedule duration and planning. How the client responds to these factors affects the performance of consultants and contractors in fulfilling the client's objectives for the project.

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Kwakye (1991) identifies the choice of procurement approach as a critical determinant of successful project execution. However, Turner (1990) reports that in practice, the traditional approach is followed in the great majority of cases, thus reflecting the reluctance of professionals and their clients to tread unfamiliar ground and incur the consequent risks. The insistence on the traditional approach to procurement due mainly to familiarity, even in situations where this type of approach cannot guarantee the realisation of clients' objectives for the project may be a possible cause of unsatisfactory outcomes of the procurement process. In this context, Rowlinson (1999) questions the rationale for continued adoption of the traditional procurement approach by many organisations when it can be argued that 'it leads to a lack of flexibility, a price to pay in terms of claims-conscious behaviour, the fallacy of cost certainty, and a release of control by the client organization' (p. 48).

Other constraints to successful project implementation include disputes and adversarial relations. Latham (1994) argues that a positive alliance between parties in the procurement process constitutes an indispensable link to a successful project. However, disputes do arise, and will continue as long as people fail to trust one another. Latham (1994) notes that the UK construction industry has become extremely adversarial and is paying the price, adding that, '… the construction environment has been degraded from one of a positive relationship between all members of the project team, to a contest consumed in fault finding and defensiveness, which results in litigation' (p. 87). Clearly, the prevalence of disputes among the parties will not augur well for the realisation of the project objectives. Perhaps it is in the light of this that Salisbury (1990) suggests that opposition should be nipped in the bud before it develops into full-blown dispute. In addition to the applications of alternative dispute resolution strategies such as adjudication, conciliation/mediation and arbitration, Latham (1994) suggests that the best solution is to avoid disputes; and that if procedures relating to procurement and tendering are improved, the causes of conflict will be reduced. Latham (1994) further posits that, 'a major step would be the adoption of a contract document, which places emphasis on teamwork and partnership to solve problems' (p. 87).

Adversarial relations also exist between the main contractors and subcontractors which undermine on-site productivity, and ultimately jeopardise the realisation of project objectives. Millet *et al.* (2000) report that where good relationships existed between main contractors and subcontractors, problems were alleviated more effectively, and they were able to provide a more efficient service; the reverse of which was the case in soured relationships. Millet *et al.* (2000) list delayed and incorrect payments, traditional contractual arrangements, holding of retention monies, lack of trust, unfair treatments and not being praised for good works, as some of the factors given by subcontractors, which could sour relationships between the main and subcontractors.

Gaps in the literature on constraints to project implementation include the magnitudes of influence, frequencies of occurrence and extent of control of these constraints by clients and the project team. Mere identification of some of these constraints is not sufficient to guide clients and project teams in properly budgeting for, and responding to, the risks involved. This paper addresses the identified gaps. In so doing, it highlights the constraints that may be peculiar to the building industries of developing countries.

Since the investigation of the factors constraining successful project implementation is a subject matter embedded in the overarching theme of project risk management, the study focuses on risk identification and risk quantification stages to provide a conceptual framework for subsequent stages of risk response development.

Project risk management

The PMI (1996) defines project risk management to include 'processes concerned with identifying, analysing, and responding to project risk' (p. 111). This definition appears to agree with other definitions of risk management. However, a more robust definition is provided by the Australian/New Zealand Standard 4360 (1999), which recognises risk management as 'the term applied to a logical and systematic method of establishing the context, identifying, analyzing, evaluating, treating, monitoring and communicating risks associated with any activity, function or process in a way that will enable organizations to minimize losses and maximize opportunities' (p. 1). Project risks are underpinned by the nature and interactions of the factors constraining successful project implementation. In the study of these factors, it may be necessary to apply project risk management principles.

Project risk in context

'Risk' could be defined in a number of ways depending on the objectives. A generic definition is provided by the *Concise Oxford Dictionary* as 'exposure to chance of injury or loss'. A holistic understanding of risk in the project management context requires three approaches to the concept of risk: an *a priori* (before-the-event) definition of project risk draws from a probabilistic perspective (Levin *et al.*, 1982), which is essentially the chance that what is expected may not be realised. An *a posteriori* (after-the-event) definition of risk sees risk as the actual loss or injury suffered as a result of not meeting expected targets or objectives due to some controllable or uncontrollable circumstances. A more profound perspective on risk is provided by the PMI (1996) in its definition of project risk management as including maximising the results of positive events and minimising the consequences of adverse events. By focusing on the set project objectives, the PMI perspective is concerned not only with meeting set project objectives by minimising adverse events, but also with exceeding project objectives by maximising positive events. However, this study focuses on the *a priori* perspective on project risk, since it emphasises a preventive rather than a remedial approach.

Project risk management process

The Project Management Institute (PMI) (1996) identifies four fundamental steps in project risk management, which could overlap and interact with each other and with the processes in the general management knowledge areas as well:

(a) Risk identification: determining which risks are likely to affect the project and documenting the characteristics of each.
(b) Risk quantification: evaluating risks and risk interactions to assess the range of possible project outcomes.
(c) Risk response development: defining enhancement steps for opportunities and responses to threats.
(d) Risk response control: responding to changes in risk over the course of the project.

This study draws on the above risk management process, but more specifically, focuses on the following:

Risk identification: Identification of internal (controllable) and external (uncontrollable) sources of project risks, and gathering information for evaluating the magnitudes of influence and probability of occurrence of the identified risk factors.

Risk quantification: Risk evaluation using the information obtained above involves computing the expected value of each risk event as the product of the magnitude of influence (depicted by the Influence Index, I_I) and the frequency of occurrence (depicted by the Frequency Index, FI). Both indexes are computed from mean values of expert-rated influence and frequencies respectively for each risk event, as shown in Table 2 and Table 3 below. This draws from the PMI (1996) concept of 'expected monetary value' as a tool for risk quantification. The concept is defined in the next section.

Risk response development and control: Establishing a procedure for risk management in the project implementation process. A conceptual framework is developed in the form of Influence–Frequency matrix for establishing the risk profile of any potential risk event. The concept is discussed in the following section.

Influence–Frequency matrix

The expected monetary value (EMV), as a tool for risk quantification, is defined by the PMI (1996) as a product of two numbers given in equation (1):

$$\mathrm{EMV} = \mathrm{X} \times \mathrm{p}(\mathrm{X}) \quad (1)$$

where X is 'the risk event value—an estimate of the gain or loss that will be incurred if the risk event does occur'; p(X) is 'the risk event probability—an estimate of the probability that a given risk event will occur' (PMI, 1996, p. 115).

The concept of EMV can be adapted to formulate a framework for establishing the risk profiles of project constraints on the basis of their risk values (depicted by Influence Index I_I values) and their probabilities of occurrence (depicted by Frequency Index FI values). Thus by plotting the FI and I_I values of a project constraint on an Influence–Frequency matrix, the risk level of a constraint on a 5-band risk spectrum could be established. Owing to the relatively small number of data points involved in the study (maximum of 40), the ordinal rating scale was not converted to interval scale using correspondence analysis. However, the 5-band risk spectrum is obtained by transcribing the 5-point ordinal scale to 5-band interval scale for the purpose of interpreting the I_I and FI values computed in the multi-attribute analyses. Table 1 presents the 5-band scale.

The risk level of any constraint is established on the basis of its location on the cells of the Influence–Frequency matrix. This was intentionally made to maintain the ordinal nature of the data (i.e. opinions) as distinct from interval data (e.g. numerical values from records). This is based on 'expert judgement'. For example, risk events could be described as having a high, medium or low probability of occurrence and a severe, moderate or limited impact (PMI, 1996). In the context of this study, the 'expert judgement' refers to the opinions of consultants and contractors as canvassed in the surveys. The 3-point rating scales of the PMI were expanded to 5-band rating scales for a more sensitive Influence–Frequency matrix (see Figure 2) used in the study.

Table 1 Converting 5-point ordinal rating scale to 5-band interval scale

Ordinal scale	Interval scale	Rating		
		Influence level	Frequency of occurrence	Risk level
5	>4.50	Very high (VH)	Very frequent (VF)	Very risky (VR)
4	3.51–4.50	High (H)	Frequent (F)	Risky (R)
3	2.51–3.50	Average (Avg)	Somewhat frequent (SF)	Somewhat risky (SR)
2	1.51–2.50	Low (L)	Occasional (O)	Not so risky (NSR)
1	<1.51	Very low (VL)	Rare (R)	Not risky (NR)

Table 2 Levels of influence of constraints of project characteristics (contractors' perceptions)

Project characteristics	*Levels of influence					TR	I_I	*Remarks	Rank
	VH 5 %	H 4 %	AV 3 %	L 2 %	VL 1 %				
Specified quality levels	13	50	31	0	6	39	3.63	H	1
Labour and materials shortages	19	31	44	0	6	40	3.56	H	2
Level of complexity/technology	13	40	20	27	0	40	3.40	AV	3
Site characteristics	25	13	25	31	6	40	3.19	AV	4
Size/scale of project	0	38	50	6	6	40	3.19	AV	5
Environmental constraints	6	38	19	25	13	40	3.00	AV	6

Notes: *Levels of influence (Remarks): see Table 1. %=Percentage of total respondents (TR) rating each level of influence of a particular constraint. I_I=Influence Index (equation (2)) of a given constraint; Rank 1=most influential constraint.

Respondents

The study was limited to the views expressed by registered members of the Association of Construction Project Managers (ACPM), and the Master Builders Association (MBA) of South Africa. The ACPM and the MBA are the major formal associations for construction project managers and building contractors, respectively, in the South African building industry. Since members of these associations are at the forefront of project conception, planning, implementation and controls, their views are considered most useful in this study. However, the views of clients and other professionals were canvassed in complementary studies.

Methodology

The descriptive survey method as used in this study is recommended in situations where achieving the research objectives demands the technique of observation (via interview schedules and questionnaires) as the principal means of collecting the research data (Leedy, 1997; Saunders *et al.*, 1997; Zikmund, 1997). The method involved two stages of data gathering. At the

Table 3 Frequencies of occurrence of constraints of project characteristics (contractors' perceptions)

Project characteristics	*Frequencies of occurrence					TR	I_I	*Remarks	Rank
	VF 5 %	F 4 %	SF 3 %	O 2 %	R 1 %				
Labour and material shortages	21	29	14	29	7	38	3.29	SF	1
Specified quality levels	7	43	21	14	14	38	3.14	SF	2
Size/scale of project	0	29	29	43	0	38	2.86	SF	3
Level of complexity/technology	0	46	8	31	15	38	2.85	SF	4
Site characteristics	15	15	23	23	23	37	2.77	SF	5
Environmental constraints	0	21	36	29	14	38	2.64	SF	6

Notes: *Frequencies of occurrence (Remarks): see Table 1. %=Percentage of total respondents (TR) rating each level of influence of a particular constraint. FI=Frequency Index (equation (2)) of a given constraint; Rank 1=most frequently occurring.

first stage non-standardised scheduled interviews were conducted with a convenience sample of 20 (10 from each group of) construction project managers and contractors in the South African major cities of Johannesburg and Port Elizabeth. The aim of the pilot interviews was to identify the relevant constructs defining the constraints on successful project delivery in the South African building industry.

Constructs generated at the pilot interview stage were used in designing questionnaires, which were pre-tested and distributed to all the members of the ACPM and MBA through a nationwide survey.

Using a 5-point rating scale, respondents were asked to rate the levels of influence and frequencies of occurrence of each identified constraint. The 5-point rating scales for the levels of influence and frequencies of occurrence are shown in Table 1.

Data analyses

The multi-attribute analytical technique was used to analyse the ratings of the respondents with a view to establishing a representative or mean rating point for each group of respondents. The analysis draws from the multi-attribute utility approach of Chang and Ive (2002), and involves the computations of the Influence Index (I_I) and the Frequency Index (FI). The I_I and FI indicate, respectively, the level of influence and frequency of occurrence of each constraint within a subset of factors. In each computation, the total number of respondents (TR) rating each constraint was used to calculate the percentages of the number of respondents associating a particular rating point to each constraint as shown in equation (2):

$$I_{Ij} = \sum_{k=1}^{5} \left(R_{pjki} \times \%R_{jk} \right) \tag{2}$$

where: $I_{I\,j}$=Influence Index for attribute j; R_{pjk}=Rating point *k* (ranging from 1–5); $\%R_{jk}$=Percentage response to rating point *k*, for attribute j. The Frequency Index (FI) was computed in the same manner.

Rank correlation analyses

For the purpose of improving reliability and validity of the research findings, the opinions of project managers and contractors were compared with a view to establishing 'multiple sources of evidence' (Tan, 2002, p. 63) or measuring internal consistency through the 'equivalent-form method' (Zikmund, 1997, p. 341). The comparison involves matching the sets of ranks analysed from the responses of project managers and contractors on the attributes of dimensions being rated.

Both Cooper and Emory (1995) and Zikmund (1997) recommend the use of Spearman rank-order correlation as the appropriate statistical technique in situations involving the ordinal level of measurement and two related sample cases. Naoum (2003) also supports the use of Spearman correlation test where 'the problem is to measure the amount and significance of a correlation between people's rank on a number of issues' (p. 124). The Spearman rank-order correlation coefficient rho (ρ) is computed (Zikmund, 1997, p. 649) using equation (3):

$$\rho = 1 - \frac{6 \sum_{i=1}^{n} d_i^2}{n^3 - n} \tag{3}$$

where d_i is the difference between the ranks given to the i^{th} attribute by each group; n is the number of attributes being ranked.

In the test of significance of the computed value of Spearman rank correlation coefficient, the null hypothesis (H_0) assumes that no significant correlation exists between the two sets of ranks of n attributes computed from the ratings of construction project managers and contractors. In statistical terms, this implies that the computed rho (ρ) is less than or equal to the critical rho (ρ_α). In the study, an alternative hypothesis (H_A) is chosen for one-tailed test, which assumes that a significant and positive correlation exists. At 5% level of significance, both H_0 and H_A could be stated as statistical hypotheses as follows:

$$H_0 : \quad \rho \leq \rho_\alpha (\text{i.e. no significant correlation exits}) \tag{4}$$

$$H_A : \quad \rho > \rho_\alpha \begin{pmatrix} \text{i.e. significant and positive} \\ \text{correlation exits} \end{pmatrix} \tag{5}$$

Results

Survey responses

Of the 81 registered members of ACPM surveyed, 31 responded before the cut-off date for receipt of responses. Twenty-eight of these responses were fully usable. This represents an effective response rate of 35%. The non-usable responses were from respondents whose demographic profiles indicated that they did not belong to the target population (i.e. registered ACPM members, as distinct from associate or graduate members).

Responses in respect of years of professional practice showed that 24 (86%) respondents had more than 10 years of professional practice. In terms of highest post-secondary qualification, 71% had first degrees as their highest academic attainment. None of the respondents had a status below the managerial position in their respective organisations (i.e. 80% were directors, while 20% were in the top management cadre).

Nearly all (95%) of the respondents belonged to other professional associations such as the South African Property Owners' Association (SAPOA), Association of South African Quantity Surveyors (ASAQS), Chartered Institute of Building (CIOB), and the South African Institute of Valuers (SAIV). The responses obtained, though not representative of these other associations, implied varied experiences over and above those of core construction project management consultants.

The demographic profiles of the contractors showed that 98% had more than 10 years of construction experience, and 90% of the respondents were directors. Higher National Diploma certificates were the highest academic qualifications of 60% of the contractors while 40% had university degrees. However, these contractors deal mainly in the residential and commercial building sector and less in civil works.

The above demographic profiles of the respondents accord sufficient quality to the responses received, and by implication, the reliability of the results and related deductions.

Factors constraining successful project delivery

The pilot interviews conducted with selected directors of client organisations, contractors and construction project managers as described in the Methodology, yielded seven groups of factors constraining successful project delivery in the South African building industry, from a content analysis of the most recurring mentions. These are further categorised as controllable and uncontrollable factors, depending on the extent to which they could be controlled by clients and project teams. The categories and their constituent factors are listed as follows:

(*A*) *Controllable (internal) factors:*

(1) Project characteristics;
(2) Service providers' (consultants' and contractors') influences;
(3) Client organisational influences.

(*B*) *Uncontrollable (external) factors:*

(4) Socio-cultural issues;
(5) Unforeseen circumstances;
(6) Economic and global dynamics;
(7) Governmental/statutory controls.

Constructs underlying each factor were investigated. The outcomes were incorporated into the questionnaire. Respondents' ratings of the magnitudes of influence and frequencies of occurrence of each construct were analysed as described in the Methodology. Table 2 and Table 3 present examples of the analyses of the responses of contractors on the levels of influence and frequencies of occurrence of the constraints underlying project characteristics.

Internal factors constraining successful project delivery

Table 4 summarises the magnitudes and frequencies of occurrence of the identified internal (controllable) factors constraining successful project delivery, as analysed from the responses of construction project managers and contractors. For each set of analysis (responses of project managers or contractors), the Influence Index (I_I) and the Frequency Index (FI) computed for each attribute were used to locate the risk profile of the attribute on the Frequency-Influence matrix, as described in the Methodology. The remarks ('Rem') served to interpret the I_I and FI values of each attribute on the 5-point rating scales used for both dimensions.

In each subset of attributes, the Spearman rank correlation test was used to test the significance of the differences between the two sets of ranks (R_i and R_f) computed from the responses of construction project managers and contractors. The tests were conducted at 5% level of significance.

Interpretation

In terms of project characteristics, Table 4 shows that construction project managers perceived the level of complexity or technology as the most influential factor constraining successful project implementation. On the other hand, contractors believed that the specified quality level is the most influential factor under this category. Though no significant correlation exists in their sets of ranks, both groups perceived that all underlying constraints under this category were 'somewhat risky'.

For the factors under consultants' and contractors' acts of omission or commission, construction project managers rated the quality and attitude to service as the most influential factor. Again, there is a divergence of views, as contractors perceived speed and comprehensiveness of services as the most influential factor under this category. However, a significant consensus of opinions exists between both groups on the frequencies of occurrence of the factors under this group. Also, both groups agreed that the quality of, and attitude to, service is one of the most risky project constraints. This accords with the findings of Ward *et al.* (1991), Maister (1993) and Richardson (1996) that the quality of, and attitude to, service with which the industry fulfils the needs of clients could influence their judgement of the level of success.

Table 4 Magnitudes and frequencies of occurrence of the internal project constraints

	Subcomponents:	Analysed from project managers' responses							Analysed from contractors' responses						
		Levels of influences			Frequencies of occurrences				Levels of influences			Frequencies of occurrences			
		[a]I_I	[b]Rem	R_i	[c]FI	Rem	[d]R_f	[e]RL	I_I	Rem	Ri	FI	*Rem	Rf	RL
(A)	*Project characteristics*														
1	Level of complexity/ technology	4.09	H	1	3.36	SF	3	SR	3.4	Avg	3	2.85	SF	4	SR
2	Specified quality levels	3.4	Avg	2	3.5	F	1	SR	3.63	H	1	3.14	SF	2	SR
3	Environmental constraints	3.27	Avg	3	3.09	SF	4	SR	3	Avg	6	2.64	SF	6	SR
4	Size/scale of project	3.18	Avg	4	2.91	SF	6	SR	3.19	Avg	4	2.86	SF	3	SR
5	Site characteristics	2.91	Avg	5	3.09	SF	4	SR	3.19	Avg	4	2.77	SF	5	SR
6	Labour and material shortages	2.82	Avg	6	3.45	F	2	SR	3.56	H	2	3.29	SF	1	SR
	Spearman's Rank Correlation Coeff, ρ (managers' versus contractors' rankings for levels of influences and occurrence frequencies) =										0.061			0.488	
	Critical rho ($\rho_{.05}$) (n=6) =										0.829			0.829	
	Results: (NSC=Not significantly correlated at 5% alpha)										NSC			NSC	
(B)	*Consultants' and contractors' acts of omission or commission*														
1	Quality of service and attitudes	4.09	H	1	4.18	F	1	R	3.88	H	2	3.71	F	2	R
2	Errors, omissions & misinterpretations	4	H	2	3.36	SF	4	SR	3.63	H	5	3.19	SF	7	SR
3	Fee-cutting & contractual claims	3.64	H	3	3.36	SF	4	SR	3.06	Avg	10	2.86	SF	10	SR
4	Speed & comprehensiveness of service provided	3.64	H	3	3.73	F	2	R	4.5	VH	1	4.21	VF	1	R
5	Technical and managerial competence	3.55	H	5	3.45	F	3	R	3.69	H	4	3.64	F	3	R
6	Poorly defined or understood roles & responsibilities	3.45	H	6	3.09	SF	7	SR	3.56	H	7	3.5	F	4	R
7	Past project performance & experience	3.4	Avg	7	3.27	SF	6	SR	3.75	H	3	3.5	F	4	R
8	Dispute & adversarial relations	3.36	Avg	8	2.82	SF	11	SR	2.63	Avg	12	2.43	O	12	NSR
9	Contractual obligation	3.18	Avg	9	3	SF	8	SR	3.13	Avg	9	3.21	SF	6	SR
10	Resource (human, equipment and material) availability and leverage	3.18	Avg	9	2.9	SF	10	SR	3.5	H	8	3.07	SF	9	SR
11	Fragmentation of services	3.09	Avg	11	2.91	SF	9	SR	3.06	Avg	10	2.86	SF	10	SR

Table 4 (*Continued.*)

	Subcomponents:	Analysed from project managers' responses							Analysed from contractors' responses						
		Levels of influences			Frequencies of occurrences				Levels of influences			Frequencies of occurrences			
		[a]I_I	[b]Rem	R_i	[c]FI	Rem	[d]R_f	[e]RL	I_I	Rem	Ri	FI	*Rem	Rf	RL
12	Financial capacity	2.64	Avg	12	2.36	O	12	NSR	3.63	H	5	3.14	SF	8	SR
	Spearman's Rank Correlation Coeff, ρ (influences and frequencies):										0.47			0.71	
	Critical rho ($\rho_{.05}$) for n=12=										0.506			0.506	
	Result: (SC=Significantly correlated at 5% alpha)										NSC			SC	
(C)	*Client organisational influences*														
1	Poor scope definition, timing & frequency of changes	4.36	VH	1	3.82	F	1	R	3.88	H	1	3.15	SF	2	SR
2	Attitudes, drives, goals, future expectations	4.09	H	2	3.73	F	2	R	3.38	Avg	5	3.14	SF	3	SR
3	Strategic decisions	3.82	H	3	3.45	F	3	R	3.31	Avg	10	2.86	SF	5	SR
4	Financial capacity	3.82	H	3	3	SF	6	SR	3.38	Avg	5	2.64	SF	8	SR
5	Late payments for works duly executed	3.73	H	5	2.91	SF	7	SR	3.56	H	4	2.79	SF	6	SR
6	Undue interferences with the project team's job	3.73	H	5	2.55	O	10	NSR	3.38	Avg	5	2.64	SF	8	SR
7	Wrong choice of procurement approach	3.55	H	7	2.91	SF	7	SR	3.38	Avg	5	2.71	SF	7	SR
8	Type of tendering & contractual arrangements (e.g. lowest price tender award)	3.55	H	7	2.64	SF	9	SR	3.63	H	2	3	SF	4	SR
9	Contractual obligations	3.36	Avg	9	3.45	F	3	SR	3.63	H	2	3.29	SF	1	SR
10	Past project experience & project management ability	3.36	Avg	9	3.09	SF	5	SR	3.38	Avg	5	2.57	O	10	NSR
11	Conflicts of goals/interests	2.91	Avg	11	2.36	O	11	NSR	2.94	Avg	11	2.5	O	11	NSR
	Spearman's Rank Correlation Coeff, ρ (influences and frequencies):										0.24			0.68	
	Critical rho ($\rho_{.05}$) (for n=11)=										0.535			0.535	
	Result: (SC=Significantly correlated at 5% alpha)										NSC			SC	

Key: see Table 1.

Lastly, both project managers and contractors agreed that under client organisational influences, poor scope definition, timing and frequency of changes or variations constitute the most influential project constraint. Overall, while both groups agreed on the relative frequencies of occurrence of the factors under this group, full consensus was not evident on the prioritisation of the magnitudes of influence of the sub-factors.

External factors constraining successful project delivery

Table 5 summarises the magnitudes and frequencies of occurrence of the identified external (uncontrollable) factors constraining successful project delivery, as analysed from the responses of construction project managers and contractors. For each set of analysis (i.e. responses of project managers or contractors), the Influence Index (I_I) and the Frequency Index (FI) were computed for each attribute as was done for the internal factors.

Interpretation

Though no significant correlation exists in the sets of ranks computed from project managers and contractors ratings of the factors under socio-cultural subset of project constraints (Table 5), both groups agreed that workers' morale is the most influential factor capable of constraining successful implementation of projects.

Again, under unforeseen circumstances, while project managers perceived site accidents as the most influential factor capable of constraining the achievement of project targets, contractors on the other hand perceived the most influential factor to be inclement weather conditions. However, a consensus of opinions exists in the ranking of the relative frequencies of occurrence of the factors under this subset.

In the list of factors under economic and globalisation dynamics, project managers perceived the volatility of the exchange rate of the Rand with major currencies as the most influential factor, while contractors perceived the potential global energy crisis and the attendant inflation as the most influential constraint.

Under the government/statutory controls, both project managers and contractors agreed that political controls such as compliance with empowerment/affirmative actions, and other forms of business controls are the most influential project constraint.

The views of construction project managers diverged significantly from those of contractors on nearly all pair-wise comparisons of the ranks of levels of influence and frequencies of occurrence of the constituent constraints to project implementation. This finding has two worrying implications for industry and practice. First, as those who work together closely and are at the forefront of project conception, planning, implementation and control, a divergence in views between construction project managers and contractors could be indicative of perceptual gaps concerning critical issues affecting successful project delivery, and by implication, lack of synergy in working together as a team. Secondly and more disturbing, the divergence in opinions could be indicative of the inability of the two groups to arrive at a consensus in finding solutions to many problems of the industry, hence the persistence of poor service delivery in the industry as reflected in client dissatisfaction (Bowen *et al.*, 1997; Nkado and Mbachu, 2001); misunderstanding, mistrust and adversarial relations (Salisbury, 1990; Latham, 1994); time and cost overruns (Luder, 1986); poor project performance (Kometa *et al.*, 1994); client lack of confidence in the professionals and contractors (Rowlinson, 1999); and lack of understanding of the priorities and requirements of clients (Richardson, 1996).

Summary of the internal and external factors constraining project delivery

Table 6 summarises the magnitudes and frequencies of occurrence of the major groupings of the internal and external factors constraining successful project delivery.

Respondents to the surveys were also asked to rate the relative percentage influence of each group of factors in contributing to the total discrepancies between the expected and actual delivered project outcomes, assuming the total discrepancies, in quantitative terms, were to be 100%. In addition to establishing quantitatively the percentage relative influences of the identified groups of project constraints, the respondents' ratings in this respect served as consistency checks on the thoughtfulness or reliability of the responses. The averages of the respondents' ratings of the relative magnitudes ('Rel Mag') are also presented in Table 6.

Figure 1 presents the graphical plots of the relative magnitudes of the major groups. The frequency–influence mapping of the factor groups is shown in Figure 2.

Establishing the risk levels of the project constraints: influence–frequency mapping

From the locations of the project constraints on the Influence–Frequency matrix (Figure 2), their risk levels could be deduced as follows:

- *Very risky (VR):* None.
- *Risky (R):*

(1) Consultants and contractors' influences.

Table 5 Magnitudes and frequencies of occurrence of the external project constraints

	Subcomponents:	Analysed from project managers' responses							Analysed from contractors' responses						
		Levels of influences			Frequencies of occurrences				Levels of influences			Frequencies of occurrences			
		I_I	Rem	R_i	FI	Rem	R_f	RL	I_I	Rem	R_i	FI	Rem	R_f	RL
(A)	*Socio-cultural factors*														
1	Workers' morale to work	3.2	Avg	1	1.36	R	5	NR	3.44	H	1	3.4	SF	1	SR
2	Labour union demands and controls	3.18	Avg	2	2.73	SF	1	SR	2.81	Avg	4	2.43	O	5	NSR
3	Cultural influences: working hours, attitude to work, beliefs, etc.	2.82	Avg	3	2.36	O	4	NSR	3	Avg	2	2.86	SF	3	SR
4	Social stigma: vandalism, gangsterism, pilfering, etc.	2.55	L	4	2.56	O	2	NSR	2.94	Avg	3	3	SF	2	SR
5	Health (e.g. HIV/AIDS)	2.55	L	4	2.45	O	3	NSR	2.81	Avg	4	2.86	SF	3	SR
	Spearman's Rank Correlation Coeff, ρ (managers' versus contractors' rankings of the levels of influence and frequencies of occurrence):										0.56			−0.75	
	Critical rho ($\rho_{.05}$) (for n=5)=										0.90			0.90	
	Result: (NSC=Not significantly correlated at 5% level of significance):										NSC			NSC	
(B)	*Unforeseen circumstances*														
1	Site accidents	3.73	H	1	1.91	O	2	NSR	2.25	L	4	1.19	R	2	NR
2	*Force majeure* (e.g. inclement weather)	3.55	H	2	2.27	O	1	NSR	3.13	Avg	1	2	O	1	NSR
3	Outbreak of hostility/political instability	3.27	Avg	3	1.45	R	3	NR	2.44	L	3	1	R	3	NR
4	Epidemic (e.g. outbreak of cholera on site)	2.82	Avg	4	1.09	R	4	NR	2.5	L	2	1	R	3	NR
	Spearman's Rank Correlation Coeff, ρ (influences and frequencies):										−0.4			0.944	
	Critical rho ($\rho_{.05}$) (for n=5)=										0.90			0.90	
	Result: (SC=Significantly correlated at 5% level of significance):										NSC			SC	
(C)	*Economic and globalisation dynamics*														
1	Volatility of the exchange rate	3.64	H	1	3.55	F	1	R	2.5	L	5	2.07	O	5	NSR
2	Timing of development in the economic cycle (e.g. peak or trough)	3.55	H	2	2.91	SF	3	SR	2.88	Avg	2	2.36	O	3	NSR
3	Inflation and interest rate	3.36	Avg	3	3.36	SF	2	SR	2.77	Avg	3	2.58	O	2	NSR
4	Energy crises (e.g. rising cost of fuel)	2.64	Avg	4	2.27	O	4	NSR	3.07	Avg	1	2.77	SF	1	SR
5	Globalisation imperatives (e.g. compliance with international best practice)	2.45	L	5	2.18	O	5	NSR	2.69	Avg	4	2.14	O	4	NSR

Table 5 (*Continued.*)

	Subcomponents:	Analysed from project managers' responses							Analysed from contractors' responses						
		Levels of influences			Frequencies of occurrences				Levels of influences			Frequencies of occurrences			
		I_I	Rem	R_i	FI	Rem	R_f	RL	I_I	Rem	R_i	FI	Rem	R_f	RL
	Spearman's Rank Correlation Coeff, ρ (influences and frequencies):										−0.3			−0.3	
	Critical rho ($\rho_{.05}$) (for n=5)=										0.90			0.90	
	Result: (NSC=Not significantly correlated at 5% level of significance):										NSC			NSC	
(D)	*Governmental/statutory controls*														
1	Political controls (Empowerment/affirmative action, business controls, etc.)	3.91	H	1	3.82	F	1	R	3.63	H	1	3.5	F	1	R
2	Fiscal policies (interest/lending rates, taxes, market regulations/economic deregulations)	3.55	H	2	3.36	SF	2	SR	3.13	Avg	3	2.64	SF	4	SR
3	Statutory (e.g. compliance with local authority regulations; statutory requirements: safety, health and environment; building regulations)	3.45	H	3	3.08	SF	3	SR	3.38	Avg	2	3.21	SF	2	SR
4	Developmental controls: rate and process of change of policies	3.27	Avg	4	2.64	SF	4	SR	3	Avg	4	2.71	SF	3	SR
	Spearman's Rank Correlation Coeff, ρ:										0.8			0.4	
	Critical rho ($\rho_{.05}$) (for n=5)=										0.90			0.90	
	Result: (NSC=Not significantly correlated at 5% level of significance):										NSC			NSC	

Key: see Table 1.

- *Somewhat risky (SR):*
  (2) Client organisational influences;
  (3) Project characteristics;
  (4) Government/statutory controls;
  (5) Economic and globalisation dynamics.
- *Not so risky (NSR):*
  (6) Socio-cultural factors;
  (7) Unforeseen circumstances.
- *Not risky (NR):* None

Table 5 shows that a set of consultants' and contractors' acts of omission or commission is the most influential and most frequently occurring group of factors constraining successful project implementation in the South African building industry, from both project managers' and contractors' points of view. Consequently, this group of factors occupies the highest level of risk as shown in the Influence–Frequency matrix of Figure 2. Table 6 shows a consensus of opinions between both groups of respondents on the relative magnitudes of influence and frequencies of occurrence for all the identified groups of factors.

In quantitative terms, the controllable factors account for 67% of the discrepancies between expected and actual project outcomes. This shows that in any given project, if the client and the project team could proactively eliminate or minimise the identified factors under their control, there would be 33% chance of not meeting expected targets due to uncontrollable factors.

Table 6 also shows that for construction project managers' and contractors' groups of responses, the rankings of the levels of influence of the constraints computed from the ratings on the 5-point scale tally with the corresponding ranks of the average percentage relative magnitudes of influence computed from similar ratings out of 100%. This implies some measure of consistency in the ratings, and by implication, the reliability of the responses. Both Cooper and Emory (1995) and Zikmund (1997) identify this alternative measure as the 'equivalent-form' method of checking internal consistency of a measuring instrument.

Strategy for addressing the identified project constraints

The influence–frequency mapping (see Figure 2) of the major groups of identified project constraints provides a framework for addressing the constraints in real life project situations. By this strategy, resources should be allocated to ameliorating the constraints in line with their relative levels of risks listed above. Thus greatest resources should be assigned to tackling consultants' and contractors' influences with highest risk levels.

Within the consultants' and contractors' group of constraints, the critical constraints could be deduced as those which were perceived to be risky by both the consultants and the contractors. These are shown in Table 4 to include quality of service and attitudes, speed and comprehensiveness of service, and technical and managerial competence.

Conclusion

This study has investigated the factors constraining successful project implementation in the South African building industry. Results showed that a set of consultants' and contractors' acts of omission or commission is the most influential and most frequently occurring group of factors constraining successful project implementation in the South African building industry. Top of the list of this group of factors are the quality of service and attitudes, and speed and comprehensiveness of service. The controllable factors, in order: consultants and contractors influences, client organisational influences and project characteristics, account for 67% of the perceived discrepancies between expected and actual project outcomes. The uncontrollable group of factors, in order: socio-cultural issues, government/statutory controls, economic and globalisation dynamics and unforeseen circumstances, have the potential to account for the remaining 33% of the discrepancies. It should be noted that these factors are not unique to South Africa. However, it could be deduced that due to socio-cultural influences, their levels of influence and frequencies of occurrence, and by implication, risk levels, could differ between countries.

Drawing on the project risk management principles of risk identification and quantification, a framework in the form of an Influence–Frequency matrix was devised for establishing the risk levels of the identified groups of project constraints. This framework is recommended as an effective risk response procedure for addressing the identified factors.

It should be noted that no significant concurrence of views was recorded in nearly all pair-wise comparisons of the ranks computed from the ratings of construction project managers and contractors on the relative levels of influence and frequencies of occurrence of the underlying factors in each group of project constraints. It is argued that the perceptual gap between these two groupings of service providers who work closely together and who are at the forefront of project

Table 6 Summary of the controllable and uncontrollable groups of project constraints

Constraint group:	Analysed from responses of project managers								Analysed from responses of contractors							
	Levels of influence			*Rel Mag	Frequencies of occurrence				Levels of influence			*Rel Mag	Frequencies of occurrence			
	I_I	*Rem	Ri	(%)	FI	Rem	Rf	RL	I_I	Rem	Ri	(%)	FI	Rem	Rf	RL
A Consultants' & contractors' actions	4.3	VH	1	33	4.11	F	1	R	3.81	H	1	30	3.27	SF	1	SR
B Client organisational influences	4.2	H	2	30	3.78	F	2	R	3.69	H	2	20	2.93	SF	3	SR
C Project characteristics	3.4	Avg	3	12	3.33	SF	3	SR	3.25	Avg	4	11	3.07	SF	2	SR
D Socio-cultural factors	3.2	Avg	4	9	3.00	SF	4	SR	2.56	L	6	10	2.13	O	6	NSR
E Government/statutory controls	2.7	Avg	5	7	2.88	SF	5	SR	3.4	Avg	3	12	2.64	SF	5	SR
F Economic and globalisation dynamics	2.7	Avg	5	5	2.78	SF	6	SR	3.13	Avg	5	11	2.67	SF	4	SR
G Unforeseen circumstances	2.2	L	7	4	1.89	O	7	NSR	2.31	L	7	6	2.13	O	6	NSR
Spearman's rank correlation coefficient, ρ (managers' versus contractors' ranks of levels of influence and frequencies of occurrence):											0.83	0.93			0.79	
Critical rho ($\rho_{.05}$) (for n=7)=											0.71	0.71			0.71	
Result: (SC=Significantly correlated at 5% alpha):											SC	SC			SC	

Key: Rel Mag=Relative Magnitude (average of the respondents' ratings of the relative percentage influence of each factor in contributing to the total discrepancies between the expected and actual delivered project outcomes, assuming the total discrepancies, in quantitative terms were to be 100%).
Rem=Remarks: Level of influence (on a 5-point rating scale) of a given factor as indicated by the Influence Index (I_I): see Table 1.

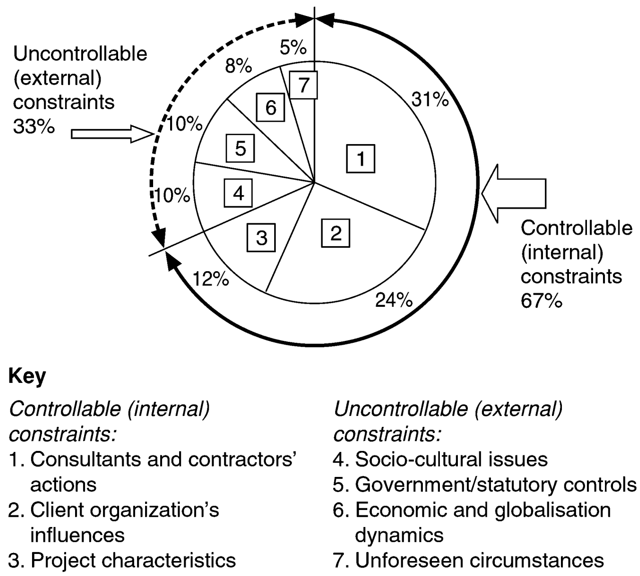

Figure 1 Relative magnitudes of influence of project constraints

conception and delivery could be responsible for the lack of synergy and inability to find common solutions to the many problems of the industry. Narrowing this perceptual gap could provide the needed panacea, and is worthy of further investigation.

Practical use of the findings

The findings of this study are generic and useful for industry-wide application. At individual project level, a flowchart (see Figure 3) has been developed for use by project managers for a simplified application of the findings of the study to the identification and classification of project constraints, and evaluation of their risk levels. The flowchart complements the use of the Influence–Frequency chart (see Figure 2).

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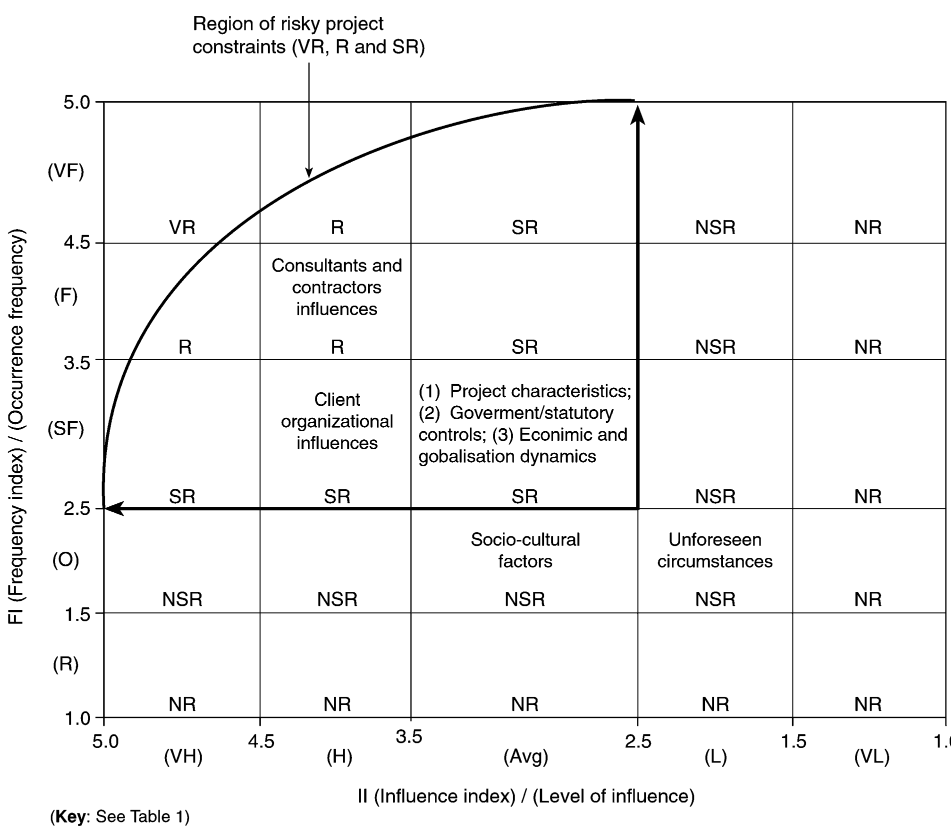

Figure 2 Influence–Frequency mapping of project constraints

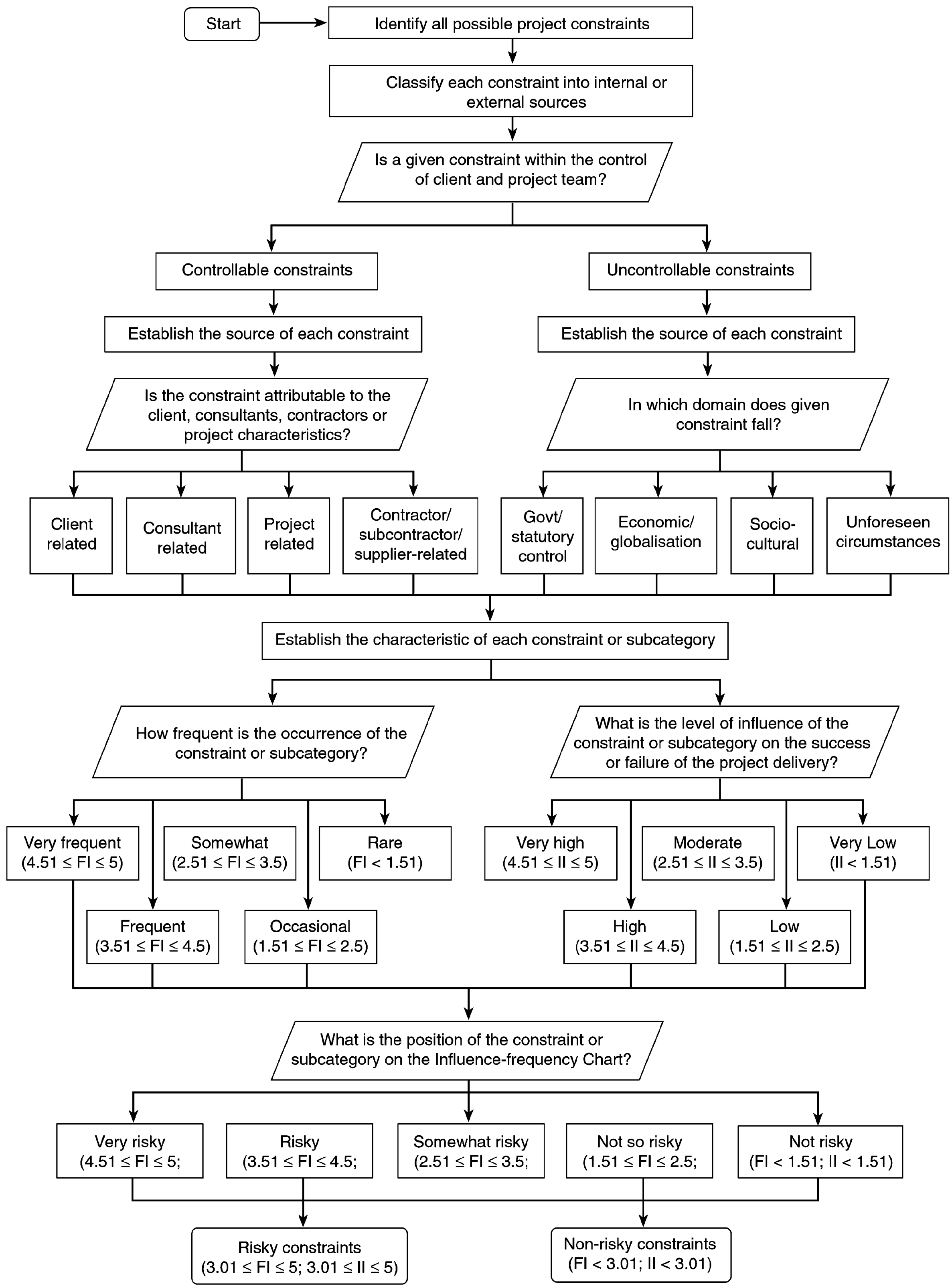

Figure 3 Process flowchart for the identification and risk level evaluation of project constraints

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