Routledge
Taylor & Francis Group

Construction Management and Economics

ISSN: 0144-6193 (Print) 1466-433X (Online) Journal homepage: https://www.tandfonline.com/loi/rcme20

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To cite this article: Mei-Yung Leung Corresponding Author , S. Thomas Ng , Martin Skitmore & Sai-On Cheung (2005) Critical stressors influencing construction estimators in Hong Kong, Construction Management and Economics, 23:1, 33-44, DOI: 10.1080/0144619042000167809

To link to this article: https://doi.org/10.1080/0144619042000167809

Construction Management and Economics (January 2005) **23**, 33–43

Critical stressors influencing construction estimators in Hong Kong

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Received 17 July 2003; accepted 16 February 2004

The main task of contractors' estimators is to predict the likely costs involved in executing a future project. This is an onerous job as any errors made can undermine project success and ultimately reduce the contractors' profit margins. The inherent uncertainty of most construction work, however, together with the often very short time periods involved, make errors unavoidable. Unsurprisingly, therefore, estimation is considered to be a very stressful business. To identify the nature of the stress involved, a survey of construction estimators in Hong Kong was conducted. Using correlation analysis, regression analysis and structural equation modelling, the relationships amongst the causes (stressors or stress factors) and effects (stress) were examined and a causal structural model developed. The results indicate work overload, role conflict, job ambiguity, and working environment to be the most critical stressors, with work underload and distrust being the main indirectly influencing factors. These results are similar to those of a previous study with site managers, suggesting that job ambiguity and work overload are the common problem in the construction industry. The study of the manageability of stress is expected to inspire other similar research involving other professionals in the construction industry. This is expected to be of particular significance in the long-term development of stress management in the industry in general.

Keywords: Construction, cost estimators, Hong Kong, stress, stressors, structural equation modelling

Introduction

It is well known that construction estimators are often pressed to produce accurate estimates of inherently uncertain events within a rigid, yet hasty, timeframe. This is often made even more difficult by lack of co-operation between the various project participants (e.g. planners, project managers, sub-contractors and suppliers). As a result, it is not uncommon for errors to occur. In estimating, these can be very costly, with the most common consequences to a contracting organization being loss of work opportunities (in case of over-estimation) or a shortfall in profits (in case of under-estimation). In such circumstances, it is not surprising to find that estimators suffer from a considerable amount of stress.

High levels of stress often compromise the personal intellect and emotion of decision makers (Jex, 1998), with decisions invariably becoming more rigid, simplistic and superficial (Cherrington, 1994). Insufficient stress, on the other hand, can induce boredom and a lack of concentration and motivation (Cooper and Marshall, 1981; Gmelch and Chan, 1994). In order to attain optimal performance, therefore, a balanced and healthy level of stress (i.e. eustress) is needed to promote enthusiasm and motivation (Freedman, 1988).

The level of stress experienced depends largely upon its causes, as stress occurs when a person's adaptive response to a stimulus places excessive psychological or physical demands on that person (Moorhead and

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Construction Management and Economics
ISSN 0144-6193 print/ISSN 1466-433X online
http://www.tandf.co.uk/journals
DOI: 10.1080/01446190410001678099

Griffin, 1995). In the working environment, these causes or stressors are likely to be of a long-term nature: inducing physical and spiritual fatigue; affecting one's health; undermining team morale; affecting the stressees' perception of their ability to fulfil a task/assignment; and eventually breaking down their working abilities (Yerkes and Dodson, 1908; Hebb, 1995).

The significance of the effects of occupational stress in general has prompted several studies to date aimed at identifying the causes of stress in various disciplines, including nurses (Dailey *et al.*, 1986), managers (Davidson and Cooper, 1986) and teachers (Byosiere, 1988). These indicate that stress is related to (1) physical condition (Braham, 1994); (2) organizational culture (Moorhead and Griffin, 1995; Cooper, 2001); (3) interpersonal conflict (Toates, 1995; Cooper, 2001); (4) personal characteristics (Caudron, 1998; Bliese, 2001); and (5) job nature (Matteson and Ivancevich, 1987). Other studies have focused on the effects of stress on the performance of various profession, such as physicians (Richardson and Burke, 1991), managers (Jex, 1998), construction site managers (Sutherland and Davidson, 1989; Djebarri, 1996), nurses (Jeanie, 2001), teachers (Chaplain, 1995) and police (Storch and Panzarella, 1996).

The research described in this paper aimed to identify the main causes of stress experienced by construction estimators in Hong Kong. Four main stressors (personal, interpersonal, task and environment) involving 32 items were first identified from the literature. Factor analyses were then applied to identify the main categories of stressors involved. Correlation analysis was used to investigate the relationships amongst the stressors (stress factors) and stress. Regression analysis was used to predict the stress caused by stressors during the estimation process. Finally, structural equation modelling was applied to cross-check the inter-relationship amongst the stressors and establishes an integrated stressors-stress model. The results imply some practical recommendations to the construction estimators for reducing the stress in the industry in Hong Kong.

Stressors to estimators

In the course of construction estimation, estimators are required to make a series of informed decisions concerning direct and indirect costs, overhead, and profit (based on the identified risks). However, as much of construction work is inherently uncertain and the time for the estimating process is usually very limited, a good deal of subjectivity is involved. In addition, estimators have to collect useful information from various departments within the company (e.g. the plant department, planning department, etc.), other organizations in the construction supply chain (e.g. subcontractors, suppliers, etc.), and/or external bodies (e.g. the statutory bodies, construction indexes, etc.) (Seeley, 1983; Smith, 1995; CIOB, 1997; Ashworth, 1999; Dysert, 2000). The nature of estimation process suggests that four types of stressors are likely to exist:

(1) *Personal stressors*: individuals have different levels of resistance to stressors depending on their personal characteristics and cultural background (Lee and Ashforth, 1990). Those who are extremely competitive, committed to work and timelines, for example, are more likely to be subject to emotional distress and suffer from stress symptoms (Ganster, 1986; Lee and Ashforth, 1990). This can escalate when individuals have to devote their time, energy and commitment to family, friends and community (Quick and Quick, 1989).

(2) *Interpersonal stressors*: construction estimators interact, in a formal and informal capacity, with many different people within and outside their companies. This can give rise to stress and tension, as team members, knowingly or unknowingly, frequently exert pressure on one another as a result of divergences in values, mistrust or an unfair microenvironment within the team (Quick and Quick, 1989). Stress also occurs as a result of role conflicts, particularly those arising out of the different expectations of superiors (Gross *et al.*, 1985; Moorhead and Griffin, 1995), and the various behavioural expectations of their positions (Van Sell *et al.*, 1981).

(3) *Task stressors*: construction projects are dynamic, and estimators are often confronted with complications caused by changes in clients' requirements, designs, laws or regulations. The problem is aggravated by job/task ambiguity, in the form of unclear scoping and task objectives, lines of responsibility, etc. Excessive workload, e.g. due to intensive work undertaken within a limited timeframe (quantitative overload) or managerial ineffectiveness is another source of task stress. If there is need for frequent travel to sites, fatigue and reduced efficiency may occur as a result of increased stress levels (Alluisi, 1982). Task stress can also result in depression, low self-esteem, dissatisfaction, futility and the intention to leave (Buller and Schuler, 2000).

(4) *Physical stressors*: physical stressors relate to the job setting, or temperature and design of office.

> Research findings indicate strong relationships amongst the environment, level of stress, and physical/psychological health (Furnham, 1997). Stress can occur by working in extreme temperatures, overcrowded environments, or poorly designed offices with too much or too little social interaction (Beehr, 2000).

Stress can be considered as a stimulus to motivate the behaviour (Carver *et al.* 1989; Weatherley and Irit, 1996), a process involving interaction (Gmelch, 1982) or an outcome of stressors (Alluisi, 1982). There are various subjective stress symbols (i.e. outcomes) in real world such as emotional exhaustion (Maslach, 1993), low self-esteem (Rosse *et al.*, 1991), depersonalization, reduced professional accomplishment (Jannsee *et al.*, 1999), cynicism and professional efficacy (Lee and Ashforth, 1996). Each dimension reflects the degree of stress indirectly.

Research method

As stress is a subjective feeling depending on the individual's perceptions, it is particularly amenable to empirical study by survey. The survey was conducted in Hong Kong with a targeted sample including quantity surveyors and estimators who were professionally qualified in the field and had direct experience of construction estimation. The sample was randomly selected from the membership records of professional institutions. A questionnaire consisting of thirty-two potential stressors was designed based on previous research, e.g., CIOB (1994) Locke and Latham (1990) (for personal and interpersonal stressors), Quick and Quick (1989) and Furnham (1997))for task stressors) and Furnham (1997) (for physical stressors). In this, the factors pertaining to personal, interpersonal, task and environmental stressor types were presented for evaluation to determine the predominant stress factors and their intrinsic relationships.

Following Schuler (1980) and Gmelch (1982), the level of stress measured by the deviation between a person's expected and actual ability to handle stressors were used. As stress becomes apparent when the actual abilities are lower than expected (McGrath, 1976; Schuler, 1980), the respondents were asked to rate the actual ('a') and expected ('b') ability to handle the thirty-two stressors (Table 1). This employed a seven-point Likert scale ranging from 1 (no impact) to 7 (a great deal of impact). The overall level of stress was taken to be represented by the sum of the differences between 'a' and 'b' ratings.

A total of 180 questionnaires were administered by post/fax after a brief telephone conversation to confirm the relevancy of the potential respondents' experience. 87 completed questionnaires were received, representing a response rate of 36%. Most of the respondents work for private consultants (64.4%), while the others are employed by main contractors (23%) or public clients (11.5%). Over half of the respondents (55.2%) have more than five years of relevant experience.

Principled stressors

To identify the main categories of stressors, the 'expected' responses to the thirty-two items were subjected to a factor analysis with varimax rotation (eigenvalue=1 cut-off). Owing to the limited sample size ($n<100$), only those items with factor loading greater than 0.5 were accepted as the principle stressors (Rahim *et al.*, 2000; Crocker *et al.*, 2003). These, together with the coefficient alpha reliabilities, are summarized in Table 2. As can be seen, the majority of the items – including 'distrust' (F1), 'conflict' (F2), 'work overload' (F3), 'dynamic tasks' (F6), 'private life' (F5), 'working environment' (F7), 'job specificity'

Table 1 Statement for the measurement of stress level

Statement	Expected ability	Actual ability
1. The number of deadlines	a) I have to meet	b) I am capable of meeting
2. The degree to which	a) My skills are used	b) my skills could be used
3. The number of tasks	a) I have to do	b) I am capable to do
4. The level of difficulty	a) of my work	b) I am capable of doing
5. The quality of work	a) I have to do	b) I am capable of doing
6. The scope and responsibility	a) of my job	b) I am capable of handling
7. The amount of work in an ordinary day	a) I have to do	b) I am capable of doing
8. The degree of complexity	a) of my assignment	b) I am capable of handling
9. The number of projects	a) I have to do	b) I am capable of doing
10. The number of people	a) I have to work with … to get my job done	b) I would like to work with … to get my job done

Table 2 Scale items, factor loadings and coefficient alpha reliabilities for the stressors

Factors (i.e. stressors)	Items	Factor loading	Alpha
F1 Distrust/disbelief	1. There often seems to be a lack of trust between myself and my subordinates	0.773	0.800
	2. I seldom delegate tasks because of incomplete the tasks as well as I can	0.757	
	3. I often feel unfair for the organization treatment	0.647	
	4. My beliefs often conflict with those of the organization.	0.635	
F2 Conflict	5. I often have difficulty deciding between high productivity and high quality	0.773	0.745
	6. Things I do are often accepted by one person and not another	0.773	
	7. I am often caught between conflicting demands from my supervisor and staff	0.660	
	8. My boss often deals with me in an autocratic and overdemanding manner	0.475	
F3 Work overload	9. There is constant pressure to work every minute, with little opportunity to relax	0.787	0.775
	10. I have a lot of responsibility in my job	0.748	
	11. I find it difficult to keep up with the development or new technology of my field	0.658	
	12. I often meet with team members and do not have enough time to myself	0.526	
F4 Competitive teamwork	13. I often believe I am successful because I can get things done faster than others	0.756	0.657
	14. I have great opportunity for upward career movement	0.581	
	15. I often have to make decisions affecting the lives of employee	0.575	
	16. My colleagues often compete with another than co-operate with a feeling of team spirit	0.558	
F5 Private life	17. My family/friends would like me to spend more time with them	0.792	0.719
	18. My devotion to work is usually in conflict with my devotion to family	0.758	
	19. I often feel that nothing matters in life besides my job	0.603	
	20. I do not have social contact with people at work	0.539	
F6 Dynamic tasks	21. New laws and regulations frequently require me to change the way I do things	0.708	0.643
	22. I often find it hard to focus on any one activity for a long period of time (>10 mins)	0.704	
	23. My job frequently takes me out of office, visiting work sites	0.680	
F7 Environment	24. My office is too crowded	0.774	0.658
	25. I have many interruptions and disturbances in my job	0.773	
	26. My job is physically demanding	0.633	
F8 Job specificity	27. I am not sure I have divided my time properly among task	0.850	0.701
	28. My job responsibilities are generally vague, unclear and incon sistent	0.806	
F9 Work underload	29. I feel my skills and abilities are not being used well	−0.807	0.721
	30. I frequently find my work boring and repetitive	−0.743	
F10 Interaction with client	31. I often have to interact with clients	0.857	0.377
	32. I am frequently in a hurry	0.516	

Note: All items were measured on a 7-point scale ranging from disagree strongly to agree strongly; italic type denotes items with the factor loadings lesser than 0.50 are deleted in the following data analysis; cumulative variance=69.8%; Kaiser-Meyer-Olkin Measure of Sampling Adequacy=0.630.

Table 3 Classification of stress factors (stressors)

Factors (sressors)	Task	(Inter)personal	Physical
F1 Distrust		✓	
F2 Role Conflict	✓	✓	
F3 Work overload	✓		
F4 Competitive Teamwork		✓	
F5 Private Life		✓	
F6 Dynamic Tasks	✓		
F7 Environment			✓
F8 Task ambiguity	✓		
F9 Work underload	✓		

(F8), and 'work underload' (F9) – load onto appropriate factors. The original 'interaction' and 'personal working behavioural' scales, however, have been transformed into two new factors, namely 'teamwork' (F4) and 'interaction' (F10). The reliabilities for only the first nine factors (F1–F9) are within acceptable ranges for newly created stressors ($\alpha > 0.60$), making the 'interaction' factor (F10) redundant.

The remaining nine factors were then classified into three major groups: task-related, (inter)personal-related and physical-related (Table 3). 'Distrust', 'competitive teamwork' and 'private life' factors are classified into the (inter)personal-related group; while 'work overload', 'dynamic tasks', 'task ambiguity' and 'work underload' are treated as part of the task-related group. Role conflict is classified between the task-related and (inter)personal-related groups as it involves incompatibility amongst the team members. 'Environment' is the only factor in the physical-related group.

Interstressor relationships

Interstressor relationships were examined by correlation, multiple regression and structural equation model analyses. Table 4 gives the intercorrelations of the criticality indices of stress and the nine stressor groups. This indicates a significantly (i.e. $p<0.01$) positive correlation between 'distrust' (F1) and 'role conflict' (0.464) and 'work overload' (0.305). 'Work overload' (F3) is also significantly positively correlated with 'private life' (0.400). Those stressors with significant negative correlations are between 'work underload' (F9) and 'stress' (−0.341), 'distrust' (−0.309), and 'Role conflict' (−0.378). Seven out of the nine stressors are significantly correlated with the stress variable, including 'work overload' (0.495), 'distrust' (0.498), 'role conflict' (0.447), 'working environment' (0.374), 'job ambiguity' (0.384), 'work underload' (−0.341), and 'private life' (0.321). 'Competitive teamwork' (F4)

Table 4 Means, standard deviations and correlations amongst stress and stressors

Factor	M	SD	Alpha	Stress	1	2	3	4	5	6	7	8	9
STRESS	7.02	5.86	0.70										
F1 Distrust	14.11	3.97	0.80	0.498**									
F2 Role conflict	10.85	3.00	0.74	0.447**	0.464**								
F3 Work overload	16.52	2.84	0.78	0.495**	0.305**	0.168							
F4 Competitive teamwork	10.16	2.68	0.66	0.199	0.222*	0.222*	0.183						
F5 Private life	10.87	3.01	0.72	0.312**	0.240*	0.174	0.400**	0.273*					
F6 Dynamic tasks	9.48	3.01	0.64	0.065	0.224*	0.230*	0.246*	0.416**	0.223*				
F7 Environment	12.37	1.87	0.66	0.374**	0.224*	0.175	0.224*	0.135	0.159	0.025			
F8 Job ambiguity	7.10	2.20	0.70	0.384**	0.225**	0.286*	0.037	0.104	0.059	0.185	0.034		
F9 Work underload	7.97	2.16	0.70	−0.341**	−0.309**	−.378**	−0.140	−.135	−0.274*	−0.218*	−0.162	−0.156	

Note: Total sample size: 87; 'M' – mean; 'SD' Standard Deviation; F1=v1+v2+v3+v4; F2=v5+v6+v7; F3=v9+v10+v11+v12; F4=v13+v14+v15+v16; F5=v17+v18+v19+v20; F6=v21+v22+v23; F7=v24+v25+v26; F8=v27+v28; F9=v29+v30; v10=v31+v32 ('Table 2' refers); correlations are significant at $p<0.05$* or $p<0.01$**; and is deleted in the following study due to the low Alpha scale (0.38).

and 'dynamic task' (F6) are not directly correlated with 'stress', but they are interrelated (0.416). The intercorrelations amongst stress and stressors are illustrated in Figure 1.

Ordinary least squares forward stepwise multiple regression analysis was used to predict the stress caused by stressors during the goal setting process (c.f. Pallant, 2001; Morgan *et al.*, 2001). Table 5 summarizes the results, showing that 'work overload' (F3) was entered into the equation at first, followed by 'Role conflict' (F2), 'job specificity' (F8), and 'environment' (F7). The result provides support for the prediction that 'work overload' (F3) is the predominantly associated with the level of stress incurred in estimation (30.9% of variance).

Being a useful technique in exploring the predictive ability of a set of independent variables (e.g. stressors) on a continuous dependent measure, the results of

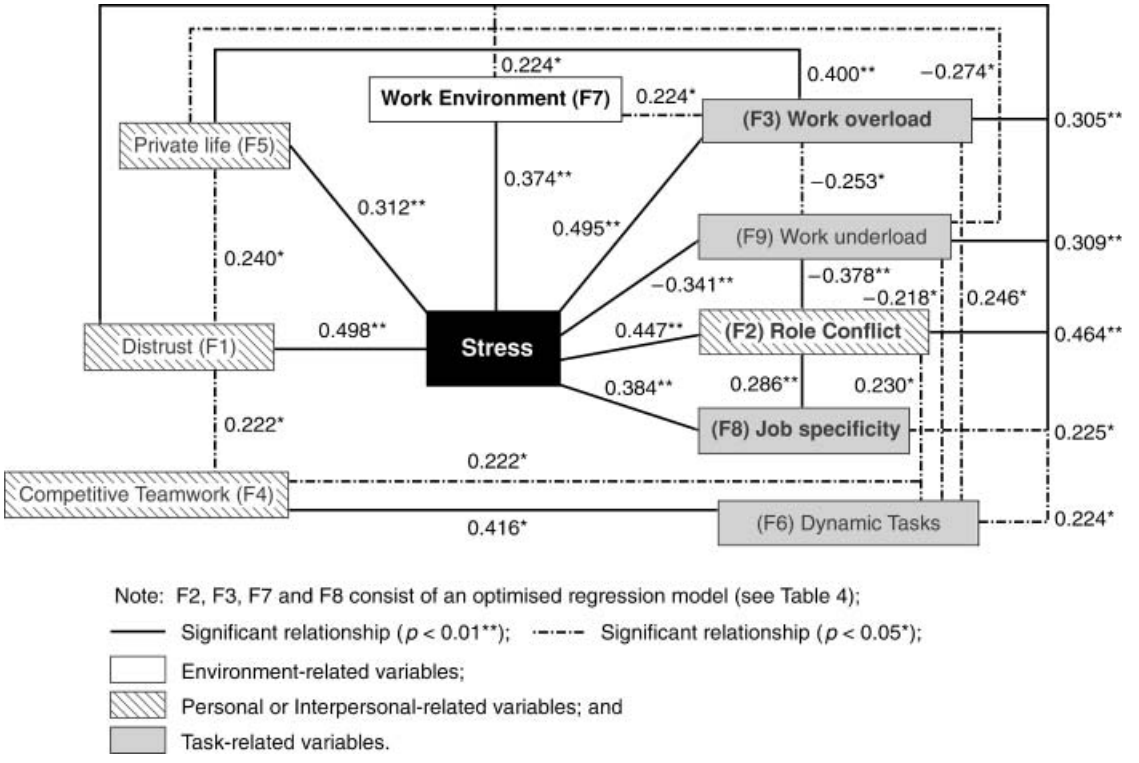

Figure 1 Hypothesized model based on results of correlation analysis (note: F2, F3, F7 and F8 consist of an optimized regression model – see Table 4)

Table 5 Regression model for the prediction of stress

Model		Unstandardized coefficients		*t*	Sig.	R	R^2
		B	Std. error				
1	(Constant)	−11.936	3.123	−3.822	0.000	0.550	0.309
	F3	1.148	0.186	6.158	0.000		
2	(Constant)	−17.034	3.140	−5.425	0.000	0.649	0.421
	F3	1.019	0.175	5.840	0.000		
	F2	0.666	0.165	4.038	0.000		
3	(Constant)	−20.084	3.120	−6.437	0.000	0.697	0.486
	F3	0.984	0.166	5.939	0.000		
	F2	0.539	0.161	3.346	0.001		
	F8	0.704	0.217	3.249	0.002		
4	(Constant)	−27.276	3.691	−7.391	0.000	0.738	0.545
	F3	0.886	0.160	5.542	0.000		
	F2	0.463	0.154	3.000	0.004		
	F8	0.693	0.205	3.373	0.001		
	F7	0.787	0.242	3.252	0.002		

regression analysis as shown in Table 5 indicate only F2, F3, F7 and F8 to be the factors causing the stress of estimators, while excluding other possible related stressors such as F1, F5 and F9 (refer to Table 4). Indeed, regression analysis does not provide any test on validation or reliability for measuring latent variables and cannot analyse the relationships amongst the latent variables (Lehaman, 1991; Diamantopoulos and Siguaw, 2000). For instance, the relationship between the 'work overload' and 'distrust' cannot be analysed by regression analysis. Structural equation model was therefore applied to develop an integrated structural model to cross-check the inter-relationships amongst the stressors (Long and Kahn, 1992; McManus *et al.*, 2002).

Structural equation model is a multivariate technique for testing structural theory, incorporating both observed/measured (indicators) and unobserved (latent) variables (Byrne, 1998; Schumacker and Lomax, 1996). A full structural equation model typically comprises two elements: the measurement model – for describing how each latent variable is measured or operationalized by corresponding manifest indicators – and the structural model – for describing the relationships between the latent variables themselves and indicating the amount of unexplained variance. For measuring and assessing an acceptable model, goodness-of-fit (or badness-of fit) criteria were formulated by LISREL (Raykov and Marcoulides, 2000; Joreskog and Sorbom, 2001) during the structural equation modelling, including chi-square (x^2), root-mean-square residual (RMSR), goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI) and comparative fit index (CFI).

Although the correlation coefficient and regression analysis cannot establish an integrated stressors–stress causal model for construction estimators, they provide a platform to investigate the inter-relationships amongst the stressors and stress involved. Based on the correlation coefficients (Table 4), three structural models were established: *Model I* (a *full two-way causal model* – a model with all two-way causal relationships amongst stress and the nine stressor groups); *Model II* (a *full one-way causal model* – a model with all one-way causal relationship amongst stress and the nine stressor groups); and *Model III* (an *optimized model* – a model involving both one-way and two-way relationships amongst the stress and nine stressor groups).[1]

The goodness-of-fit indices for *Model I* indicate a poor fit with the data (Table 6). *Model I* needs to be modified by converting the two-way paths to one-way paths. Although the χ^2 and RMSR are improved for *Model II*, the fit indices of Model II are still far from the acceptable range. Model III is further modified by deleting parts of indicates (including the deletion of item 2 for F1, item 6 for F2, items 9 and 12 for F3, items 17 and 19 for F5, items 25 and 26 for F7) and deleting parts of one-way and two-way paths (including the deletion of relationships between F1–F6, F1–F4, F2–F6, F2–F4, F4–F5, F6–F9). An optimized structural equation Model *III* is finally obtained with a χ^2, RMSR, GFI and AFGI of 108.30, 0.057, 0.87 and 0.79 respectively (Table 6).

Figure 2 indicates the complicated stressors and stress interrelationships for structural equation *Model III*. Although these are rather similar to those represented by the correlation coefficients (Figure 1), the whole model (including measurement model for the latent variables and the structural model for the relationships amongst stressors) are fundamentally modified. The 'distrust' (F1), 'role conflict' (F2), 'work overload' (F3), 'private life' (F5), 'environment' (F7), 'job ambiguity' (F8), and 'work underload' (F9) are still the major stressors, while 'competitive teamwork' (F4) and 'dynamic task' (F6) are less significant.

Discussion

The results of the analyses identify 'role conflict' (F2), 'work overload' (F3), 'job ambiguity' (F8), and 'working environment' (F7) as the critical stressors most affecting estimators (Table 5), while 'competitive teamwork' and 'interaction with clients' are of lesser significance. This suggests that estimator stress is more likely to be induced by the tasks involved than company peers or clients. The findings are basically consistent with the preliminary study conducted in fifteen years ago, which found task ambiguity, work overload and inadequacy of communication flow to be the top three sources of stress for site managers (Sutherland and

Table 6 Fit indices of the structural models I, II and III

Model	df	x^2	df /x^2	RMSR	GFI	AGFI	CFI	Remarks
I	303	1693.97	0.18	0.210	0.45	0.26	0.05	–
II	323	1597.10	0.20	0.190	0.48	0.34	0.13	–
III	72	108.30	0.66	0.057	0.87	0.79	0.91	See Figure 2

df=degree of freedom; x^2=chi-square; RMSEA=Root mean square residual; GFI=Goodness of Fit Index; AGFI=Adjusted Goodness of Fit Index; CFI=Comparative Fit Index; $p<0.01$; $^{**}p<0.001$.

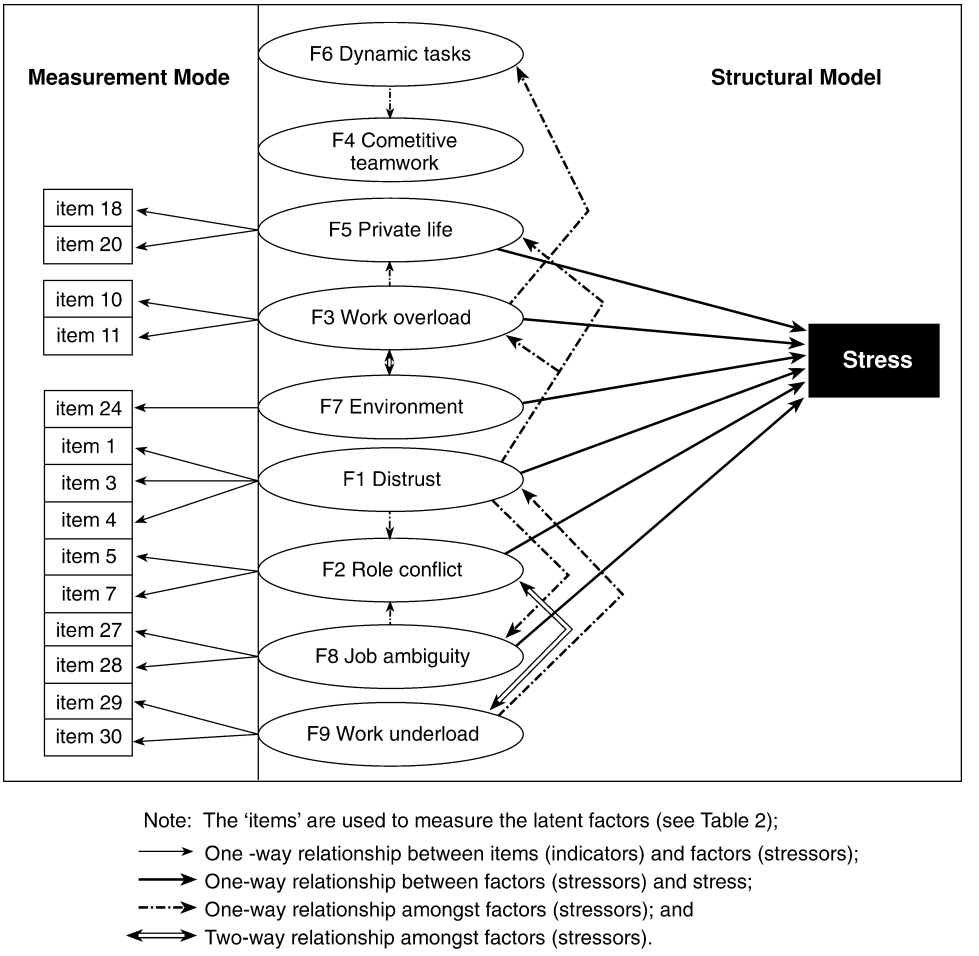

Figure 2 Structural equation model III (note: the 'items' are used to measure the latent factors – see Table 2)

Davidson, 1989). This suggests these to be a common problem in the construction industry. Construction projects are often dynamic and can be changed at any time during the design and construction period, while the construction period is fixed in the contract or project schedule. Therefore, stress may be gradually induced in both estimators and site managers due as these two influences take effect.

By combining the correlation coefficients (Figure 1) and structural equation model (Figure 2), the causal relationships amongst the stressors and stress can be posited (Figure 3). This shows 'work underload' (F9) not to be an independent factor in the regression model, but interrelated with 'role conflict' (F2) and 'distrust' (F1). This implies that 'distrust' (F1) does not induce stress directly, but indirectly through various other stressors including 'work overload' (F3) and 'role conflict' (F2). Therefore, F1, F2, F3, F7, F8 and F9 all affect, either directly or indirectly, the level of estimator stress.

Figure 3 also shows that 'private life' (F5) in terms of 'social contact' (item 3) and 'family life' (item 4) is influenced by 'distrust' (F1) and 'work overload' (F3), while affecting stress levels. This suggests that both F1 and F3 influence the level of stress through the private life of estimators, e.g., poor social contact and lack support of family life. On the other hand, 'work overload' (F3) also affects 'activities of task' (F6) and 'performance of teamwork' (F4).

These findings carry some important implications for the reduction of stress in the estimation process. Firstly, consultant/construction companies need to provide a comfortable *environment* to the estimators, for example, sufficient space, quiet office, etc. The records of all previous projects should be tidily filed to leave the space for a new project. Secondly, the *roles of estimators* for each project should be clearly assigned. Furthermore, requesting estimators to participate in a several projects simultaneously could be problematic, especially when they are asked to provide estimates within a short period. The company needs to review or relocate their jobs frequently in order to balance estimator *workloads*. A systematic data repository could be provided to encourage information sharing among

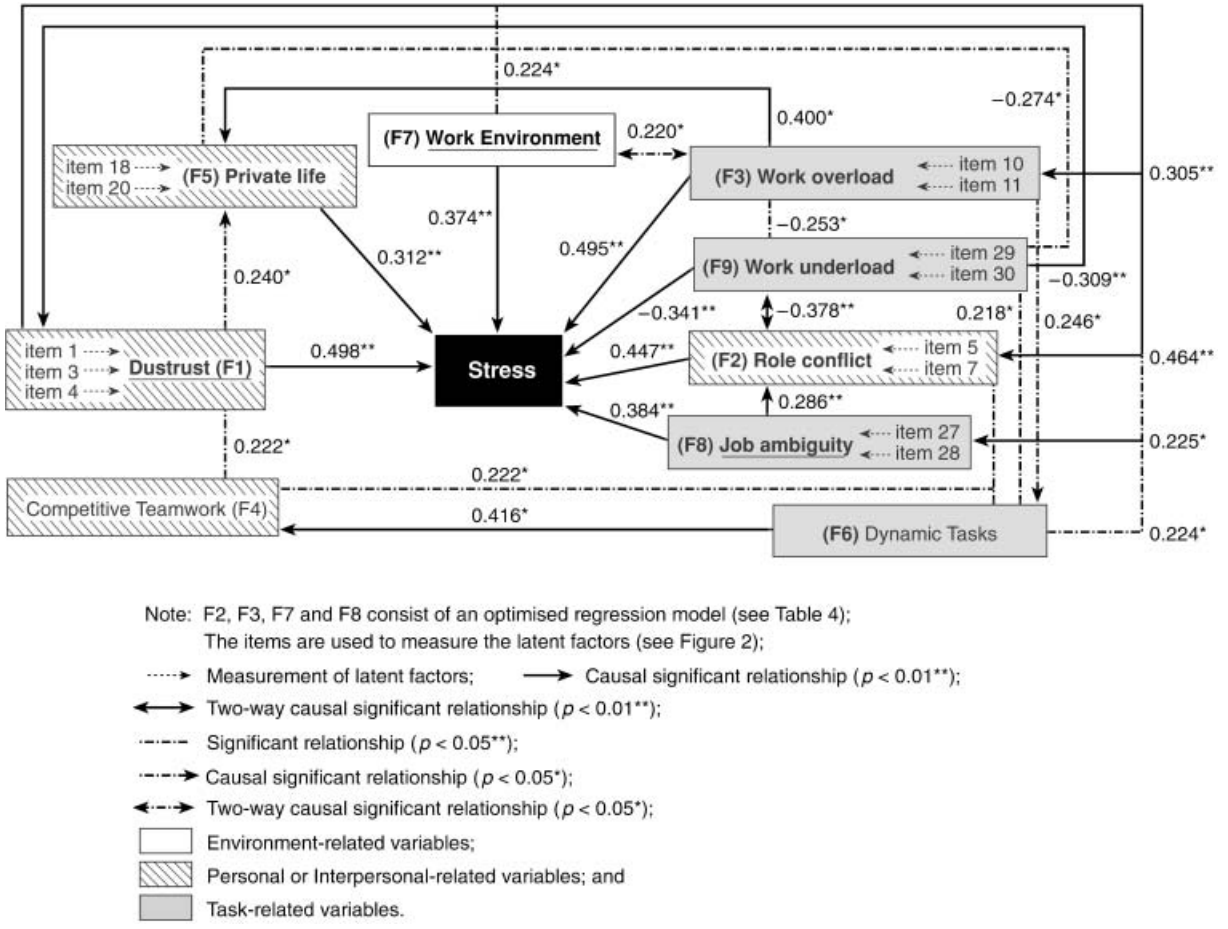

Figure 3 Causal model of stressors – stress (note: F2, F3, F7 and F8 consist of an optimized regression model – see Table 4; the items are used to measure the latent factors – see Figure 2)

estimators. This would enable estimators to clarify or make assumptions based on historical data. Thirdly, *team building* through workshops (inside the office) and activities (out of office) could enhance trust amongst the staff, reduce workload (by shortening the information searching period) and avoid role conflict. Finally, it would be beneficial for consultant/contracting firms to work with public organizations (e.g. Caritas and Christian Society Services Communities) to provide stress-release training/workshops, or employ a *psychological councillor* to help alleviate the stress of individual estimators (private life) and avoid burnout or rust out (Buller and Schuler, 2000; Lingard, 2003). In fact, some international construction companies already employ psychological consultants to assist their employees in reducing stress so as to ensure the quality performance of construction projects is improved.

Some comments on the research method are appropriate, as the study described here has clear limitations. For instance, the study used self-report measures, which are of uncertain reliability, and there is a potential risk of common method variance. In addition, the relatively small sample size of the present study might limit the extent to which the results can be generalized. However, it should be pointed out that all respondents were professional quantity surveyors with direct experience of construction estimation in the industry. The sampling method could assure the results from being biased by any differential response to the measured variables. Since this was a generalization survey, the results can only reveal the relationship between stressors and stress arising in the general estimation situation. Further research is needed to investigate the manageability of stress, particularly for estimators with different working experiences in different organizations (e.g. consultant firms and construction companies) /working environments (e.g. head office and site office) and with different levels of stress tolerance. Lastly, this study did not examine the effect of stress on the accuracy and timeliness of the estimation process. Further research investigating the relationship between stress and performance is desirable in order to determine how stress management could be best applied to improve the performance of

estimators. To do this, some qualitative analysis (e.g. via case studies) would be useful to crosscheck results in a controllable environment.

Indeed, the research will be significant to the long-term development of construction performance and productivity. Research into the manageability of stress is a novel departure and is expected to inspire other, similar, research studies. For instance, the findings could be beneficial to project managers and other professionals in the construction industry and in other disciplines. The study of the manageability of stress is expected to inspire other similar research involving other professionals in the construction industry. This is expected to be of particular significance in the long-term development of stress management in the industry in general.

Conclusions

In this paper, different stressors – including personal, interpersonal, task and physical stressors – have been identified in connection with the estimating process in Hong Kong. *Personal and interpersonal stressors* arise from a poor allocation of time between work, social activities and family life, and feelings of distrust or disbelief of colleagues and the organization. *Task stressors* include vague task objectives, excessive or insufficient workload, difficult tasks beyond an individual's experience or perceived abilities, time pressures, lack of relevant information and unclear responsibilities. Stress may also be caused by the organization or clients, such as pressures from senior personnel within the organization, demands from clients and even disruptions to work plans. *Physical stressors* relate to the appropriateness of the estimator's working environment (e.g. health and work conditions).

Basically, all stressors except for work underload have a positive relationship with estimator stress. The amount of work overload, specificity of tasks, identification of estimating role, and the physical working environment are significant independent stressors, with the degree of lack of trustiness having a significant indirect effect (through the four stressors of workload, specificity, role conflict and environment). Moreover, the amount of workload and feelings of distrust against the organization also affect the private life of estimators, which ultimately indirectly escalates the level of stress felt in the workplace.

Acknowledgement

The work described in this paper was fully supported by a grant from CityU (Project No. 7100209).

Note

1. The results of the correlation analysis basically consist of the results of regression analysis.

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