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Integrated model for the stressors, stress, stress-coping behaviour of construction project managers in the UK

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3 Introduction

4 The Association of Project Management (2017) defined Project management as “the
5 application of processes, methods, knowledge, skills and experience to achieve the project
6 objectives”. In view of this definition, the project manager is responsible for the day-to-day
7 management of the project and must be competent in managing the six aspects of a project,
8 i.e. scope, schedule, finance, risk, quality and resources. All these tasks together with tight
9 deadlines and observed long working hours with limited resources on site and intrinsic
10 uncertainties of construction projects, play an important role in increasing occupational
11 stress on the Construction Project Managers (C-PMs) and other similar professions (Bowen
12 *et al.*, 2013a, 2013b, 2014, Leung *et al.*, 2011, Cattell *et al.*, 2016). According to an
13 occupational stress study in the construction industry, nearly 70% of construction
14 professionals suffer from stress, anxiety, or depression (CIOB 2006). Therefore, there is
15 clearly a need for more research on the impact of stress on construction professionals.

16 **Table 1** illustrates a historical trend of published papers related to stress by year, country,
17 authors and journals. Serious research on stress topics in construction started in 1989 where
18 Journal of Construction Engineering and Management (JCEM) and Construction
19 Management and Economics (CME) published the most stress related papers. The number
20 of academic research publications in a country may imply the extent to which that research
21 area progresses in that particular location. In general, findings from these studies revealed
22 that stress could be related to (a) physical conditions; (b) organisational culture; (c)
23 interpersonal conflict; (d) personal characteristics (e) job nature; (f) role conflict; (g) work
24 overload; (h) job ambiguity; (i) work environment; (j) family related issues.

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3 25 **INSERT TABLE 1 HERE**
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6 26 **Table 1** also shows that the impact of stress on C-PMs has rarely been investigated in the
7
8 27 UK (only 8 out of 50 known papers related to the UK construction industry have been
9
10 28 published and most of them are rather dated). Moreover, based on the literature review and
11
12 29 the list of publications shown in Table 1, previously developed integrated models of work
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14 30 stress in construction have focused on examining the relationship between two or three sets
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16 31 of data and have largely been undertaken in Hong Kong and South Africa. For example,
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18 32 Leung et al (2009) developed an integrated model for the Stressors and Stresses of
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20 33 Construction Project Managers in Hong Kong; Chan et al (2014) examined the structural
21
22 34 relationships between cultural values and coping behaviours of professionals in Hong
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24 35 Kong; and Bowen (2014) developed a structural equation model of occupational stress in
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26 36 South Africa.
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32 38 Therefore, it was considered valuable to investigate this area of research in the UK
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34 39 construction industry and to include (within one study) four sets of factors, namely, i)
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36 40 Stressors; ii) Stress; iii) Stress-Coping Behaviour and iv) the Performance of C-PMs. In
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38 41 particular, this study seeks to investigate the sources of stress, how C-PMs deal with the
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40 42 stress that they are exposed to; how different types of stresses affect their performance; and
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42 43 the stress-coping behaviours adopted by the C-PMs in the UK. The ultimate aim of the
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44 44 study is to display the findings of the survey results in a causal model showing the
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46 45 relationship between these four sets of factors stated above.
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51 47 **Literature review**

48 ***Stress Experienced by C-PMs***

49 The concept of stress was first introduced by endocrinologist Hans Selye in 1936, who
50 described it as a physical response to a negative impulse (distress) or positive impulse
51 (eustress), being defined by himself as a ‘nonspecific result of any demand upon the body’
52 (Selye, 1980, p. 127). However, for the purpose of this paper, stress is defined as: ‘the
53 adverse reaction people have to excessive pressure or other types of demand placed on
54 them’ (Health and Safety Executive, 2007, p.1). It is based on the relationship between the
55 person and his/her environment (Lazarus and Folkman, 1984).

56 Leung et al. (2009) divided stress into objective stress, physiological stress and
57 burnout. Objective stress refers to the evaluation of a threat arising from cognitive factors.
58 Physiological stress appears when the sources of stress are continuous. Therefore, stress
59 becomes chronic, which implies that the physiological adjustments of one’s body do not
60 revert back to normal. Mind Tools Ltd. (2007) also affirmed that there are forms of stress
61 with a short-term effect. They could occur during confrontational situations, difficult
62 meetings or when prompted with controversial issues, but their effect may not be
63 significantly relevant if the stress fades quickly. However, long-term stress can imply
64 physical and psychological fatigue affecting one’s health and/or undermining confidence or
65 morale. Physiological and psychological problems could lead to behavioural change
66 affecting a C-PM, which could have repercussions at work and on his/her personal life.
67 This is a state of chronic emotional fatigue caused by long-term chronic stress or by a
68 failure to obtain an expected reward (Leung *et al.*, 2011).

69 Burnout on the other hand occurs as a result of a complex interaction of individual
70 characteristics and issues in the work environment but, it is also associated with a complex
71 interaction between experiences at work and other life domains, including family (Lingard,

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2
3 72 2003; Lingard and Francis, 2005 & 2006; Yip and Rowlinson, 2009; Turner & Mariani,
4
5 73 (2016). The symptoms of burnout include changes in the social life of individuals (i.e., C-
6
7 74 PMs could avoid communicating with people at home or in their private life) (Leung *et al.*,
8
9 75 2008a), low attitude to work (i.e., low motivation, low commitment and low
10
11 76 accomplishment complaints) (Leung *et al.*, 2008a) and withdrawal behaviour (i.e., being
12
13 77 late for work, absenteeism and even quitting) (Leung *et al.*, 2011).
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17 78 ***Stressors affecting C-PMs***

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20 79 Stressors are the sources of stress. Sutherland and Davidson (1989) were one of the first
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22 80 to identify the sources of stress among construction site managers in the UK. They
23
24 81 classified the sources of managerial stress into, i) Role in organisation; ii) Career
25
26 82 development; iii) Organisational structure and climate; iv) Relations with organisations; v)
27
28 83 Intrinsic to job; vi) Organisational interface with outside. Subsequent research by Leung
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30 84 and colleagues (2005a, 2007, 2008b, 2008c, 2009 and 2010b) divided stressor into four
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32 85 categories, these are:
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- 36 86 • Task stressors: they refer to work overload, role conflict and ambiguity in the day-
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38 87 to-day work of CPMs.
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40
41 88 • Organisational stressors: they are the sources of stress coming from the organisation
42
43 89 such as the organisation structure and the career-developing environment.
- 44
45 90 • Personal stressors: they include both intrapersonal and interpersonal stressors.
- 46
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48 91 • Physical stressors: they refer to environmental sources of stress coming from the
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50 92 home and/or the work environment of CPMs.
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93 Empirical research into stressors was also conducted by the HSE (2007) to analyse the
94 work-related stress of (1,732) returned questionnaires from of a group of construction
95 industry workers. (279) responses were returned from project managers, representing a
96 (17.1 %),. The ‘top three’ stressors were:

97 • ‘I have too much work to do in the time available’. (27,88 %) of the respondents
98 found this aspect the most stressful.

99 • ‘I am responsible for the safety of others at work’ (16.35 %)

100 ‘I work long hours’ (11.06 %). 50.8 hours were the average hours worked by C-PMs
101 per week.

102 In a parallel survey by the CIOB (2006), it was acknowledged that ‘too much work’
103 was the main cause of stress (61.4%); ‘Pressure’ (59.9 %); ‘ambitious deadlines’ (59.7 %),
104 ‘lack of feedback’ (56.8 %); ‘poor communication’ (55.7 %); ‘inadequate staffing’ (55.0
105 %) and ‘conflicting demands’ (52 %). Interestingly, Gunning and Cooke (1996) already set
106 some major causes of stress that later fitted rather well with other surveys and research.
107 The following was the main categories that were identified:

108 • Job characteristics: quantity of work, deadlines and responsibilities. It applies to the
109 3 main stressors stated by HSE (2007) and the ‘too much work’ and ‘ambitious
110 deadlines’ factors stated by CIOB (2006)

111 • Role in the company: role ambiguity or conflict, lack of autonomy, etc. Related to
112 the ‘conflict demands’ factor from the CIOB survey.

113 • Interpersonal relationships with colleagues, superiors, friends or family. ‘Poor
114 communication’ from the CIOB survey would be included here.

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3 115 • Career-developing pressures and internal pressure (such as perfectionism or fear of
4
5 116 failure). This category fits with the factor ‘pressure’ from the CIOB survey as well
6
7 117 as the work of El-Sabaa (2001) and Xiong et al (2015).
8
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10
11 118 • Climate and structure of the company and/or position, where ‘lack of feedback’ and
12
13 119 ‘inadequate staffing’ from the CIOB survey fit in.
14

15
16 120 • The interaction between work and private life. The stressors ‘I have too much work
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18 121 to do for the time available’ observed by HSE (2007) might indicate a negative
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20 122 impact on free time due to work overload.
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23 123 *Performance of C-PMs*

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27 124 Naturally, the role of C-PMs demands full-time involvement with the project from the
28
29 125 beginning (if not earlier) until its completion (if not until later). The role of a C-PM spans
30
31 126 from assessing the feasibility of a project at the preconstruction stage to responding to the
32
33 127 needs of the client at the post-construction stage (CIOB, 2002). Apart from the objective
34
35 128 tasks that C-PMs have to accomplish, they have to demonstrate hard skills such as
36
37 129 planning, scheduling, cost control, decision making, prioritisation as well as well-
38
39 130 developed interpersonal skills such as leadership, communication and conflict
40
41 131 management. (APM, 2017). Therefore, decision making under stress becomes defective
42
43 132 (CIOB, 2002). Instead of undertaking careful analysis, individuals under stress find
44
45 133 themselves trapped in a vicious circle of non-productivity. It may result in faulty decisions
46
47 134 made hastily or in defensive reactions because stress accelerated decisions made by
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49 135 construction managers.
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53 136 Leung et al (2008a) identified key C-PM performance as follows:
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3 137 • Task performance: it includes the performance of a C-PM at three classic levels:
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5 138 cost, time and quality and time. The overall construction outcome will depend on
6
7 139 the decisions that a C-PM makes in regard to the profit of a project (cost), meeting
8
9 140 the client's demands (quality) and the control of the project duration and the
10
11 141 effectiveness of the planned schedule (time).
12
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14
15 142 • Interpersonal performance: several parties are involved in construction projects
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17 143 (client, contractor, sub-contractors, consultants, etc.). The communication among
18
19 144 them directly affects not only their relationship but whether the project will be
20
21 145 successful or not and C-PMs are the link among the parties. Stress could induce a
22
23 146 lack of concern for colleagues, disrespect for or distrust of those who are working
24
25 147 together with the C-PM and that will affect his/her performance.
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29 148 • Organisational performance: stress can have a negative effect not only on C-PMs
30
31 149 but on their organizations. When working under stress, C-PMs might exhibit
32
33 150 withdrawal behaviours, such as absenteeism from project meetings, lack of
34
35 151 commitment and a reduced sense of belonging to the organisation or even quitting
36
37 152 (Djebarni, 1996). It may occur when there is a difference between the C-PM's
38
39 153 personal values and the ones of his/her organization and the consequences of this
40
41 154 type of stress could negatively affect the firm directly, especially in financial terms.
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44

45 155 On the other hand, Gmelch and Chan (1994) and Djebarni (1996) asserted that a
46
47 156 moderate level of stress leads to a positive performance. Insufficient stress leads to lack of
48
49 157 concentration, boredom and lack of motivation or initiative to make someone's best.
50
51 158 Subsequent research studies have confirmed that there is an inverted U-shaped relationship
52
53 159 that shows levels of performance depending on the levels of stress (Gmelch, 1982; Leung
54
55 160 *et al.* 2005b; 2008a). These studies confirmed that low levels of stress would lead to
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3 161 boredom and low level of productivity while high-stress levels would make the individual
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5 162 unhappiness or anxiety and a moderate level of stress would help to attain optimal
6
7 163 performance.
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10 164 ***Stress-coping behaviours of C-PMs***

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14 165 Lazarus and Folkman (1984) defined ‘coping’ as any conscious effort by an individual to
15
16 166 overcome or to deal with a given stressful event. The coping strategies implemented by a
17
18 167 C-PM may depend on how he/she appraises a stressful situation, personality, environmental
19
20 168 factors and experience, which will result in an enhanced or decreased psychological
21
22 169 adjustment (Haynes and Love, 2004, Aitken and Crawford, 2007).
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25
26 170 There are commonalities in several researchers into the subject of coping behaviour. For
27
28 171 example, Lazarus and Folkman, (1984); (Djebarni, 1996); Haynes and Love, (2004); Ng el
29
30 172 al (2005; Leung *et al.*, (2006); Yip el al (2008); Smith et al, (2011); Chan *et al.*, (2012);
31
32 173 Chan et al, (2014), all confirmed that, there are two fundamental and differentiated types of
33
34 174 stress-coping behaviour. These are:

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37 175 • Problem-focused coping: it includes all the cognitive behaviours adopted to deal
38
39 176 with stressors through modifying the own problem’s mentality or environmental
40
41 177 conditions (Djebarni, 1996). This coping behaviour means confronting the source of
42
43 178 stress, removing the stressor, seeking instrumental support, planning and scheduling
44
45 179 or appraising a problem (Leung *et al.*, 2006).
46
47
48
49 180 • Emotion-focused coping: it refers to the adoption of activities or actions to manage
50
51 181 distressful emotions maintaining moderate levels of arousal (Lazarus and Folkman,
52
53 182 1984). They include emotional support-seeking, escape-avoidance, regulation, self-
54
55 183 control and denial/escape (Ng el al (2005, Chan *et al.*, 2012).
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3 184 In a survey conducted by Gunning and Keaveney, (1998) in Northern Ireland, the
4
5 185 coping strategies that were identified as being mostly adopted were as follows:
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11 187 1 Think objectively about situation and control feelings 72%
12

13
14 188 2 Find out more about problem 66%
15

16
17 189 3 Take immediate action on basis of present understanding of problem 63%
18

19
20 190 4 Draw on past experiences 59%
21

22
23 191 5 Follow formal channels of procedures 55%
24

25
26 192 6 Make a plan of action and follow it 47%
27

28
29 193 7 Seek advice from superiors at work 35%
30

31
32 194 8 Reduce tension by physical activity 28%
33

34
35 195 9 Go on as if nothing happened 26%
36

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38 196 10 Become more involved in non-work activities 23%
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41 197 11 Express anger to person who causes problem 12%
42

43
44 198 12 Wait and see before progressing 9%
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47 199 13 Become more involved in family life 7%
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50 200 14 Make myself feel better by eating, drinking taking medication 5%
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3 202 **Research Design and Methodology**
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6 203 **Theoretical framework**
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10 204 ***Stress-related Factors Influencing C-PMs***
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13 205 The aim of this research is to develop an integrated model that explains the strength of the
14
15 206 relationship between stress, stressors, stress-coping behaviours and performance of C-PMs
16
17 207 in the UK. **Figure 1** shows the relationship among the key research factors where the
18
19 208 performance of C-PMs is exposed as a dependent variable and the independent variables
20
21 209 are the level of stress and stress-coping behaviour. The key research questions that needed
22
23 210 to be answered were: how does stress affect the work of a C-PM in the UK? What type of
24
25 211 stressors generates the different levels of stress? What kinds of coping behaviours do C-
26
27 212 PMs adopt to deal with the stress? What is the effect of stress on the performance of C-
28
29 213 PMs?
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32

33 214 The next section will explain how components of the research framework were
34
35 215 measured in this research.
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39 216 **INSERT FIGURE 1 HERE**
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42 217 **The research sample**
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45 218 A questionnaire was designed and randomly disseminated to some 150 construction project
46
47 219 managers by e-mail using the survey-monkey tool of which 44 questionnaires were fully
48
49 220 completed. The respondents to the questionnaire were mainly men (43, representing 97.7
50
51 221 %), with only one C-PM female responded (2.3 %). This fact reflects a male dominance
52
53 222 gender in the UK construction industry which confirms the CIOB report that was
54
55 223 conducted in 2006. It has to be highlighted that “Gender” does play a part when it comes to
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224 risk factor for occupational stress in construction profession as revealed in an earlier study
225 by Loosemore et al (2004) and later by Sang et al (2007). The age of the respondents was
226 equally distributed from 30 to 60 years of age. In terms of their highest completed
227 education, most respondents held a postgraduate degree (27 C-PMs, representing 61.4 %),
228 while respondents with an undergraduate degree (13 CPMs, being 29.5 %) represented the
229 second largest group. The respondents were mainly employed by SMEs representing 34.1
230 % (15 respondents) or firms larger than 200 employees, being 38.6 % (17 respondents).
231 Most of the C-PMs that returned the completed questionnaire estimated the average
232 contract value of the projects they were involved within the last 5 years range between £1m
233 - £30m. The respondents had mainly between 21 and 30 years of experience in the
234 construction industry (17 respondents) and up to 20 years of experience (36 respondents)
235 working as a C-PM.

236 The questionnaire was designed to include variables of the research model that is
237 shown in **Figure 1** and were measured as follows:

238 **Measurement of the Research variables**

239 *Measuring Stressors*

240 Four types of stressors were measured in this study, namely, task stressors, organisational,
241 personal and physical. The different statements of this section of the questionnaire (26 in
242 total) were adapted from previous research by Leung and colleagues (2005a, 2007, 2008b,
243 2008c, 2009 and 2010b) and were made to fit the types of stressors adopted for this
244 research: these are as follows:

- 245 • Task stressors: those related to the day-to-day work (work overload, role conflict
246 and ambiguity, responsibilities, etc.) (7 factors)

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3 247 • Organisational stressors: generated from the organisation (organisation structure,
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5 248 career-developing environment, bureaucracy, etc.) (6 factors)
6
7 249 • Personal stressors: including both intrapersonal and interpersonal stressors (6
8
9 250 factors)
10
11
12 251 • Physical stressors: those affecting home and work environment (7 factors)
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14

15 252 A seven -point Likert scale was used to measure the stressors level, where 1 stood for
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17 253 ‘strongly disagree’ and 7 stood for ‘strongly agree’. The average score obtained was used
18
19 254 to indicate the degree of stressors. The results section below explains how the data was
20
21 255 analysed and presented to ensure reliability.
22
23

24 256 *Measuring Stress*

25
26
27 257 In this section of the questionnaire, the method used by Leung et al.’s (2008b, 2008c and
28
29 258 2009) was adopted to measure the level of stress. Three types of stress factors were
30
31 259 identified, namely, objective stress, burnout, and physiological stress. In order to measure
32
33 260 the level of objective stress, the discrepancy between a person’s expected and actual
34
35 261 abilities to handle stressors was assessed Gmelch, (1982). The respondents were requested
36
37 262 to rate their actual ability (A) and their expected ability (B) in various dimensions i.e., the
38
39 263 number of tasks, the responsibility of the work, the level of difficulty of the work, etc.,
40
41 264 selecting ratings from 1 (none) to 7 (a great deal) Leung et al., (2006). The overall
42
43 265 objective stress was calculated by summing the differences between the ratings of (A) and
44
45 266 (B). The results section below explains how the data was analysed and presented to ensure
46
47 267 reliability.
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52 268 A seven-point Likert-type scale was used to measure the burnout levels and
53
54 269 physiological stress levels of the C-PMs as adopted by Greenberg, (2003) and (Wharton
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2004). The respondents were requested to rate their agreement with the statements, ranging from 1 (much less than usual) to 7 (much more than usual). The average score obtained was used to indicate the degree of burnout and physiological stress level. The results section below explains how the data was analysed and presented to ensure reliability.

Measuring C-PM Performance

Three types of performance are taken into consideration to measure the performance of C-PMs, namely, task, interpersonal and organisational.

- Task performance: at three levels: cost, quality and time (3 factors)
- Interpersonal performance: referring to communication and relationship with colleagues, subordinates, superiors, client, sub-contractors, etc. (2 factors)
- Organisational performance: referring to personal behaviours in comparison with the company's demands (3 factors)

An eight-factors scale was used to measure the performance of the C-PMs. Respondents were asked to rate their performance on a seven-point Likert-type scale ranging from 1 (strongly disagree) to 7 (strongly agree). The results section below explains how the data was analysed and presented to ensure reliability.

Measuring stress- coping behaviour

Two types of stress-coping behaviour were measured, namely, problem- focused and emotion-focused behaviour.

Measuring Problem-focused behaviour

In order to measure the problem-focused behaviour, the discrepancy between a person's expected and actual impact of doing several activities or actions was assessed. The different

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3 292 statements of this section of the questionnaire were adapted from previous research by Djebarni
4
5 293 (1996) and Leung *et al.*, (2006). and were made to fit the types of problem-focused behaviour
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7 294 adopted for this research. The respondents were requested to rate their actual behaviour (A) and
8
9 295 their expected behaviour (B) in various dimensions. The overall problem-focused behaviour was
10
11 296 calculated by summing the differences between the ratings of (A) and (B). The 11 statements had to
12
13 297 be rated on a 7-point Likert-scale (from 'no impact' (1) to 'a great deal' of impact (7)). Since each
14
15 298 statement was rated twice (expected and actual impact), the final rating ranged from 0 (same
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17 299 impact) to 6 (the highest difference between expected and actual impact). The results section below
18
19 300 explains how the data was analysed and presented to ensure reliability.

21 301 ***Measuring emotion-focused behaviour***

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25 302 This section measures the difference between the C-PM's perception of the expected and
26
27 303 actual impact of doing several activities or actions in regard to the second type of
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29 304 stress-coping behaviour, namely, emotion-focused behaviour. The different statements of
30
31 305 this section of the questionnaire were adapted from previous research by Lazarus and
32
33 306 Folkman (1984), Ng *et al* (2005), Chan *et al.* (2012) and were made to fit the types of
34
35 307 emotional-focused behaviour adopted for this research.

36
37
38
39 308 The method used was the same as with the problem-focused behaviour above. In
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41 309 this section, Ten statements were assessed by the respondents on a 7-point Likert scale (for
42
43 310 the expected and actual impact). Thus, the final rating ranged from 0 (same impact) to 6
44
45 311 (highest impact). The results section below explains how the data was analysed and
46
47
48 312 presented to ensure reliability.

313 **Data Analysis and Results**

314 *Reliability and Factor Analysis of stressors*

315 Following the practice in the literature and, in particular, the work of Leung (2009) in Hong
316 Kong, the stressors of the C-PMs were categorised into 4 groups (task, organisational,
317 personal and physical). The sum of all these items (26) is appropriate for obtaining
318 adequate feedback from respondents but too many to develop an understandable
319 framework. In order to reduce the number of variables in the model, the four types of
320 stressors (7, 6, 6 and 7 items respectively) were subjected to exploratory factor analysis
321 using SPSS version 21.0 to extract factors best representing the four standards areas. Given
322 the known overlap of the stressor areas represented in the 4 groups, the Varimax rotation
323 method was employed to ensure maximal loading on the factors extracted. Varimax and
324 other rotation methods, are not specific to SPSS, as they are general exploratory factor
325 analysis (EFA) terms. Detail description of this analysis and rotations are not described in
326 this paper as they are beyond the scope of its content. However, more detail can be found in
327 Costello & Osborne (2005).

328 All items were loaded onto the appropriate factors, generating ten in total, these are: 'role
329 conflict' (TS1), 'work overload' (TS2), 'responsibility overload' (TS3), 'poor
330 organisational structure' (OS1), 'career-developing environment' (OS2), 'workgroup
331 cooperation' (PS1), 'type A behaviour' (PS2), 'poor work environment' (PHS1), 'lack of
332 cleanness' (PHS2) and 'poor home environment' (PHS3).

333 The Kaiser-Meyer-Olkin was used for measuring the sampling adequacy. Items
334 contained factor loadings higher than 0.5 are adequate (as recommended by Hair *et al.*
335 (2005). Kaser-Meyer-Olkin for task stressors was 0.559, for organisational stressors 0.682,

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3 336 for personal stressors 0.599 and for physical stressors 0.673, while the variance explained
4
5 337 were 71.97%, 70.45%, 64.54% and 78.70% respectively. All the items studies have
6
7 338 contained factor loadings higher than 0.5 and therefore, none of them were deleted for
8
9 339 further analysis. Then, Cronbach's alpha was applied to ensure the reliability of the ten
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11 340 generated stressors and, following Hair *et al.*' (2005) observation, the ones with values
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13 341 under 0.6 were deleted (TS3 and PS2).
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17 342 ***Reliability and Factor Analysis of stresses***

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20 343 Following the methodology adopted by Leung (2009) in Hong Kong, the items of the
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22 344 questionnaire regarding objective stress, burnout and physiological stress were subjected to
23
24 345 the varimax rotation as well. The Kaiser-Meyer-Olkin value for performance was 0.590
25
26 346 and its variance explained was 55.883%. As a result, three items of objective stress and
27
28 347 burnout were deleted due to their low factor loading (under 0.5 as Hair *et al.* (2005)
29
30 348 suggests). Consequently, Cronbach's alpha values were calculated to confirm the
31
32 349 reliability of the factors, which were accepted because their values (0.866, 0.725 and 0.692
33
34 350 for 'objective stress', 'burnout' and 'physiological stress') were higher than 0.6 (Hair *et al.*,
35
36 351 2005).
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40 352 **C-PMs Performance:**

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44 353 The eight-item performance scale was subjected to factor analysis with varimax rotation.
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46 354 As described in the literature above, 3 factors were generated: 'task performance' (TP),
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48 355 'interpersonal performance' (IPP) and 'organisational performance' (OP). The Kaiser-
49
50 356 Meyer-Olkin value for performance was 0.716 and its variance explained was 75.16%.
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53 357 **Stress-coping behaviours:**

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Both problem-focused and emotion-focused coping behaviour items were subjected to varimax rotation. This analysis created four factors in total for the problem-focused behaviour: 'control action' (PF1), 'thinking action' (PF2), 'support seeking' (PF3) and 'alternative thinking' (PF4). For the emotion-focused behaviour another four factors were generated: 'avoiding action' (EF1), 'emotional discharge' (EF2), 'relax seeking' (EF3) and 'escape' (EF4). The Kaiser-Meyer-Olkin value for the problem-focused behaviour was 0.678 and 0.522 for the emotion-focused behaviour, with a variance explained of 72.15% and 68.77% respectively. Two items were removed from further analysis due to their low factor loading (under 0.5). Consequently, Cronbach's alpha was applied to ensure the reliability of the generated factors stressors and the ones with values lower than 0.6 were deleted (PF1, EF3 and EF4).

Correlation Analysis

The interrelationship between stressors, stresses, stress-coping behaviours and performances of CPMs was established by applying the Pearson correlation analysis. The results indicated that 'objective stress' (OBS) had a positive significant relationship with 'interpersonal performance' (IPP: 0.352, $\rho= 0.05$) and a negative significant relationship with 'career-developing environment' (OS2: -0.398, $\rho= 0.01$). In addition, there were some positive significant correlations regarding 'burnout' (BO): with 'role conflict' (TS1: 0.421, $\rho= 0.01$), with 'poor home environment' (PHS3: 0.311, $\rho= 0.05$), with 'organisational performance' (OP: 0.339, $\rho= 0.05$) and with 'avoiding action' (EF1: 0.419, $\rho= 0.01$). The last type of stress: 'physiological stress (PHS) had a positive significant correlation with 'alternative thinking' (PF4: 0.412, $\rho= 0.01$) and negative with 'task performance' (TP: -0.426, $\rho= 0.01$).

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3 381 'Organisational performance' had a positive significant relationship with 'role conflict'
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5 382 (TS1: 0.527, $\rho= 0.01$), 'poor organisational structure' (OS1: 0.545, $\rho= 0.01$) and 'poor
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7 383 work environment' (PHS1: 0.332, $\rho= 0.05$). To finish with performances, 'interpersonal
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9 384 performance' was correlated with 'workgroup cooperation' (PS1: 0.37, $\rho= 0.05$).

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12 385 There was no internal correlation within the three types of stress, nor within the three
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14 386 types of performances. However, the next correlations were found within stress-coping
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16 387 behaviour factors: 'emotional discharge' (EF2) which was positively correlated to 'support
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18 388 seeking' (PF3: 0.334, $\rho= 0.05$) and to 'alternative thinking' (PF4: 0.389, $\rho= 0.01$).

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22 389 Moreover, 'emotional discharge' (EF2) had a positive significant correlation with 'poor
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24 390 home environment' (PHS3: 0.323, $\rho= 0.05$). 'Avoiding action' (EF1) had a positive
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26 391 correlation with 'poor organisational structure' (OS1: 0.315, $\rho= 0.05$), which in turn had a
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28 392 negative correlation with 'thinking action' (PF2: -0.477, $\rho= 0.01$).

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32 393 There were several interrelationships within the stressors, 'Poor work environment' (PHS1)
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34 394 was positively correlated with 'poor organisational structure' (OS1: 0.36, $\rho= 0.05$) and
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36 395 there was a positive correlation between 'poor home environment' (PHS3) and 'work
37
38 396 overload' (TS2: 0.297, $\rho= 0.05$). On the other hand, 'lack of cleanness' (PHS2) was
39
40 397 negatively correlated with 'career-developing environment' (OS2: -0.366, $\rho= 0.05$). 'Role
41
42 398 conflict' (TS1) was positively correlated with 'poor organisational structure' (OS1: 0.338,
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44 399 $\rho= 0.05$) and negatively with 'career-developing environment' (OS2: -0.405, $\rho= 0.01$ and
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46 400 'workgroup correlation' (PS1: -0.396, $\rho= 0.01$).

401 ***Interpretation of the correlation matrix***

402 As 'role conflict' affects organizational performance and is related to burnout, there is a
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404 need for C-PMs to clarify their roles, in particular, acquisition of adequate information
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406 about job responsibilities, job scope, job objectives, the expectations of workgroups in the

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3 405 construction management process and indeed job redesign Yip and Rowlinson (2009) .
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5 406 Several studies such as Leung (2009) and (Gmelch 1982), found that both role conflict and
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7 407 role ambiguity can lead to poor communication and stimulate stress in C-PMs, especially
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9 408 when they do not want to carry out a particular construction project or task or where
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11 409 information about it is limited. Therefore, role problems and other similar difficulties like
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13 410 too much work or lack of authority (factor relevant to C-PMs interviewed by HSE (2007)
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15 411 and to the research conducted by EL-Sabaa (2001) on project managers) should be reported
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17 412 at management meetings by the C-PMs and dealt with by stress management workshops or
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19 413 counselling meetings. According to Ben-Zur and Michael (2007), Eastburg et al (2006)
20
21 414 and Love et al., 2010), social support has found to be associated with decreased burnout of
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23 415 general professionals and good mental health of construction professionals. Thus, Leung et
24
25 416 al., (2009) recommended that construction employers need to organize some regular non-
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27 417 work related organization gatherings and sharing sections to facilitate the interpersonal
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29 418 relationships and supports between the workgroup.
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33 419 The significant impact of “Workgroup cooperation”, “Lack of cleanness” and “Work
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35 420 environment” on “organizational and interpersonal performances” indicates that group
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37 421 formation at work place need to be well thought through. Workgroup cooperation can be
38
39 422 considered as a buffer of stress in that it reduces the role of congruence problems of C-
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41 423 PMs. These factors (together with outdoor group activities) foster good teamwork and are
42
43 424 necessary to adjust the stress levels of C-PMs and, subsequently, improve their
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45 425 performance and the productivity of construction projects. Moreover, as poor physical
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47 426 environment acts as a source of the stressors of the surveyed C-PMs in the UK, a
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49 427 comfortable and suitable working environment is also important (Gallstedt et al 2003). For
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51 428 example, a well-designed office layout, either on-site or in office with a moderate and
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53 429 constant temperature, sound insulation facilities, and hearing protection equipment are
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3 430 strongly recommended in order to avoid a stressful work environment. Leung et al (2009)
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5 431 added the need of sufficient lighting, good space management, sufficient privacy, housing
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7 432 subsidy, in-house activities, and employment of psychological consultants.
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9 433 As 'career-developing environment' and 'poor organizational structure' have an impact
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11 434 on organizational performance and objective stress, companies need to ensure that C-PMs
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13 435 feel properly treated within the organizational hierarchy. Naturally, if a C-PM feels that
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15 436 there is no possibility of progressing, then his/her commitment, sense of belonging to the
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17 437 company and loyalty may fail. This finding corresponds closely with an earlier study by
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19 438 Weiss (1983) and El-Sabaa, S. (2001) who emphasised that career development difficulties
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21 439 and problems involving the organizational structure are significant sources of stress.
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23 440 Needless to say, the more complex the organizational structure in terms of rules and
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25 441 bureaucracy, the greater the intrapersonal conflict (Gmelch 1982). Leung et al (2009) added
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27 442 that, it would also inhibit one's personal creativity, which is an essential element in the role
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29 443 of C-PMs. Career-developing environment indicates the culture of an organization, the
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31 444 degree of participation in the decision making process, and the instability of the job of C-
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33 445 PMs (Karasek et al. 1998 and El-Sabaa, S. 2001). Employees who have greater
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35 446 opportunities to participate in decision making can experience higher feelings of self-
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37 447 esteem and job satisfaction (French and Caplan 1970), and lower feelings of stress
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39 448 (Margolis et al. 1974). Therefore, a good career developing environment is necessary if the
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41 449 stress of C-PMs is to be relieved.
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48 ***Developing the Integrated Model - SEM Analysis***

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51 451 SEM stands for Structural Equation Model and is the last step in developing the
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53 452 integrated model of stressors, stresses, stress-coping behaviours and their impact on the
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55 453 performance of C-PMs. To conduct the SEM analysis, AMOS version 22.0 was used and
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the fit indices of the structural equation model. According to Kline (1998) and Hair et al. (2005), at least, four fit indices have to be considered to quantify the degree of the fit model. This study used five indices to obtain an acceptable outcome, these were: i) Relative chi-square (X^2/DF); ii) Goodness-of-Fit Index (GFI); iii) Adjusted Goodness-of-Fit Index (AGFI); iv) Root-Mean-Square Error of Approximation (RMSEA); v) Comparative Fix Index (CFI).

The first model (Model 1) was based on the relationships found in the correlation analysis. Therefore, all the observed relationships were included in model 1. However, since the objective of the model is analysing the impact of stress (and all the other stress-related aspects) on the performance (of C-PMs), the relationships with all aspects of the stress-related factors and all types of performance were considered as predictors. That means that in the first model, the three types of performances were established as endogenous variables (predicted by the others). Once model 1 was analysed, the fit indices were checked and the outcome was:

Model	DF	X2	X2/DF	RMSEA	GFI	AGFI	CFI
1	145	164.451	1.13	.026	.746	.667	.875
2	140	141.160	1.01	.014	.767	.684	.993
3	138	130.210	0.94	.000	.781	.698	1.000

Hair *et al.* (2005) state that DF/X^2 ratios about 3:1 or lower are associated with the better fit. Likewise, lower values of RMSEA and higher of GFI, AGFI and CFI (values between 0 and 1) are related to a better fit. Therefore, as shown above, model 3 had the best fit (reaching 0 for RMSEA and 1 for CFI). Based on this result, the final integrated causal

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3 476 model of stressors, stress, stress-coping behaviours and performance is presented in **Figure**
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8 478 **INSERT FIGURE 2 HERE**

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10 479 **Discussion of the SEM analysis**

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13 480 SEM analysis enhanced the relationships seen in the correlation analysis and set an
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15 481 integrated model that includes the stressors, stress-coping behaviours and types of stress
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17 482 that affect the different types of performances of the work of C-PMs in the UK.

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21 483 The causal model in Figure 2 shows that all types of performance are predicted by
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23 484 several factors. Task performance is negatively affected by physiological stress and by
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25 485 'lack of cleanness'. This source of stress especially affects those C-PMs who spend most of
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27 486 their time on site, where that condition is often not under control. Unlike previous studies
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29 487 that were undertaken in Hong Kong, this research shows that task performance is not
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31 488 affected by objective stress or burnout. On the contrary, task performance was observed to
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33 489 be affected by physiological stress.

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37 490 Moreover, burnout and objective stress are predictors of interpersonal performance
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39 491 on C-PMs. Burnout seem to be detrimental to interpersonal performance whereas objective
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41 492 stress affects interpersonal performance positively. In addition, interpersonal performance
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43 493 is improved by 'workgroup cooperation' (having a good relationship with superiors and
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45 494 subordinates), as Djebarni (1996) observed, due to the linking role of C-PMs, who have to
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47 495 coordinate the work of different parties (client, suppliers, subcontractors, etc.) that often
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49 496 have different objectives.

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53 497 On the other hand, organisational performance is positively affected by burnout but
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55 498 only in a moderate way. Moreover, there are many stressors affecting organisational

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3 499 performance: unexpectedly, 'workgroup cooperation' is shown to have a moderately
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5 500 negative impact on organisational performance; perhaps, that implies a relaxed
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7 501 environment that does not foster C-PMs to offer their best at organisational level. The fact
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9 502 that, 'role conflict' and poor 'organisational structure' have a positive impact on C-PMs
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11 503 organisational performance, indicates that C-PMs might try to show their best under those
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13 504 delicate circumstances. Organisational performance is negatively affected by a 'career-
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15 505 developing environment' and by a 'poor work environment'. This study shows that a poor
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17 506 environment, with noise, interruptions, and dirt ('lack of cleanness' factor) decreases C-
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19 507 PMs' performances (task and organisational), which has a high potential to stress, as
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22 508 Gmelch (1982) and Selye (1980) also specified.

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25 509 Within the three types of stress included in this research work, physiological stress
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27 510 has no direct relationship with any stressor, aside from its impact on task performance
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29 511 mentioned above. However, physiological stress is related to two problem-focused coping
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31 512 behaviours in the present study: it has a negative relationship with 'thinking action',
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33 513 meaning that a thoughtful attitude before tackling a problem has a negative physiological
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35 514 impact on C-PMs. In addition, the model shows that an 'alternative thinking'
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37 515 (brainstorming) attitude has a positive influence on C-PM's physiological stress.

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41 516 On the contrary, objective stress is not affected by any coping behaviour but has a
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43 517 positive relationship with 'poor organisational structure' and a negative relationship with
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45 518 'career-developing environment' in this research work. Objective stress would be increased
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47 519 by a 'poor organisational structure' and would decrease in a 'career-developing
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49 520 environment'.

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53 521 Burnout is positively related with the 'avoiding action' factor (emotion-focused
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55 522 behaviour) that includes attitudes towards forgetting about problems and deferring
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3 523 decision-making. This observation shows a relationship that was not found in the Haynes
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5 524 and Love (2004) research work in the Australian construction industry. Additionally,
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7 525 burnout is positively related to the stressors 'role conflict' and 'poor home environment', as
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9 526 displayed by Leung *et al.* (2009) in their study of C-PMs and in their research work on cost
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11 527 estimators as well (Leung *et al.*, 2005a, 2007 and 2008b). The existence of these three
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13 528 factors ('avoiding action attitude', 'role conflict' and a 'poor home environment') would
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16 529 lead to burnout of C-PMs.
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19 530 Furthermore, the present research work outlines a positive relationship among
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21 531 'emotional discharge' (emotion-focused behaviour), 'alternative thinking' and 'support
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23 532 seeking' (both problem-focused behaviours). And, although the stress-coping behaviours
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25 533 are the only stress-related factors that do not directly influence the performance of C-PMs,
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27 534 some of them are related to a few stressors: the existence of a 'poor home environment' of
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29 535 a C-PM is shown as positively related to his/her 'thinking action' and 'emotional
30
31 536 discharge' behaviour. In addition, a 'poor organisational structure' has a negative
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33 537 relationship with 'thinking action' and a slightly positive one with 'avoiding action' as an
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36 538 attitude towards problems. Furthermore, a positive relationship between 'workgroup
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38 539 cooperation' and 'thinking action' is shown in the causal model developed in Figure 1.
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41 540 The stressors take a big part in the developed model in the present study. Aside
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43 541 from the previously described relationships, there are other interrelationships displayed:
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45 542 'career-developing environment' is negatively related to 'poor work environment' and to
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47 543 'lack of cleanness', but positively with 'workgroup cooperation'. In addition, the stressor
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49 544 'workgroup cooperation' has a negative relationship with the 'role conflict' of C-PMs,
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51 545 which is positively related to 'poor organisational structure'. The model developed here
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3 546 shows, as well, that ‘organisational structure’ and ‘work environment’ have a positive
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5 547 impact on C-PMs.
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8 548 **Summary and conclusions**

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11 549 This research was conducted based on literature review and structured questionnaire, which
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13 550 was formulated and fully completed by 44 C-PMs across the UK. The aim was to develop a
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15 551 structural equation model (SEM) that shows the causal relationships between stressors,
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17 552 stress, stress coping behaviour and performance of the C-PMs. The statistical package
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19 553 SPSS and AMOS were utilised to analyse the data in order to obtain the best-fit model that
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21 554 is presented in **Figure 1**.
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25 555 *Summary of stress related factors*

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28 556 Three types of stress related factors were identified and measured in this research, namely,
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30 557 objective stress, burnout and physiological stress. The level of objective stress (also called
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32 558 job stress) refers to the evaluation of a threat arising from cognitive factors and improves
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34 559 the C-PMs interpersonal performance. On a daily basis, those cognitive factors affecting C-
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36 560 PMs are project deadlines, the number of tasks (too many meetings, frequent phone calls,
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38 561 numerous site visits or too much paperwork) and the difficulty of the tasks (conflicts,
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40 562 complex decisions to make, lack of time. Objective stress was measured by the difference
41
42 563 between expected and actual ability to perform a task and both abilities were rated from 1
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44 564 to 7. The means of items related to objective stress were rather low (below 1.00 with
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46 565 standard deviations between 0.818 and 1.267).
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51 566 The mean scores for burnout stress and physiological stress are somewhat higher than
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53 567 the objective stress but still rather low (just over 2.00 with standard deviations between
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55 568 1.017 and 1.780 for burnout and between 1.129 and 1.646 for physiological stress).
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3 569 Burnout stress (occurs as a result of a complex interaction of individual characteristics and
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5 570 issues in the work environment) is the type of stress that has the highest impact on the
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7 571 performance of C-PMs, being detrimental to their interpersonal performance and positive
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9 572 for their organisational performance. The symptoms of burnout include changes in the
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11 573 social life of individuals (i.e., C-PMs could avoid communicating with people at home or in
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13 574 their private life), low attitude to work (i.e., low motivation, low commitment and low
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15 575 accomplishment complaints) and withdrawal behaviour (i.e., being late for work,
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17 576 absenteeism and even quitting). Whereas physiological stress refers to factors such as
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19 577 adverse work environment, imprecise and inconsistent job responsibilities, poor
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21 578 interpersonal relationships or excessive work overload affect stress experienced by C-PMs.
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25 579 ***Summary of stressors related factors***
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28 580 Results of this research shows that 'workgroup cooperation' (personal stressor) has a mean
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30 581 over 5 (standard deviation between 1.227 and 1.336), 'career-developing environment'
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32 582 (organisational stressor) has means close to 5 (from 4.680 to 5.090) and standard deviation
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34 583 between 1.567 and 1.665), 'work overload' (task stressor) shows means over 4 (from 4.270
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36 584 to 4.700 and standard deviations of 1.436 and 1.488 respectively. Further analysis of the
37
38 585 respondent's questionnaire shows that 'work cooperation', 'career-developing
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40 586 environment' and 'work overload' are, positively or negatively, the most common sources
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42 587 of stressors for C-PMs. Workgroup cooperation has an impact on the interpersonal
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44 588 performance in a positive way but is detrimental to the organisational performance. In
45
46 589 contrast to the observations described in the literature review, the work overload of C-PMs
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48 590 has no direct impact on any type of performance. This study also shows that both, problem-
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50 591 focused and emotion-focused stress coping behaviours, are related to stress and stressors
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52 592 but do not have a direct impact on the performance of C-PMs. Regarding the stress-coping
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behaviour of the C-PMs who responded the questionnaire, it is worth noting that 37 out of 44 respondents stated that they follow a problem-focused stress-behaviour, representing an 84.1 % of the respondents.

The causal model has been developed, and takes account of the most common stressors in the construction industry, which are 'role conflict', 'career-developing environment', 'poor home environment', 'poor organisational structure', 'work cooperation', and 'work overload'. This study also added 'lack of cleanness' and 'poor work environment'.

Finally, in order to evaluate if the size of the company is related to the stress that C-PMs suffer from, Pearson correlation and regression analysis were applied to the three types of stress and the results were as follows:

- Objective stress: -0.075 (Pearson correlation) and 0.006 (R square)
- Physiological stress: 0.221 (Pearson correlation) and 0.049 (R square)
- Burnout: -0.002 (Pearson correlation) and 0.000 (R Square)

All the values were too close to zero to mean any relationship between the size of the companies and the level of stress that the C-PMs experience.

The study outcomes and the developed model have wider implications and ramifications to construction project managers, human resources departments of construction companies, and the construction industry generally. The different sources and typologies of stress and the impact they have on productivity provide an opportunity for organisations to "focus minds" on those issues that are likely to impact on the welfare and wellbeing of their staff. Similarly, it should provide targeted attention on those stress-related issues that impact on construction productivity. Talent managers, recruiters, and

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3 615 HR professionals in construction may find the study outputs and model useful in
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5 616 informing. and putting together the most appropriate supportive and developmental
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7 617 programme for new and upcoming managers entering the construction industry as part of a
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9 618 wider “health and welfare” programme. In the same way, the study outputs may inform
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11 619 educational materials on stress and wider mental issues in educational establishments that
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13 620 offer courses in construction related disciplines.

16 621 **Limitations and Recommendations**

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20 622 The construction work environment is continuously changing, especially with the
21
22 623 advent of “digital construction”. With the introduction of Building Information Modelling
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24 624 (BIM), Internet of Things (IoT), and Big Data Analytics (BDA), the impact that these are
25
26 625 likely to have on an increasingly “pacey” construction environment, especially with
27
28 626 regards to these as potential sources of stress in certain circumstances is worthy of further
29
30 627 consideration and research. This research considered Construction Project Managers (C-
31
32 628 PMs) in the UK, and drew from forty-four (44) usable questionnaires. There is ample
33
34 629 scope for comparative and international research that looks at different professionals in
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36 630 the construction industry in terms of the sources and impact of stress in the professions, in
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38 631 an increasingly changing global construction industry, together with the role of
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40 632 professional bodies, industry, organisations, policy makers and higher education
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42 633 institutions in playing vital roles in addressing this important area that impacts on health
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44 634 & welfare of individuals, as well as the productivity of organisations and nations. Again,
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46 635 with an increasing level of Mental Health issues in construction, as well as with students
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48 636 involved in Higher Education (especially students off Architecture), there is need to
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50 637 consider the transition of these students (future professionals and leaders of the
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638 construction industry) from universities to industry, and how they are best placed to cope
639 with stressful construction environments and other mental health issues.

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Title	Country	Year	Author/s	Journal
Stress among construction site managers, preliminary study	UK	1989	Sutherland, V.J. and Davidson, M. J.	SM
Stress and construction site managers	UK	1992	Davidson, M.J. and Sutherland, V.J.	ER
Multivariate influences on the people side of projects: stress and conflict	UK	1994	Sommerville, J. and Langford, V.	IJPM
Impact of stress in site managers effectiveness	UK	1996	Djebarni, R.	CME
The influence of occupational stress on construction professionals	IE	1996	Gunning, J. G. and Cooke, E.	BRI
The impact of individual and job characteristics on 'burnout' among civil engineers in Australia and the implications for employee turnover	AU	2003	Lingard, H.	CME
Working conditions in projects: perceptions of stress and motivation among project team members and project managers	NL	2003	Gällstedt, M.	IJPM
Gender differences in occupational stress among professionals in the construction industry	AU	2004	Loosemore, M. and Waters, T.	JME
Psychological adjustment and coping among construction project managers	AU	2004	Haynes, N.S. and Love, P.E.D.	CME
Management standards and work-related stress in the UK: policy background and science	UK	2004	MacKay, C.J., Cousins, R., Kelly, P.J., Lee, S., McCaig, R.H.	WS
Critical stressors influencing construction estimators in Hong Kong	HK	2005	Leung, M.Y., Ng, S.T., Skitmore, M., Cheung, S.O.	CME
Impacts of stress on estimation performance in Hong Kong	HK	2005	Leung, M.Y., Olomolaiye, P., Chong, A., Lam, C.C.Y.	CME
Taking the pulse of UK construction project managers' health: influence of job demands, job control and social support on psychological wellbeing	UK	2005	Love, P.E.D. and Edwards, D.J.	ECAM
Manageability of stress among construction project participants	HK	2005	Ng, S.T., Skitmore, M., Leung, T.K.C.	ECAM
Taking the pulse of UK construction project managers' health: influence of job demands, job control and social support on psychological wellbeing	AU	2005	Love, P and Edwards, D.	ECAM
Does work-family conflict mediate the relationship between job schedule demands and burnout in male construction professionals and managers?	AU	2005	Lingard, H. and Francis, V.	CME
Impact of stress coping behaviour on estimation performance	HK	2006	Leung, M.Y., Liu, A.M.M., Wong, M.K.W.	CME
Does a supportive work environment moderate the relationship between work-family conflict and burnout among construction professionals?	AU	2006	Lingard, H and Francis, V	CME
Subjective and objective stress in construction cost estimation	HK	2007	Leung, M.Y., Skitmore, M., Chan,	CME

			Y.S.	
Gender: a risk factor for occupational stress in the architectural profession?	UK	2007	Sang, K.J.C., Dainty, A.R.J., Ison, S.G.	CME
The experience of burnout among future construction professionals: a cross-national study	AU+ HK	2007	Lingard, H.C., Yip, B., Rowlinson, S., Kvan, T.	CME
Coping with stress: dispositional coping strategies of project managers	AU	2007	Aitken, A. and Crawford, L.	IJPM
Model for predicting the performance of project managers at the construction phase of mass house building projects	UK	2008	Ahadzie, D.K., Proverbs, D.G., Olomolaiye, P.O.	JCEM
Effects of organizational supports on the stress of construction estimation participants	HK	2008	Leung, M.Y., Zhang, H., Skitmore, M.	JCEM
Impact of stress on the performance of construction project managers	HK	2008	Leung, M.Y., Chan, Y., Olomolaiye, P.	JCEM
Developing structural integrated stressor–stress models for clients’ and contractors’ cost engineers	HK	2008	Leung, M., Chan, Y., Chong, A., Sham, J.	JCEM
Coping strategies as moderators in the relationship between role overload and burnout	HK	2008	Yip, B., Rowlinson, S., Siu, O.L.	CME
Integrated model for the stressors and stresses of construction project managers in Hong Kong	HK	2009	Leung, M.Y., Chan, Y.S., Yu, J.	JCEM
Job burnout among construction engineers working within consulting and contracting organizations	HK	2009	Yip, B. and Rowlinson, S.	JME
Job redesign as an intervention strategy of burnout: organizational perspective	HK	2009	Yip, B. and Rowlinson, S.	JCEM
Impacts of stressors and stress on the injury incidents of construction workers in Hong Kong	HK	2010	Leung, M.Y., Chan, Y.S., Yuen, K.W.	JCEM
Work stress, support, and mental health in construction	AU	2010	Love, P.E.D. and Edwards, D.J.	JCEM
Chinese values and stressors of construction professionals in Hong Kong	HK	2010	Leung, M.Y., Chan, Y.S., Chong, A.M.L.	JCEM
Work stress among professionals in the building construction industry in Nigeria	NG	2011	Ibem, E.O., Anosike, M.N., Azuh, D.E., Mosaku, T.O.	AJCEB
A project manager's optimism and stress management and its project success	ZA	2011	Smith, D.C., Bruyns, M., Evans, S.	IJMPB
Structural linear relationships between job stress, burnout, physiological stress, and performance of construction project managers	HK	2011	Leung, M.Y., Chan, Y.S.I., Chen, D.	ECAM
Managing the stress of Hong Kong expatriate construction professionals in Mainland China.	HK	2012	Chan, Y.S., Leung, M.Y., Yu, S.W.	JCEM
Exploring stressors of Hong Kong expatriate construction professionals in Mainland China: focus group study	CN	2012	Leung, M.Y. and Chan, I.Y.S.	JCEM
Workplace stress of construction profession in South Africa	ZA	2013	Bowen, P., Edwards, P., Lingard, H.	JCEM
Workplace stress, stress effects, and coping mechanisms in the construction industry	ZA	2013	Bowen, P., Edwards, P., Lingard, H., Cattell, K.	JCEM
Structural relationships between cultural values and coping behaviors of professionals in the stressful construction industry	HK	2014	Chan, I.Y.S., Leung, M.Y., Yuan, T.	ECAM

Development of a job-stress model for construction professionals in South Africa and Hong Kong	HK+ ZA	2014	Leung, M.Y.I., Bowen, P., Liang, Q., Famakin, I.	JCEM
Occupational stress and job demand, control and support factors among construction project consultants	ZA	2014	Bowen, P., Edwards, P., Lingard, H., Cattell, K.	IJPM
Structural equation modelling of occupational stress in the construction industry	ZA	2014	Bowen, P., Govender, R., Edwards, P.	JCEM
Occupational stress and job demand, control and support factors among construction project consultants	ZA	2014	Bowen, P., Edwards, P., Lingard, H., Cattell, K.	IJPM
Impact of job stressors and stress on the safety behavior and accidents of construction workers	HK	2015	Leung, M.Y., Liang, Q., Olomolaiye, P.	JME
Exploring and validating the internal dimensions of occupational stress: evidence from construction cost estimators in China	CN	2015	Xiong, B., Skitmore, M., Xia, B.	CME
Development of a mindfulness–stress–performance model for construction workers	HK	2016	Leung, M.Y., Liang, Q., Yu, J.	CME
Stress among South African construction professionals: a job demand-control-support survey	ZA	2016	Cattell, K., Bowen, P., Edwards, P.	CME
Managing the work-family interface: experience of construction project managers	AU	2016	Turner, M. and Mariani, A.	IJMPB

AJCEB *Australasian Journal of Construction Economics and Building*

BRI *Building Research and Information*

CME *Construction Management and Economics*

ECAM *Engineering, Construction and Architectural Management*

ER *Employee Relations*

IJMPB *International Journal of Managing Projects in Business*

IJPM *International Journal of Project Management*

JCEM *Journal of Construction Engineering and Management*

JME *Journal of Management in Engineering*

SM *Stress Medicine*

WS *Work and Stress*

Table 1 – Historical trend of published papers related to stress by year, country, authors and journals

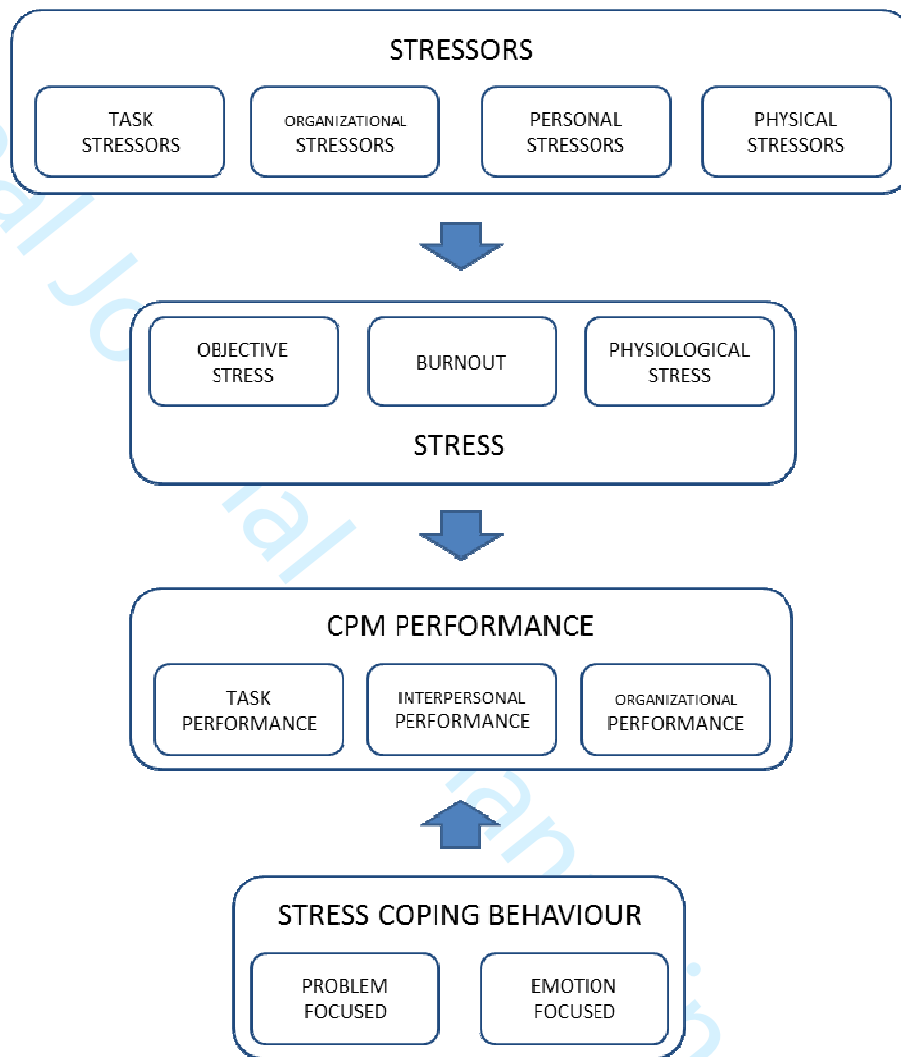
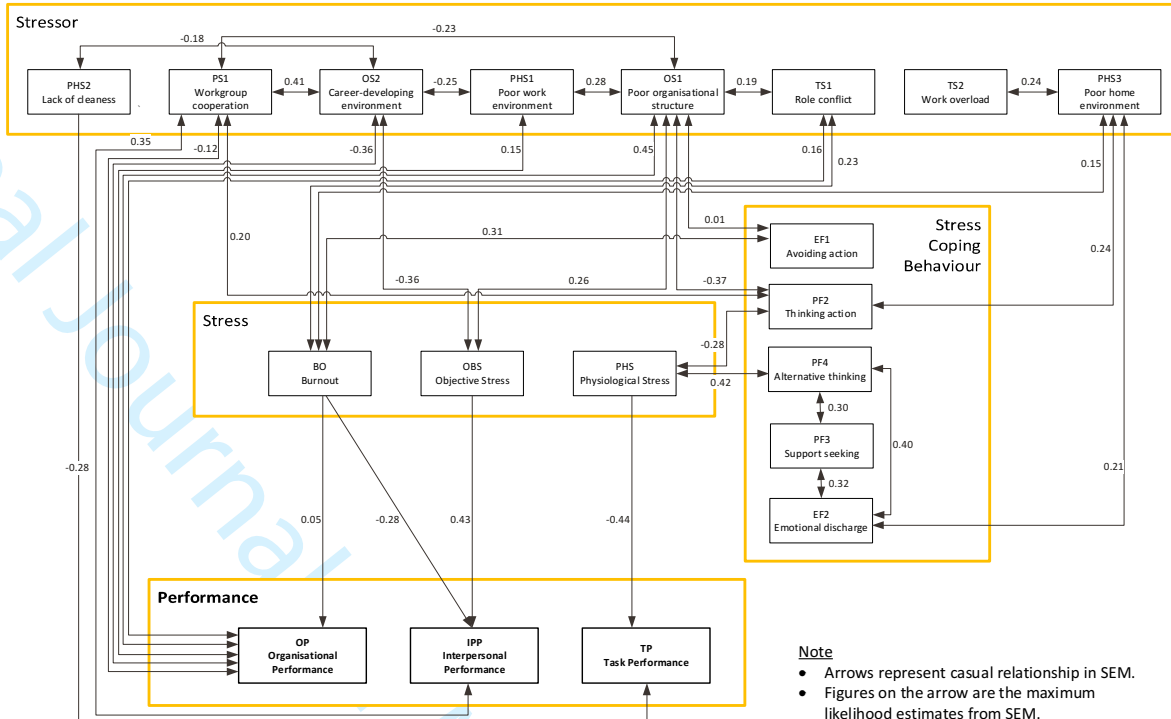


Figure 1. The research framework



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