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An Ocean of Stress? The relationship between psychosocial workload and mental strain among engine officers in the Swedish merchant fleet

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ABSTRACT

Objectives. *The first purpose of this study was to compare the psychosocial working conditions and mental health of our sample of maritime engine officers with a sample of British shore-based professional engineers. The second purpose was to analyse the relationship between the psychosocial working conditions onboard and mental strain for the Swedish maritime engine officers.*

Material and methods. *There were a total of 731 engine officers in the Swedish merchant fleet, almost all males with higher education. The British comparison sample consisted of 312 professional shore-based engineers. A questionnaire was distributed to the Swedish engine officers with a modified version of the JCQ for the DC-S model, the Role conflict and Ambiguity scale, and two items on family–work inter-role conflicts (WFI/FWI), as workload indicators. The General Health Questionnaire (GHQ12) and Perceived Stress Scale (PSS10) were used as strain indicators.*

Results. *There were no significant differences in perceived job stain or in WFI/FWI between the Swedish engine officers and the British professional engineers in perceived job strain. While the British shore-based engineers reported significantly higher role ambiguity the Swedish engine officers perceived a significantly higher degree of role conflict and higher perceived stress. Hierarchic linear regression analysis showed that the Role Stress was strongly related to perceived stress (R^2 = 0.319) as well as to mental health (R^2 = 0.222). When introduced in the second step the DC-S model was significantly related to the outcome measures, as was WFI/FWI when finally introduced.*

Conclusions. *The main source of the high degree of perceived stress among the engine officers does not seem to be the job content but may rather be understood from an interactional perspective, where conflicting requirements are directed towards the individual officer. It can be assumed that the fast technological and organizational changes and the increased pressure for economic profitability that characterize the shipping industry have attenuated these role conflicts.*

Key words: engine officers, role conflict, job content, stress, work–family conflict

INTRODUCTION

Exposure to work-related job stressors has been firmly associated with a broad spectrum of health problems and impeded wellbeing [1–3]. The shipping industry has a number of distinct characteristics which may create stressful working conditions and, in con-

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sequence, health problems among seafarers. The requirements for profitability in the shipping industry have resulted in reduced numbers of crew members and nationally mixed crews, extended working hours, increased automation, shorter turnaround time in ports, and a striving to optimize the cargo hold with regards to capacity and logistics [4, 5]. The reduction in the number of crew members has been made possible by technical developments and increased automation both on the bridge and in the engine department. Not only has the increase in automation led to those tasks being performed differently, but also new tasks have been added, especially administrative duties [5, 6]. However, a lot of the maintenance work, repairs, and different routines have basically been unaffected by technological development, and still have to be carried out to the same extent despite reduced crew numbers. Work continues on a 24/7 basis, often with permanent shift work and extended work shifts [7, 8].

Working conditions in the shipping industry have been associated with chronic fatigue and sleeping problems, disturbed circadian rhythms, and various stress-related and psychosomatic health problems [7, 9–12]. The increased automation and the consequent decreased number of seamen per ship have been reported as one of the major causes of stress-related psychological problems [4, 7, 9, 10]. In a multi-occupational sample from the Finnish merchant fleet it was found that the engine crew reported the highest stress levels [13]. In a study from the German shipping industry, engine personnel reported significantly higher stress from heat at the workplace than the deck or catering personnel, while no significant differences in frequency of psychosocial stressors was found between the occupational categories [14]. In an epidemiological study based on more than 22,000 seamen in the US merchant fleet it was found that midlevel managers in both deck and engine room departments had significantly elevated rates of health problems, such as cardiovascular disease and emotional disturbances, compared to non-licensed seamen [9]. Higher stress levels for officers, compared to subordinate crew members, were also found in the German merchant fleet [14]. It has been suggested that the ongoing downsizing, along with the swift technological and organizational changes in the merchant fleet, has had the hardest impact on midlevel managers [9].

Long shifts, variable work hours, high levels of perceived work stress, and job demands were strongly associated with higher levels of mental health problems and self-reported general health problems among seafarers [12]. In general, the self-rated health status among seafarers is relatively good, although this may be due in part to selection factors and the "healthy workers effect", as well as to systematic under-reporting [14, 15].

GENERIC MODELS TO CAPTURE THE ESSENCE OF WORK-STRAIN RELATIONSHIPS

Several generic models have been developed to describe and analyse the complex relationship between the psychosocial work environment and the health reactions of the individual by identifying core elements in the work-strain relationship [16]. There is an ongoing debate about the how accurately these types of models can capture occupation-specific workload. Different types of working conditions and different pathways between the working conditions and health may be of importance for the emergence of work-related strain in different occupations [17], and a possible result of the simplification embraced by the generic models may be the loss of knowledge of occupation-specific sources of job stress. Other authors [1, 18] claim that a limited number of core dimensions of working conditions are enough to explain the work-strain relationship in all types of professions and that profession-specific models are of limited value. Thus, there are inconsistencies in the present literature with regard to the value and usefulness of generic work-strain models.

WORK ROLE CONFLICT AND AMBIGUITY

An established generic approach to understanding and analysing work-related strain which departs from sociological role theory is the tradition of stress caused by work role conflict and role ambiguity. Rizzo defines work role conflict as "when the behaviours expected of an individual are inconsistent" and work role ambiguity to be present "if an employee does not know what he has the authority to decide, what he is expected to accomplish, and how he will be judged" [19]. Quite similarly, role ambiguity has been claimed to occur "when employees are unclear about role requirements and performance standards" and role conflict to occur "when two or more requirements of an employee's role are conflicting; that is when complying with one role requirement makes it more difficult to comply with another" [20]. Work role conflict and ambiguity are associated with stress, anxiety, reduced job satisfaction, and decreased job performance and to predicted mental and somatic complaints [19–22].

THE DEMAND-CONTROL-(SUPPORT) MODEL

The Demand-Control-(Support) (DC-S) model comprises three dimensions of psychosocial working conditions [1, 2, 3, 23]. Psychosocial work demand relates to how hard and intense the job holder has to work and includes, for example, time pressure and quantitative workload. Control or decision latitude comprises two distinct but closely related components: task authority reflects the scope of the job holder's authority to make decisions at work, while skill discretion relates to the level and variety of the skill required for the work tasks and the long-term possibilities to acquire new skills in the work role. The third dimension, work-related social support, refers mainly to emotional and instrumental support from colleagues and immediate superiors [1, 23]. The causal relationship between the dimensions of the DC-S model and a wide range of health outcomes has been firmly validated [2]. When the DC-S model was applied to compare the psychosocial working conditions for a sample of French seafaring officers and ratings to those of a group of non-seafarers (engineers and technicians) employed by the same company and also participating in sea voyages [24] it was found that the seafarers reported a significantly higher proportion of job strain (low control–high demands) than the comparison group.

WORK–FAMILY; FAMILY–WORK INTERFERENCE

Work–family conflict has been defined as "a form of inter-role conflict in which the pressures from the work and family domains are mutually incompatible in some respect" [25]. From this definition two types of conflicts or interference have been distinguished: work-family interference (WFI), when the role requirements of work interfere with home life; and family–work interference, where the demands from family and home interfere with work role requirements [26–28]. Work–family conflicts have been associated with, for example, reduced job satisfaction, perceived stress, depressive symptoms, perceived health symptoms, reduced compliance with safety rules, and absence from work [28–30]. Working onboard means that seafarers are parted from their families for extended periods, which may create work–family interference as well as family–work interference [12, 16, 31, 32]. The long periods away from home were associated with emotional problems among seafarers [12] as well with the experience of role displacement and feelings of being an outsider in the family [32]. Thus the work–family conflict perspective is important when analysing the relationship between work and mental wellbeing among seafarers.

AIMS OF THE PRESENT STUDY

Even though the studies referred to above suggest that the working conditions in the shipping industry are strenuous, we have found very few studies comparing psychosocial workload or mental health among seafarers to that of the working population in general. The first aim of this study was to compare the perceived psychosocial working conditions and mental strain reported by a sample of engine officers in the Swedish merchant fleet with a sample of British shore-based professional engineers participating in a survey in which the same scales on work-related stressors and mental strain were used [33]. This part of the study is more descriptive and we did not formulate any hypotheses on the relative distributions of job stressors or mental strain in the two samples.

A second aim of the study was to analyse the relationship between working conditions and mental strain among maritime engineers by the generic approaches described above: role stress, the DC-S model, and work-family interference. To the best of our knowledge, the role stress approach has not previously been applied to analyze the working conditions of seafarers, and previous studies that have applied the DC-S model to the working conditions of seafarers have either not used the full model [12] or have been based on a limited sample [24].

Considering the computerization, reduced manning onboard, and pressure for profitability in the shipping industry, and thereby the induced changes of work content and working conditions for the seafarers, there are reasons to assume this may have created role conflicts as well as high levels of perceived stress.

MATERIAL AND METHODS

PROCEDURE

A questionnaire comprising 129 items was distributed to all engine officers affiliated to the Swedish Merchant Marine Officers' Association, which held the only reliable address register of the target group for this study, and also administrated the dispatch of the questionnaire, which was followed by two reminders — mainly to the home addresses of the participants. A requirement of the Merchant Marine Officers Association for their assistance in the study was that participation should be anonymous, which rendered any drop-out analysis or longitudinal follow-up study impossible.

PARTICIPANTS

The sample consisted of 1383 engine officers. A total of 731 (54%) of the participants returned the completed questionnaire. The mean age of the participants was about 47 years (SD = 11.6), 99% were men and 1% were women. The nationality of 99% of the participants was Scandinavian; 76% of the participants were in a relationship while 24% were living alone; and 41% had children living at home. The mean time in their current position was about 13 years (SD = 10.5) and their total experience at sea was, on average, about 24 years (SD = 12.8). The positions on board represented in the sample were Chief engineer (44.5%), Second engineer (29.5%), Third engineer (14.0%), Electrical engineer (11.5%), and Other (0.6%), all categorised as engine officers. Even though none of the participants were asked about their education level, the Swedish Regulation on Qualification Requirements for Sea-personnel [34] require Chief engineers as well as Second engineers to have at least a bachelor's degree in engineering. Even though the formal minimum requirements for Third engineers are somewhat lower, the majority of them are newly recruited from technical universities and are training for higher level engineering qualifications. While there is no specialized education for maritime electrical engineers in Sweden, the vast majority of them have some form of university degree in engineering. So the vast majority of the participants could be classified to the sub-major occupational group "professional engineers" according to the British SOC system [35].

As a comparison group 311 persons with SOC sub-major occupational code "professional engineers" [35] were used. The mean age of this comparison group was 40.6 years (SD 10.57), with a mean job experience of about 13 years; 82% were men and 67% were married or had a partner; and four out of ten (41%) had children. To our knowledge all the British participants worked onshore.

VARIABLES

INDEPENDENT VARIABLES

Role Conflict and Ambiguity were measured by a slightly shortened version of the Role Conflict and Ambiguity Scale [18, 36]. This scale contained 12 items, comprising 8 items on conflict (α = 0.76) *e.g. "Do you receive incompatible requests from two more persons?"* and 4 items on ambiguity (α = 0.78*) e.g. "Do you feel certain about how much authority you have?"* This scale has been extensively used to study chronic role stress [22]. The scales were coded so that a higher numerical value means a greater presence of conflict.

The Demand-Control-Support model was assessed by the Job Content Questionnaire (JCQ) modified for the Whitehall II study [37]. Demands were measured by four items with an a coefficient of 0.69. Work-related control was measured by 16 items with an α coefficient of 0.77, with ten focussing on decision authority in the work situation and six items focussing on skill variety. Work-related social support was measured by ten items with an a coefficient of 0.80, with two extra items added to the original set of items used in the Whitehall II study. One of the additional social support items concerned help and support from the shipping company, while the second concerned help and support from the occupational health service. The scales were codes so a higher numerical value indicates a higher degree of the actual dimension.

Work–family inference (WFI) and Family-work interference (FWI) were both measured with single items *"Do the demands of your work interfere with your home and family life?"* and *"Do the demands of your family or spouse/partner interfere with your work related activities?"*

OUTCOME VARIABLES

The short version of the General Health Questionnaire (GHQ12) was used as an indicator of mental strain (38), with an α coefficient of 0.85. As a second indicator of mental strain the 10-item version of the Perceived Stress Scale — PSS10 (α = 0.84) was used [39]. The time frame referred to was "the last month", and each item had five response alternatives (0 never – 4 very often).

STATISTICAL ANALYSES

For the comparisons between the Swedish marine officers and the British professional engineers, Analysis of Covariance (ANCOVA) was used, controlling for the effects of age and sex on the outcome variables.

For the analyses of the relationships between working conditions and mental well-being, hierarchic linear regression analysis was used, with the Role Stress scales initially introduced, while the dimensions of the DC-S model were introduced in the second step of the regression. In the third and final step the two items on WFI/FWI were added to the regression equation.

RESULTS

The inter-correlations for all the variables in the study are presented in Table 1. As expected, almost

all the inter-correlations were of significant magnitude. Of particular strength was the inter-correlation between the outcome variables PSS10 and GHQ12. Table 1 also reveals that there were considerable inter-correlations between, on the one hand the Control and Support dimensions of the Job-Strain model, and on the other hand Role Conflicts and Role Ambiguity, thus revealing a certain degree of conceptual overlap between these constructs.

The comparison between engine officers and the sample of British shore-based engineers is shown in Table 2. While, on the one hand, the Swedish engine officers reported significantly a higher presence of role conflicts, they also reported a significantly lower degree of role ambiguity than the British engineers. There were no perceived significant differences either in psychosocial work content, as conceptualized by the dimensions of the DC-S model, or in WFI/FWI between the groups. With regard to mental well-being, the engine officers reported significantly higher perceived stress, while the two groups did not differ in mental strain as measured by GHQ.

Table 3 shows the results of the hierarchic regression analyses. As seen in the left column of the table, Role Stress accounted for almost a third of the variance (R^2 = 0.319) in perceived stress. As shown by the B weights, the conflict dimension was more strongly related to perceived stress than was role ambiguity. When introduced in the second step of the equation, the DC-S model accounted for an additional 5.4% of the variance in perceived stress — and the B weight reveals that psychosocial job demands, but neither control nor social support, significantly affected perceived stress. The third step of

Table 1. Correlation coefficients for all variables in the study (n = 686–731)

	1	2	3	4	5	6	7	8
1. Role conflicts	–							
2. Role ambiguity	0.52	–						
3. Demands	0.36	0.18	–					
4. Control	0.42	–0.38	–0.11	–				
5. Support	0.45	–0.36	–0.31	0.38	–			
6. WFI	0.32	0.19	0.32	–0.12	–0.20	–		
7. FWI	0.19	0.09	0.19	0.01[1]	–0.07[1]	0.42	–	
8. PSS10	0.56	0.38	0.41	–0.27	–0.34	0.34	0.22	–
9. GHQ12	0.47	0.29	0.34	–0.28	–0.32	0.30	0.16	0.66

[1]p > 0.05

Table 2. Comparisons between Engine officers in the Swedish merchant fleet and British professional engineers for psychosocial working conditions and mental strain indicators ANCOVA — Control for age and sex

	Engine officers (n = 681–685)		British engine professionals (n = 303–311)		
	M	SE	M	SE	F-value
1. Role conflicts	2.49	0.03	2.26	0.05	12.33***
2. Role ambiguity	2.09	0.03	2.32	0.06	7.50**
3. Demands	2.71	0.03	2.78	0.05	0.90 n.s
4. Control	3.06	0.02	3.05	0.04	0.00 n.s
5. Support	3.03	0.03	3.12	0.05	1.55 n.s
6. WFI	2.59	0.06	2.46	0.11	1.32 n.s
7. FWI	2.08	0.05	1.99	0.09	0.42 n.s
8. PSS10	1.80	0.03	1.38	0.06	26.65***
9. GHQ12	1.91	0.02	1.84	0.03	2.52 n.s.

**p < 0.01, ***p < 0.001

Table 3. The relationships between Role Stress, the DC-S model, WFI/FWI — and Perceived Stress (n = 711) and General Mental Health (n = 715). Linear hierarchic regression analysis

	Perceived Stress Scale			General Health Questionnaire		
	β	R^2	ΔR^2	β	R^2	$\Delta R^{2??}$
1. Conflict/Ambiguity Scale		0.319***	0.319**		222***	0.222***
Role conflicts	0.347***			0.277***		
Role ambiguity	0.104**			0.035		
2. The DC-S model		0.373***	0.054***		0.268***	0.046***
Demands	0.205***			0.153***		
Control	–0.035			–0.088*		
Support	–0.044			–0.082*		
3.WFI/FWI		0.391***	0.018***		0.284***	0.016***
WFI	0.108**			0.108**		
FWI	0.062			0.050		

*p < 0.05; **p < 0.01; ***p < 0.001

the regression analysis also showed that the relationship between work–family conflicts and perceived stress reached a significant level, albeit marginally so. The β weights reveal that WFI, but not FWI, was significantly related to perceived stress. Taken together, the model accounted for 39.1% of the variance in perceived stress.

The right column of Table 3 shows the same analysis with GHQ12 as the outcome measure. Role stress accounted for 22.2% of the variance in this measure of mental health and the β weights reveal that conflict, but not ambiguity, contributed significantly to this relationship. The D,C,S model accounted for 4.6% of the variance in GHQ, and the β weights show that all three dimensions of the model contributed to this outcome — although the contribution from job demands showed the strongest influence. The influence from work–family conflicts showed an almost identical influence on mental health as on perceived stress, that is a significant influence of WFI, but not of FWI.

DISCUSSION

An obvious advantage of using generic models is that they permit comparisons of the psychosocial working conditions between different occupations and industries. The comparison in this study did not generally indicate the generic psychosocial working conditions of engine officers in the Swedish merchant fleet to be more strenuous than for the British professional engineers. While the participants in the two groups did not perceive any significant differences with regard to the dimensions of DC-S models or WFI//FWI, the sea engineers reported lower work role ambiguity compared to the British professional engineers. The latter could be expected as the organisation on board is hierarchical and each position has clearly defined areas of responsibility [40].

The elevated work-role conflicts reporeted by the Swedish engine officers was the only indicator of elevated work stress and may reflect the changed working conditions in the shipping industry, with increased computerization and automation, and diminished manning [4, 5, 7, 9, 12]. This, in combination with increased numbers of national and international regulations, and multinational crews has accordingly led to new work tasks, changed work roles, and the division of work for seafarers, and has increased the requirements for economic efficiency that are mainly imposed on midlevel managers [4, 9]. Discontent among the seafarers with the new work tasks has also been previously reported [5], in particular with the increased administrative tasks that have been imposed on them as a result of increased computerization. According to the same study many of seafarers also felt their skills and education inadequate for the new work tasks. It seems highly probable that this profound and rapid technical, organizational, and economical development in the entire shipping industry is a prominent cause behind the relatively high levels of work role conflicts among engineers. The results presented by Agerberg and Passchier [10] support the results in this study, which suggests that there could be an association between the changes

in the work role on board and the engine officers' perceived stress. However, this needs to be investigated further. The generic models cannot be expected to provide a specific root cause as they aim to capture those generic constituents that have been generally defined as important contributors to work stress. Occupation-specific instruments thus need to be developed to better capture which work-related constituents cause ill-health among seafarers.

The different findings in the present study compared to the French study [24] with regard to perceived job strain can be explained by the fact that the sample in that study also included ratings while the comparison group in that study consisted mainly of highly qualified technical professionals. Considering the strenuous working conditions in the shipping industry previously reported in the literature, the fact that the engine officers did not report higher work demands than the shore-based engineers was somewhat surprising. It may be that the generic measures of work demands are insufficient to fully capture the occupation-specific stressors of the shipping industry, e.g. long periods of work onboard, shift-work, conflicting requirements, etc. A recommendation for future studies of working conditions in the shipping industry is to supplement the study with measures of more occupation-specific stressors.

Somewhat surprisingly, despite their long periods away from home, marine officers did not report a higher level of WFI/FWI than the shore-based British engineers. This could suggest that seafarers who find the separation from their family strenuous leave the shipping industry in favour of a shore-based job. Swedish engine officers also spend relatively short periods on board, in comparison with the international shipping industry. The shore leave is of the same length as the period spent on board, which enables the sea farer to spend half the year ashore together with his/her family. But, when entered in the third and last stage of the regression analysis, the WFI/FWI items related significantly to both the mental strain measures, thus confirming the multisource antecedents of work-related stress in the shipping industry.

While the engine officers did not report higher mental health problems compared to the shore-based British engineers as measured by GHQ12, they perceived substantially higher levels of stress as measured by PSS10. This study thus adds to the current knowledge [4, 7, 9, 10, 12] on the elevated levels of perceived stress among seafarers. With the rapid transformation of the shipping industry described above, where the work content, work roles, and qualification requirements have changed for most seafarers work, the relatively high frequency of work role conflicts as well as their impact on perceived stress among the engine officers was not unexpected. The findings of this study suggest the role stress perspective to be of high relevance for assessing the psychosocial working conditions among seafarers. This is not least due to the fact that individuals who are primarily oriented towards their professional norms tend to face more conflicts with their organizations [18]. The increasing demands for profitability in the shipping industry may cause conflicts with professional norms for engineers in middle management positions.

A shortcoming of this study is the cross-sectional design, which rules out any conclusions on causality relationships between psychosocial working conditions and mental health outcomes. Since the research group were not permitted access to the address register of the participants, it was not possible to carry out a study with longitudinal design, which of course would have had been preferable.

CONCLUSIONS

The findings from the present study indicate that it is not the job content or qualification levels that are the main source of work stress for engine officers. Rather, as indicated by the highly elevated role conflict, the often contradictory requirements raised by other actors and interested parties in the shipping operation seem often to create conflicts for the midlevel managers — who are supposed live up to their professional standards in shipping and at the same operate the ship with reduced crew numbers and high speed, so as to satisfy the requirements for profitability [4, 9]. To fully understand the work pressures of seafarers a socio-technical perspective is necessary which allows us to study the work role and the working conditions of the individuals in interaction with the technical and organizational context.

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