

A COMPARISON OF FATIGUE LEVELS AMONG MALAYSIAN SEAFARERS
OF DIFFERENT MARITIME SECTOR

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ABSTRACT

This report is to identify the sources of fatigue and fatigue levels of Malaysian seafarers for different maritime sectors. The objective is to determine the sources of fatigue among seafarers from different sectors. Questionnaires are used to collect field data and then analyze using SPSS and MiniTAB. From the analysis, it was found that fatigue problem is caused by two main factors which are shift of work and seafarers' working environment. The result proves the two factors caused fatigue to seafarers from different sectors where the score of mean for group of seafarers who work in Port (*Mean=3.52 and 4.12*), Coastal Container (*Mean=3.80 and 3.61*), Foreign-Tanker (*Mean = 4.05 and 3.91*) and Foreign-LNG (*Mean =4.05 and 3.85*) were classified as high score. Technology used onboard ship is one of the factor to take into consideration as a tool to overcome the fatigue problem at sea. The finding shows that respondents in Port (*Mean =3.74*), Coastal-Container (*Mean =4.11*), Foreign-Tanker (*Mean = 4.14*) and Foreign-LNG (*Mean = 3.87*) mostly agreed on the effect of technology at sea based on the high mean score.

ABSTRAK

Laporan ini adalah mengenai kajian statistik terhadap sumber kepada kelesuan dan tahap kelesuan yang dihadapi oleh pelayar-pelayar Malaysia di dalam sector maritim yang berbeza. Objektif kajian adalah untuk menentukan sumber kelesuan bagi kumpulan pelayar yang berlainan sektor. Kaedah soal selidik telah digunakan bagi mendapatkan data lapangan dan dianalisa dengan menggunakan SPSS serta perisian MiniTAB. Daripada analisa yang dijalankan, telah didapati bahawa kelesuan pelayar-pelayar Malaysia adalah disebabkan oleh dua faktor utama iaitu kesesuaian masa aturan bekerja dan persekitaran tempat bekerja. Keputusan membuktikan bahawa masalah kelesuan pelayar berpunca daripada dua faktor utama tersebut dengan markah skor purata yang diperolehi bagi pelayar-pelayar yang berkhidmat di sektor Pelabuhan (*Mean = 3.52 dan 4.12*), Kapal Kontena Pesisir (*Mean = 3.80 dan 3.61*), Kapal Tangki Antarabangsa (*Mean = 4.05 dan 3.91*) dan Kapal LNG Antarabangsa (*Mean = 4.05 dan 3.85*) diklasifikasikan sebagai tahap skor tinggi. Faktor penggunaan teknologi di atas kapal perlu diambil kira dalam membantu pelaut bagi mengurangkan kadar lesu di lautan. Dapatan kaji selidik menunjukkan responden di perkhidmatan pelabuhan (*Mean = 3.74*), Kapal Kontena Pesisir (*4.11*), Kapal Tangki Antarabangsa (*4.14*) dan Kapal LNG Antarabangsa (*Mean = 3.87*) kebanyakannya bersetuju bahawa teknologi memberikan kesan kepada masalah kelesuan berdasarkan skor purata yang tinggi.

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his focal point is about the lack of human resource to cope with the expansion of maritime industry, which is generally related to fatigue problem.

There're also haven't any study conducted in identifying the existence of fatigue and its differences among Malaysian seafarers in different maritime sectors. Hence it is appropriate to conduct this kind of study knowing the fact that Malaysia is in the track of becoming one of a well known maritime country.

1.3 Objectives of Research

This study is conducted to accomplish these following objectives:-

- i. To identify the sources of fatigue and fatigue level among Malaysian seafarers
- ii. To confirm the effect of technology to fatigue among seafarers.

1.4 Scope of Research

This research is carried out under these scopes:-

- i. Analyses are based on demographic
- ii. Research on various types of maritime sectors including offshore sector, deep sea sector (container ships, tankers, bulkers) and near coastal sectors including passenger liners.
- iii. Research on implementation of technology onboard ships and the effect to the fatigue issues.

1.5 Problem Identification

In order to ensure that this project can be carried out smoothly and finally achieves its objectives, certain problems which are part of the project itself would have to be identified. These are the problems, which require consideration of various problems solving methodology in order to produce a reliable solution. The major problems in this project have been identified as follows:

- The suitable approach to process and analyze the data and also the suitable software to be used later.
- Obtaining the suitable sector to be surveyed for this project. Consideration should be given to the fact that shipping industry in Malaysia now is monopolizing by one or two major player. So that, networking to this company must be initiated from the beginning of the project to ensure the survey can be carried out.
- Identifying the right time to get the respondents which are very difficult. It's because of the unpredictable and tight schedule of the Malaysian ship.

1.6 Thesis Organization

This report consists of six main chapters where each chapter will focus on the relevant topics as follows:

1.6.1 Chapter 1

This is an introduction section where the background of the study will be elaborated briefly. The objectives and the scope of research also will be stated clearly in this chapter.

1.6.2 Chapter 2

For the purpose of understanding and knowing on the topic of the project in details, this chapter will focus on theoretical and any findings which related to the research topic. It is called as literature review. Clear information on fatigue such as definition, concept, effect, sources, measurement and etc can be read in this chapter. For better understanding, there are also a lot of readings on the maritime sector and brief information on technologies at sea had been added in this chapter.

1.6.3 Chapter 3

This chapter presents the details of the research methodology where will be focused on the processes of executing the project or study from drafting the questionnaires, data collection, result processing and method of analysis. At the end of this chapter, the analysis of pilot study also will be presented.

1.6.4 Chapter 4

In chapter 4, the final result where the evidence of the sources of fatigue is shown. The details of analysis of the data and result will be presented in details. All the figures, tables and chart which represent the analysis of the data will be shown and the details description of the analysis will be given clearly in this chapter.

1.6.5 Chapter 5

Chapter 5 discusses the result which shown in previous chapter in detail. The discussion to be made based on the result obtained in chapter 4. The arguments and evidences on the results also will be discussed further in this chapter as well.

1.6.6 Chapter 6

Chapter 6 presents the overall conclusion and some recommendations for future research. This chapter will formulate the findings and the objectives of the project. At first, the objectives of the project will be reviewed and conclusions will be made based on the outcomes of study. To reinforce the outcome of this project, some recommendations were made at the end of this chapter where the proposed future studies to be carried out.

1.7 Summary

This chapter actually presents of the need of this study. The objectives and the scope of the study also clearly stated at the beginning of write up and it gives clearer direction what sort of expected outcome to be achieved at the end of the project. The scope of the study is also important as a direction to complete the study. The result must be relevance and significant to the overall topic and objectives.

CHAPTER 7

REFERENCES

- Abdullah, M., (2007), *A Pilot Study To Identify The Source Of Fatigue Among Malaysia Seafarer*, Fakulti Kejuruteraan Mekanikal, Universiti Teknologi Malaysia, Malaysia.
- Akerstedt, T., (1995), 'Work hours, Sleepiness and the Underlying Mechanisms', *Journal of Sleep Research*, 4(Suppl. 2): 15-22.
- Anna, J., H., M., Bultmann, U.,(1999), Fatigue Among Working People: Validity of A Questionnaire Measure. *Occup Environ Med* 2000. 57:353–357 Downloaded from <http://oem.bmj.com/cgi/content/full/57/5/353> on 2nd February 2009.
- Barton, J., (1995), 'Choosing to Work at Night: A Moderating Influence on Individual Tolerance to Shift Work', *Journal of Applied Psychology*, 79(3): 449-454.

- Boardman H., J., (2007), Issue of fatigue and its relationship to the safety of railroad operations, Federal Railroad Administration, U.S. Department of Transportation.
- Berger, Y., (1987), Sea Pilots: The Problem of Irregular Hours. *Seaways*, January, 7 - 10.
- Chua, Y.,P., (2006), Asas Statistik Untuk Penyelidikan Buku 2, McGraw-Hill, Singapore.
- Collins, A., Matthews,V., & McNamara, R., (2000), Fatigue, Health & Injury Among Seafarers & Workers On Offshore Installations: A Review, SIRC/Centre for Occupational & Health Psychology, Cardiff, University, UK
- Colquhoun, W, P, Rutenfranz, J, Goethe, H., Neidhart, B., Condon, R., Plett, R., And Knauth, P., (1988), Work at Sea: A Study of Sleep and of Circadian Rhythms in Physiological and Psychological Functions, in Watchkeepers on Merchant vessel I. Watchkeeping on Board Ships: A Methodological Approach. *International Archives of Occupational and Environmental Health*, 60, 321-329.
- Couper, A.,D., (1996), *Understanding Some of the More Difficult Research Problems in Maritime Human Factor Research*. Proceedings of a Research Workshop on Fatigue in the Maritime Industry. Seafarers International Research Centre for Safety and Occupational Health. University of Wales, Cardiff.
- Folkard, S, & Barton, J, (1993), 'Does the 'Forbidden Zone' for Sleep Onset influence Morning Shift Sleep Duration?', *Ergonomics*, 36(1-3): 85-91.

Houtman, I., Miedema, M., Jettinghoff, K., Starren, A., Heinrich, J., Gort, J., (2005), *Fatigue In The Shipping Industry, Work and Employment*, Hoofddorp, The Netherlands.

House, J.,D., (1985), Working offshore: The other price of Newfoundland's oil. Institute of Social and Economic Research, Memorial University of Newfoundland.

Hoyos, C.,G., (1995), Occupational safety: Progress in understanding the basic aspects of safe and unsafe behaviour. *Applied Psychology: An International Review*, 44(3), 235-250.

IMO, (2001), International Maritime Organization, *Guidance on Fatigue Mitigation and Management, MSC/CIRC. 1014*, London: IMO, p.1

IMO, (2002), International Maritime Organization, MSC/Circ.813/MEPC/Circ.330

Krupp, A, L, (2001), *Fatigue in Multiple Sclerosis: A Guide to Diagnosis and Management*, Demos Medical Publishing, LLC, Downloaded on 4 August 2007.

Linington, A, (2008), The regulation of seafarers' working hours. Nautilus Federation Report. UK

Lützhöft, M., & Kiviloog, L., (2003), Sjöfartsdagen 2003: Kommenterade voteringsresultat. Ångfartygsbefälhavare-sällskapet i Stockholm (In Swedish). Available: <http://www.ikp.liu.se/usr/marlu/> [2008, Nov].

Main Accident Investigation Branch, (2005), Department of Transport. Safety Digest. Lessons from Marine Accident Reports 1/2005.

- Malawwethanthri, K., (2003). *Fatigue and Jet Lag In search of Sound Sleep*. Seaways. November.
- Malaysian Shipowner Association (MASSA)., Annual Report 2007.
- Mohd. Hasrul, H., (2007), *A Pilot Study To Identify Fatigue Level Among Malaysian Seafarers*, Fakulti Kejuruteraan Mekanikal, Universiti Teknologi Malaysia, Malaysia.
- Munn, P, and Drever, E, (1993), *Using Questionnaires in small-Scale Research. A Teacher's Guide*, rev.ed. Edinburgh: Scottish Council for Research in Education
- NUMAST, (2006), *Fatigue: IMO Must Act*, NUMAST Telegraph, March 2006, p.40
- NUMAST, (1995), *All in Good Time*. London, NUMAST, UK
- NUMAST, (2001), *Seafarers' Hours: Time to Act*. London, NUMAST,UK
- NUMAST, (2002), *Conditions for change: A NUMAST survey on working conditions in today's shipping industry*, London: National Union of Marine, Aviation and Shipping Transport Officers
- Nunan, D., (1992), *Research Methods in Language Learning*, Cambridge: Cambridge United Press
- Omdal, K., A., (2003), *A survey of health and work environment onboard Norwegian ships 7th International Symposium on Maritime Health*.
- Osman., N., A., (2001), *Study on Malaysia's manpower requirements: The seafarer's dimension*. Kuala Lumpur: Maritime Institute of Malaysia

Osman, N.,A.,(2004), MIMA - HRD for Malaysian Seafarers: Issues and Challenges.

Maritime Institute of Malaysia, Martec, Johor Bahru

Parker, A.,W., Hubinger, L., Green, S., Sargent, L., & Boyd, R., (1997), *A Survey of the Health, Stress and Fatigue of Australian Seafarers*, Australian Maritime Safety Authority, Canberra.

Parker, A.,W., Balanda, K., Briggs, L., And Hubinger, L.,M., (1998), A Survey of the Work and Sleep Patterns of Great Barrier Reef Pilots. *Australian Maritime Safety Authority (AMSA)*

Patraiko, D., (2006), Fatigue onboard Raising awareness: *The Nautical Institute reporting plan*, 202 Lambeth Road, London SE1 7LQ, UK.

Razif.,M., (2004), HRD for Malaysian Seafarers: Issues and Challenges. Presented at Seminar on HRD for Malaysian Seafarers: Issues and Challenges. Kuala Lumpur: Maritime Institute of Malaysia

Reyner, L., Baulk, S., (1998), Fatigue In Ferry Crews: A *Pilot Study*, *Sleep Research Group*, Loughborough, University, UK.

Sutherland, K.,M., And Flin, R.,H., (1989), Stress at sea: a review of working conditions in the offshore oil and fishing industries. *Work Stress*, 3: 269-285

Sanquist, T., F., Raby, M., Maloney A.,L., Carvalhais, T., (1997), *Work Hours, Sleep Patterns and Fatigue Among Merchant Marine Personnel*. *Journal of Sleep Research*, 6: 245-251

Smith, A., Allen, P., & Wadsworth, E.,(2006), Seafarer Fatigue: The Cardiff Research Programme *Centre for Occupational and Health Psychology*, Cardiff University, 63 Park Place, Cardiff.