FAILURE MODE AND EFFECTS ANALYSIS (FMEA) OF DIESEL ENGINE MARITIME TRANSPORTATION FOR SHIP NAVIGATION SYSTEM IMPROVEMENT

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked the thesis and have strong belief that the thesis is adequate in terms of scope and quality for obtaining the degree of Master of Technology Management (Operation Management).

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I hereby declare that the work in this thesis is my own except for quotation and summaries which have been duly acknowledged. The thesis has not been accepted for any degree and is not concurrently submitted for obtaining other degree.

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DEDICATION

"TO MY BELOVED WIFE, ANGGRAINI SETYASARI, AND MY CHILDREN,
ANGGIA, AMANDA AND ANDHIKA,
MY PARENTS AND ALSO MY PARENTS-IN-LAW"

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ABSTRACT

Indonesia is the world largest archipelago, 2/3 of the country is covered by sea. However, a lot of ship accidents occur every year due to many factors, and claim a large number of casualties. Efforts which have been taken to improve the safety of domestic sea transportation to fully comply with the SOLAS (Safety of Live at Sea) regulations regarding to the International Maritime Organization (IMO) convention, are worsened by varying sea and cargo characteristics, low educated passengers who are at risk and are very vulnerable to accidents. There are many accidents happened in sea transportation in Indonesia, especially during 2005 until 2010, which mostly are due to human errors and only a few caused by natural and other factors. Most of the accidents occur due to low awareness on the aspects of security and safety. The equipments and system on board ship will not continuously remain safe or reliable if they are not properly maintained. In this study, Failure Mode and Effects Analysis (FMEA) approach is chosen as a risk assessment methodology to synthesize the potential failure modes and their associated causes for product and system design important of, especially in the ship diesel engine section. This study put particular checking of the fuel oil system of the ship diesel engine. Fuel oil system is extremely important part on a ship which is designed to supply clean fuel oil to main engine, diesel generators and emergency diesel generators. FMEA is found to be an effective tool or technique to be used for identifying possible failures and mitigating their effects. In various life cycle phase of diesel engine, FMEA activities are advised to be properly executed, and detailed FMEA documents produced should be used as priority reference. Design changes can be executed according to the developed FMEA documents, especially for the most dangerous failure modes identified with highest difficulty on their prevention possibility.

ABSTRAK

Indonesia adalah Kepulauan terbesar di dunia, 2/3 daripada negara dilindungi oleh laut. Walau bagaimana pun, banyak kemalangan kapal berlaku setiap tahun yang disebabkan oleh banyak faktor, dan melibatkan bilangan manusa yang besar. Usaha-usaha yang telah dilakukan untuk meningkatkan keselamatan pengangkutan laut tempatan, sebagai hasil kepada pematuhan sepenuhnya kepada peraturan-peraturan Keselamatan Kehidupan di Laut (SOLAS) menurut Konvensyen Organisasi Maritim Antarabangsa (IMO) menjadi lebih teruk dengan ciri-ciri laut dan kargo yang berbeza-beza, dan penumpang berpendidikan rendah, mereka berisiko dan sangat terdedah kepada kemalangan. Terdapat banyak kemalangan di laut pengangkutan di Indonesia, terutamanya pada tahun 2005 hingga 2010 adalah kebanyakan kerana kesalahan manusia dan hanya segelintir yang disebabkan oleh faktor alam dan lain-lainnya. Kebanyakan kemalangan yang berlaku disebabkan kesedaran yang rendah tentang aspek-aspek keselamatan dan keamanan. Peralatan dan sistem di atas kapal, tidak akan kekal selamat atau boleh dipercayai jika ia tidak dijaga. Dalam kajian ini, pendekatan mod kegagalan dan analisis kesan (FMEA) dipilih sebagai metodologi penilaian risiko untuk mensintesis mod kegagalan yang berpotensi dan sebab-sebab yang berkaitan untuk reka bentuk produk, terutama dalam enjin diesel kapal. Kajian ini mencadangkan sistem minyak bahan bakar dalam enjin diesel kapal. Studi ini bertujuan untuk melakukan pemeliharaan rutin pada sistem minyak pada enjin diesel kapal. Sistem minyak adalah sistem yang sangat penting pada sesebuah kapal yang direka bentuk untuk membekalkan minyak bahan api yang bersih kepada enjin utama, generator diesel dan penjana diesel kecemasan. Mod kegagalan dan analisis kesan (FMEA) merupakan alat atau teknik efektif yang digunakan untuk mengenal pasti kemungkinan kegagalan dan mengurangkan kesan-kesannya. Dalam pelbagai fasa kitaran hayat enjin diesel, aktiviti-aktiviti FMEA dijalankan dan dokumen FMEA terperinci biasanya digunakan sebagai rujukan. Reka bentuk perubahan boleh dilaksanakan mengikut dokumen FMEA yang sedia ada, terutamanya bagi mod kegagalan paling berbahaya dengan kemukaan pencegahan yang tinggi.

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BMKG	: Badan Meteorologi, Klimatologi dan Geofisika
CSR	: Continuous Service Rating
DFMEA	: Design Failure Mode & Effect Analysis
DNV	: Det Norke Veritas
FMEA	: Failure Mode and Effect Analysis
FO	: Fuel Oil
FSA	: Formal Safety Assessment
GMDSS	: Global Maritime Distress Safety System
GT	: Gross Tonnage
HAZID	: Hazard Identification
HFO	: Heavy Fuel Oil
ILO	: International Labour Organization
IMO	: International Maritime Organization
ISM	: International Safety Management
ISPS	: International Ship and Port Security
ITU	: International Telecommunication Union
KNKT	: Komite Nasional Keselamatan Transportasi
LO	: Lubricating Oil
LOA	: Length Over All
LPP	: Length between Perpendicular
LWT	: Light Weight Tonnage
MAIB	: Marine Accident Investigation Branch
MEPC	: Marine Environment Protection Committee
MCR	: Maximum Continuous Rating
MSC	: Maritime Safety Committee
NTSC	: National Transportation Safety Committee
OR	: Operational Rating
SAR	: Search And Rescue
SMS	: Safety Management System
STCW	: Standards of Training Certificate and Watch keeping
SWIFT	: Structured What If Techniques
USCG	: United States Cost Guard
PHA	: Preliminary Hazard Analysis
RCMs	: Risk Control Measures