DEVELOPMENT OF AN EXPERT SYSTEM FOR THE ANALYSIS OF TECHNOLOGICAL DISASTERS IN MALAYSIA

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DOCTOR OF PHILOSOPHY
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DEDICATION

I DEDICATE THIS THESIS TO MY PARENTS

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in Fulfilment of the requirement for the degree of Doctor of Philosophy

DEVELOPMENT OF AN EXPERT SYSTEM FOR THE ANALYSIS OF TECHNOLOGICAL DISASTERS IN MALAYSIA

By

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Malaysia has experienced several technological disasters in the last decade due to the operation of Major Hazard Installations (MHIs). Currently Malaysia operates 177 MHIs and Malaysia is witnessing continuous growth in MHIs. The number of MHIs increases at an average rate of 19 installations per year.

This study reviews and analyses technological disasters (TD), which has occurred in Malaysia. The objectives of this study were to identify factors responsibel of technological disasters, a combination of which triggered the technological disasters, to develop a model describing the pre-technological disaster stage, and an Expert System that could be used to aid the management of MHIs to control their installation. To achieve these objectives, a review of previous studies on disaster management in Malaysia was carried out together with an analysis of the technological disaster inquiry reports. A field survey and interview of the domain experts was also done.

Information research accidents, which occurred in Malaysia, was obtained from several sources. It has been found that Malaysia has experienced 28 disasters during the period 1968 to 2002. The disasters have resulted in 1,635 fatalities, 1,929 injuries, and caused severe damage to properties. Seven technological disasters have resulted in 104 fatalities and 201 injuries.

Four technological disaster inquiry reports have been reviewed in detail. This study shows that the factors, which contributed to the technological disasters in Malaysia, were mainly due to Social, Technical, Organizational, Operational, Investigational and Defences errors. It has been found from international experience that there are only a few models describing the disaster precondition stage. This study has produced a pre-technological disaster model. The model is called the Ibrahim-Razi model for technological disasters. This model describes the sequence of development of the pre-disaster stage in eight phases.

A field survey was carried out through a questionnaire. The targeted respondents were the Safety, Health and Environment Managers at the MHIs. Domain experts interviews were also conducted. Descriptive analysis, Pearson correlation, and regression analysis were used for the data analysis.

CLIPS (C Language Integrated Production System) was used as a medium for the development of Technological Emergencies Expert System (TEES). The TEES is versatile, portable, reliable, and applicable to other emergencies applications. This study provides a tool as an aid for the Safety Managers, as well as the DOSH in decision making and to assess the state of the MHIs.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
Sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

PEMBANGUNAN SISTEM PAKAR UNTUK TUJUAN ANALISIS BENCANA-BENCANA TEKNOLGI DI MALAYSIA

Oleh

IBRAHIM MOHAMED SHALUF

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Pengerusi: **Associate Professor Fakhru'l-Razi Ahmadun, Ph.D.**

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Dalam tempoh sepuluh dekad yang lalu, sejak beroperasinya Pemasangan Berbahaya Besar atau 'Major Hazard Installations' (MHIs), Malaysia telah beberapa kali mengalami bencana teknologi. Pada masa ini 177 MHIs telah beroperasi dan Malaysia menunjukkan pertumbuhan MHIs yang berterusan. Bilangan MHIs meningkat pada kadar purata 19 pemasangan setahun.

Penyelidikan ini berkait dengan ulasan dan analisis bencana teknologi yang berlaku di Malaysia. Objektif kajian bertujuan untuk mengemukakan faktor-faktor bencana yang bergabung dan mencetuskan bencana teknologi, membangunkan model yang menerangkan tahap-tahap pra-bencana teknologi, dan Sistem Pakar yang boleh digunakan bagi membantu pengurusan MHIs mengawal pemasangan. Bagi mencapai objektif ini, ulasan tentang kajian-kajian terdahulu tentang pengurusan bencana di Malaysia telah dijalankan bersama analisis laporan penyiasatan bencana teknologi. Tinjauan lapangan dan temu bual dengan pakar-pakar bidang juga dijalankan.

Kemalangan yang berlaku di Malaysia berpunca daripada beberapa sumber. Antara tahun 1968 hingga 2002, Malaysia telah mengalami kira-kira 28 bencana yang mengakibatkan 1635 kematian, 1928 kecederaan dan kemusnahan harta benda. Tujuh bencana teknologi telah menyebabkan 104 kematian dan 201 kecederaan.

Penilian terperinci telah dijalankan ke atas empat laporan penyiasatan bencana teknologi. Kajian menunjukkan faktor-faktor yang menyebabkan bencana teknologi di Malaysia kebanyakannya berkait dengan kesilapan Sosial, Teknikal, Organisasi, Operasi, Penyisatan dan Pertahanan. Berdasarkan pengalaman antarabangsa, hanya beberapa model sahaja yang menerangkan tahap-tahap prasyarat bencana. Kajian ini telah menghasilkan model bencana prateknologi. Model tersebut dikenali sebagai Model Ibrahim-Razi yang menerangkan urutan perkembangan tahap-tahap prabencana dalam lapan fasa.

Kajian lapangan telah dijalankan melalui soal selidik. Responden sasaran adalah Pengurus-pengurus Keselamatan, Kesihatan, dan Alam Sekitar di Malaysia. Temu bual dengan pakar bidang turut dijalankan. Analisis deskriptif, korelasi Pearson dan analisis regresi telah digunakan untuk menganalisis data.

CLIPS telah digunakan sebagai alat untuk membangunkan Sistem Pakar Kecemasan Teknologi (TEES). TEES bersifat versatil, mudah alih dan boleh disesuaikan dengan aplikasi-aplikasi kecemasan. Kajian ini menyediakan alat bantuan untuk Pengurus-pengurus Keselamatan dan juga kepada DOSH dalam membuat keputusan dan untuk menilai keadaan MHIs.

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I certify that an Examination Committee met on 29 of August 2004 to conduct the final examination of Ibrahim Mohamed Shaluf on his Doctor of Philosophy thesis entitled "Development of an Expert System for the Analysis of Technological Disasters in Malaysia" in accordance with the Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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This thesis submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee are as follows:

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations that have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or any other institution.

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IBRAHIM MOHAMED SHALUF

Date: December 2003

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