SUSTAINABLE MAINTENANCE OF NAVIGATION CHANNEL

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A DISSERTATION SUBMITTED AS A PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF ENGINEERING (MECHANICAL ENGINEERING – MARINE TECHNOLOGY)

FAKULTI KEJURUTERAAN MEKANIKAL
UNIVERSITI TEKNOLOGI MALAYSIA

NOVEMBER 2006

Dedicated to my beloved parents, People that taught me
People that supported me and all people of goodwill

ACKNOWLEDGEMENT

I thank to Almighty God for giving me an opportunity to complete this thesis. First and foremost my sincere appreciation goes to my supervisor, Prof. Dr. Ab Saman Ab Kader who gave me invaluable support, encouragement and guidance in completing this thesis. I also register my sincere appreciation for my teachers for all their support and knowledge they passed to me.

I would like to express my gratitude to my beloved family for their continuous support; they have encouraged me mentally and spiritually in completing the project. I also appreciate the support of IDB and the state of Johor for their support, as this project will not be successful without them. I am very appreciative to the management of Port Tanjong Pelepas given me their supports and data's that I needed to complete analysis on the case study.

I would also like to express my gratitude to my course mates and friends for their assistance, cooperation and ideas during my studies. Last but not least, I would like register my profound thanks to all those who have contributed either directly or indirectly in produce this thesis that I could mention. Without you all, this thesis would have not been successfully completed.

ABSTRACT

Maritime industry is the cradle of all modes of transportation, where port and ship are necessary to facilitate trading through marine transportation, recent time has proved that there is continuous growth or need for larger and sophisticated ship through increasing shipping activities and this has lead to design and production of sophisticated state of art, safety oriented marine vehicles, in term of size, speed and structure. Albeit, the rate of growth of ship is out of phase with the condition of navigation channel, the channel due to environmental pressure is subject misplacement of allowance required to keep the channel safe to receive larger target vessel. Channel operators rarely have a simplified system to monitor and exercise to balance safe reception and navigation of large ship in inland water, which are always considered as restricted water, due to exposure to accident that could to environmental disaster. This project seeks to apply various models to Port Tanjung Pelepas (PTP), with thrust to deduce simplified model that will provide insight for port operator on sustainable way to maintain the channel.

ABSTRAK

Industri maritim merupakan tempat asal atau lahirnya pelbagai model bagi pengangkutan air di mana pelabuhan dan kapal adalah kemudahan yang digunakan untuk berdagang melalui pengangkutan air. Kepentingan pengangkutan air ini dapat dilihat melalui pertumbuhan yang berterusan atau keperluan kepada penggunaan kapal yang besar dan canggih melalui peningkatan aktiviti perkapalan. Disebabkan peningkatan permintaan tersebut, ia menggalakkan penghasilan model-model baru di mana ia memperkembangkan pelbagai rekabentuk baru serta pembuatan yang ditetapkan dengan mengambil kira saiz, halaju serta struktur sekalipun peningkatan kadar pembinaan kapal adalah di luar fasa dengan keadaan pelayaran ‘channel’ yang sama. Ketahanan ‘channel’ tersebut adalah bergantung kepada bebanan yang bertindak, kadangkala ia juga berhubung dengan kesilapan yang biasa dilakukan oleh operator pelabuhan. Mereka perlu memastikan agar ‘channel’ tersebut selamat digunakan bagi penggunaan kapal yang lebih besar saiznya. Pada kebiasaanya operator ‘channel’ mempunyai satu sistem yang dipermudahkan untuk mengawasi serta melatih bagi tujuan keselamatan untuk pelayaran kapal-kapal besar di laut dalam sebagai persediaan menghadapi bencana alam. Projek ini dijalankan untuk mengenalpasti beberapa model yang praktikal untuk kegunaan pihak PTP (Port of Tanjung Pelepas). Diharapkan model yang telah dipermudah ini akan digunakan sebagai persediaan pengetahuan kepada operator pelabuhan. Ia merupakan kaedah yang memungkinkan untuk mengekalkan ‘channel’ tersebut.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS AND ABREVIATION

ACRONYM	DEFINITION
AAPA	American Association of Port Authorities
UNDP	United Nations Development Program
UNEP	United Nations Environmental Program
GESAM	Global Environmental studies and monitoring
NOAA	National Oceanic and Atmospheric Administration
ICOLRELS	International Committee for Receipt of Large Vesse
COLS	Committee on Large Ships
PIANC	International Navigation Association Congresses
TBT	Trybutylin
FSZ	Free Zone Status
MSSC	Malaysia Singapore crossing
EIA	Environmental Impact Assessment
RIA	Risk Impact Assessment
PTP	Port Tanjung Pelepas
IMPA	International Maritime pilot association
APM	International Association of Ports and harbors
IALA	International Association Lighthouse Authority
LOA	Length overall
LBP	Length between perpendiculars (measured at
LWL	Length along waterline (usually similar to LBP)
B	Beam (maximum width of ship cross section)
D	Draft
DWT	Dead weight tonnage (= DT - LWT)
GRT	Gross register tonnage
NRT	Net register ton
TEU	20-ft equivalent units; standard (6.1 x 2.4 x2.4) m

AC	Channel cross-section area [length2]
CB	Block coefficient [dimensionless]
Fh	Channel depth Froude number [dimensionless]
FL	Schijf limiting Froude number [dimensionless]
g	Gravitational acceleration [length/time2]
h	Depth of channel [length]
h1, h2	Overbank depths [length]
L	Ship length [length]
T	Vessel draft [length]
V	Vessel speed [length/time]
VL	Schijf limiting ship speed in squat analysis
W	Width of channel [length]
Z	Maximum ship squat [length]

LIST OF APPENDICES

APPENDIX		TITTLE
Appendix	A	Vessels
Appendix	B	Channel
Appendix	C	Environments

CHAPTER 1

INTRODUCTION

1.1 Background

Maritime industry is the cradle of all modes of transportation, ports and ships are necessary to facilitate trading through marine transportation, recent time has proved the continuous growth or need for larger and sophisticated ship through increasing shipping activities, demands and this has lead to design and building of sophisticated, state of the art, safety oriented marine vehicles in term of size, speed and structure- albeit, this safety based designed development is out of phase with conditions of navigation channels. To create a balance for safe navigation in restricted water these big ships will ply, channel must be maintain at a frequency the ships building are growing.

Maintenance dredging is the activity that involve periodic removal of material which has been deposited in an area where capital dredging has been undertaken, The frequency of maintenance dredging varies from port to port, however, the objective remain to allow ships to enter and leave port at stated draft without delay and ensure efficiency of maintenance dredging, steps must be taken during the process to minimize siltation and shoaling in channel.

This project addresses the navigation aspect of channel maintenance using a "pressure–state–response" approach. "Pressure" is the demand placed upon the marine environment and its resources by human Activities. "State" describes the current conditions resulting from these pressures. "Response" is what is being done to address the pressures and finally evaluating these states and come up with what need to be done in a sustainable manner.

Every human activity on earth is about need and response, of course mitigation. I issue relating to channel and ships are not left behind in this. The Ship is about port, access to port by optimum size ships can be made available through navigable channel where maintenance dredging is needed. Economics of scale and demand has begot big ship to emerge within a short period of time after second world war- however less attention has been given to the channel that will continue to accommodate these ships.

1.1.1 Shipping trend

Ships and shipping remains a very important instrument for mobility. If ships could no longer transit waterways, there will shortages of power, heat and food in days or weeks at the outside. Recent years have seen economic of scale due to improved trade, the significance of these trends is that more, larger ships will continue to use waterways for the foreseeable future. But there are limits on size of ship that a channel can accommodate, Therefore a means of determining special measures must be imposed on handling ships in order to ensure the continued safe, efficient, and environmentally friendly use of our channel.

This make it incumbent for authorities concerned regarding waterways to evaluate and address the risks associated with ships that are plying them and find way and information sharing avenue for channel designers, naval architects, ship masters and pilots, and waterway managers that will help develop policy, recommendations that will address the way channels are maintain, enlarged and how ships of various types using them should be designed and handled. And of course, ways to monitor existing and new ships operating at channel approach in order to guide ship designers to understand, review ships, pilotage, channel, current design and operational practices on how to incorporate needed improvements.

Under sustainability, environmental issues are an important part of today's operation, and management linked to governmental level policy work. Since, the Rio

declaration, the themes aspects regulation and management of “environment” have been increasing and changing. Public awareness about the environmental consequences of several types of activities (e.g. the waste and emissions from in industrial processes, ships, and their direct and indirect discharge (through river runoff) to the ocean impacts of infrastructure building, etc) has increased.

Associated with environmental examination is problems of uncertain issue, aggregating through its characterizes point form degradation, high risk, disputed values, and short time line for decision , and this has called for dire need of , philosophy and new science to design, maintain and prevent alarming system failure, One example is the Post-Normal Science (PNS) where diligent care is recommended to acknowledge, communicate, and manage uncertainties under holistic consideration including value commitment and community participation in the assessment work.

This project presents the case of a comprehensive simple models to balance sustainability relating to economic maintenance of port access for safe navigation of vessels (bigger ships) in restricted water while sustaining other purpose of water resources through assessment and evaluation, central discussion will focus on aim to improve on existing practice, entity of things that are being consider in ports that are innovative will be captured in a way that can affords ready access and promotes technology transfer. The sustainability elements of the Project are a green port initiative, whose outcome hope to give insight in developing Environmental Management Handbook for Ports.

1.12 The case study

This thesis presents a case study on Port Tanjung Pelepas (PTP), which is considered as one modern port that currently accept big vessel up to 430m as of now, however, having such room can easily put monitoring need for siltation and decision-making process of environmental implications and uncertainty where scientific knowledge is important role in oblivion. Specifically linked to the case, is the case consists in the balancing system leading to decision regarding the application of models for deepening (through dredging) which is very important for the area.

PTP, a subsidiary of Seaport Terminal Sdn. Bhd., modern port given a free zone status in a location know as tip of Asia, where almost all vessels crossing Asia through the straights of Malacca, it was part of Malaysia`s determined program under vision 2020, with projection to have the 800ha port developed to 12 berths by year 2020. It was one of the fast track, mobilized project done under rapid schedule whose after project condition need monitoring to cater for uncertainty that might have mixed with the shortened time of the project. Thus the project execution programme contained numerous intermediate milestones or partial completion dates, which has allowed close monitoring and adherence of progress, minimizing delays and financial risks with substantial increase in production capacity for site clearing, dredging, and reclamation and soil improvement which turned the river and mangrove area at its peak in 1998 into one of the world's most equipment, intensive dredging projects, with some 12 large dredging vessels being employed in total (Allard Renkema and David Kinlan,2000).

In less than five years the area stretching from the state capital Johor towards the west along the Johor Straits, has rapidly changed from a quiet oil palm plantation area into a totally new area to develop with excellent infrastructure, housing facilities and new areas for industrial development. Major infrastructure projects such as the Second Crossing, Johor Airport and the new port development at PTP at the east bank of the Sungai Pulai, form the cornerstone of the Johor growth triangle west of the city. A study made by Johor port authority in 1990 about

anticipation of congestion over the Johor port that has been existing since 1977, gave birth to site selection for PTP as the most suitable location for Johor's new port.

The main reason for choosing examples of maintenance of PTP channel in the case study is because of the acceleration program practice in PTP may not have enough initial allowance to the channel, in the project as a result of location and there is envisaged expansion in the area there will be potential rise of traffic in that areas and the need for a simple model for the port to monitor the design channel draft, the ships plying it and the rate of siltation, couple with innovative scientific uncertainty analysis is going to be one key thing that will continue to surface in this areas in respect to population and development work in the area. This study will look into the simplified balancing system for between channel and vessels leading to sizing and soil removal decision, issue of sustainability, risk and uncertainty assessment will be discussed as related to channel maintenance in a broader scientific context, holistic risk and goal based assessment will be suggested for further studies.

Uncertainty as the name imply, is very complicated and scientific solution is not enough to cover insurance related to issues like consequence of dredging of polluted sediments on environment or human health, and even suggested mitigation. In the past convention, methodology rarely consider issue of uncertainty, age of awareness has called for new philosophy to avert future accumulated problem that could result from point form environmental degradation due to oversight or negligence of small issues attached to uncertainty. Dredging work around the world is associated with conflict especially on issue of dredged material disposal, this area will be deeply looked into sustainable ways and method of disposal, that satisfied all concern under this case study and of course the various stakeholders whose interests and values always influence decision relating to this issue.

In summary, the key element in the discussion to be presented in the following chapters is the daily practice of monitoring and maintaining post dredged channel, decision-making on environmental issues, where a number of difficulties arise. Uncertainty, risk and policies issue is some of these difficulties and this will be discussed. The main research question of this master thesis can be asked through the following question: In the context of local navigation aspect of channel maintenance,

what is a user friendly model that can be use to generate necessary clearance and siltation condition of the channel, In term of sustainability, risk, uncertainty, which role does science take in the practice of decision making on environmental issues and its relative implication, And in broader context, what are the suggestions, quest and research work to deal with this for necessary zero tolerance.

1.2 Objectives

One of the main purposes of this study is to discuss the relevance of the theoretical developments on sustainable management of navigation channel and managing sustainability associated with the work. The cases chosen PTP as exploratory cases for the study of the role of channel usage, maintenance needed, risk, uncertainty and the daily practice of environmental management by authorities. The study takes into consideration retroactive analysis on the role of maintenance and sustainability, risk and uncertainty in the process, as perceived by the parties involved and from an external analysis. It should be mentioned that since PTP was built, channel deepening work was performed only one

In the case studies presented here, the data's, the documents, interviews, and the discussion around the maintenance process, are analyzed. The longer title of the project (Maintenance and Management of Complex Channel work, Sustainability through Scientific, Risk, uncertainty, Community Participation and Environmental Governance) provides a clue to the approaches and the main concepts, and the interests at the core of the channel maintenance project.

The cases discussed in this study are interesting for three reasons. First, because navigation channels maintenance work are very complex, second the concept of sustainable balancing of issues relating to economic and demand, environment and social, technical safety are recognized for most of the actors that involved in the process to be a key element for the development of the decision, making process in channel maintenance as they imply to actors. Third, risk, and uncertainty was present

in the discussion as a key issue that need to be take seriously, The research was done through data collection and a dialogue with the people involved. Specifically, the main objectives of the project can be phrased as follows:

i. To identify and evaluate, compare current tradition, changes and need for maintenance of navigable channel
ii. To test model towards an alternative simplified method that can help improve ways to maintain the channel.
iii. To apply principle of sustainability associated to balancing work between demand, cost and environment as related to channel maintenance work.
iv. To discuss concept of new technological innovation, holistic risk and cost benefit assessment scientific, uncertainty and policy analysis (based on limitations of the existing methods) including need for improving the public decisions on environmental issues when there are scientific uncertainties.
v. To generate recommendation that can help to develop and improve the channel maintenance strategies and manage the design change based on sustainability best practice regarding the maintenance of channel needed for PTP and role of risk assessment, scientific knowledge and uncertainty in the development of these particular cases.

1.3 Scope of work

Project will go through collection of projects from the ports, to develop a list of issues and recommend criteria by which best decision relating to complex issue of navigation project can be made through providing answer to question relating to what is needed to put the channel in the right condition from:

i. Maintenance – Fairway, economic analysis and demand
ii. Maintenance -Navigation requirement and dimensioning, vessels and channel
iii. Maintenance -Hydrographic work, sediment studies and volume calculation
iv. Maintenance - Yearly Output calculation, dredger output and Selection
v. Sustainability - social- economic, health and ecological consideration best technology to use and when the best time to dredge are:
vi. Sustainability -Beneficial disposal of sediment and mitigation for environmental impact.
vii. Sustainability-How can the channel be continuously managed and monitored from trend studies
viii. Sustainability - Concept discussion on issue of uncertainty, risk- cost-benefit-assessment, science, uncertainty and regulation regime

1.3.1 Data source

Data source will be from the case study area, and this will include vessel and channel related as well as sediment, the environment, others will be generated as required.

1.3.2 Work area

PTP is being considered, this model can be applied to other areas in Malaysia that seriously troubled by issue of channel maintenance.

1.4 Planning and execution

Figure 1.1 and 1.2 are the flowchart for method and the time schedule for the Project.

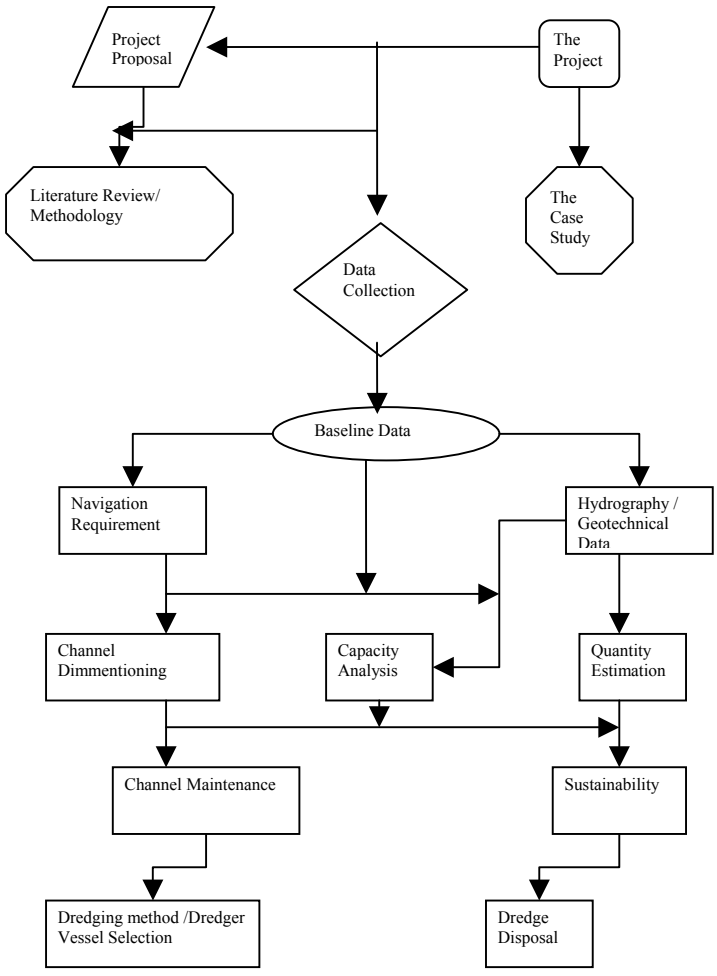

Figure 1.1 Project flowchart

1.5 Thesis Layout

The chapters of the thesis are organized as follows: Chapter 1 having introduced the context of interrelation between ship and port local and need to balance this relation, environmental sustainability and uncertainty, chapter 2 presents general literature work on the broader issue of harbor maintenance, associated models and marine pollution, as well as the main potential environmental impacts of channel maintenance activity. This chapter is intended to provide a platform of knowledge required to understand the case study in the following chapter.

Chapter 3 contains methodology for the case, and chapter 4 contains a detailed description, application of models analysis of the case study, beginning with a description of the methodology used for the elaboration of the studies, the case of the dredging at global level is briefly presented from literature works and introduction as a background element earlier to influence the PTP case considering, dredging, material disposal, and assessing environmental state through sustainability. The chapter also discusses the main actors involved, highlighting their perceptions on sustainability, and an analysis of the technical reports and data that were provided.

In chapter 5, there is a discussion on concept of environment, social, ecological, technical, social, economic, sustainability and the balancing work between developments, human need and response, the implication of uncertainty that can be extracted from the case, relating them to the main theoretical developments presented in the beginning of the literature work. The role and implications of sustainability and sustainability in environmental management are discussed in chapter 6, and the conclusions are summed up in chapter 7.

1.6 Expected result

With overall aim geared towards ensuring that channels are designed and maintained by their custodians and operators in environmentally sustainable manner, the project will help contribute to improvement on safe navigation and environmental protection in the following way:

i. Environmental and ecological sustainability of commercial channels
ii. Safe and effective transits and access to ports.
iii. Protect the usage rights of maritime commercial shipping in the channel
iv. Economic, social and technological sustainability of commercial waterways
v. Maintenance dredging with objective to reduce channel delay, accept big ship to be done in environmental sustainable manner and optimal efficiency, in maintenance dredging quantifying the loss of depth pave wave for dredging requirement to be determined and this lead to optimal choice of dredger.

Generic calculation on data results from analysis of:

i. Vessel and channel requirement,
ii. Basic rate output of the dredger,
iii. Computation of volume
iv. Cycle time and Number of work day per year,
v. Working condition and
vi. Environmental discounting.

Suggestion for iterative process in analyzing the data's will involve dealing with uncertainty and managing the risk that will end up:

i. To get all concerned involve in formulation of new method
ii. To identify the significant, level of each cause, source and impact of the design changes
iii. To help deduce the possible corrective actions and preventive measures to minimise the avoidable design changes

iv. To help Verified the limitations of the existing methods

This project will help improve on condition need relating to:

i. Port delay, and Accident,
ii. Pollution,
iii. Beneficial Dredge disposal and contaminated seeds,
iv. Endangered and threatened species through bio-diversification,
v. Habitat restoration
vi. Weak regulation

As result of this there will be increase in: Controllability or scheme monitoring, Efficiency of the system, More revenue money, Time management.

Recommendation on this project could end up to:

i. Provides tools to facilitate management decisions in allocating resources efficiently and maximizing operational efficiencies.
ii. Improve Operational efficiencies gained reduce maintenance requirements, which in turn reduce workload
iii. Save money and time through process re-engineering that can be used to better serve the port and coastal inhabitant.