

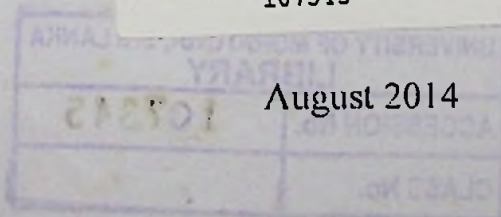
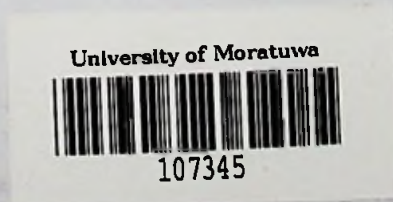
EVALUATION OF OPTIMUM TIME FOR PLANNING, SCHEDULING AND RESOURCE ALLOCATIONS OF NEW SHIP CONSTRUCTION PROJECT AT COLOMBO DOCK YARD

B.M.C.S.H.Bandara
(09/8452)

Dissertation submitted in partial fulfillment of the requirements for the degree Master of Science
in Operational Research

Department of Mathematics

University of Moratuwa
Sri Lanka



$\frac{51.14''}{519.8(043)}$

107345
+
CD-ROM

107345

DECLARATION

I declare that this is my own work and this thesis/dissertation does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any University or other institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text

.....
B.M.C.S.H.Bandara
(09/8452)

.....12/08/2014.....
Date

I have supervised and accepted this thesis for the submission of the degree.

UOM Verified Signature
.....
Mr. T.M.J.A. Cooray
(Supervisor)

.....12.....14.....
Date

Senior Lecturer
Department of Mathematics,
Faculty of Engineering,
University of Mortuwa.

UOM Verified Signature ...

.....10-08-2014.....

Mr. R.M.S.C. Rathnayake
BSc. Eng., C.Eng, MBA, MIMarEST
Asst. General Manager (New Construction)
Colombo Dockyard Limited

Date



ABSTRACT

GOOD PLAN OF THE JOB IS HALF THE JOB. As of this statement the present scenario of working scheduling and project tracking is augmented with large projects such as new ship building projects.

Building a new vessel can be considered as a high-tech job which is actually a project with a deadline and a dedicated team. Project manager is the leading person and the holder of the main responsibility to deliver the project under the stipulated time and budget with the required quality. Project manager equipped with the authority to acquire any resource to complete the project by coordinating with the other departments and acts as the operational in charge of every engineer under the other departments in a matrix organizational structure. This is aimed to evaluate optimum time for planning, scheduling and resource allocation for future new ships construction projects at Colombo Dock Yard (CDI).

All the previous data have taken by consecutive past three sister vessels for calculations and Critical Path Method (CPM) and Program Evaluation and Review Technique (PERT) used to find critical path and critical activities. More information about which activities are "critical", meaning that they have to be done on time or else the whole project will take longer. This report indicated that what those are.

Also this report illustrated that the way to schedule human resource without disturbing that critical activities and smoothen the resources accordingly. In addition, though the collection of information the study can emphasize the idea about the CPM and PERT applied in the shipping industry.

The shipbuilding project planner should consider the uncertainty during scheduling and the above results have implications for manager's decision makings.

ACKNOWLEDGEMENT

This is an outcome of a collection of long term perennial efforts.

It is a gigantic achievement in my life.

However,

My dear Sirs,

Mr.T.M.J.A.Cooray

Mr.R.M.S.C.Rathnayake

You are the pillars of my achievement

Giving me

Enthusiasm, Encouragement, Supervision and Guidance.

Therefore,

This is the tribute to commemorate your paramount support given to me.

Last but by no means the least I thank to my loving wife, parents, brother & dearest friends for
always being there for me.

Since

This is never become an achievement in my life

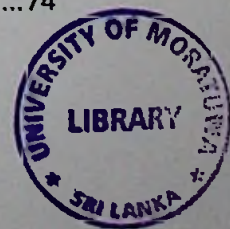
Without your presence.

TABLE OF CONTENTS

DECLARATION.....	i
ABSTRACT	ii
ACKNOWLEDGEMENT	iii
TABLE OF CONTENTS	iv
LIST OF TABLES.....	vii
LIST OF FIGURES	viii
LIST OF ACRONYMS	ix
LIST OF ABBREVIATIONS	x
CHAPTER 1	11
INTRODUCTION	11
1.1 Background of the Study.....	11
1.2 Overview of Colombo Dockyard PLC.....	12
1.2.1 Ship Repair (SR) projects.....	13
1.3 New Construction (NC) projects.....	15
1.3.1 CDL Vision.....	15
1.3.2 CDL Mission	15
1.4 Objectives of the Study	16
1.5 Methodology	16
1.6 Scope and the Limitation of the Study.....	17
1.7 Content of Thesis	18
CHAPTER 2.....	19
LITERATURE REVIEW	19
2.1 Introduction.....	19
2.2 Literature Review.....	19
2.3 Activity Definition, Sequencing and Methods.....	21
2.3.1 Activity Sequencing	21
2.3.2 Critical Path Methods (CPM), Arrow Diagramming	21
2.3.3 Precedence Diagramming Method (PDM)	22
2.4 Program Evaluation Review Technique (PERT) networks.....	22
CHAPTER 3	23
METHODOLOGY	23
3.1 Introduction.....	23
3.2 Steps for CDL New Construction Project.....	23



3.2.1 Project Structure	23
3.3 Unit/ Block Construction:	24
3.3.1 Unit Construction Location layout	27
3.3.2 The unit construction Process flow chart	28
3.3.4 Drawing preparation and Approvals.....	28
3.3.5 Material Ordering/Inspection and Storing.....	28
3.3.6 Sand Blasting and Painting.....	28
3.3.7 Cutting, Sizing and Prefabrication works.....	29
3.3.8 Assembly and the Fit up of the Unit.....	29
3.3.9 Dry Survey of the Unit	30
3.4 Other Installations	30
3.4.2 Painting, Systems Commissioning, Sea trials and Delivery	31
3.5 Research Method.....	32
3.5.1 CPM & PERT analysis	32
3.5.2 Differences between PERT network and CPM network.....	33
3.6 D.R.Fulkerson's rule	35
3.7 Critical path.....	36
3.7.1 Find the probability of completing the project	36
3.7.2 Central limit theorem.....	37
3.8 Critical Path Method (CPM) for Calculating Project Completion Time.....	38
3.8.1 Writing the CPM Network	38
3.8.2 Time Estimation in CPM.....	38
CHAPTER 4	41
DATA ANALYSIS	41
4.1 Introduction.....	41
4.2 Data Preparation.....	41
4.2.1 Project Network Diagram.....	45
4.3 Network Diagram and List of paths	46
4.4 Summary of Activities' Start, Finish and Slack times	63
4.5 Resource Scheduling for an entire project	66
4.5.1 Loading Chart	72
4.5.1 Shifted Time-Scaled version of the Network	73
CHAPTER 5	74
CONCLUSION	74
5.1 Introduction.....	74



5.2 Conclusion, Limitations and Drawbacks	74
5.3 Suggestions to complete project less than 417 days	77
5.4 Limitations of the study	78
5.5 Recommendation for Future Research.....	78
5.6 References.....	79
APPENDIX 1	80

LIST OF TABLES

	Page
4-1: Activities for CDL-AHSV Construction Project	41
4-2: List of paths for the CDL New Ship Construction Project	46
4-3: Summary of Activities' Start, Finish and Slack times	63
4-4: Details of Man Power requirement for Unit Fabrication	66
4-5: Details of Man Power requirement for by an activity	68
5-1: Limitations and Drawbacks	75

LIST OF FIGURES

	Page
Figure 1-1: Machinery Repairs	13
Figure 1-2: Hull Repairs	13
Figure 1-3: Propeller Repairs	14
Figure 1-4: Cargo Gear Repairs	14
Figure 3-1: The General Arrangement of an Anchor Handling Supply Vessel	25
Figure 3-2: Hull division For Unit Construction of an Anchor Handling Supply Vessel	26
Figure 3-3: Unit Construction Facility Layout	27
Figure 3-4: The Unit Construction Process Flow Chart	28
Figure 3-5: Sample Hull Unit	29
Figure 3-6: The Unit Construction Process Flow Chart for Non-hull Installation	30
Figure 3-7: Pipe and Machinery installation	31
Figure 3-8: Delivery of completed vessel to the owner	31
Figure 3-9: Bar chart	32
Figure 3-10: Milestone chart	32
Figure 3-11: Logical relationship in PERT and CPM.	33
Figure 3-12: Three time estimates	34
Figure 3-13: β distribution curve	36
Figure 3-14: Network Activity	38
Figure 3-15: Free float	40
Figure 3-17: Independent float	40
Figure 4-1: Network Diagram	45
Figure 4-2: Loading Chart	72
Figure 4-3: Shifted Time-Scaled version of the network	73

LIST OF ACRONYMS

AHSV	-	Anchor Handling Supply Vessel
CDL	-	Colombo Dockyard Limited
CPM	-	Critical Path Method
CNC	-	Computer Numerical Control
DWT	-	Deadweight Tonnage
DW	-	Durbin-Watson
EST	-	Earliest Starting Time
EFT	-	Earliest Finishing Time
HUC	-	Hull Construction
LST	-	Latest Starting Time
LFT	-	Latest Finishing Time
LRQA	-	Lloyds Register Quality Assurance
LKR	-	Sri Lankan Rupces
MAG	-	Metal Argon Gas
MAO	-	Machinery Out Fitting
MIG	-	Metal Inert Gas
NC	-	New Construction
PERT	-	Program Evaluation and Review Technique
TIG	-	Tungsten Inert Gas
VMS	-	Vessel Management System

LIST OF ABBREVIATIONS

A	-	Activity A
B	-	Activity B
C	-	Activity C
i	-	Activity Start point
j	-	Activity End Point
t_o	-	Optimistic Time
t_p	-	Pessimistic Time
t_l	-	Likely Time
σ	-	Standard Deviation