The copyright © of this thesis belongs to its rightful author and/or other copyright owner. Copies can be accessed and downloaded for non-commercial or learning purposes without any charge and permission. The thesis cannot be reproduced or quoted as a whole without the permission from its rightful owner. No alteration or changes in format is allowed without permission from its rightful owner.

A QUALITATIVE CASE STUDY ON VARIATION ORDERS OF PROJECT MANAGEMENT TEAM EFFICIENCY IN A NAVAL SHIP CONSTRUCTION COMPANY

ANIZAN BIN ALI

Universiti Utara Malaysia

Thesis submitted to
Othman Yeop Graduate School of Business,
Universiti Utara Malaysia,
in Partial fulfilment of the requirements for the
Doctor of Business Administration

OTHMAN YEOP ABDULLAH GRADUATE SCHOOL OF BUSINESS
UNIVERSITI UTARA MALAYSIA

PERAKUAN KERJA TESIS / DISERTASI
(Certification of thesis / dissertation)

Kami, yang bertandatangan, memperakukan bahawa **Anizan Bin Ali**
(We, the undersigned, certify that)

calon untuk Ijazah **Doctor of Business Administration**
(candidate for the degree of)

telah mengemukakan tesis / disertasi yang bertajuk:
(has presented his/her thesis / dissertation of the following title):

A qualitative case study on variation orders of project management team efficiency in a naval ship construction company.

seperti yang tercatat di muka surat tajuk dan kulit tesis / disertasi.
(as it appears on the title page and front cover of the thesis / dissertation).

Bahawa tesis/disertasi tersebut boleh diterima dari segi bentuk serta kandungan dan meliputi bidang ilmu dengan memuaskan, sebagaimana yang ditunjukkan oleh calon dalam ujian lisan yang diadakan pada: **22 November 2022.**
(That the said thesis/dissertation is acceptable in form and content and displays a satisfactory knowledge of the field of study as demonstrated by the candidate through an oral examination held on: ***22 November 2022****.*

Pengerusi Viva *(Chairman for Viva)*	: **Prof. Ts. Dr. Norazah Bt. Mohd Suki**	Tandatangan *(Signature)*	
Pemeriksa Luar *(External Examiner)*	: **Assoc Prof. Ts. Dr. Kasypi Mokhtar (UMT)**	Tandatangan *(Signature)*	
Pemeriksa *Dalam (Internal Examiner)*	: **Assoc. Prof. Dr. Sabariah binti Yaakub**	Tandatangan *(Signature)*	

Tarikh: **9 Julai 2023**
(Date)

Nama Pelajar (Name of Student)	:	**Anizan Bin Ali**
Tajuk Tesis / Disertasi *(Title of the Thesis / Dissertation)*	:	**A qualitative case study on variation orders of project management team efficiency in a naval ship construction company.**
Program Pengajian *(Programme of Study)*	:	**Doctor of Business Administration**
Nama Penyelia/Penyelia-penyelia *(Name of Supervisor/Supervisors)*	:	**Assoc. Prof. Dr. Rohafiz Binti Sabar**

Tandatangan
(Signature)

Universiti Utara Malaysia

PERMISSION TO USE

In presenting this dissertation in partial fulfilment of the requirements for a Post Graduate degree from the Universiti Utara Malaysia (UUM), I agree that the Library of this university may make it available for inspection with the approval from researcher, I further agree that permission for copying this dissertation in any manner, in whole or in part, for scholarly purpose may be granted by my supervisor(s) or in their absence, by the Dean of Othman Yeop Abdullah Graduate School of Business where I did my dissertation. It is understood that any copying or publication or use of this thesis or parts of it for financial gain shall not be allowed without my written permission. It is also understood that due recognition shall be given to me and to the UUM in any scholarly use which may be made of any material in my dissertation.

Request for permission to copy or to make other use of material in this thesis in whole or in part should be addressed to:

Universiti Utara Malaysia

Dean of Othman Yeop Abdullah Graduate School of Business
Universiti Utara Malaysia
06010 UUM Sintok
Kedah Darul Aman

ABSTRACT

Variation Orders (VOs) have a detrimental effect on ship building project management in terms of cost and delayed schedules. This study discovered a four-year schedule delay and an increment up to Ringgit Malaysia (RM) 2.4 billion in Littoral Combat Ship (LCS) ship building project cost. Next, this study determined the contributing factors and impact of VOs on the efficiency of LCS Project Management Team (PMT). A standard operating procedures (SOPs) framework is proposed in this study to reduce VOs for ship building project management. Data were collected via semi-structured interviews held with 12 respondents from LCS PMT selected using the purposive sampling method. The data were analysed using NVIVO software. The six contributing factors to VO occurrences were project financial problems, changes in project scope by client, delay in decision-making, insufficient project drawings, low adherence to ship building project management processes, and inadequate management personnel with ship building experience. The VOs affected the efficiency of LCS PMT in terms of negative management evaluations, declining morale, poor job search, and additional workload. The eight measures that the ship building company management can deploy to reduce VOs in LCS projects are training on VO management for PMT, developing SOPs for VO management, management support, adherence to ship building project management processes, design authority support, reducing the number of ship class standard, ship building process integration, and clear understanding of LCS contract. This study adds to the body of knowledge by identifying the factors of VOs and framework to develop SOPs that lists PMT work process in ship building project management for the industry. The theory of constraints was expanded by highlighting the factor of VOs that hindered the success of PMT.

Universiti Utara Malaysia

Keywords: Variation Orders, Variation Order Factors, Project Management Team Efficiency, Variation Order Improvement Measures, Littoral Combat Ship Project.

ABSTRAK

Perubahan Kerja (VO) mempunyai kesan yang memudaratkan ke atas pengurusan projek pembinaan kapal dari segi kos dan jadual projek. Kajian ini mendapati bahawa VO menyebabkan kelewatan 4 tahun dalam jadual projek dan tambahan Ringgit Malaysia 2.4 bilion dalam kos bagi projek pembinaan Kapal Tempur Persisir (LCS). Seterusnya, kajian ini menentukan faktor penyumbang dan impak VO terhadap kecekapan Pasukan Pengurusan Projek (PMT) bagi LCS. Sebuah rangka kerja pembangunan prosedur operasi standard (SOP) bagi pihak pengurusan projek pembinaan kapal diusulkan dalam kajian ini untuk mengurangkan VO. Temu bual separa berstruktur digunakan sebagai kaedah pengumpulan data, dengan dua belas responden daripada LCS PMT dipilih menggunakan kaedah persampelan bertujuan. Data dianalisis menggunakan perisian NVIVO. Enam faktor yang menyebabkan berlakunya VO ialah masalah kewangan projek, perubahan pada skop projek oleh pelanggan, kelewatan dalam membuat keputusan, lukisan projek tidak mencukupi, kekurangan pematuhan kepada proses pengurusan projek pembinaan kapal, dan kekurangan kakitangan pengurusan yang berpengalaman dalam pembinaan kapal. VO mempengaruhi kecekapan LCS PMT dari segi penilaian pengurusan yang tidak wajar, semangat yang menurun, pencarian kerja yang tidak berkesan, dan peningkatan beban kerja. Lapan langkah yang boleh digunakan oleh pengurusan syarikat pembinaan kapal bagi mengurangkan VO dalam projek LCS ialah latihan berkaitan pengurusan VO untuk PMT, pembangunan SOP untuk pengurusan VO, sokongan pengurusan, pematuhan kepada proses pengurusan projek pembinaan kapal, sokongan pakar reka bentuk, pengurangan bilangan standard kelas kapal, penyepaduan proses pembinaan kapal, dan pemahaman yang jelas tentang kontrak LCS. Kajian ini menyumbang kepada badan ilmu dengan mengetengahkan faktor VO dan membangunkan rangka kerja pembangunan SOP yang menyenaraikan proses kerja PMT untuk industri dalam pengurusan projek pembinaan kapal. *Theory of Constraints* (TOC) diperluaskan dengan mengetengahkan faktor VO yang menghalang kejayaan PMT projek pembinaan kapal.

Kata kunci: Perubahan Kerja, Faktor Perubahan Kerja, Kecekapan Pasukan Pengurusan Projek, Langkah Menambah Baik Perubahan Kerja, Projek Kapal Tempur Pesisir.

ACKNOWLEDGEMENT

This thesis is completed with grace of ALLAH S.W.T, I would like to express my greatest gratitude to my dedicated supervisor Associate Professor Dr. Rohafiz Sabar for her guidance and support, to both of my supportive parents, to my beloved wife Dr. Aisa Azira, to my lovely girl and boy Aishah Az Zahra, Ameer As Sulaiman. Not forgetting my supportive friends and BOUSTEAD NAVAL SHIPYARD.
May ALLAH S.W.T bless you all.
Ameen

Universiti Utara Malaysia

TABLE OF CONTENT

		Page
CERTIFICATION OF THESIS WORK		**i**
PERMISSION TO USE		**ii**
ABSTRACT		**iii**
ABSTRAK		**iv**
ACKNOWLEDGEMENT		**v**
TABLE OF CONTENT		**vi**
LIST OF TABLES		**x**
LIST OF FIGURES		**xi**
LIST OF ACRONYMS		**xiii**
CHAPTER ONE INTRODUCTION		**1**
1.1	Research Background	1
1.2	Problem Statement	4
1.3	Research Questions	9
1.4	Research Objectives	9
1.5	Significance of the Study	10
1.6	Scopes of the Study	12
1.7	Definition of Terminologies	14
1.8	Thesis Outline	15
CHAPTER TWO LITERATURE REVIEW		**17**
2.1	Introduction	17
2.2	Project Management	17
2.3	Project Management Efficiency: Cost and Schedule	25
	2.3.1 Project Cost Management	27
	2.3.2 Project Schedule Management	32
2.4	Naval Ship Construction Projects	38
	2.4.1 Boustead Heavy Industries Corporation Berhad: Boustead Naval Shipyard Sdn Bhd	39

Universiti Utara Malaysia

2.5 Variation Orders (VO) 44
2.5.1 Contributing Factors to Variation Orders (VO) Occurrence in Naval Ship Construction Projects 47
2.5.2 Impacts of Variation Orders on Naval Ship Construction Projects 52
2.5.2.1 Earned Value Analysis as a Method on Managing Project Cost and Schedule 55
2.6 Underpinning Theory: Theory of Constraints 58
2.7 Conceptual Framework 60
2.8 Conclusion 62

CHAPTER THREE RESEARCH METHODOLOGY 63
3.1 Introduction 63
3.2 Research Philosophy 63
3.3 Research Design 66
3.3.1 Qualitative Research 66
3.3.2 Case Study 68
3.4 Population and Sampling Technique 70
3.5 Instrumentation 71
3.6 Data Collection 74
3.7 Data Analysis 77
3.8 Ethical Concerns and Reliability 78
3.9 Conclusion 79

CHAPTER FOUR DATA ANALYSIS & INTERPRETATION 80
4.1 Introduction 80
4.2 Respondents' Demographic Profile 82
4.3 Research Objective One: Contributing Factors to Variation Orders (VO) Occurrence in Littoral Combat Ship (LCS) Project 85
4.3.1 Project Financial Problem 88
4.3.2 Change of Scope by Client 90
4.3.3 Delays in Decision Making 92
4.3.4 Insufficient Project Drawing 93
4.3.5 Other Factors 94

Universiti Utara Malaysia

4.4 Research Objective Two: The Impacts of Variation Orders (VO) on Littoral Combat Ship (LCS) Project Management Team Efficiency (Costs and Schedules) 96
4.5 Research Objective Three: The Improvement Measures in Reducing Variation Orders (VO) in Littoral Combat Ship (LCS) Project 100
4.6 Findings Summary 104
4.7 Conclusion 107

CHAPTER FIVE DISCUSSION AND CONCLUSION 108
5.1 Introduction 108
5.2 Recapitulation of the Study 108
5.3 Discussion 110
5.3.1 Discussion: Contributing Factors to Variation Orders (VO) (RO 1) 113
5.3.1.1 Main Factor 1: Project Financial Problem 113
5.3.1.2 Main Factor 2: Change Project Scope by Client 116
5.3.1.3 Main Factor 3: Delay in Decision Making 120
5.3.1.4 Main Factor 4: Insufficient Project Drawing 124
5.3.1.5 Additional Factor 1: Engineering, Procurement, Construction, and Commissioning (EPCC) Project Management Process to be Followed 127
5.3.1.6 Additional Factor 2: Lack of Shipbuilding Experience Management for Shipbuilding Projects 129
5.3.2 Discussion: Impacts of Variation Orders (VO) towards LCS PMT Work Efficiency (RO 2) 134
5.3.2.1 Main impact 1: Bad Image of the Project Management Team (PMT) by the BNS High Management in Managing Project Cost and Schedule. 135
5.3.2.2 Main impact 2: PMT team working morale down due to being badly judged by the BNS high management because LCS PMT unable to manage the LCS project cost and schedule efficiently. 136
5.3.2.3 Main Impact 3: Staff of PMT working curriculum vitae record is tarnished due to being unable to deliver the LCS Project

successfully and this contribute to a negative effect for them to find another working place. 138
5.3.2.4 Main Impact 4: Extra workload for the PMT due to retention of existing PMT staff 140
5.3.3 Discussion: Improvement Measures in Reducing Variation Orders (VO) in Littoral Combat Ship (LCS) Project (RO 3) 142
5.3.3.1 VO Management training for LCS PMT 143
5.3.3.2 Developing SOP for VO Management 143
5.3.3.3 Management Support 144
5.3.3.4 Following EPCC shipbuilding process. 145
5.3.3.5 Design authority to give full support and engagement during VO process 146
5.3.3.6 Reduce number of ship class approval standards. 147
5.3.3.7 Shipbuilding process integration. 149
5.3.3.8 Clear understanding of LCS contractual baseline 150
5.4 Recommendations: Standard Operating Procedure (SOP) in accordance with EPCC Shipbuilding Project Management Proses for Variation Orders (VO) Management 152
5.5 Practical Contribution 176
5.6 Theoretical Contribution 178
5.7 Limitations of the Study and Recommendations for Future Studies 179
5.8 Conclusion 180

REFERENCES **182**

APPENDICES **201**

Universiti Utara Malaysia

LIST OF TABLES

Table	Title	Page
Table 2.1	Project Management Process Group and Knowledge Area Mapping	23
Table 2.2	Factors of Variation Orders (VO)	50
Table 3.1	Research Design	66
Table 4.1	Demographic Profile of the Respondents	84
Table 4.2	Research Objectives and Findings	106
Table 5.1	Research Questions, Findings and Results/Consequences	112
Table 5.2	Integration of Project Management Group Process Group With EPCC Shipbuilding Project Management Process Group	137

Universiti Utara Malaysia

LIST OF FIGURES

Figure	Title	Page
Figure 1.1	Project Life Cycle	3
Figure 1.2	Variation Cost Impact in BNS LCS Project (Million RM)	6
Figure 1.3	Variation Schedule Impact in BNS LCS Project	
Figure 2.1	Ten Project Management Knowledge Area	21
Figure 2.2	Project Cost Management Overview	29
Figure 2.3	Project Schedule Management Overview	33
Figure 2.4	Project Three Dimesions of Dynamic Scheduling	38
Figure 2.5	Organizational Structure of Boustead Naval Shipyard Sdn Bhd	41
Figure 2.6	Ship Building by Boustead Naval Shipyard Sdn Bhd	42
Figure 2.7	Ship Repair by by Boustead Naval Shipyard Sdn Bhd	43
Figure 2.8	Ship Repair Activities	43
Figure 2.9	Purposes of VO	46
Figure 2.10	Three Critical Aspects to be Considered When Performing EVA	56
Figure 2.11	A List of Questions Common for All Project Types	58
Figure 2.12	Conceptual Framework	61
Figure 3.1	The Procedures for Interview Session	76
Figure 3.2	Six Phases of Thematic Analysis	77
Figure 4.1	Nodes from NVIVO According to the Theme of Research	81
Figure 4.2	Nodes from NVIVO-Impact of VO on LCS PMT Efficiency	99
Figure 4.3	Nodes from NVIVO-Ideas and Suggestions to Reduce VO Occurrence in LCS Project	103
Figure 5.1	Heuristic Decision-making Process	122
Figure 5.2	Shipbuilding Project Management Phase: Project Integration Management (Recommendation 1)	157
Figure 5.3	Shipbuilding Project Management Phase: Project Scope Management (Recommendations 2)	159
Figure 5.4	Shipbuilding Project Management Phase: Project Schedule Management (Recommendations 3)	161

Universiti Utara Malaysia

Figure 5.5 Shipbuilding Project Management Phase: Project Cost Management (Recommendations 4) 163
Figure 5.6 Shipbuilding Project Management Phase: Project Quality Management (Recommendations 5) 165
Figure 5.7 Shipbuilding Project Management Phase: Project Resource Management (Recommendations 6) 167
Figure 5.8 Shipbuilding Project Management Phase: Project Communication Management (Recommendations 7) 169
Figure 5.9 Shipbuilding Project Management Phase: Project Risk Management (Recommendations 8) 171
Figure 5.10 Shipbuilding Project Management Phase: Project Procurement Management (Recommendations 9) 173
Figure 5.11 Shipbuilding Project Management Phase: Project Stakeholder Management (Recommendations 10) 175

Universiti Utara Malaysia

LIST OF ACRONYMS

BNS	Boustead Naval Shipyard
BHIC	Boustead Heavy Industries Corporation
CPM	Critical Path Method
DA	Design Authority
EPCC	Engineering, Procurement, Construction and Commissioning
LCS	Littoral Combat Ship
MRO	Marine Repair and Overhaul
PM	Project Management
PMI	Project Management Institute
PMT	Project Management Team
PMBOK	Project Management Body of Knowledge
PERT	Project Evaluation Review Technique
PHO	Physical Handing Over
RMN	Royal Malaysian Navy
SOP	Standard Operating Procedure
SubCon	Sub-Contractor
WBS	Work Breakdown Structure
VO	Variation orders

Universiti Utara Malaysia

CHAPTER ONE
INTRODUCTION

1.1 Research Background

The construction industry contributes significantly to many country gross domestic products (GDP). Cruz et al. (2019) stated that the construction industry is critical to any economy due to the jobs it generates, the cashflow it generates, and the infrastructure it develops. This sector is divided into several distinct segments, which are primarily defined by the types of projects undertaken. Archibald (2013) asserted that constuction industry is determined by the type of project. The types of projects range from minor interior remodelling and maintenance to large-scale developments such as ship construction. Nikjow et al. (2021) added that while contractors may be highly specialised in a single task or take a more "turnkey" approach, commonly referred to as engineering, procurement, and construction, it is undeniable that the purpose of construction companies is to execute construction projects.

Abdullah et al. (2021) emphasise that the project management (PM) discipline has been developed worldwide through the practise and theories implemented in various types of projects. The practise of project management (PM) has rapidly evolved over the years since it was formally introduced in 1957. It has evolved into a vital element of project development tools (Matos & Lopes, 2013). Project management is generally acknowledged as a significant tool in business improvement and achievement. Numerous project management structures, strategies, and approaches have been developed in recent decades, with the Project Management

Universiti Utara Malaysia

Body of Knowledge (PMBOK) from the Project Management Institute (PMI) being the most well-known approach (Langley, 2017).

The primary goal of project management is to create a comprehensive project that adheres to the client's objectives and meets all project objectives within specified constraints. In other words, efficiency should be a priority in all projects, but especially in shipbuilding, which is one of the most complicated manufacturing processes, requiring a wide variety of activities, procedures, and employees with a wide variety of trade abilities. According to Viter (2018), shipbuilding activity is viewed as one of the most unpredictable projects that involves unique project management structures, strategies, and approaches.

With approximately 2,500 shipyards and ship organisations around the globe currently engaged in new construction, repairing, and fixing of yachts, military ships, luxury ships, and oceangoing traveller ships, project management is notably the key to successful shipbuilding projects. World Maritime News (2018) reported that shipbuilders structured new eco-accommodating project management to identify innovations for the fulfilment of project objectives. These changes in shipbuilding project management required cautious consideration, careful planning, and brilliant vision by the project management team (PMT). The project management standards specified by PMI (2017) highlight four project stages that are also applicable to shipbuilding project management: initiation (initiating the project), planning (preparation and management), execution (performing the project), and closeout (ending the project).

Figure 1.1 shows, the duration and price involved in the project life cycle throughout the preparation stage of any shipbuilding project management would exhibit an increase in these two variables (cost and time) that would be at their peak in

Universiti Utara Malaysia

the execution stage. Gasparotti (2006) also stated that the challenges in shipbuilding project management are normally the occurrence of variation in the agreed contract, resulting in a significant influence on the project cost and schedule. Durdyev and

Hosseini (2019) also agreed that project costs and schedules would normally be more challenging in shipbuilding projects. Shipbuilding project management also normally involves various stakeholders and contractors, contributing to the challenges in aligning the work process.

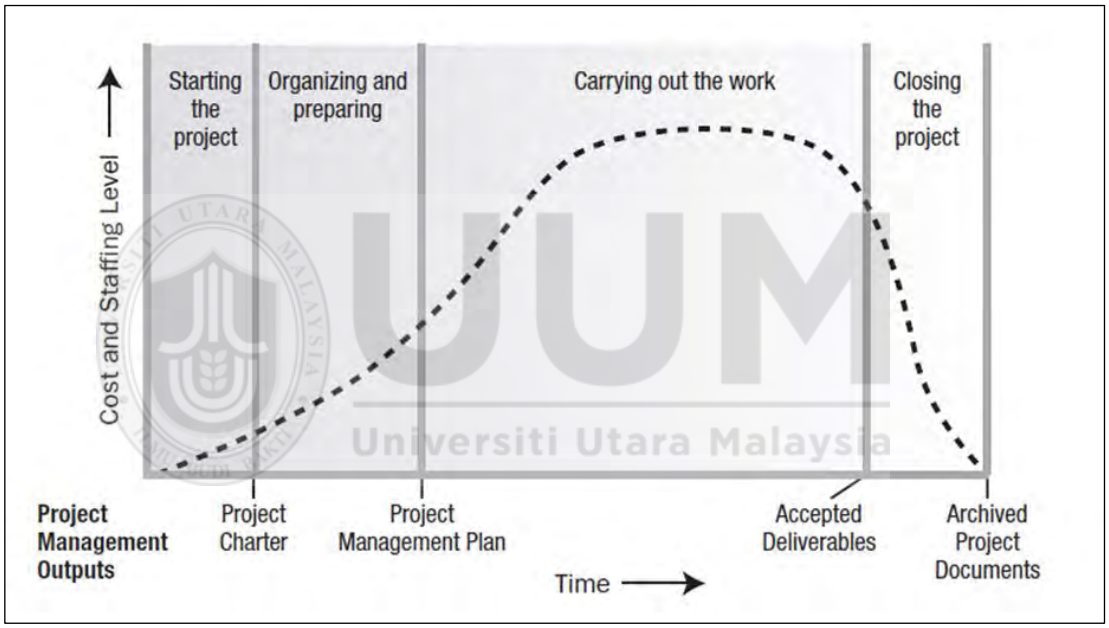


Figure 1.1
Project Life Cycle
Source: PMI (2017)

Universiti Utara Malaysia

1.2 Problem Statement

According to Okubo and Mitsuyuki (2022), the shipbuilding process is one of the most complex manufacturing processes. They emphasised that a ship is composed of an immense number of separate components containing 100,000 hull components and 300,000 outfitting components. Due to the variety of types and sizes of these components, Okubo and Mitsuyuki (2022) noted that the shipbuilding process necessitates a variety of tasks, processes, and workers with a variety of trade abilities. Additionally, Molina et al. (2021) noted that ships are classed as Engineering to Order (ETO) industries, as opposed to mass produced Assemble to Order (ATO) sectors like automobiles and electronic equipment.

Variation orders (VO) can be issued for several reasons, and the frequency with which work instructions are changed during the construction phase will likely result in significant changes to the building contract, which will impact negatively on all parties involved in the sector. A study conducted in Saudi Arabia by Al-Dubaisi (2000) states that VO's are the major cause of failure in construction projects. According to a survey conducted by Odeck (2013), 52.42% of 620 projects undertaken by the Norwegian Public Roads Management (NPRA) encountered extra costs of 519 million Norwegian kroner caused by VO's.

Variation Orders in construction projects can have a major impact on both project cost and schedule, particularly in the Malaysian construction industry. Studies have shown that VOs can lead to a significant increase in project costs due to added complexity and work. To mitigate this, project managers must implement effective systems to manage and reduce the impact of VOs on project cost. The study by Mohammad et al. (2022) found that in a two-storey terrace housing project in Shah Alam, Selangor, Malaysia, VOs led to an increase of RM 1,924,000.00 or 13% of total

Universiti Utara Malaysia

project cost. Du, Mohamed, and Zhao (2016), also stated that VO has become almost unavoidable in many construction projects. However, the occurrence of VO should not be compromised because it will have negative impact on the project and its stakeholders (Abdul Kadir, 2018).

Firstly, the occurrence of VO caused the project to cost overrun. Scholars agreed on this effect Oyekunle et al., 2016; Yadeta, 2016; Lindhard, 2014; Shehu, Endut, & Akintoye, 2014; Odeck, 2013; Shrestha et al., 2013; Kerzner, 2009; Oladapo, 2007; Sambasivan & Soon, 2007; Arain & Pheng, 2005; Ibbs, 2005; Koushki et al., 2005; Bower, 2000; Al-Momani, 2000; Hester et al., 1991; CII, 1990a; Clough & Sears, 1994). Koushki et al. (2005) highlighted that the occurrence of VO's throughout the construction phase caused delay on project completion and increased project costs.

Clough and Sears (1994) stated that any modification or expansion of the project's scope may result revision on project component, resulting in an increase in the project's cost. Typically, these overhead costs are subsidised funds from the shipbuilder profits. Hester et al. (1991) also highlighted that logistical costs increase when a shipbuilder revises the project timeline in response to VO's due to the revision of delivery time.

In other words, equipment providers must deliver the equipment in accordance with the amended timetable, which has a substantial impact on the overall cost of the project due to the payment of new logistic delivery costs. In the meantime, Oladapo (2007) concluded that variation accounts for 78% of the cost overruns in project budgets and that some project managers frequently used the management reserve budget for project progress, resulting in more significant losses to the contractors.

Universiti Utara Malaysia

Currently, the government of Malaysia has awarded a contract to Boustead Naval Shipyard Sdn. Bhd (BNS). The contract is for the construction of 6 naval warship type ‘’Maharaja Class’’ knows as Littoral Combat Ship (LCS) with a total contract value of Ringgit Malaysia (RM) 9 billion. According to the agreed-upon terms, BNS must design, build, acceptance test, and deliver the ship on agreed time-frame and cost. In the case of LCS project, figure 1.2 shows the impact of VO on the project cost.

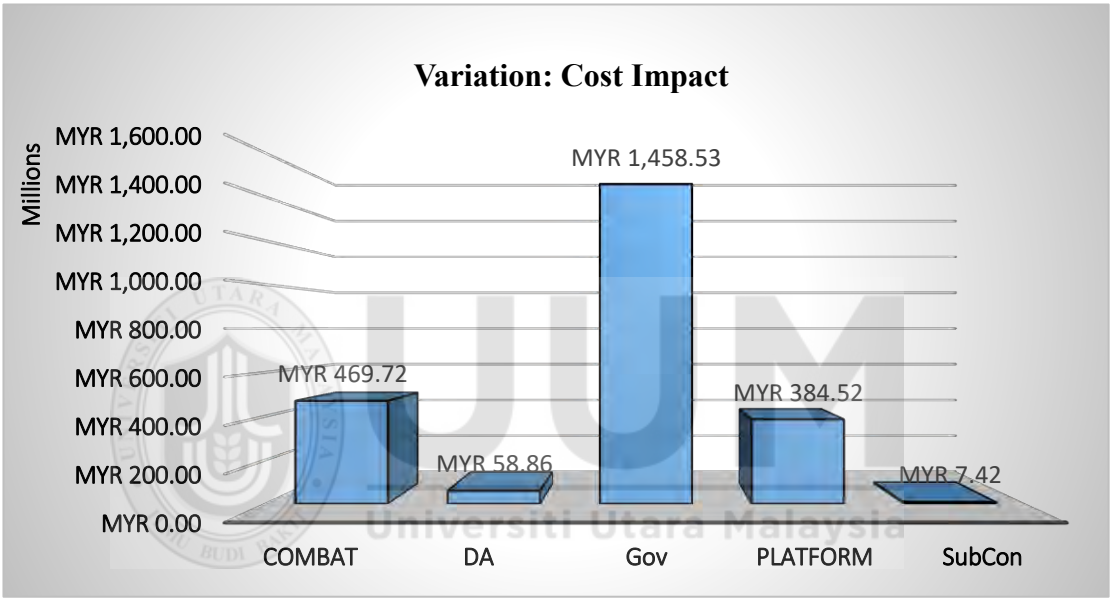


Figure 1.2
Variation Cost Impact in BNS LCS Project (Million RM)
Source: Compiled by Author

Based from figure 1.2 the grand aggregate of VO influenced the LCS project cost by RM 2.4 billion from RM 9 billion total project cost. According to Philippine (2016), the amount of VO cost should not exceed 10% of the original project cost; the higher the percentage, the greater the negative impact on the project budget. The increment in VO cost in the LCS project is amounting to 26.67%, which is having a negative impact on the total project budget.

Mustapha et al. (2018) stated that an increase of project cost due to VO was predicted around 5% to 10% in most construction projects. Furthermore, the increment of project cost due to VO in the LCS project amounted to 26.67%. It was also indicated that the increase in LCS project cost percentage was higher than the predicted increase.

Secondly, the occurrence of VO has also been reported to cause project schedule delay (Durdyev & Hosseini, 2019). Fisk (2005) previously stated that deviations in the nature of the agreed-upon work scope would force shipbuilders to compensate for lost time by decreasing on work quality. He also stated that the final cause was logistical delays, and when variances occurred, new needs in the work scope necessitated more material requirements. This situation resulted in the shipbuilder's logistics plan being delayed. Therefore, O'Brien (1998) mentioned that deviations require additional planning, documentation, and assessment prior to implementation of new logistics plan.

In the case of the LCS project, would be effective from 3rd October 2011 until 2nd October 2023 in accordance with the contract. Following that, the project completion of the first class of LCS deliverable has been postponed until 2023, from the actual contractual delivery date (Rahmat, 2019). The sheduled delay due to VO occurance amounting to 4 years of project completion.

Universiti Utara Malaysia

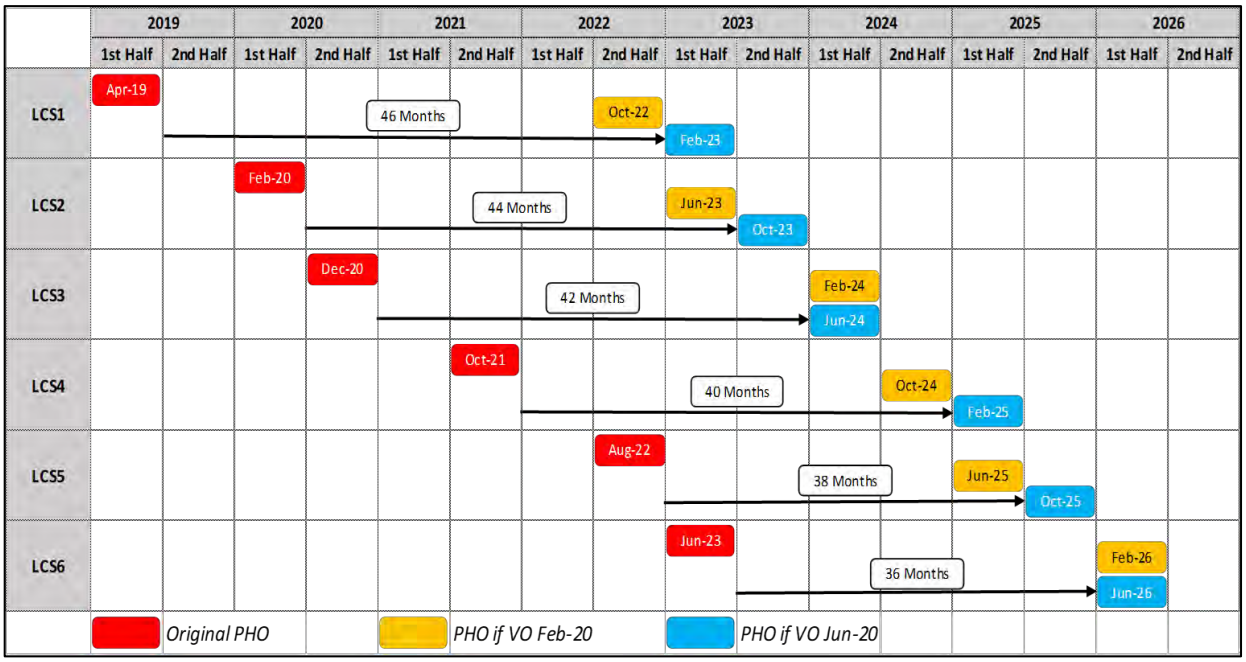


Figure 1.3
Variation Schedule Impact in BNS LCS Project (Months)
Source: Compiled by Author

Based from figure 1.3 the grand aggregate of VO influenced the LCS project schedule for each ship everage to 4 years from the actual contracted PHO dates. From the recent Malaysian Defence Minister's visit to Boustead Naval Shipyard, numerous issues were observed in the LCS project completion (Aliman, 2019). These issues might lead to adverse outcomes in the trust for BNS to complete the whole six LCS ships.

Carvalho et al. (2020) reported from the recent parliamentary session held in early August 2020, where the Malaysian defence minister addressed the progress of the LCS project. He reported that as of July 2020, none of the six LCS ships had been completed by BNS. He added that the ministry has the option to terminate the LCS project. The following sections explain the research questions and objectives of this study in detail.

1.3 Research Questions

The primary aim of this qualitative study is to understand the variation orders (VO) in a naval ship construction company and to improve the project management efficiency through a standard operating procedure (SOP) in accordance with the Engineering, Procurement, Construction and Control (EPCC) shipbuilding project management process flow for VO management. Thus, the specific research questions of this study are:

(i) What are the factors contributing to variation orders (VO) occurrence in the Littoral Combat Ship (LCS) project?

(ii) What are the impacts of variation orders (VO) in terms of costs and schedules on the efficiency of the Littoral Combat Ship (LCS) project management team?

(iii) What are the improvement measures required in reducing the variation orders (VO) occurrence in Littoral Combat Ship (LCS) project?

Universiti Utara Malaysia

1.4 Research Objectives

By considering the primary aim and three specific questions explained in the previous section, the three research objectives for this study are listed below.

(i) To determine the contributing factors on variation orders (VO) occurrence in Littoral Combat Ship (LCS) project

(ii) To examine the impacts of variation orders (VO) in terms of costs and schedules on the efficiency of the Littoral Combat Ship (LCS) project management team

(iii) To propose the improvement measures in reducing variation orders (VO) in Littoral Combat Ship (LCS) project

1.5 Significance of the Study

This study focuses on clarifying the (i) factors and (ii) the impacts of variation orders (VO) in terms of costs and schedules on the efficiency of the Littoral Combat Ship (LCS) project management team, as well as (iii) proposing improvement measures to reduce VO in the Littoral Combat Ship (LCS) project. It is believed that this study is significant in a few ways.

The first significance of this study is that it adds to the body of knowledge in the scope of project management, specifically regarding the VO management procedures in shipbuilding projects. This study contributes significantly by adding new, meaningful information to the body of knowledge through a conceptual framework on this topic. The first section of the framework identifies the study's emphasis as being connected to a project management variation order in a naval ship construction company.

Then, the framework emphasises the issues raised by this research, which include the contributing factors that lead to VO and its cost and schedule implications. Aside from that, the framework emphasises the actions that must be taken to address the aforementioned issues. Finally, the framework identifies the study's projected output in terms of improving project management efficiency. This research framework can benefit future research and studies on this topic. Chapter Two elaborates further on this framework.

The second significance of this study is that it adds to the body of knowledge by identifying the major factors that can contribute towards the occurance of VO in shipbuilding projects. The factors are based from respondents view and opinion, the factors are explained in Chapter Four and how can BNS management overcome this factors are explained in Chapter Five. While this study scrutinises the variation orders

Universiti Utara Malaysia

in a naval ship construction company and improves their project management efficiency, it also contributes to the wealth of knowledge through (i) the factors and (ii) the impacts of variation orders (VO) in terms of costs and schedules on the efficiency of the Littoral Combat Ship (LCS) project management team, and (iii) proposing improvement measures to reduce VO.

Practically, all these factors attained by this study can prepare the project management teams to avoid the contribution factors, thus minimising their impacts on all stakeholders and preventing the occurrence of VO, thus optimising their efficiency. In other words, these study results are important in BNS Shipbuilding Management as the proper and suitable project management work procedures for shipbuilding were determined to reduce the Variation Order. The Littoral Combat Ship (LCS) was also an important project for the country, as this is the first ever naval warship built in Malaysia from design phase to construction phase (Naval Technology, 2014). The factors and impacts of VO's can be identified early and improved upon in the overall shipbuilding project management.

Universiti Utara Malaysia

Besides, they can also consider practising the standard operating procedure (SOP) proposed by this study in accordance with the EPCC shipbuilding project management process flow for VO management. Chapter five discussed this SOP in further detail.

1.6 Scopes of the Study

The primary aim of this study is to understand the variation orders in a naval ship construction company and to improve the project management efficiency through a standard operating procedure (SOP) in accordance with the EPCC shipbuilding project management process flow for Variation Order (VO) management. The first scope is related to the primary focus of the study. While there are various topics related to the VO, such as VO identification, evaluation, approval, implementation, VO management, VO process and procedures, and others, the primary focus of this study is related to the factors, impacts, and improvement measures of the VO.

The second scope is related to the respondents of the study. As mentioned earlier, this study aimed to understand the VO in a naval ship construction company, Boustead Naval Shipyard Sdn Bhd, and to improve the project management efficiency of the Littoral Combat Ship (LCS) project management team from this company through a standard operating procedure (SOP) in accordance with the Engineering, Procurement, Construction and Control (EPCC) shipbuilding project management process flow for VO management. The government of Malaysia is the client for this contracted shipbuilding activity. The contract involves the construction of a Littoral Combat Ship (LCS) naval warship, with an obligation to design, construct, perform the trial, and deliver the ship based on agreed terms.

Thus, this study specifically focused on the project management supervisory group known as the project management team LCS. A project management team refers to several individuals grouped together, who have direct involvement in any or all programmes related to project management (PMI, 2017). Notably, this team aims towards the achievement of a particular business objective and could be formed temporarily or for an extended period of time, which may last from a week to several

Universiti Utara Malaysia

years. The group members with expertise could either originate from separate functional fields or the same field (Langley, 2017).

The third scope of the study is regarding the research design used in this study. While there are three types of research design that are frequently used by past studies, which are quantitative, qualitative, and mixed methods, this study adopted the qualitative research design in achieving the objectives. According to Huang (2020), qualitative methodology provides a rich, detailed picture of why and how problems happen in the natural setting. In this study, the respondents were interviewed from the project management team who performed the VO's management process. Respondents could have the freedom to discuss their perceptions, experiences, and perspectives. The qualitative methods also used a dynamic method for research, which allowed valuable findings to be drawn from the responses of the people who took part in the study (Aspers & Corte, 2019).

Harrison et al. (2017) stated that a project management team is possibly responsible for two or more elements of a project based on its characteristic and focus. Furthermore, the team should be updated to each applicable phase throughout the project stages and ensure the distribution of crucial data to the group members. The project management team should essentially create a schedule to fulfil the important deadlines, interact with the members regarding the schedule, and be updated to work to meet the deadlines (Doğan & Helvacioğlu, 2017). The team is also expected to multitask daily.

Universiti Utara Malaysia

1.7 Definition of Terminologies

This subsection lists the definitions of terminologies used throughout the study.

a. Variation orders (VO): Ndekugri and Rycroft (2019) defined VO as a modification to the agreement for the purpose of extending, replacing, or correcting an error in the agreement. They also explained the leading factors to the VO's occurrence, such as technological advancement, legislative changes or implementation, changing conditions, topographical anomalies, inaccessibility of indicated materials, or as a result of the project's progression.

b. Project management: PMI (2017) defined project management as a short-term endeavour performed to develop a unique outcome, service, or product and to achieve purposes through the distribution of deliverables.

c. Project cost management: PMI (2017) refers to project cost management as the assessment of the charges associated with the project's resources, which may include labour, supplies, hardware, management, and offices.

d. Project schedule management: PMI (2017) explains that project schedule management is the method for developing strategies, processes, and documentation to generate, manage, execute, and control the project's schedule. The key benefits of this stage are that project managers are instructed on how to manage the timetable.

Universiti Utara Malaysia

e. Project Management Team Efficiency: Hyvari (2016) defined project management team efficiency as the degree to which project objectives are attained within the contractual project budget and schedule.

1.8 Thesis Outline

This thesis is segmented into five chapters. Chapter One presents as an introductory chapter. This chapter starts with the research background and the problem statement. Then, this chapter explains the primary aim, specific research questions, and objective of this study. Moving forward, this chapter also highlights the significance and scope of the study before listing the definitions of terminologies.

Chapter Two highlights the literature reviews related to the focus of the study. This chapter starts the review of project management, specifically regarding project management efficiency, project cost management, and project schedule management. Then, this chapter emphasised the naval ship construction projects, particularly Bousted Naval Shipyard Sdn. Bhd. The employees of this company are the respondents in this study. Next, this chapter discussed VO and the underpinning theory. This chapter ends after discussing the conceptual framework.

Chapter Three focuses on the methodology used in answering the research questions and fulfilling the research objectives of this study. This chapter starts by discussing research philosophy and research design, followed by population and sampling technique. Then, this chapter also emphasises the instrumentation and data collection of this study before concluding with emphasis on the data analysis as well as ethical concerns and reliability.

Universiti Utara Malaysia

Chapter Four presents the findings of the study. This chapter starts with the respondents' demographic profile. Next, this chapter presented the findings based on the three research objectives of the study. Firstly, this chapter presents the findings for research objective one, which is on the contributing factor to VO in the Littoral Combat Ship (LCS) Project. Secondly, this chapter presents the findings for research objective two, which is the impact of VO on this project and towards the efficiecy of PMT. Thirdly, this chapter presents the findings on objective three, which is the improvement measure that reduces VO in this project. This chapter ends after providing a findings summary.

Chapter Five is the final chapter of this study. This chapter provides a recapitulation of the study. Then, this study explains the findings and provides some suggestions. This chapter ends by presenting the implications and limitations of the study and making recommendations for future studies.

Universiti Utara Malaysia

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This section reviews the literature to understand the variation order in a naval ship construction company and project management efficiency. Therefore, this chapter starts to review project management and project management efficiency, particularly in relation to cost and schedule management. Then, this chapter discusses naval ship construction projects. Besides, this chapter also reviews the variation order and its contributing factors before it focuses on the impact of variation orders on naval ship construction projects. This chapter ends with a discussion of the underpinning theory and the conceptual framework.

Universiti Utara Malaysia

2.2 Project Management

According to PMI (2017), project management is defined as a short-term endeavour performed to develop a unique outcome, service, or product and to achieve purposes through the distribution of deliverables. In this case, "project" refers to the building of naval ships. Project management may consist of a person or a group, one or multiple organisational units. Despite the engagement of individuals with projects since the beginning of human advancement, the area of project management has been a specific contributor to an effective project (Flyvbjerg et al., 2004).

According to research, the project management body of knowledge (PMBOK) is frequently utilised as a project management guideline (Ahlemann, 2009). Wirth and Tryloff (1995) identified five types of PMBOK used in project management: (i) American Project Management Institute's (PMI) A Guide to the Project Management

Body of Knowledge (PMBOK), (ii) Australian Institute of Project Management's Reference Curriculum for Project Management Courses, (iii) Project Management Austria Institute's (PMA) Project Management Body of Knowledge, (iv) Norwegian Organisation of Project Management's Fundamentals, (v) ISO 21500:2012 Guidance on Project Management.

According to Pollack (2007), A Guide to the Project Management Body of Knowledge (PMBOK) by American Project Management Institute's has been officially acknowledged by different project management organisations. It was frequently used as a guide for project management. Doan and Helvaciolu (2016) emphasised the widespread use of PMBOK by the American Project Management Institute (PMI) due to its benefits to the organisation and its personnel. For example, PMI PMBOK enables businesses to standardise procedures, allowing project management teams to handle projects using common methods as long as the guidelines and techniques are followed thoroughly. Villanova (2020) and OMI (2017) explained project management team is composed of individuals who have participated actively in one or more stages of the project activity.

The Project Management Institute (PMI) (2017) categorises five distinct project management groups, namely (i) establishing the process team to determine project by acquiring a permit to initiate the project, (ii) setting up a process team to generate the project scope, specify the purposes, and identify the measures, (iii) executing process group to fulfil the project presented in the project management strategies and qualifications, (iv) supervising and managing the process team to analyse and stabilise the project quality and development, determine any areas requiring adjustments and execute the adjustments, and (v) performing the closure of the process group to reach a formal completion of the project stage.

Universiti Utara Malaysia

As shown in Figure 2.1, PMI (2017) characterised ten project management knowledge areas for the project management teams. The first knowledge area is project integration management. This area consists of the procedures for identifying, defining, combining, unifying, and coordinating a wide range of procedures and project management activities within project management. The second knowledge area is project scope management, which includes the critical stages necessary to ensure that all work is incorporated into the project and completed successfully. The third knowledge area is project schedule management. This area includes the critical methods for managing the timely completion of projects within the contractual time. The fourth knowledge area is project cost management. This is the process of coming up with a project idea, measuring it, figuring out how much it will cost, getting money for it, financing it, supervising it, and controlling the costs.

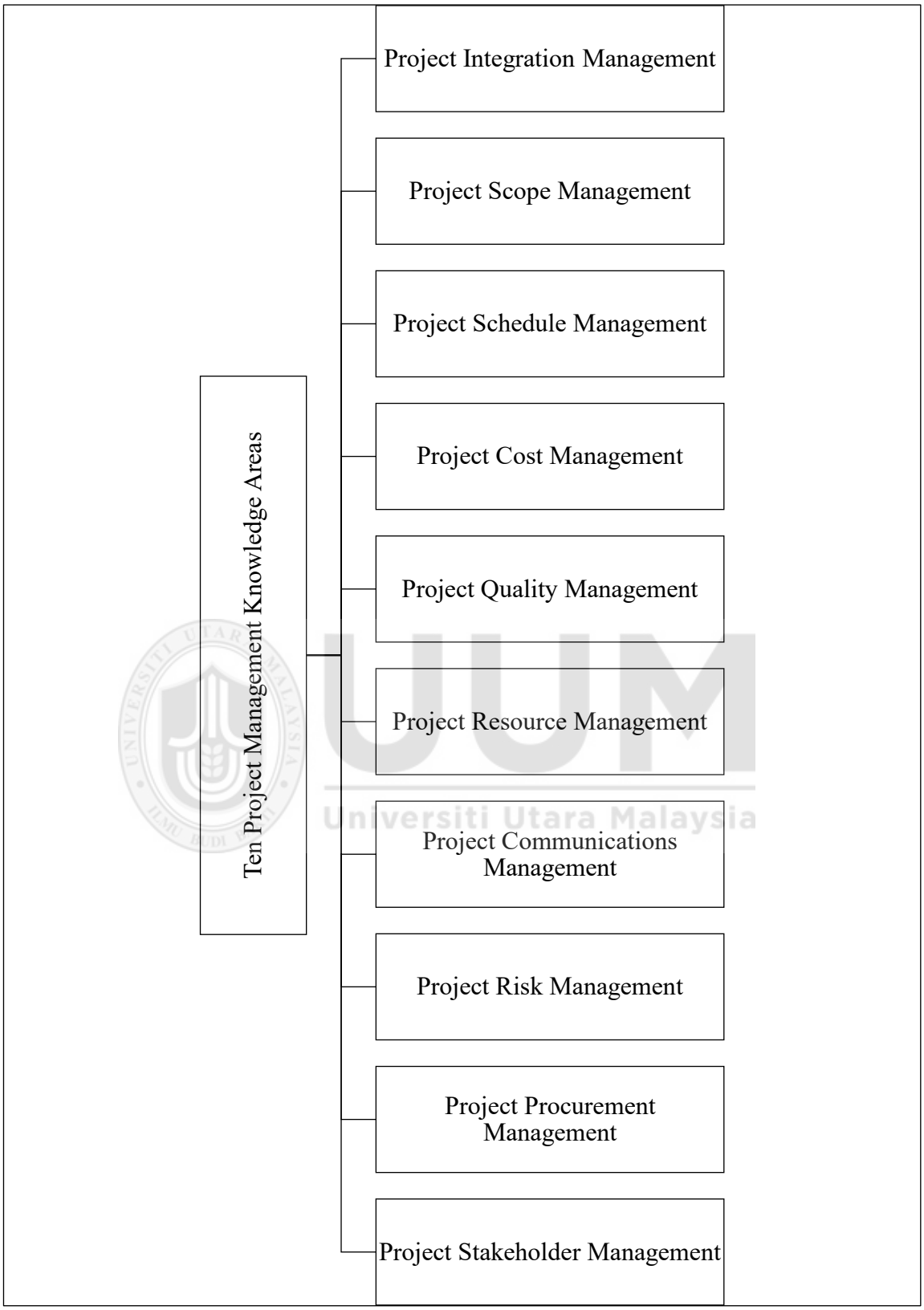
The fifth knowledge area is project quality management, which includes the stages of planning, managing, and ensuring the product or project met the prerequisites standards of project stakeholders. The sixth area is project resource management, which involves identifying, procuring, and managing the elements necessary for a project's success.The seventh area is project communications management. This knowledge area covers the methods for timely and appropriate strategy formulation, incorporation, development, administration, extraction, supervision, of project information.

Project risk management techniques are the eight knowledge areas. This area includes risk strategizing, identifying, reviewing, developing, and implementing feedback, and supervising project risk. The ninth knowledge area is procurement management, which includes the critical stages involved in obtaining and procuring products, services, or outcomes from sources other than the project team. The tenth

Universiti Utara Malaysia

area is project stakeholder management, which includes methods for identifying firms, teams, or individuals who could affect or be affected by the project. This field sought to meet stakeholders' expectations and their impact on the project, as well as to employ appropriate management techniques for effective stakeholder engagement.

Universiti Utara Malaysia



Universiti Utara Malaysia

Figure 2.1
Ten Project Management Knowledge Area
Source: PMI (2017)

The project management knowledge areas were demonstrated in terms of procedures, methods, operations, inputs, and outputs. Each knowledge area of project management consists of its respective data source to accomplish the objective (PMI, 2017). Table 2.1 illustrates the interrelation between the project management process group and the knowledge areas to be followed for successful project management as suggested by PMBOK.

Universiti Utara Malaysia

Table 2.1
Project Management Process Group and Knowledge Area Mapping

Knowledge Areas	Project Management Process Phase Groups				
	Initiating Process Group	Planning Process Group	Executing Process Group	Monitoring and controlling Process Group	Closing Process Group
1. Project Integration Management	Develop Project Charter	Develop Project Management Plan	Direct and Manage Project Work	Monitor and Control Project Work and Perform Integrated Variance Control	Close of project, document the project data
2. Project Scope Management		Collect Project Scope Requirements, Define project scope, Create Work breakdown Scope		Validate and control scope, Integrated Variance Control	
3. Project Schedule Management		Define Activities, Sequence Activities, Estimate Activity Durations and Develop Schedule		Control Schedule, Integrated Variance Control	
4. Project Cost Management		Estimate Costs and Determine Budget		Control Costs, Integrated Variance Control	
5. Project Quality Management		Plan Quality Management	Manage Quality	Control Quality, Integrated Variance Control	
6. Project Resource Management		Plan Project Resource, Estimate work scope	Acquire Resources, Develop Team, Manage Team	Control Resources, Integrated Variance Control	

Universiti Utara Malaysia

Table 2.1 (Continued)

Knowledge Areas	Project Management Process Phase Groups				
	Initiating Process Group	Planning Process Group	Executing Process Group	Monitoring and controlling Process Group	Closing Process Group
7. Project Communication Management		Define Stakeholders, Plan Communication	Manage Communication	Monitor Communication	
8. Project Risk Management		Identify Risk, Perform Risk Analysis, Plan Risk Response	Implement Risk Response	Monitor Risk, Integrated Variance Control	
9. Project Procurement Management		Procurement Management Plan	Conduct Procurement	Control, Integrated Variance Control	
10. Project Stakeholder Management	Identify Stakeholders	Stakeholders Engagement Plan	Stakeholder Engagement Management	Monitor Stakeholders Engagement	

Source: PMI (2017)

Universiti Utara Malaysia

2.3 Project Management Efficiency: Cost and Schedule

In a project, efficiency refers to how effectively and creatively a Project Management Team uses resources to achieve predetermined objectives. However, efficiency in project management refers to knowing how to complete project tasks and operate the project efficiently within the agreed-upon project constraints of scope, time, quality, and budget. Project effectiveness measures the relevance of the goals that an organisation is pursuing, as well as the degree to which they are meeting them. Successful projects are the result of the project management team's (PMT) members' detailed plans. Hyvari (2016) previously defined project management effectiveness as the degree to which objectives are attained within the project budget and project schedule.

Numerous elements must be addressed to ensure the project's effectiveness. These elements include the following: (i) the project's objectives have been met to the complete satisfaction of the users; (ii) all activities have been completed; and (iii) all designated stakeholders, including the project's sponsor and initiator, have accepted the project's results and closed the project. According to Wysocki (2011), it is critical to assess the efficacy of project management team due to their responsibility in completing the project within the budget and schedule.

Earlier, Kerzner (2009) and John (1993) mentioned that the project management team is rigorously picked to administrate the project's operations and guide various technical decisions in accordance with the main contract. According to them, this is because the efficiency of the project management team is determined by the project's cost and schedule. Not only that, but Scott-Young & Samson (2008) also determined that the most significant predictors of project management team efficacy are project cost and schedule management.

Universiti Utara Malaysia

A study conducted by Dansoh, Oteng, and Frimpong (2017) also concluded in their study that the efficacy of a project management team is determined by its ability to manage project costs and schedules effectively.

Wysocki (2011) describes Project Management Team must need good cost and schedule management techniques, to manage project. Effectiveness, on the other hand, is not defined; rather, it relates to improvements in project management with the purpose of improving project delivery on time and at a lower cost. In a nutshell, cost incurred and time spent completing work must be measured in deviations from a plan (Trisanto & Wardhan, 2021). The increase of cost and time in a project indicates failure for the project management team (Seng, 2017; Cloughand & Sears, 1991).

The existence of cost and time performance indicators can allow for early intervention, allowing the project to proceed as intended. There is a link between the expenditures incurred and the time it takes to complete the project, and effective activity scheduling is required to keep costs to a minimum (Wulan et al., 2013; Soeharto, 2005). Therefore, this study focuses on both the cost and schedule of the project in accordance to the reseach objective number two.

Universiti Utara Malaysia

2.3.1 Project Cost Management

The term "project cost management" refers to the assessment of the charges associated with the project's resources, which may include labour, supplies, hardware, management, and offices (PMI, 2017). It enables the estimation of future expenditures in order to reduce the likelihood of an excessive project cost, which is calculated during the phases of the project. Cost approval from stakeholders prior to the start of the project is critical (Wrike Inc, 2017). Similarly, project cost management is critical in comparing the expected budget to actual expenditure in order to better understand future cost management plans and project budgets (Kerzner, 2009).

Kerzner (2009) also stated shipbuilders occasionally employ the project profit margin to mitigate the impact of any modifications in the scope of the project's work due to project cost overruns. Another study established that the impact of project cost overruns generates financial susceptibility for shipbuilders as a result of increased work scope due to VO's occurance in the project. In this scenario, a larger VO cost resulted in a greater likelihood of the shipbuilder's reserve depletion (Nicholas & Steyn, 2012). Additionally, shipbuilders face increased labour costs as a result of project scope extensions (Kerzner, 2009; Nicholas & Steyn, 2012). Due to this issue, the project management team must work to minimise the occurrence of VO's in a project, as their influence on the shipbuilder's cash flow is significant (Doan & Helvaciolu, 2016).

Earlier, Kaming et al. (1997) have identified that 54.5% of project management team complete 90% of project completion over the project budget, 30.3% of project management team complete 70 - 90% of project completion according to budget and 15.2% of project management team complete less than 70% completion of the project according to the budget.

Universiti Utara Malaysia

Trigunarsyah (2004) identified that only 30% of the projects studied completed their work in accordance with the budget, 34% completed less than the budget, and 36% completed projects more than the set budget. The cost efficiency aspect is one aspect of project success that is very important for company stakeholders to pay attention to. Accurate costings should include all the resources required for developing and delivering a project.

The necessity of cost efficiency was also emphasised by several researchers. According to Tanko et al. (2018) and Li et al. (2012), using value engineering and picking an alternative work technique can contribute to cost efficiency by lowering unnecessary costs, improving quality, and fostering teamwork as a means of enhancing productivity. Furthermore, Shahhosseini and Amiri (2018) claimed in their study that picking an alternative work procedure might result in construction cost savings of up to 41%.

According to PMI (2017), the project management team are responsible for managing the project's cost, as well as ensuring that the project's cost stays within the spending limit. Numerous procedures are involved managing projet cost. This includes: (i) cost management plan, (ii) cost estimation, (iii) budget determination, and (iv) cost control, as illustrated in Figure 2.2. Bridges (2019) emphasised that all budget-influencing factors should be considered in the cost management plan, and that all costs should be computed to determine the financial commitment to the project. The project cost management methods are focused on the formulation and management of the project's expenditure constraint.

Universiti Utara Malaysia

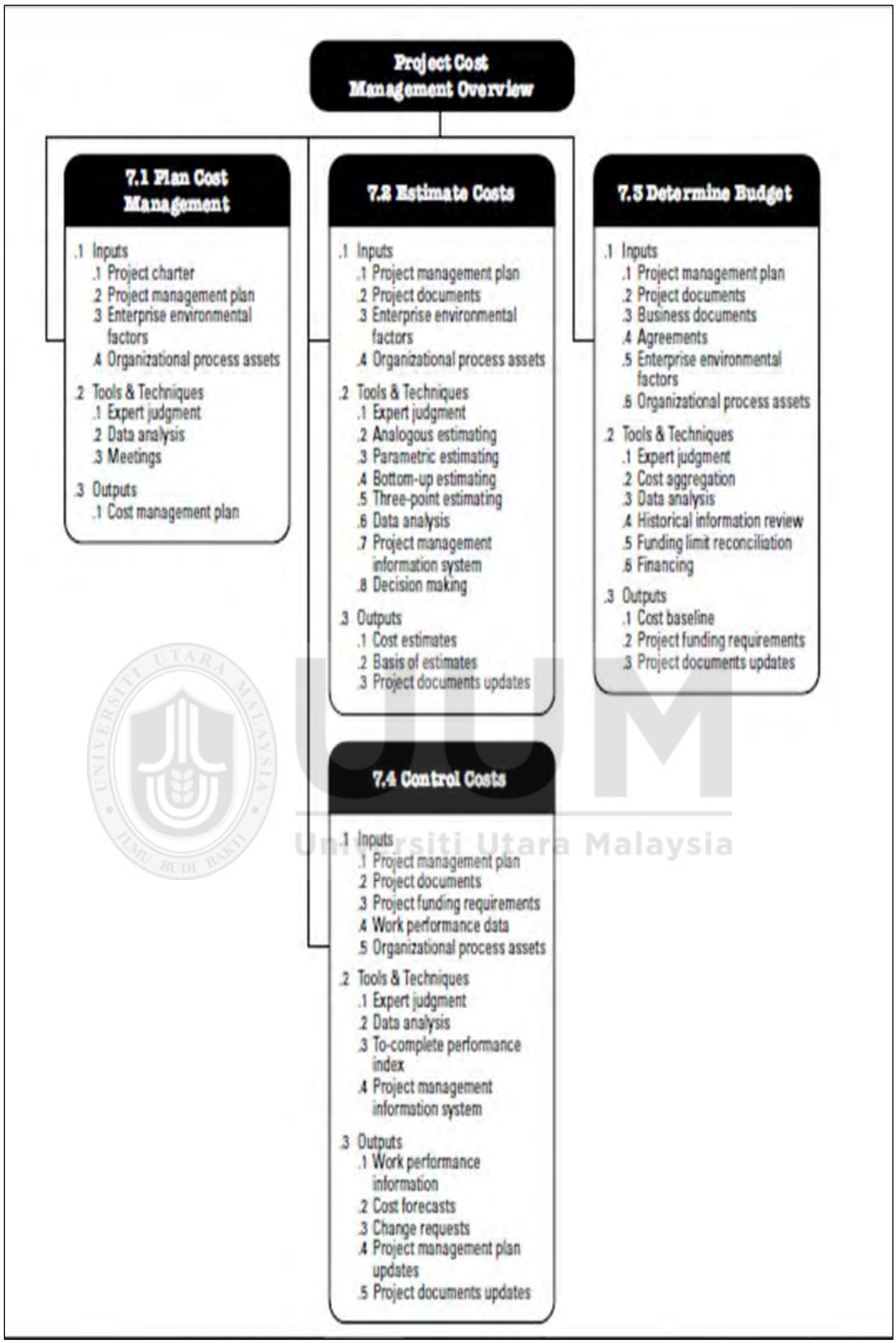


Figure 2.2
Project Cost Management Overview
Source: PMI (2017)

Universiti Utara Malaysia

Smith (2016) discovered that variation was the key factor for the increase cost for projects in the Western Cape, affecting 79% of the analysed projects. As a result, it was established that the project with a greater VO saw more cost overruns and hence had an effect on the entire project cost. In general, trustworthy data collection is critical for project management teams prior to conducting cost assessments. One of the tools to be employed in the assessments was judgement based on prior project experience, which was backed up by recorded data and contributed significantly to the project's understanding of more seasoned comparator projects (Kerzner, 2009; Nicholas & Steyn, 2012). Another technique that might be used in the assessments was conclusive evaluations, which worked well when comprehensive work plans, work details, and unit costs were available (Kerzner, 2009).

Project contractual agreements are a critical piece of information in determining the project's cost (PMI, 2017). Additionally, research established that the type of agreement had an effect on the amount of information available for expense appraisal (Bajari & Tadelis, 2001). When determining the project's cost, the project sponsor specifies the amount of management budget allotted to the project. Additionally, another study found that a well-defined work extension, strategy, and analysed resources were critical in the decision-making process of project managers (Fleming & Koppelman, 2002).

Aside from that, cost control is another factor to consider while controlling project costs. It is the process of keeping track of the project's progress in order to update the project budget and manage cost adjustments. The baseline is crucial in cost control since we will be able to determine cost performance by comparing it to the baseline. It will be extremely difficult to keep costs under control without a baseline. There were four steps in this process.

Universiti Utara Malaysia

The first step is to acquire information. This group of operations is related to gathering actual project performance data. However, before beginning the data collection process, project team members should build a cost control system to provide direction on how data will be collected on the project. All relevant project materials, including the existing project management plan, the cost performance baseline, project funding information, and work performance criteria, organisational standards, and procedures, should be reviewed while building the cost control system. Gathering is the process of getting data that fits with the system after it has been built.

The next stage is to get organised. The team gathers and prepares data for analysis in this step, following corporate norms and personal preferences in gathering project performance data in a way that allows for effective analysis. Who will be examining and analysing the data, and what format lends itself to good analysis, are the most important factors. To assist with organising data, organisations frequently employ the dashboard functionality found in most popular software packages. A dashboard is a graphical display it shows important cost, time, or resource information in an easy-to-read way.

The third step is to assess. After the data has been organized, the project team members must be thoroughly review the data and compare with the project actual progress and timeline. It is crucial to keep the project progress within the timeline. Furthermore, project management team should strive to figure out how far the project has deviated from the baseline, what that means in terms of the future, and what the causes are. The team may also come up with ideas for how to deal with differences.

The fourth stage is to make a decision. Data analysis will disclose facts that may necessitate action. The goal at this point is to take the necessary actions to keep the project on track, in accordance with organisational guidance and best project

Universiti Utara Malaysia

practices. The most common mistakes made by project management teams are processing VO when they have no visibility to the project true financial condition. As a result, project team members are unaware of the project's true finacial condition and consequently the project cost overruns. If the VO is un-avoidable, project management team should engage for VO price negogiations in line with the current project financial conditions.

2.3.2 Project Schedule Management

According to PMI (2017), project scheduling lays out a comprehensive strategy for delivering the products, outputs, and services specified in the project scope. Regardless of the greater difficulty that may result, the project management team roles are to ensure the project timely completion. Additionally, given the high degree of uncertainty and unpredictability associated with the long-term project scope, project management team should apply a contextual framework to successfully adapt and alter the project schedule in response to changing demands.

Universiti Utara Malaysia

The project schedule management process involves the following steps: (i) strategizing schedule management, (ii) defining work activities, (iii) organising work activities, (iv) estimating the duration of work activities, (v) constructing the schedule, and (vi) administering the schedule (PMI, 2017). The techniques for managing the project schedule are summarised in Figure 2.3.

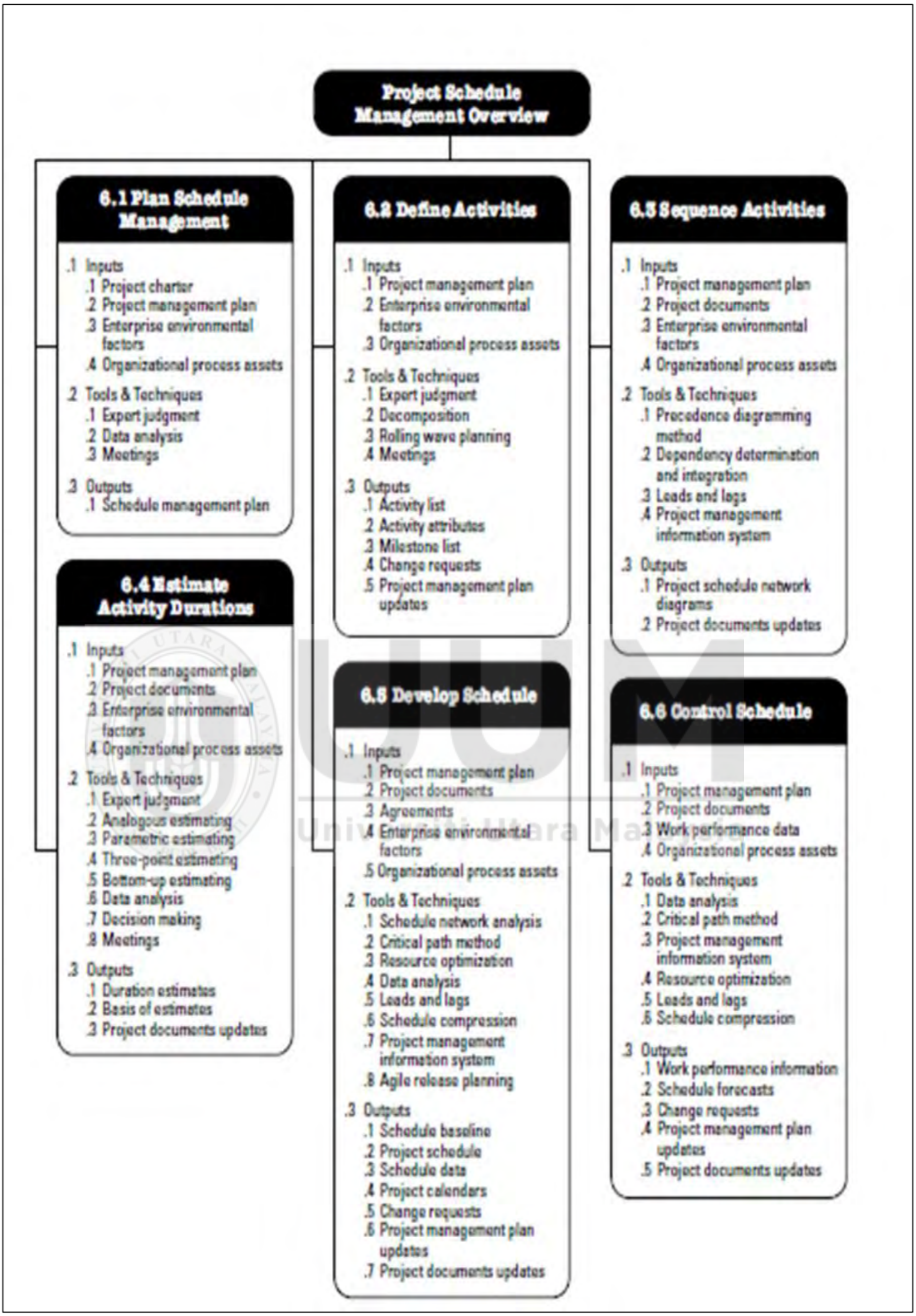


Figure 2.3
Project Schedule Management Overview
Source: PMI (2017)

The term "project schedule management" refers to the methods for developing strategies, processes, and documentation to generate, manage, execute, and control the project's schedule. The key benefits of this stage are that project management teams are instructed on how to manage the timetable (PMI, 2017). When the Work Breakdown Structure (WBS) is defined, the project schedule management is to be executed. Once the work bundles are defined, they are segregated into smaller components referred to as work exercises (PMI, 2017). This element is critical for the project management team to conduct an accurate resource assessment in order to manage the resource impact on the project's timeline (PMI, 2017).

Project scheduling is an important sub-process of project management that is used to define the time limits in which the project must be completed, the costs associated with resource and labour requirements, and the order in which tasks must be completed (Mubarak, 2010). Project schedule management is a complex and iterative job that entails allocating resources to project tasks. According to Bowen et al. (2012), project management teams should adopt schedule management planning to reduce overheads by ensuring that the project is not overstaffed, which results in a reduction in the cost of completing a project through efficient time management.

Project schedule management planning, according to Hyvari (2016), is the process of deciding when project activities will take place based on established durations and preceding activities. Project schedule management planning is influenced by at least six aspects. The first aspect is resource inventory. Scheduling is contingent on an accurate estimation of the inventory supply that the organisation must maintain. According to Lim and Mohamed (2009), most companies retain a one-month supply of any product they require as inventory.

Universiti Utara Malaysia

It is necessary to alter scheduling by determining if the resource required is fast or slow-moving. As a result, it is very important to keep an accurate inventory of resources to make sure that the project goes as planned.

The second aspect to consider is the work scope priority of the project. According to Kerzner (2013), project management team must prioritise which work scope requires the longest time to complete and plan ahead for the work scope. Project schedule management planning is necessary to accomplish the project's objectives, which must also be presented in a manner that facilitates identification and assignment of priority within the project. The third aspect is the delivery date. The production timeline is also influenced by the delivery dates since project management team must adhere to the deadlines set for project completion. A production schedule must be established in such a way that timely delivery to customers is guaranteed. According to Morris, Pinto, and Soderlund (2011), it is also critical for resource inventories to be spread out across the year in the case of seasonal products in order to avoid increasing demand during the project schedule's demand season.

Universiti Utara Malaysia

The fourth aspect is proper project resource allocation. The practise of allocating the required number of resources identified in the planning stage to each activity identified in the plan is known as resource allocation or resource loading. This is because, as Jugdev and Muller (2015) describe, a few activities may require fewer resources at one time but more of the same resources at a later stage of the project. Example is allocating man power on each stages of shipbuilding.

The fifth factor to consider is the availability of raw materials and labour. Scheduling is influenced by the availability of raw materials and labour. To guarantee smooth implementation, the timetable must have provisions for these changes.

In addition, having a consistent supply of supplies allows the organisation to maintain normal operations. If, on the other hand, the supply of materials is not standard or items that have long lead time to arrive, the schedule must be adjusted to avoid delays.

The sixth aspect is hiring untrained or inexperienced people in Project Management Team results incapacity to properly complete their project. Successful leadership and trained project management team is crucial for the development and integration of fresh procedures, as well as for the timely completion of the project. According to Hyvari (2012) and Muller and Turner (2007), a lack of well-informed project management team adversely affects project schedule management. Inadequate leadership can result in cost increases or project delays as a result of insufficient resource planning.

Vanhoucke (2013) discussed about the project three dimensions of dynamics scheduling methodology as illustrated in Figure 2.4. He explained that the dynamic scheduling consists of four quadrants. There three factors to be considered by the project management team in considering which appopriate project schedulling tools to be implemented in controlling the project schedule (i) complexity of the project, (ii) uncertainity of the project, and (iii) project control startegy.

PERT, CPM, SRA, RCP and CCBM are project management schedule planning tool used to calculate the amount of time it will take to realistically finish a project with the resources in hand. Figures 2.4 explains that when the project is certain and with low complexity, project management team can do the project schedulling using the tools shown in (Quadrants 1).

Universiti Utara Malaysia

When the degree of project complexity risen up, a project's schedule becomes increasingly susceptible to unexpected changes as the project progresses. The SRA method shown in Figure 2.4 (Quadrants 2) can be used by the project management team. SRA method can be used by providing a certain degree of safety reserve to the schedule. The earlier project uncertainities are identified, the more time will be be remaining for the project management team to plan the best schedule fits the project and reduce VO.

For the project with high complexity and with the certain work activites, project management team can opt with RCP method shown in (Quadrant 3), the schedule is done within the presence of limited reources. In the case of LCS project, the complexity is high and there are still production activities is uncertain due to the detail design is not completed, therefore project management management team should implement method shown in Quadrant 4.

The progress of the project must be monitored and regulated to ensure that it is being completed according to the intended baseline timetable. Both reactive and proactive scheduling approaches can be mapped to the quadrants of the project mapping approach, allowing for prompt remedial action when the project encounters difficulties.

Universiti Utara Malaysia

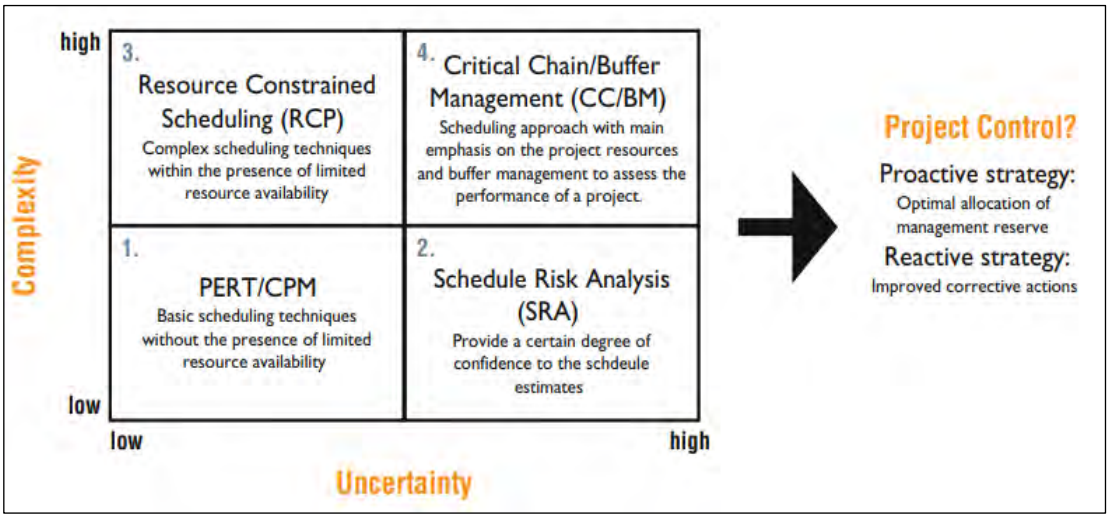


Figure 2.4
Project Three Dimesions of Dynamic Scheduling
Source: Vanhoucke (2013)

2.4 Naval Ship Construction Projects

As Widias (2020) points out, naval shipbuilding projects are a complex mix of art and science in project management. A shipbuilder agrees to deliver to a client a vessel with particular dimensions, capabilities, and attributes that has been tested and is ready for service by a certain date and at a certain price. A naval shipyard's primary role is to produce completed ships in compliance with the shipbuilder's commitments. Oy (2013) stated that the labour force in the naval shipyard consists of various workmen such as steelworkers, welders, shipwrights, plumbers, fitters, electricians, riggers, and painters. This requires a specific project management team (PMT) with experiece to organise and control the naval ship construction projects.

The chairman and board of directors of a naval shipyard are normally made up of 6 to 12 members from the technical, commercial, and secretarial divisions, with one or more representing outside interests. The navy shipyard divisions are organised into two major departments: (i) engineering, which is responsible for design work that includes production and installation drawings, (ii) production, which is responsible for

Universiti Utara Malaysia

project planning, manufacturing, and quality control, (iii) procurement, are in charge of procurement, storage, and support.

The construction of the ship hull begins as soon as the contract is placed between the client and the naval shipyard. The project management team (PMT) will negotiate with equipment subcontractors for the delivery of things like ship electric power plants, ship propulsion machinery, ship deck machinery, and ship furnishings that are not produced by naval shipyards. This is a difficult deal to negotiate because it includes subcontracts between the shipyard and several equipment suppliers local and overseas. PMT must remember to maintain expenses as low as feasible while adhering to the main contract's timeline.

2.4.1 Boustead Heavy Industries Corporation Berhad: Boustead Naval Shipyard Sdn Bhd

Universiti Utara Malaysia

While the primary aim of this study is to understand the variation orders in a naval ship construction company and to improve the project management efficiency through a standard operating procedure (SOP) in accordance with the EPCC shipbuilding project management process flow for VO management, the project team members from Boustead Naval Shipyard Sdn Bhd under the Boustead Heavy Industries Corporation Berhad (BHIC) are among the respondents in this study. Briefly, the core business of BHIC is shipbuilding, ship repair, and maintenance naval vessels, with the Royal Malaysian Navy (RMN) as their primary client.

BHIC has a long history of providing the RMN with high-end, powerful naval warships, including the Littoral Combat Ships (an ongoing project), the next Generation Patrol Vessels, and MRO support for the RMN armada, which also includes the Prime Minister's Class Scorpene submarines. Additionally, BHIC has the

capability to construct a range of commercial vessels, including anchor handling tug supply vessels (AHTS), offshore service vessels (OSV), passenger ships, tankers, and barges.

BHIC and its affiliates own three shipyards on the west coast of Peninsular Malaysia, near the important and busy waterway of the Straits of Malacca, and one government-owned shipyard in Sabah. Boustead Naval Shipyard, a naval shipyard located near to RMN's station in Lumut in the state of Perak, is the largest among them and also the largest in Malaysia in terms of capacity. The Boustead Naval Shipyard is a one-stop shop for all naval defence and maritime needs. It was previously known as the Royal Malaysia Navy Dockyard and became fully operational in 1984, covering 46 hectares.

In 1991, the company was corporatized, and in 1995, it was privatised as PSC Naval Dockyard Sdn Bhd. In August 2005, the company was acquired by Boustead Holdings, a multinational Malaysian corporation controlled by the Armed Forces Provident Fund. The name was changed to Boustead Naval Shipyard Sdn Bhd. The organisational chart for this company is depicted in Figure 2.5.

Universiti Utara Malaysia

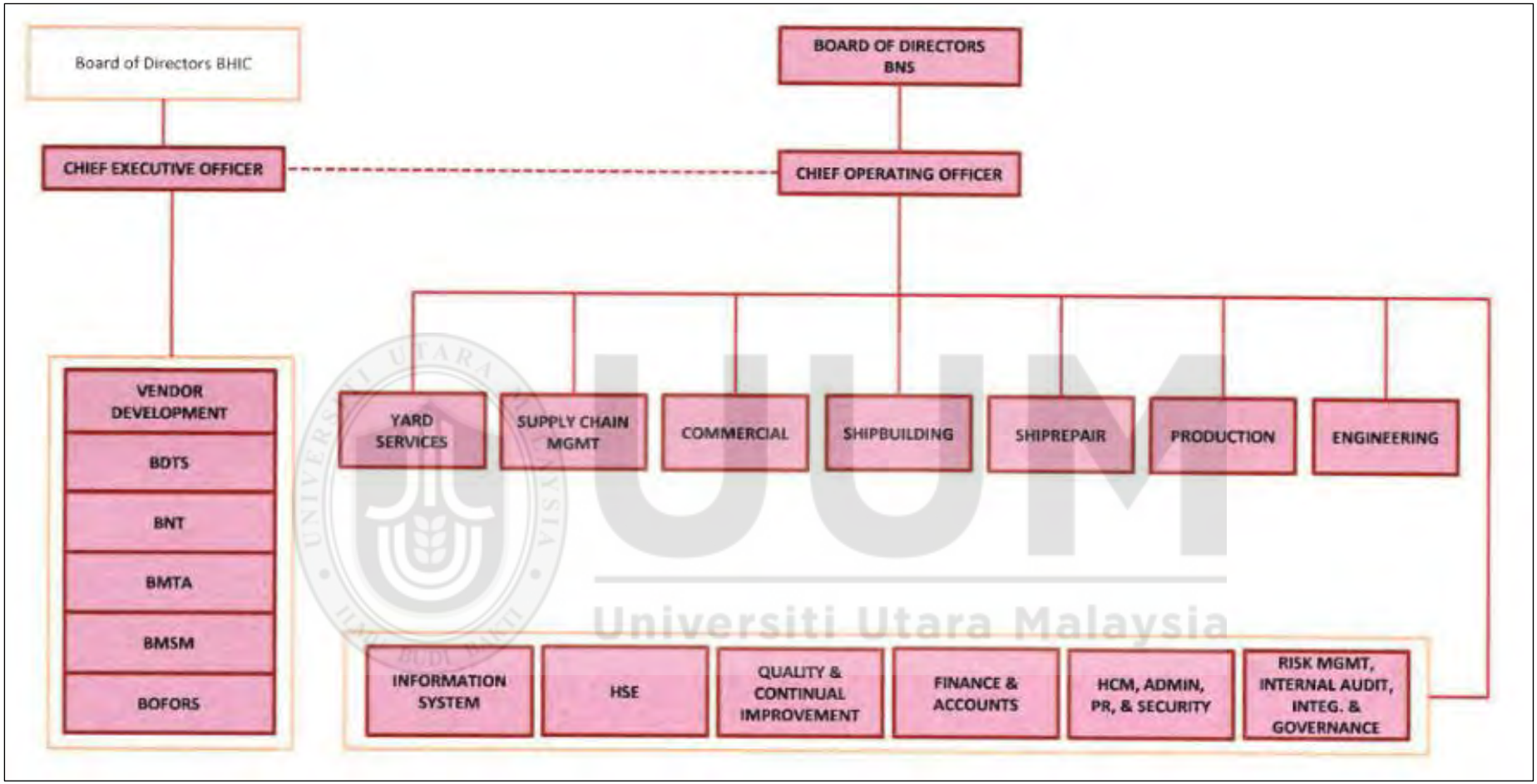


Figure 2.5
Organizational Structure of Boustead Naval Shipyard Sdn Bhd
Source: Compiled by author

Universiti Utara Malaysia

Figure 2.6
Ship Building by Boustead Naval Shipyard Sdn Bhd
Source: Compiled by author

As shown by Figure 2.6, Boustead Naval Shipyard is capable of building a wide range of naval and commercial boats. Figure 2.7 and Figure 2.8 show ship repair activities by this company.

Universiti Utara Malaysia

Figure 2.7
Ship Repair by by Boustead Naval Shipyard Sdn Bhd
Source: Compliled by author

Figure 2.8
Ship Repair Activities
Source: Compiled by author

Universiti Utara Malaysia

Since 1984, the shipyard's major operation has been ship repair, providing customers with high-quality and comprehensive depot level maintenance services. A 4500-tonne ship lift and a 400-meter-long berth through a floating pontoon all contribute to the activities. Apart from that, they have a variety of specialised facilities and equipment that enable them to provide services spanning the entire spectrum of expertise required for shiprepair work on vessels as sophisticated as navy battleships. The workshops are staffed by highly skilled specialists and technicians who are capable of providing comprehensive technological solutions to even the most complex situations.

2.5 Variation Orders (VO)

Variation orders (VO) are defined by Thakar (2020) as any alteration or change in the project's pre-existing conditions or needs. According to Schaulfelbeger and Holm (2002), VO is a change to the original contract. Then, Fisk (2006)refers to VO as an agreement between the owner and contractor to approve modifications in the plan and the amount of cost compensation to the contractor that happened during construction after the owner and contractor signed the work agreement. Previously, O'Brien (1998) explained VO refers to any adjustments made on the building strategy of the project after the main contract have been agreed by the stake holders, exhibited through the study.

According to Abdul Kadir (2018), VO can come from a variety of sources and at any stage, and it can have significant consequences. Kumaraswamy and Yogeswaran (1998) noted that VO are a common source of dispute among contractual parties, particularly the client and contractor, in a building contract. These disputes arise when variation orders are not adequately managed (Charoenngam, et al., 2003).

Universiti Utara Malaysia

When contractual conditions, design, or construction processes are breached during the course of the job, VO is formed. Cost, time, and technique of performance are examples of alterations or modifications.

As a result, a VO is a written order between units that denotes any additional work, omission, or change that occurs during execution. Then, according to Thakar (2020), VO in construction projects can take the form of increasing or decreasing the volume of work indicated in the contract, increasing or decreasing the type of work, and changing technical requirements to meet field needs. Modifications in project timing and cost overruns have resulted as a result of these changes. Figure 2.9 lists eight purposes of VO as explained by Ade and Sarwono (2015).

Universiti Utara Malaysia

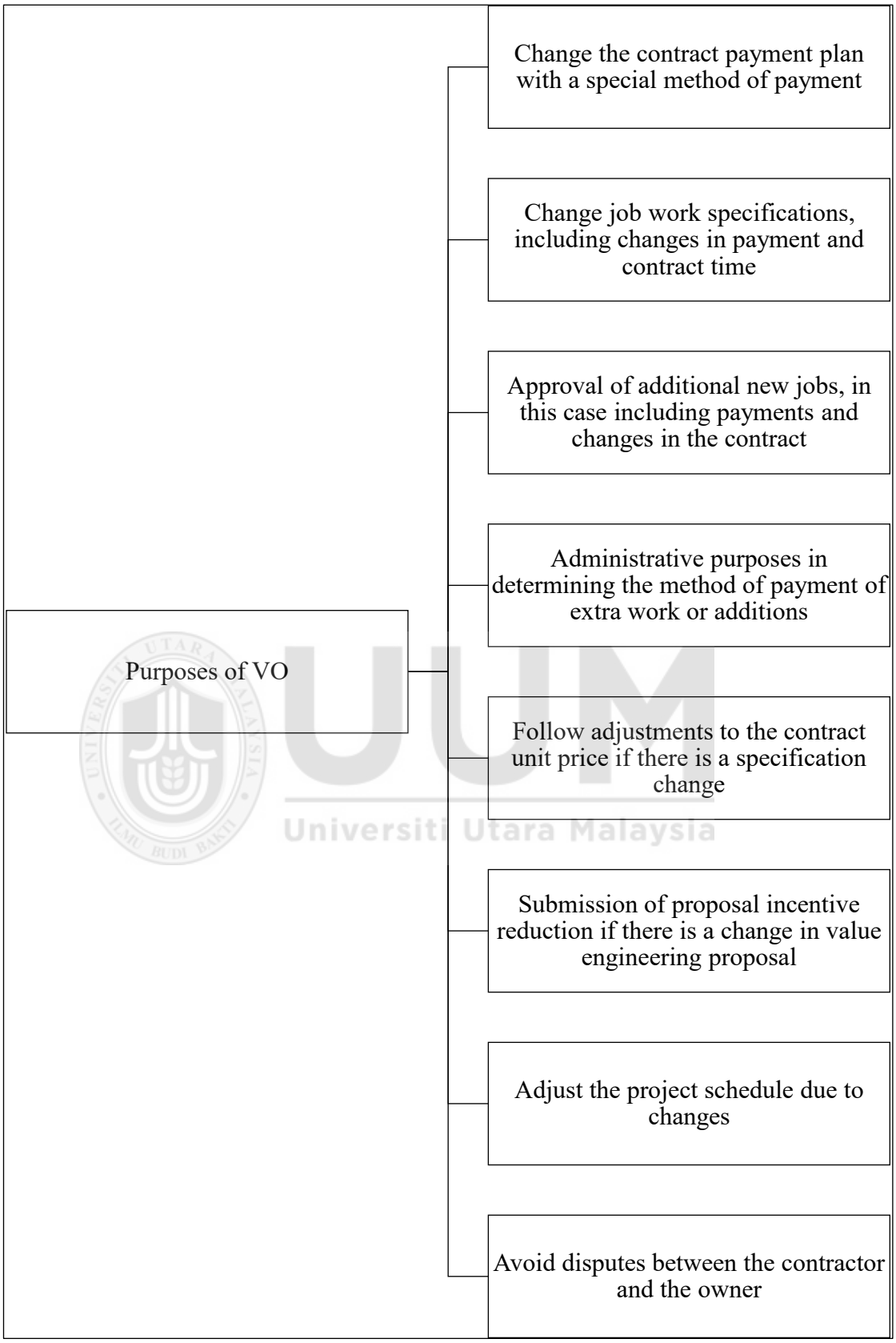


Figure 2.9
Purposes of VO
Source: Ade and Sarwono (2015)

Universiti Utara Malaysia

2.5.1 Contributing Factors to Variation Orders (VO) Occurrence in Naval Ship Construction Projects

A Variation Order (VO) is a technique employed by shipbuilders to register any changes in the construction agreements during the progression of the projects. Variations in the project were revealed to impact the project schedule and cost, which any adjustments to the project contractual terms. While significant discussion has been held on cost and schedule, almost no research has been performed on the management and reduction of VO by the project management team in a project.

Previously, Ndekugri and Rycroft (2019) mentioned that VO is a modification to the agreement for the purpose of extending, replacing, or correcting an error in the agreement. This progression may occur as a result of technological advancement, legislative changes or implementation, changing conditions, topographical anomalies, inaccessibility of indicated materials, or as a result of the project's progression, which included an enhancement of the structure following agreement.

Universiti Utara Malaysia

Earlier, Halwatura and Ranasinghe (2013) defined VO in the context of naval shipbuilding construction as the customer's modification of the legally binding contract with the shipbuilder to include a new term of the agreement as an addition to the contract document. According to Arain and Pheng (2005), VO refers to the normal processes associated with a naval shipbuilding project, which are unavoidable because they frequently occur when shipbuilding construction is renovated and modified. Arain and Low (2005) confirmed a rise in the number of VO in naval shipbuilding projects as a result of the projects' complexity. The shipbuilding project's management team must take basic precautions to limit the number of VO's and adverse effects to project cost and schedule.

Previous research has established that VO's are widespread in a wide variety of initiatives (Oladapo, 2007; Thomas et al., 2002). Apart from the inherent uniqueness of projects (Hanna & Gunduz, 2004; Hanna et al., 2002), Muhammad et al. (2015) and Sunday (2010) discovered that no project could be completed without VO due to the changes that occur during the project. As a result, the project management team's meticulous planning is critical. Unexpected events may arise during the course of the project and should be managed using proper procedures that were not included in the early stage building contract.

Al-Nuaimi et al. (2010) found two variables that contribute to the occurrence of VO's in naval shipbuilding projects: (i) the client's request for alterations during the production phase, and (ii) the absence of VO's handling rules and practises. Mohammad et al. (2010) defined the key three causes of VO's as (i) client-modified production techniques, (ii) client-supplied equipment replacement, and (iii) project consultant-supplied design adjustments. In general, it was established that the key element influencing VO's in naval shipbuilding projects was the client.

Ismail et al. (2012) identified three significant VO factors: (i) client-driven strategy or scope adjustments, (ii) design phase oversights, and (iii) production phase quality concerns. Meanwhile, Hanif et al. (2016) identified the most significant VO variables as (i) changing scope of work by customer, (ii) omitted structure, and (iii) changing building tactics.

Briefly, VO arise as a result of the changes in the base agreement or work scope at the time of contracting. It is a contractual agreement between the contracting parties, who are typically referred to as the client and the contractor, about the expansion, termination, or modification of the contractual conditions.

Universiti Utara Malaysia

Subsequently, the new arrangement would have an effect on the price and schedule of the project (Keane et al., 2010). It is worth noting that numerous researchers have found a variety of elements that contribute to the occurrence of VO's. Table 2.2 summarises the details of each factor.

Universiti Utara Malaysia

Table 2.2
Factors of Variation Orders (VO)

No	Source	Factors	Descriptions
1	CII, (1990); Memon, (2014); Arain and Pheng (2005); Arain et al. (2004)	Changes in project scope by client	i. Disparities in planning for the project's development stage may result in considerable supply redistribution. ii. Changing the scope of construction or extending the scope of a project is one of the key causes of variance in construction projects. iii. These modifications are the result of insufficient preparation during the project definition phase and the absence of client participation during the design phase.
2	Arain and Pheng (2005); Asamaoh and Offei-Nyako (2013)	Project financial issues	i. Financial difficulties at the shipyard may have an effect on the project's quality and progress. ii. Additionally, it would result in a delay in subcontractor job payment, which would result in a delay in progress.
3	(O'Brien, 1998)	Changes in design by the design authority	Changing design is a typical occurrence in shipbuilding construction projects, resulting in project variance, delay, and a significant cost increase.
4	Ekhator (2016); Arain et al. (2004)	Insufficient project drawing	i. The input from other project contractual documents must be precise and clear; this is critical to the accuracy of the functional drawings. ii. However, an erroneous functional drawing may cause confusion in the manufacturing process and postpone the project's construction phase.
5	Ismail et al. (2012)	Delayed project decision making	Immediate decision-making by project stakeholders is critical to the project's success. As a result, delaying a critical decision on changing the scope of work may result in an increase in the variance cost.
6	O'Brien (1998)	Project material	Unavailability of critical project components is a procurement issue that could jeopardise the project's completion.
7	Arain et al. (2004)	Lack of skilled labour	Skilled labour remains a vital component of technological operations. Variations and delays may develop as a result of an insufficient supply of trained workers.
8	Ibbs (2005)	Contractual worker's financial challenges	The financial constraints that a contractual worker faces during a project result in insufficient resources. Subsequently, the progress of the project may result in deviations and an extended duration.

Universiti Utara Malaysia

9	Serdar (2019)	Contractual documents conflicts	Between the contractual parties, misinterpretation frequently occurs, resulting in project delays and deviations.

Source: Compiled by author

Universiti Utara Malaysia

2.5.2 Impacts of Variation Orders on Naval Ship Construction Projects

Kerzner (2009) highlighted that project cost control and project schedule management are significant in project management, numerous experts have discovered that Variation Order (VO) is the primary reason for cost and schedule delays in naval shipbuilding projects. For example, Lindhard (2014) stated that VO has a detrimental effect on current naval shipbuilding project, most notably through cost increases and timetable delays. Ibbs (2005) and Al-Momani (2000) also state it similarly. They agreed that VO has a significant impact on the cost and schedule of naval shipbuilding projects. Dansoh et al. (2017) and O'Brien (1998) also validated the negative elements of VO in the projects, despite the fact that they occur in a wide variety of naval shipbuilding construction projects as a typical working method.

Bower (2000) claimed that VO can result in an increase in project cost and schedule. Thus, he addressed that the project stakeholders continually emphasised the need to complete the project on time and within budget. Yadeta (2016) in his study emphasised the multiple implications of VO's on naval shipbuilding projects. These implications include schedule delays and increased project costs. Yadeta (2016) also mentioned the other related impacts are supplemental payment to the contractor, influence on progress, and increased overhead expenditures.

Arain and Pheng (2005) also explained that various studies have discovered the occurrence of VO can have an effect on the quality of naval shipbuilding projects. This, including increasing the amount of VO in naval shipbuilding, significantly reduces the quality of the construction phase due to the project's limited cash flow and schedule. Koushki et al. (2005) also agreed with this statement, while they mentioned that the occurrence of VO throughout the shipyard construction phase harmed project completion and increased project costs.

Universiti Utara Malaysia

Zeitoun and Oberlender (1993) reported that variance can result in a 9% delay in the start of a project's time period. Kumaraswamy et al. (1998) claimed that challenges in Hong Kong's shipbuilding construction projects were delayed due to a variety of variables. As a solution, temporary staff were engaged to match the work load discrepancies. However, this approach increased the initial project cost significantly. Another consequence of VO was the increase in project cost, which was considered to be the strongest effect (CII, 1990a).

In addition, Clough and Sears (1994) stated that any modification or expansion of the project's performance may result in the degradation or revision of any project component, resulting in an increase in the project's price. The technique and application of deviations in shipbuilding construction projects would result in an increase in overhead expenses for each project participant. Typically, these overhead costs are met from the funds for the shipbuilding construction project.

According to Fisk (1997), the impact of deviations in the nature of the agreed-upon work scope will force shipbuilders to compensate for lost time by decreasing the work quality. He also stated that VO causes the logistical delays, and when variances occurred, new needs in the work scope necessitated for more material requirements.

This situation resulted in the shipbuilder's logistics plan being delayed. Therefore, O'Brien (1998) mentioned that deviations require planning, documentation, and assessment prior to implementation. Hester et al. (1991) also demonstrated that logistical costs increase when a shipbuilder revises the project timeline in response to VO's new timeline. In other words, equipment providers must deliver the equipment in accordance with the amended timetable, which has a substantial impact on the overall cost of the project due to the payment of new logistic delivery costs.

Universiti Utara Malaysia

As a result, Oladapo (2007) concluded that variation accounts for 78% of the cost overruns in project budgets due to the usage of management reserve budget for project progress, resulting in more significant losses to the organisation. According to a survey conducted by Odeck (2013), 52.42% of 620 projects undertaken by the Norwegian Public Roads Management (NPRA) encountered extra costs of 519 million Norwegian kroner.

This predicament arose as a result of unmanaged variation orders. Meanwhile, Shrestha et al. (2013) discovered that variance accounted for 32.3% of the cost increase on 363 transportation projects in Nevada, USA. Additionally, according to another study conducted by Shehu (2014), on 359 projects undertaken in Malaysia, 55% of the projects were influenced by variances in project costs.

A survey conducted by Kumaraswamy and Chan (1998) in Hong Kong explained the variation's effect on the project schedule. They found out that 83 projects were delayed due to variations. Meanwhile, Durdyev and Hosseini (2019) discovered that studies from underdeveloped nations contributed the most to determining the scheduling overwhelm elements. In total, 149 pieces of research indicated that project delays occurred as a result of uncontrolled variation, which had an effect on the project's completion timeline.

Additionally, Sambasivan and Soon (2007) conducted a study on the factors that contribute to and affect deferrals in the Malaysian construction industry. Following that, it was determined that distinct variances resulted in project schedule delays. This also increased the project's cost. As found by Kerzner (2009) as well as Shenhar and Dvir (2007), any factor contributing to project schedule overwhelm would also contribute to project cost overwhelm.

Universiti Utara Malaysia

2.5.2.1 Earned Value Analysis as a Method on Managing Project Cost and Schedule

Hales (2017) explained five common methods of managing project cost and schedule. The first method is expert judgement. The purpose of this method is to provide a guess of the project cost. This usually happens early in the project phase and can be inaccurate due to project differences and estimator expertise. The second method is analogous estimating. This method is known as the top-down method of estimation. This method is also used in early project phases by comparing the current project with similar completed project data. The third method is parametric estimating, which is believed to be more accurate than other methods in estimating because it combines costs from similar previously completed projects with known costs of changes.

The fourth method is three-point estimating. This method is used to reduce bias and uncertainties by performing an average calculation on three different scenarios: the best case, the most likely case, and the worst case. The fifth method is earned value analysis. This method is also known as "bottom-up estimating." This estimation is the most accurate because the cost is derived from the detailed project work scope and the time for each work scope can also be monitored.

Universiti Utara Malaysia

PMI (2017), Newton (2015), and Kerzner (2009) reported that the Earned Value Analysis (EVA) is the most useful project management method for determining the influence of variation orders on project cost and schedule. EVA is a systematic project management technique that project managers use to assess the cost and schedule performance of their projects. EVA is very relevant in the forecast of the most accurate project budget when it is implemented in the management of price and schedule (Dwivedi, 2015). As illustrated in Figure 2.10, PMI (2017) confirmed three critical aspects that need to be considered by project management team when

performing the EVA. These aspects are (i) projected value (PV), (ii) earned value (EV), and (iii) actual cost (AC).

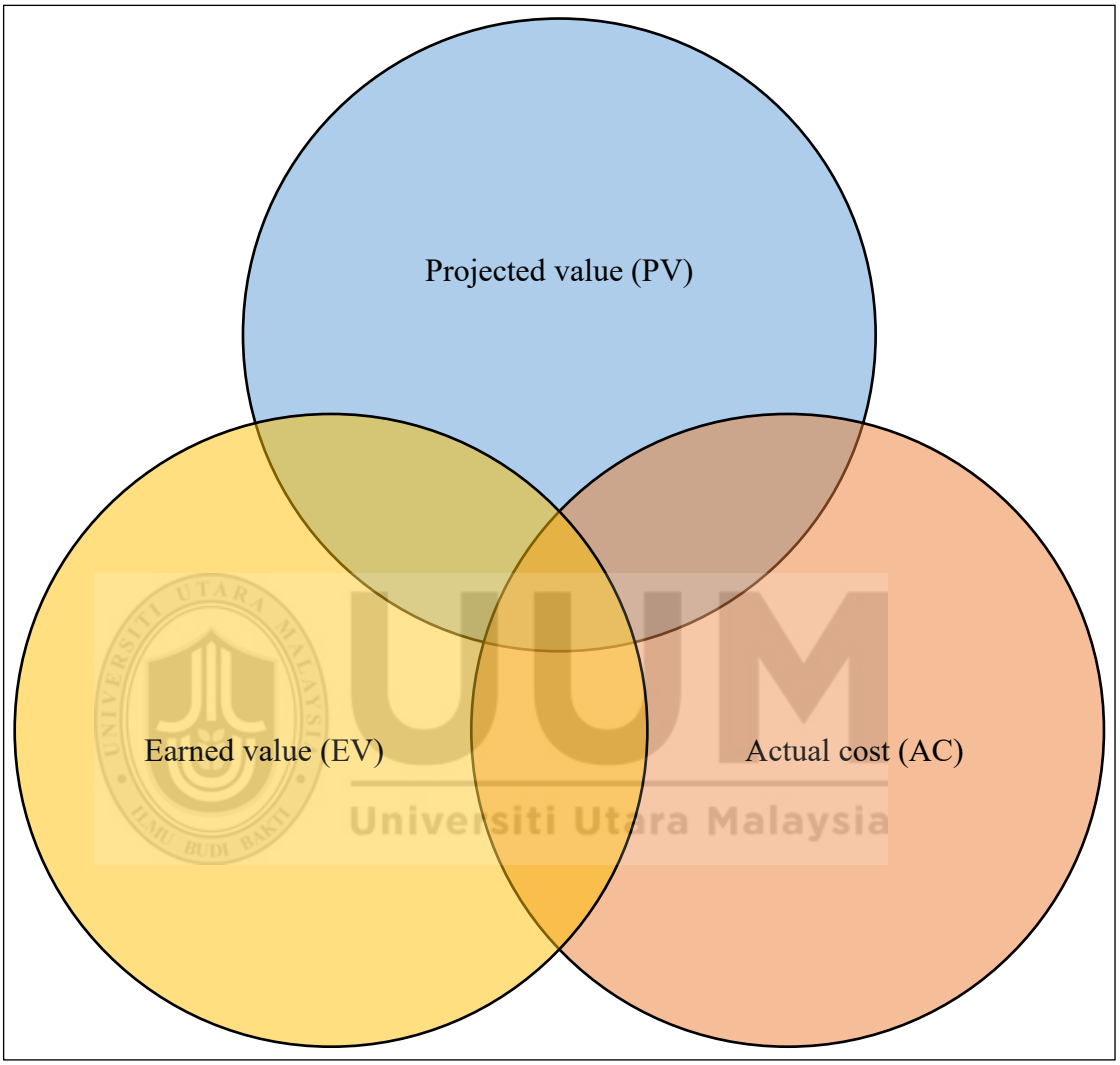


Figure 2.10
Three Critical Aspects to be Considered When Performing EVA
Source: PMI (2017)

Universiti Utara Malaysia

The term planned value refers to the budget set aside for scheduled work that is achieved for an activity or work breakdown structure (WBS) component but does not include the management reserve (Hodgson, 2017; PMI, 2017). Meanwhile, earned value (EV) denotes the extent to which work has been completed in relation to the approved budget and is usually used to calculate the percentage of project completion (PMI, 2017). Additionally, the actual cost (AC) shows the total cost of the work performed on an activity over a certain length of time and for the completion of the project (PMI, 2017).

The three measurements, namely PV, EV, and AC, enable the project manager to make a judgement regarding corrective action for the cost performance index (CPI) and schedule performance index (SPI). Meanwhile, the cost performance index (CPI) quantifies cost effectiveness, which is expressed as a ratio between the estimated and actual costs. As a result, a CPI number of less than 1.0 indicates a cost overrun, whereas a value of more than 1.0 indicates that the project's cost is under control (PMI, 2017).

Universiti Utara Malaysia

An SPI is a measurement used to determine how close a project is to being completed in comparison to the project schedule. It is calculated as the ratio of the budgeted cost to the actual project work executed. Additionally, it determines the project team's efficiency in meeting the project's cost with the work accomplished on the project. Additionally, an SPI number less than 1.0 indicates that work is not being completed on time, whereas a value greater than 1.0 indicates that work is being completed on time and the project is ahead of schedule (PMI, 2017).

2.6 Underpinning Theory: Theory of Constraints

Izmailov (2016), highlighted that the theory of constraints is a methodology for identifying the limiting factors that constraints any management or production system from reaching a greater proportion of its objectives. In 1984, Eliyahu Goldratt popularised this theory and considered the time-honored adage. This theory tries to detect and remove the contraints. As illustrated in Figure 2.11, they also added that there is a list of questions common for all project types.

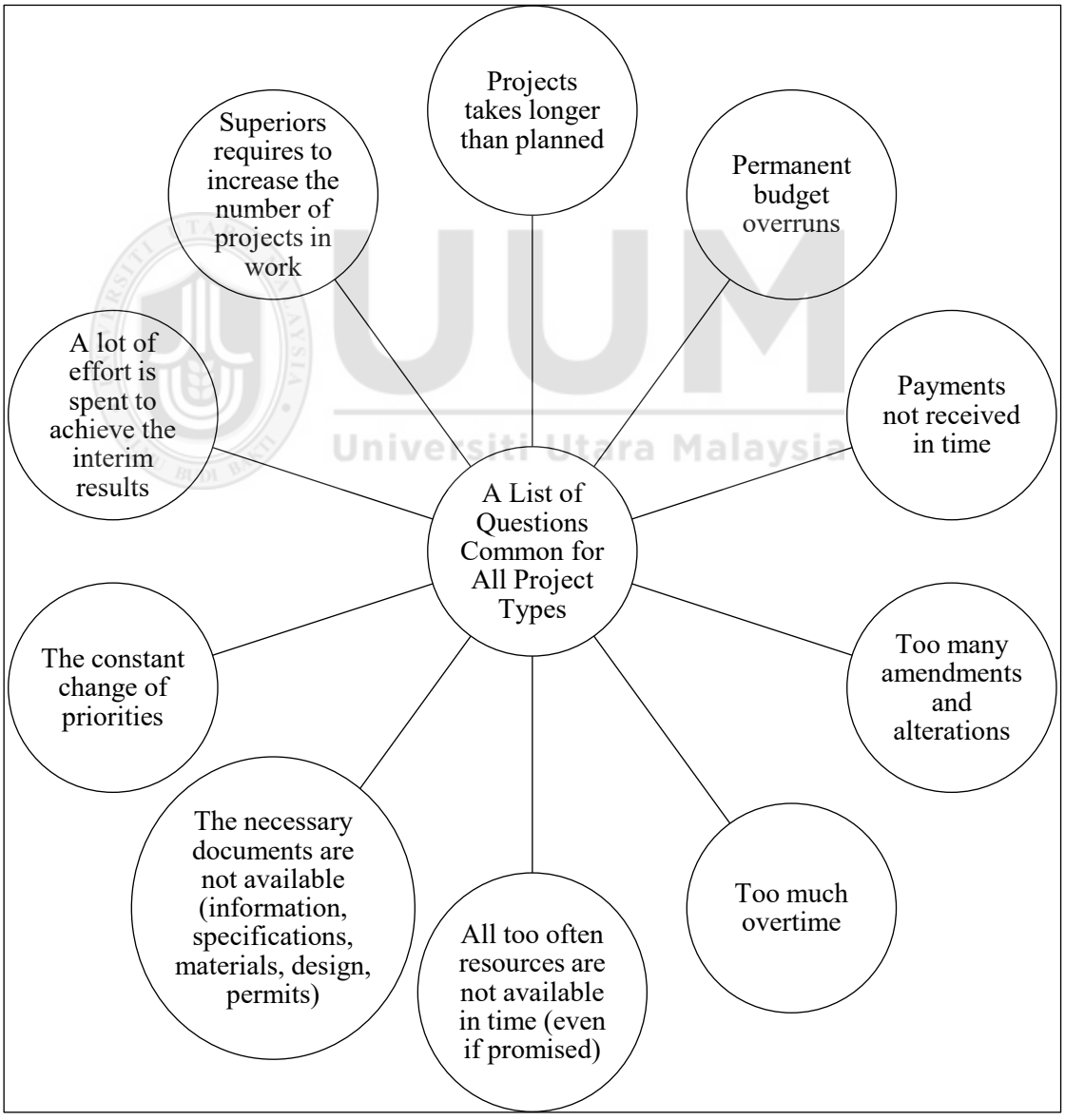


Figure 2.11
A List of Questions Common for All Project Types
Source: Izmailov, Korneva, and Kozhamiakin (2016)

Universiti Utara Malaysia

Critical Chain, a methodology based on the Theory of Constraints for project management, identifies project management factors that almost always result in negative consequences. The factor is bad multitasking. The act of interrupting a task before it is completed in order to complete another task that is deemed more essential or necessary in this case to clear up the VO's. Each time a job is paused, efficiency is immediately lost due to the necessity to recall details in order to resume the task execution later.

Even worse, when one task's execution is halted, subsequent tasks' execution is also slowed. As a result, the project's overall time increases. This rapidly results in the "cascade effect." In other words, the delay propagates across the project like a domino effect, lengthening the entire project time ultimately postponing the project.

Therefore, while this theory includes the process of exploring the limiting factors that affect the productivity of a project, focusing steps on identifying constraints and improving the system, as well as involving thinking processes in identifying problem-solving tools, this theory underpinned this study. As mentioned in the introductory chapter 1, the primary purpose of this qualitative study is to understand the variation orders in a naval ship construction company and to improve the project management efficiency through a standard operating procedure (SOP) in accordance with the EPCC shipbuilding project management process flow for VO management.

Specifically, this study determined the factors contributing to VO occurrence in the LCS project. Besides, this study also examined the impacts of VO in terms of costs and schedules on the efficiency of the LCS project management team. Not only that, but this study also proposed the improvement measures required to reduce the occurrence of VO in the LCS project.

Universiti Utara Malaysia

2.7 Conceptual Framework

This study developed a conceptual framework, as shown in Figure 2.12, to explain the concept of this study. The initial part of the framework highlights the focus of the study as being related to the variation order in project management in a naval ship construction company. Next, the framework emphasises the issues discovered by this study, which are the contributing factors that lead to the occurrence of VO and their impacts on cost, schedule and project management team efficiency. The exploration of these issues is aligned with the first and second research objectives (R1 and RO2) of this study.

The framework also highlights the action that needs to be undertaken to overcome the mentioned issues. This is aligned with the third research objective (RO 3) of the study. In the end, the framework also points out the expected output of the study in achieving higher project management efficiency.

Universiti Utara Malaysia

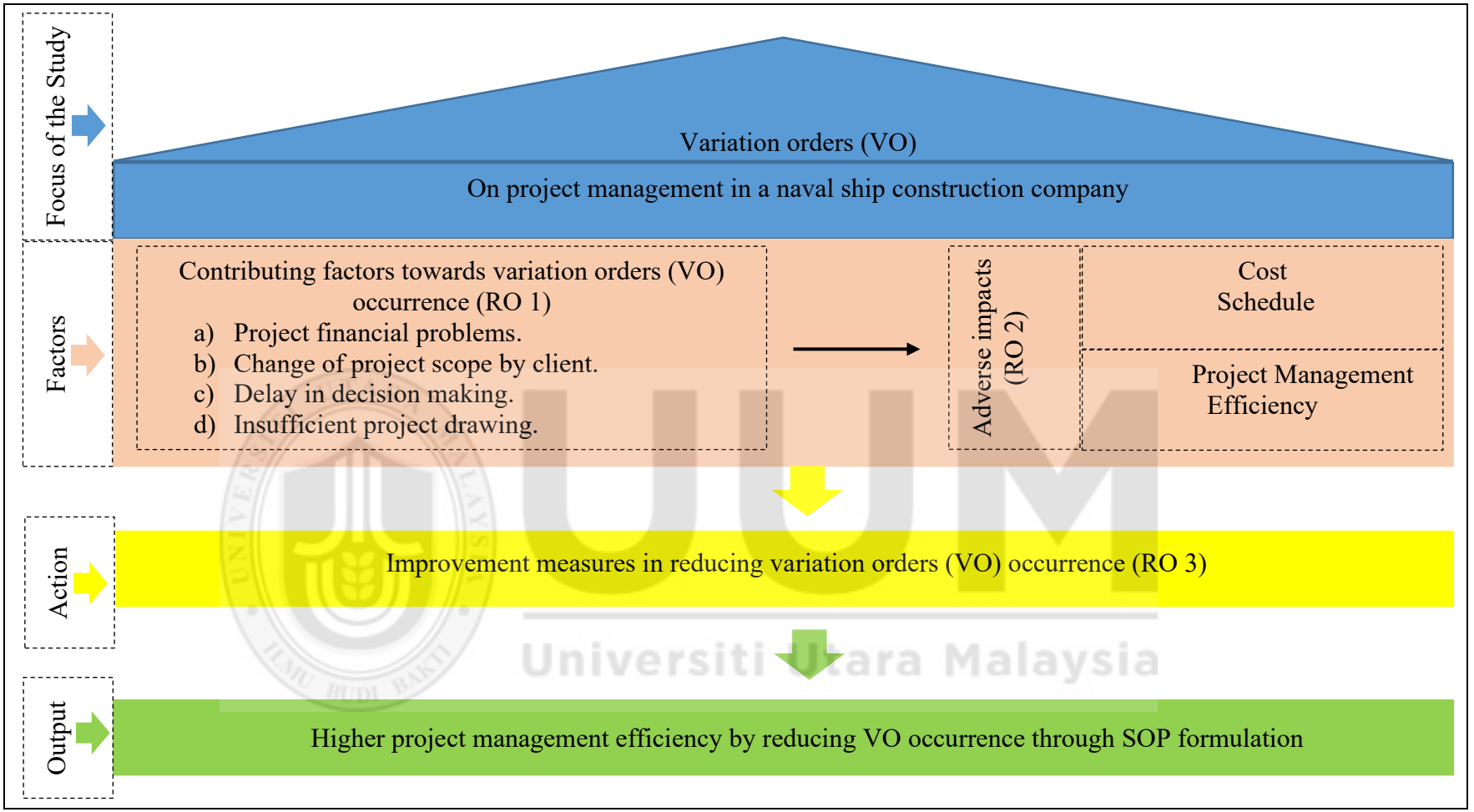


Figure 2.12
Conceptual Framework
Source: Compiled by author

Universiti Utara Malaysia

2.8 Conclusion

In summary, this chapter aids in the understanding of the variation order within a navy ship construction company and the effectiveness of project management. The literature review covers review the project management and project management efficiency (cost and schedule management), naval ship construction projects, and variation orders, as well as the factors that contribute to and impacts of VO on naval ship construction projects. Additionally, this chapter discusses the underpinning theory and conceptual framework. This chapter exemplifies the study's specific orientation in attaining its objective of gaining a better knowledge of the variation in order inside a naval ship construction company and project management.

Following that, the next chapter serves to highlight the methodology employed to accomplish the study's objective and guide the study's path.

Universiti Utara Malaysia

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

The previous chapter 1 highlighted the main focus of the study, specifically the primary aim, research questions, and research objectives. Following these elements, this chapter presents the methodology used in answering the research questions and in fulfilling the research objectives. The explanation of this chapter starts with the research philosophy and research design of the study. Then, this chapter highlighted the population, sampling technique and the instrumentation used. This chapter also emphasised data collection and data analysis. This chapter ends after focusing on the ethical concerns adopted by this study.

Universiti Utara Malaysia

3.2 Research Philosophy

It is vital to understand the research philosophy in order to aid this study in identifying the most effective technique for expressing the study's goal. Creswell (2012, 2018) explained that the key decision about which technique to adopt in examining a given occurrence of interest should be chosen based on this study's philosophical ideas about the issue. As a result, given that the purpose of this study was to better understand variation orders within a naval ship construction company and to increase project management efficiency, the research needed to select the most appropriate method for addressing the research question raised in the preceding chapter.

According to Creswell (2012), grasping the research paradigm permits this study to establish how its efforts should be focused in order to encompass all possible research phases. As a result of Patton's (2002) logic, a paradigm selection must be made in order to determine the applicability of the study approach. Typically, two perspectives are used to view the research paradigm: positivist and non-positivist. According to Creswell (2012), positivists frequently investigate the social environment through scientific means, prioritising information above in-depth understanding and forming preconceived notions.

Aliyu et al. (2014) similarly justified this claim by referring to quantitative research as a positivist or scientific paradigm. According to researchers, the world is made of observable and quantifiable facts. As a result, positivists have generally preferred quantitative approaches to resolving research problems. This stands in stark contrast to the non-positivist worldview (constructivism or social constructivism) defined by Creswell and Creswell (2018). They argue that humans cannot be assessed scientifically because they radiate feelings, emotions, and thoughts that affect how they view a problem dynamically.

Alessandrini (2012) asserts that a non-positivist technique can be distinguished from pure science. It is founded on a humanistic view of sociology. Similarly, it takes an interpretive perspective, acknowledging how difficult it is to systematically probe human behaviour in certain friendly conditions. Additionally, this study determined that non-positivism, constructivism, or social constructivism were the most suited methodologies for conducting qualitative research on this subject. Because this perspective acknowledges that people derive abstract meanings from their lived interactions with specific wonders in order to have a deeper understanding of the environment in which they live and work (Creswell, 2018).

Universiti Utara Malaysia

Non-positivists face an ontological dilemma in the form of relativism, which maintains that truth is abstract and subjective. Independently, the truth is formed (Scotland, 2012). Thus, non-positivists argue that, while individuals do indeed exist as living entities, their jobs, practises, and effects are social phenomena; they exist purely because a group of people deciphers them (Alessandrini, 2012).

Meanwhile, non-epistemology positivism is a type of subjectivism that is predicated on genuine miracles. A non-positivist researcher reveals their subjectivity in a variety of ways, including recognising evidence of other sources of information, incorporating personal preferences into the inquiry, and interfering unduly with the analyst's point of view throughout the process. A non-positivist is reactive and prone to self-reference, constantly on the lookout for procedural inconsistencies (Alessandrini, 2012).

Thus, based on the judgement and definition of the research philosophy, it was found that a qualitative research design would be appropriate for this study, as Creswell and Creswell (2018) advice. Qualitative research design evaluates and interprets the interpretations of an event made by individuals or respondents.

Universiti Utara Malaysia

3.3 Research Design

The term "research design" is used to describe a method for conducting research. The procedure includes the formation of a problem statement, analysis of the research issue, development of a technique, analysis of the results, and the giving of justification and explanation.

Table 3.1
Research Design

Research Design	
1. **Research Approach**	Qualitative Method (Case Study)Place (Naval Ship Construction Company, Boustead Naval Shipyard) Shipbuilding section (LCS project)
2. Sampling Technique	Using Purposive sampling LCS Project Management Team
3. Sample Size	Total 12 respondents from LCS project PMT
4. Data Collection	Semi-structured interview
5. Data Analysis	NVIVO

Source: Compiled by author

3.3.1 Qualitative Research

This study adopted a qualitative research design that focuses on semi-structured interviews as the data collection method. Previously, Hammarberg, Kirkman, and De Lacey (2016) stated that qualitative research design is needed to improve understanding through first-hand experience as it aims to facilitate participants in deriving meanings from their surroundings and determine the influence of the meaning influences on the situation in the organisation. Meanwhile, Bryman and Bell (2003) highlighted that the interview approach is the most commonly used research procedure in qualitative methodologies as it offers an adaptable technique that could be used to record an individual's notable perspectives and beliefs.

Universiti Utara Malaysia

According to Oishi (2003), qualitative research characterises and comprehends experience. He said that the one-on-one interview involves direct contact between researchers and respondents. Respondents were asked an open-ended question and allowed to react freely during the interview session. Oishi (2003) also recommends informing respondents that they have the right to decline to answer any question that causes them discomfort.

They are free to make additional comments and recommendations throughout the session, if necessary. Besides, qualitative research offers numerous advantages. According to McClelland (1998), an open-ended question results in a much more accurate assessment of employee attitudes and behaviour.

Universiti Utara Malaysia

3.3.2 Case Study

This study is considered a case study. As stated in the introductory chapter 1, the general scope of this study is the shipbuilding activity contracted by the Malaysian government to the shipbuilder, Boustead Naval Shipyard Sdn Bhd. The contract covers the construction of a naval warship called the Littoral Combat Ship (LCS), with the contractor responsible for designing, building, testing, conducting trials, and delivering the ship according to agreed parameters in the contract. This study concentrated on the project supervisory group for project management, “project management team LCS."

Case studies were among the earliest forms of qualitative research. They currently account for a sizable portion of the research published in books and journal articles in subjects such as psychology, history, education, and medicine, to name a few. Much of what we know about the empirical world today comes from case study research, and many of the sciences' most revered classics are case studies (Flyvbjerg, 2011). Case studies are commonly used in the social sciences and can be especially valuable in occupations that need practical knowledge (such as education, management, public administration, and social work). Despite its long history and widespread application, case study research has received less attention than other approaches to social science research.

Mills, Durepos, and Wiebe (2010) report that just a few texts explicitly cover case studies. According to Thomas (2011), the majority of research methodology manuals omit or combine case studies with other types of social research. As a result, case studies are characterised by ambiguity and inconsistency in their definition, research topics, and methodological selection (Verschuren, 2003).

Universiti Utara Malaysia

As a result, case studies are frequently misunderstood as a subtype of qualitative research and a qualitative research approach (Gerring, 2004). A case study, according to Yin (2003), is an empirical study that investigates a current phenomenon in its naturalistic setting, particularly when the boundaries between the phenomenon and the setting are ambiguous.In contrast to other methods, Yin (2003) says that case study is the best way to look at a case from a real-world point of view, mostly through the use of documents, archival records, interviews, direct observation, participation observation, and physical artifacts.

Numerous scholars from a variety of disciplines and sectors have utilised case studies to analyse current real-world events and lay the framework for the application of ideas and methodology development (McClelland, 1998). A case study is an in-depth assessment of a phenomenon in real-world settings and from the perspective of the phenomenon's subjects. It frequently seeks answers to how and why questions through the eyes of interested people rather than through the lens of a study's predetermined conclusion (McClelland, 1998). These definitions were used as a guide for conducting the inquiry.

Universiti Utara Malaysia

3.4 Population and Sampling Technique

As mentioned earlier in chapter 1, the primary aim of this study is to understand the variation orders in a naval ship construction company and to improve the project management efficiency through a standard operating procedure (SOP) in accordance with the EPCC shipbuilding project management process flow for VO management. So, the population selected for this study is specifically the project management supervisory group known as the Project Management Team (PMT) LCS. 12 persons from PMT is selected for this study. Purposeful sampling was employed in this research. Patton (2002) and Martínez-Mesa et al. (2016) justified the significance of purposeful sampling, particularly in the selection of cases full of information. Through these types of cases, individuals would be able to understand crucial matters, which fulfilled the purpose of the research.

Besides, the examination of cases full of information contributed to new and detailed understandings instead of empirical generalisations. Meanwhile, Suri (2011) defined purposeful sampling as a method used by the qualitative researcher to involve respondents who were able to offer comprehensive data regarding the examined case. Notably, a thorough investigation of an individual's work experience is considered an essential element of information in this study as it facilitates understanding regarding the participants' perspective of their experience in managing the VO processes.

Universiti Utara Malaysia

3.5 Instrumentation

It is critical to use instrumentation that is able to collect useful and reliable data for the study. Previously, Paelke et al. (2018) stated that instrumentation selection is a critical step that mirrors the transformation of reality's features into concrete numbers and values that may be evaluated appropriately. Besides, Ai et al. (2019) also endorsed the statement, emphasising the need for precision instrumentation in producing empirical data that accurately reflects the statistical type. Therefore, this section discusses the qualitative instruments used in this study. While this study adopted a qualitative research design that focuses on the semi-structured interview, the instrumentation developed can be categorised into five sections. These sections were designed based on the specific research questions and research objectives of the study.

The first section consists of the introductory statement for the respondents and a few questions regarding their demographic questions. According to Welsh (2002), demographic information determines whether the individuals in a study represent the aimed population to be generalised. These demographic questions include: (i) age, (ii) gender, (iii) highest academic qualifications, (iv) shipbuilding project management experience, (v) previous employment experience (based on sector), (vi) numbers of contracts managed, and (vii) section of equipment contracts managed.

The second section consists of questions for answering research question one. These questions were designed to obtain information on the factors contributing to variation order (VO) occurrence in the Littoral Combat Ship (LCS) project. Some examples of these questions are: (i) What do you think are the factors contributing to the occurrence of VO's in the LCS project?, (ii) In your opinion, what are other factors that can contribute to the occurrence of VO in LCS project?.

Universiti Utara Malaysia

The third section consists of questions to answer research question two. These questions were designed to obtain information on the impacts of variation orders (VO) in terms of costs and schedules on the efficiency of the Littoral Combat Ship (LCS) project management team. Some examples of these questions are: (i) In your opinion how can VO impact to project cost and schedule?, (ii) In your opinion how does VO can affect the efficiency of project management team in the LCS project?, (iii) What approach have been taken by the Project Management Team (PMT) to measure the impact of VO in LCS project efficiency?

The fourth section consists of questions answering research question three, which inquires about the improvement measures required to reduce the variation orders (VO) occurrence in the Littoral Combat Ship (LCS) project. Some examples of these questions are: (i) How is VO managed in this project?, (ii) Do you satisfy with the VO management in this company?, (iii) Are you aware of the any improvement measure in reducing VO in this company?, (iv) Is there any work instruction or procedure in this company regarding the preparation of VO?, (v) How to reduce the occurrence of VO in the LCS project?, (vi) Which of the following approaches can reduce occurance of VO?, and (vii) Can you please provide suggestions on how to improve the VO management in this company?

The fifth section concludes the interview questions. During this session, this study expressed appreciation to the respondents, followed by additional questions presented to them. An open suggestion was provided for the respondents to reduce the VO in shipbuilding projects, especially LCS.

Universiti Utara Malaysia

Notably, this answer could offer vital information that developed a recommendation for improvement when this study was concluded. Some examples of these questions are: (i) Can you please provide some suggestions or ideas to overcome the occurrence of VO in shipbuilding project?, and (ii) In your opinion, how could Project Management Team control the impact of VO in shipbuilding project?.

Universiti Utara Malaysia

3.6 Data Collection

Following the development of the research design, the data collection approach was determined. The data collection procedure entails contacting and gathering information from secondary sources as well as the relevant data from the analytical units. Patton (1990) asserts that no hard standards for data gathering and technique selection in evaluation can be supplied. This enables the researcher to select and arrange the most appropriate approach for data collecting. This study collected the data from 4th till 29th January 2021 and utilised semi-structured interview as the data collection method by using the instrumentation presented in the earlier section. Semi-structured interviews are arranged according to an interview guide, which assists in performing a more systematic and comprehensive interview. It also ensures the achievement of optimal data collection during the duration of an interview (Jamshed, 2014).

Jamshed (2014) also stated that the effectiveness of the interview is crucial for more efficacious data collection. DeJonckheere and Vaughn (2019) highlighted that a relative focus and practise on the facilitation skills are essential in a semi-structured interview, including: (i) specifying the scope and objective of the research, (ii) determining the respondents, (iii) taking ethical matters into account, (iv) generating the interview guide, (v) establishment of reliability and affinity, (vi) data analysis, (vii) illustrating the research reliability, and (viii) demonstrating the results.

Ranney and Zachary (2015) continued, Several procedures are crucial for conducting relevant and dependable qualitative research, which focuses on interview-based research. Based on the procedures of the interview shown in Figure 3.1, the project management team was invited to the interview session using e-mails.

Universiti Utara Malaysia

After an agreement for participation was obtained from the participants, another e-mail with the arrangement of time and date was sent. The interviews were written in the transcript, which was then verified by the respective participants. It is noteworthy that the confidential information from this interview was solely for the purpose of this research.

Universiti Utara Malaysia

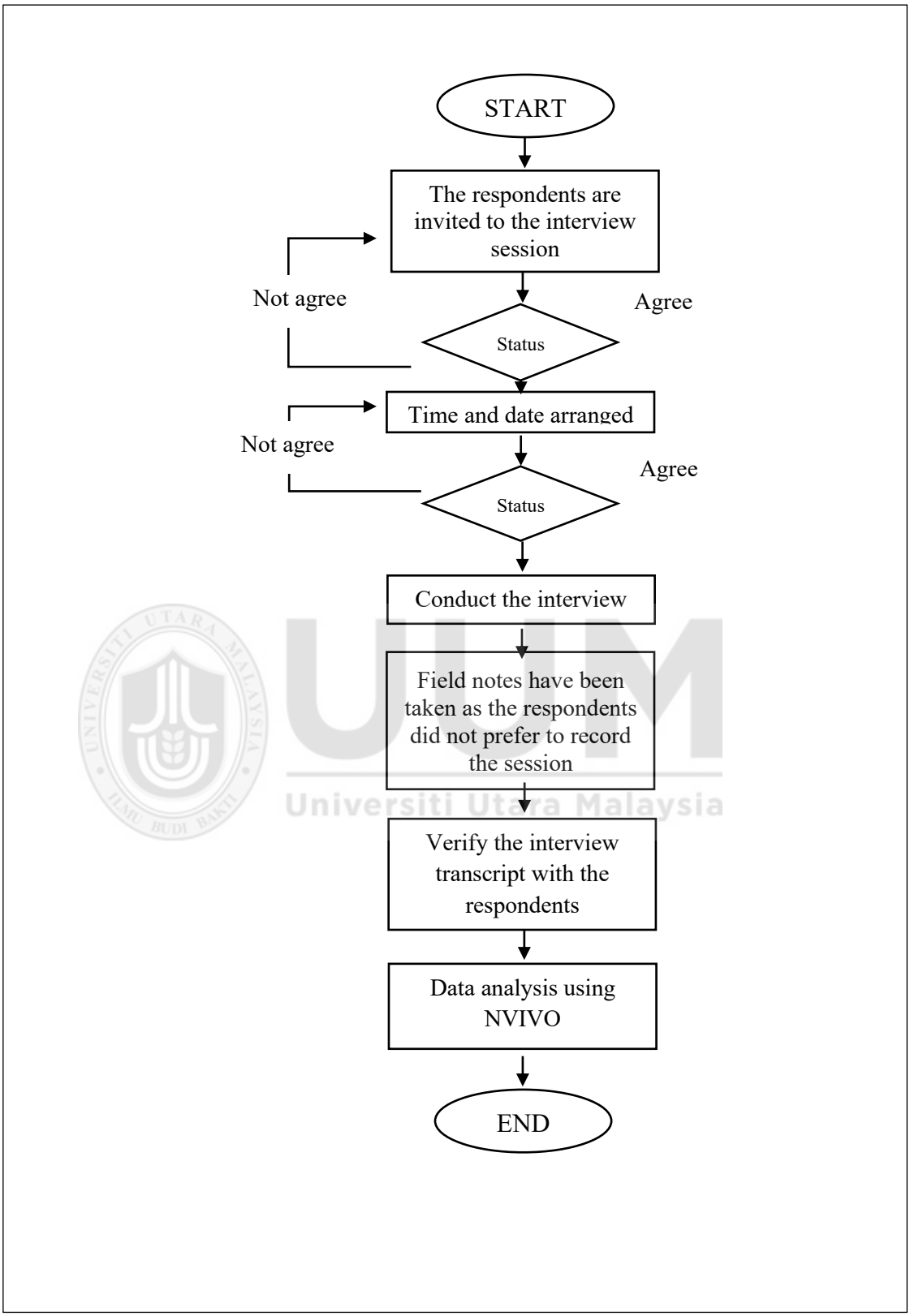


Figure 3.1
The Procedures for Interview Session
Source: Compiled by author

3.7 Data Analysis

The analysis technique is a critical component of any qualitative study, and thematic analysis was used in this study. This is the trending method introduced by Braun and Clarke (2006), for qualitative data analysis. Thematic analysis, they said, is the act of detecting, analysing, and reporting on data patterns referred to as "themes." As a result, the data analysis followed Braun and Clarke's six-phase framework for theme analysis. Figure 3.2 illustrates these phases.

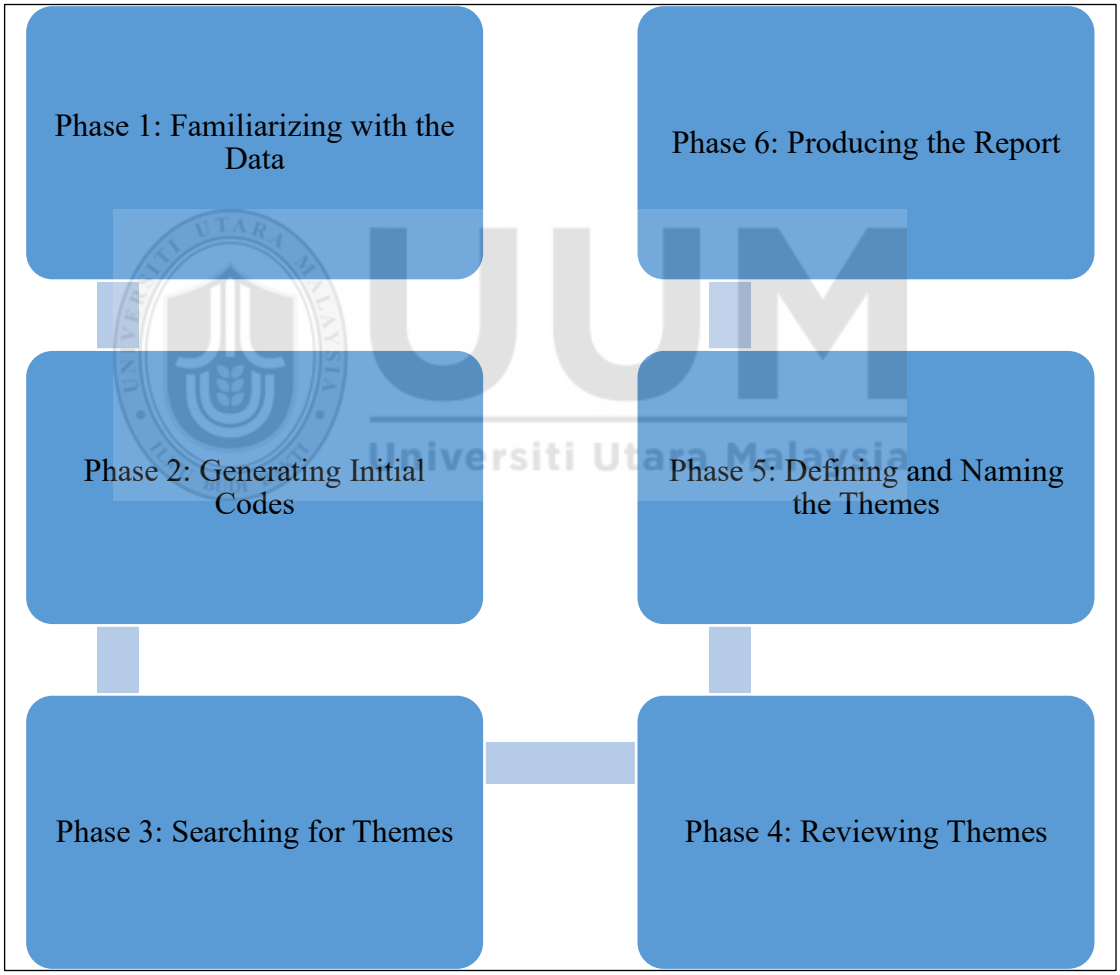


Figure 3.2
Six Phases of Thematic Analysis
Source: Braun and Clarke (2006)

Universiti Utara Malaysia

Besides, this study also utilised the NVivo software in managing the wealth of qualitative data. (Bazeley, 2007). Using this NVivo software, there are five principles in which NVivo supports analyses in this qualitative research. First, using this software helps the researcher to manage the research data. Second, it helps the researcher to manage ideas by categories or nodes in the data. Third, it assists the researcher in creating a database from which this study can retrieve answers to all research questions. Fourth, it helps the researcher to develop a model built from the data. Last, by using the contents of the data, a qualitative research report is produced (Bazeley, 2007).

3.8 Ethical Concerns and Reliability

This research posed no risk to the members involved in it or the organisations they worked for. Before the semi-structured interview, the interviewees were informed that their knowledge and experiences were communicated during the interview procedure. It was also clarified that their name and organisation would not be revealed in this research and distributed to anyone. This study took steps to ensure the confidentiality of respondents' information.

Universiti Utara Malaysia

According to Neuman (2011), this is an ethical safeguard for subjects being studied by maintaining the confidentiality of research data and keeping them hidden from the public. This is because this research contains confidential information on the project worth and related to the arm forces security. It is also noteworthy that the data recorded from the interview was solely for research purposes, and information about the interviewees remained anonymous.

Second, ethical concern is demonstrated by the accurate presentation of information. In other words, any false information and biassed representation of the main data findings can be prevented.

Bryman (2004) then emphasised the importance of reliability in establishing and evaluating the quality of research for a qualitative researcher. As a result, during the data analysis procedure, two criteria of qualitative dependability were used. To begin with, researcher analysed the consistency of transcripts with the respondets for transcription errors. Second, the coding was updated to improve its correctness. It is critical that no changes in the meaning of the codes occur during coding.

3.9 Conclusion

In summary, this chapter explains the study's research philosophy and methods. This chapter serves as a guide for this study in meeting the purpose and research objectives stated previously, notably in obtaining trustworthy findings regarding the variation orders in a navy ship construction firm and in enhancing their project management efficiency. The following chapter 4 reviewed the results obtained from respondents using the methodology mentioned in this chapter.

Universiti Utara Malaysia

CHAPTER FOUR
DATA ANALYSIS & INTERPRETATION

4.1 Introduction

This chapter presents the findings of the study attained from semi-structured interview sessions with 12 respondents from PMT. As mentioned in the previous chapter 3, this study utilised the purposive sampling technique to reach the respondents. This study conducted the semi-structured interview sessions at the respondents' workplace, and field notes have been taken as they did not prefer the study to be recorded. Due to that, this study confirmed their feedback after producing the full written transcripts. Next, the reliability of outcomes is a cornerstone of high-quality qualitative research. Member checking, alternatively referred to as participant or respondent validation, is a method for determining the trustworthiness of results. Therefore, this study also returned data or results to respondents to ensure their accuracy and consistency with their own experiences.

Universiti Utara Malaysia

As mentioned previously in chapter 1, this study contained three research objectives. Thus, the presentation of the findings in this chapter is based on these objectives. Specifically, this study begins the presentation of the findings related to the factors contributing to variation orders (VO) occurrence in the Littoral Combat Ship (LCS) project. Then, this chapter presents the findings related to the impacts of variation orders (VO) on Littoral Combat Ship (LCS) project management team efficiency (costs and schedules). This chapter ends after the presentation of the findings related to the improvement measures in reducing variation orders (VO) in the Littoral Combat Ship (LCS) project. Figure 4.1 provides a brief illustration of these findings.

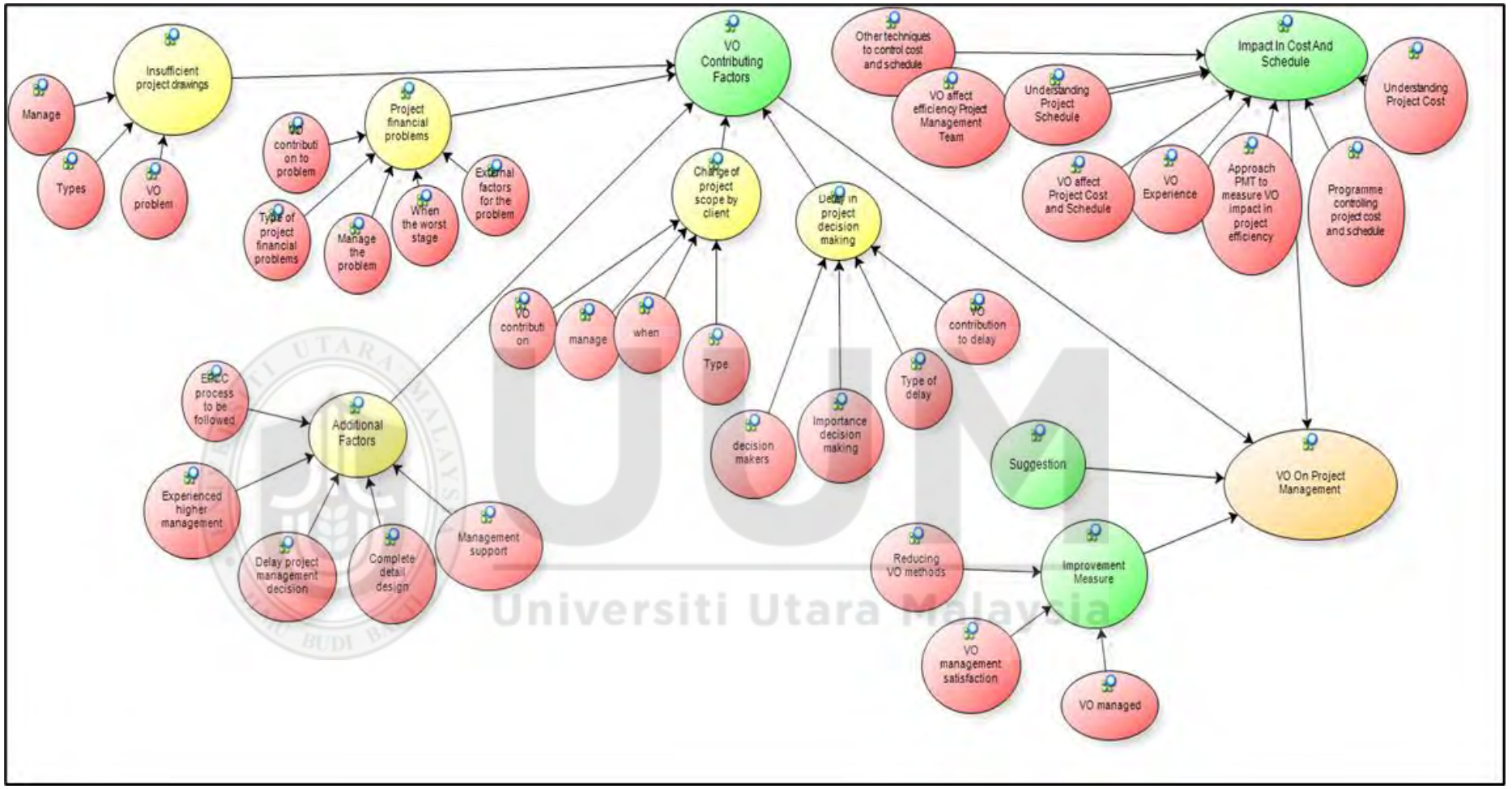


Figure 4.1
Nodes from NVIVO According to the Theme of Research
Source: Compiled by author

4.2 Respondents' Demographic Profile

The interview session was conducted starting from 4th January 2021 and completed by the end of January 2021. The interview sessions involved 12 participants from the Littoral Combat Ship (LCS) project management office. The participant had willingly agreed to be interviewed but with the condition that no recordings be made during the interview sessions. The interview sessions revealed crucial information on the actual problem faced by the LCS Project Variation Orders (VO) management. The respondents wanted to highlight what was happening and the problems faced by them in managing VO in the LCS project.

The respondent demographic is categorised as follows: (i) respondent age; (ii) gender; (iii) respondents' academic qualifications; (iv) shipbuilding project management experience; (v) previous employment experience; (vi) numbers of contracts managed; and lastly, (vii) section of equipment contract managed. Table 4.1 details the demographic profile of these respondents.

Universiti Utara Malaysia

Referring to Table 4.1, the highest respondent age range is from 30–35 years old, and the lowest age group is from 41–45 years old. For the age ranges of 36–40 and 46–50, there is no group of participants from this age range, there were 2 participant for age range above 50 years old. The majority of the respondents from the LCS Project Management Office are below the age of 40 years old and are male. Most of them also have a bachelor's degree as their highest academic qualification. Due to the need for technical understanding of the contractual requirements, academic qualification is essential in LCS project management. Education is also necessary for determining the correct technical terms to be used and comprehending the work procedure.

Most of them have experience in shipbuilding ranging from 6 to 10 years. The second highest has experience ranging from 1 to 5 years. There are also 2 respondents who have vast experience in shipbuilding. The second highest group is from recent graduates. This group of respondents has the tendency to make mistakes in the variation order management due to a lack of experience and training. Due to the complexity of the project, past employment experience plays a vital role in managing the project management for shipbuilding. Basically, respondents with experience other than shipbuilding can cope with the project management because the concept of project management is the same.

Table 4.1 also shows that the highest number of contracts managed by the respondents is in the range of 6–10 contracts per person. Secondly, in the range of 1 to 5 contacts, there are still 2 respondents managing 11 to 15 and 16 to 20 numbers of contracts. This shows the respondents are heavily burdened by too many contacts to manage. This can also cause them to lose focus and sometimes mis-manage the contracts. Most respondents are from the platform department, as the equipment under the platform covers 80% of the LCS ship equipments.

Platform equipment also has many sub-components with different contacts each. For combat systems, this is related to various types of ship weapons and ship sensor equipment, and it is a critical part due to the complexity and importance of national security. Respondents who manage combat system equipment contracts must have experience and related technical knowledge.

Universiti Utara Malaysia

Table 4 -1
Demographic Profile of the Respondents

No	Category	Description	Total
1	Respondent age range	25 - 29	3
		30 – 35	6
		36 – 40	0
		41 – 45	1
		46 – 50	0
		Above 50	2
2	Gender	Male	11
		Female	1
3	Highest academic qualifications	Diploma	0
		Bachelor's degree	8
		Master's Degree	4
		PhD	0
4	Shipbuilding project management experience	1 – 5 years	3
		6 – 10 years	7
		11 – 15 years	1
		16 – 20 years	0
		21 – 25 years	0
		26 – 30 years	0
		Above 30 years	1
5	Previous employment experience (based on sector)	Fresh Graduate	3
		Shipbuilding	6
		Oil and gas industry	2
		Civil building	1
		Others	0
6	Numbers of contracts managed	1 – 5	3
		6 - 10	6
		11 – 15	2
		16 - 20	1
7	Section of equipment contracts managed	Platform System	8
		Combat System	4

Source: Compiled by author

Universiti Utara Malaysia

4.3 Research Objective One: Contributing Factors to Variation Orders (VO) Occurrence in Littoral Combat Ship (LCS) Project

As mentioned in the introduction chapter, research objective one aims to determine factors contributing to variation orders (VO) occurrence in the Littoral Combat Ship (LCS) project. These factors are derived from the literature review explained in Chapter 2. The guideline to determine the significant level of impact towards the project are defined by Lavanya and Malarvizhi (2008). Both authors have categorized the significant level of impact with three (3) level of percentage, which are: (i) A rating for 100% significant level, (ii) B rating for 50% significant level, and (iii) C rating for 10% significant level. The rating guideline is described in Figure 4.2.

Project Objective	C Rating 10	B Rating 50	A Rating 100
Cost	Cost increase > 0 % or > 0 €	Cost increase 5 - 10% or > 50.000 €	Cost increase > 10 % or > 100.000 €.
Schedule	overall project schedule delay > 0 days	overall project schedule delay > 1 week	overall project schedule delay > 2 weeks *
Scope	Scope decrease barely noticeable	Minor areas of scope are affected	Major areas of scope are affected; scope reduction unacceptable to the client
Quality	Quality reduction barely noticeable	Quality reduction does not affect vital functionality	Quality reduction requires client approval

Figure 4.2
Significant level selection guideline
Source:Lavanya, N & Malarvizhi, T. (2008)

Each respondent gives the rating for each of the contributing factors and the result is shown in Table 4.2.

Universiti Utara Malaysia

Table 4.2
Significant factors contributing VO occurance in LCS Project

No	Contributing Factors	Overall significant rating
1	Change of project scope by client	A
2	Project financial problems	A
3	Change of design by design authority	B
4	Delay in project decision making	A
5	Insufficient project material	B
6	Inadequate skilled labour	B
7	Financial issues faced by contractual workers	C
8	Changes in contractual documents	B
9	Insufficient project drawing	A

Source: Compiled by author

Thus, Figure 4.3 illustrates these factors in the NVIVO. According to the feedback from the respondents, this study categorised these factors into four main themes, which are: (i) project financial problems, (ii) change of project scope by client, (iii) delay in decision-making, and (iv) insufficient project drawing. The following subsections present these themes.

Universiti Utara Malaysia

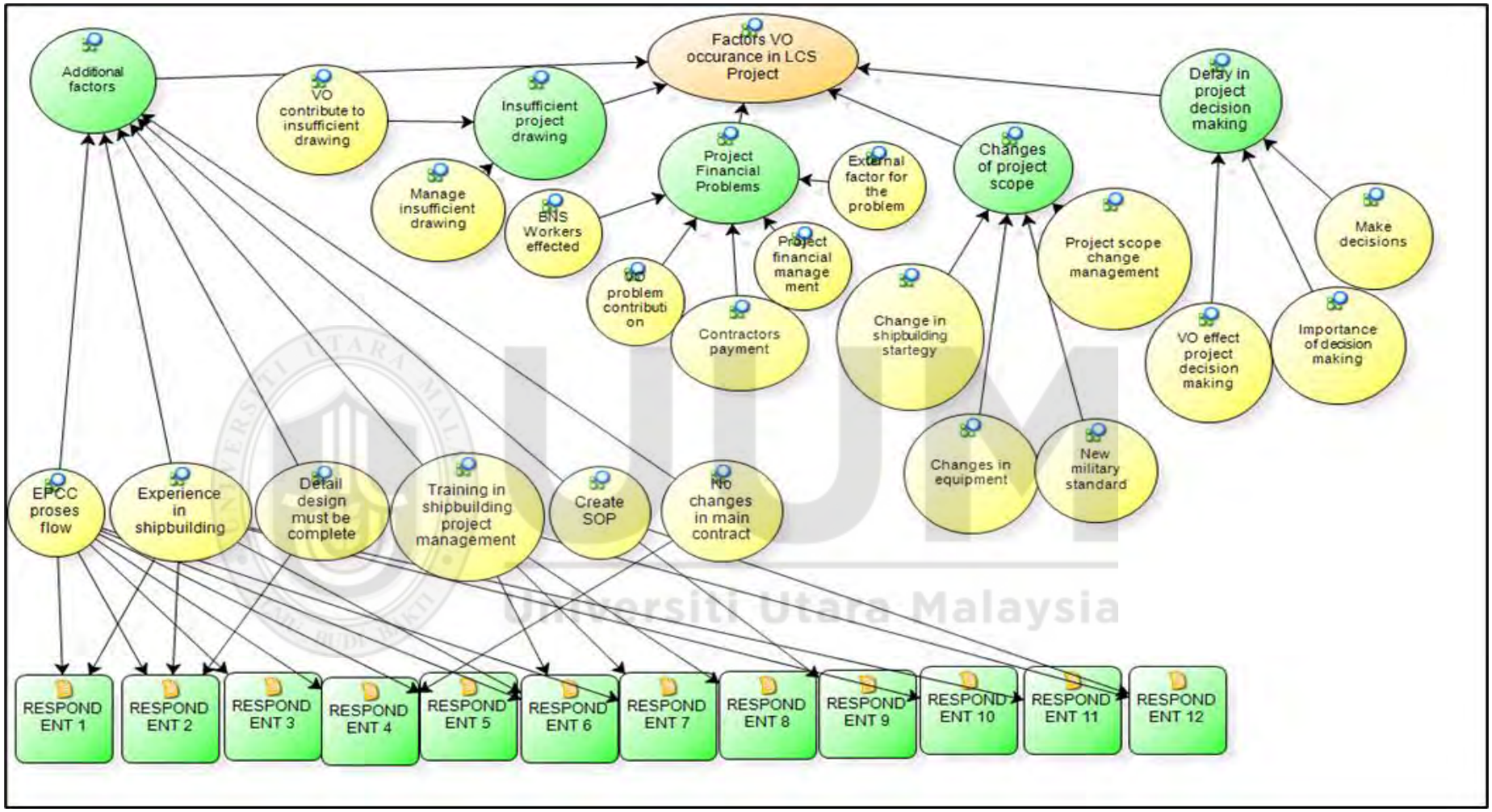


Figure 4.3
Factors Contributing to Variation Order (VO) Occurrence in the Littoral Combat Ship (LCS) Project
Source: Compiled by author

4.3.1 Project Financial Problem

The first theme is the project's financial problems. Based from the study findings, all respondents agreed that project financial problems are one of the major contributor to the increased occurrence of VO in LCS projects. The specific issues cited were an increase in project cost due to additional work scope and materials. Respondents stated as follows:

> *VO create additional work scope, extra budget approval (Responden#1, interview date: 04/01/2021, line 33)*
>
> *VO increases the project cost duet to extra work scope requirement (Responden#2, interview date: 05/01/2021, line 32) Need extra budget to the new additional work scope from VO (Responden#3, interview date: 06/01/2021, line 34)*
>
> *Extra work scope needs extra budget (Responden#4, interview date: 07/01/2021, line 33)*
>
> *When additional work scope is required ultimately additional budget needed to cover the extra work (Responden#5, interview date: 08/01/2021, line 33)*
>
> *VO add in additional work cope need additional budget (Responden#6, interview date: 11/01/2021, line 33)*
>
> *Additional work scope needs extra budget (Responden#7, interview date: 12/01/2021, line 32)*

Based on the information provided, it seems that the respondents have identified that variation orders (VO) can significantly impact the financial aspects of LCS projects. This is because VO often leads to additional requirements from clients, which in turn leads to an increase in the project's budget.

Universiti Utara Malaysia

This extra budget is typically paid for by the client, however, the shipyard still incurs costs such as using the company budget to keep up with the project schedule, and ordering materials from overseas, which may be delayed due to shipment issues or require special permits for military materials.

This study also found that the project management team may not have adequate access to the project budget, which is managed by the company's financial officer. The financial officer may not have a clear understanding of how to manage variation orders (VO) in LCS projects. Additionally, the project management team may not have a clear understanding of their job responsibilities for managing the project budget, as this is not clearly defined in their work scope. Furthermore, the study found that there is a lack of reference guide for the project management team in managing project costs, and determining which method can be used for cost management. The project management team is also not trained in project cost management which can lead to difficulty in managing the financial aspect of the project.

Based on the feedback from the respondents, this study also found that the shipyard was facing problems with payments to its subcontractors. The payments were either delayed or not paid. This issue appears to stem from the fact that payment claims from the main client are deferred, and require multiple stages of approval due to the large amounts of money involved. This leads to subcontractors stopping their work activities and some even filing court cases for payment claims. This has a negative impact on the project schedule and can lead to more financial problems.

Universiti Utara Malaysia

4.3.2 Change of Scope by Client

Based on the study, it appears that the respondents all agreed that changes to the scope of the project requested by the client are a major contributor to the increased occurrence of variation orders (VO) in LCS projects. The changes can be classified into four categories:

1. Changes in shipbuilding strategy
2. Changes in equipment
3. New military standards
4. Additional requirements from clients

The respondents noted that these types of changes can significantly impact the project schedule and budget, as well as leading to additional costs and delays.

> *Changes in the contractual agreed equipment, add more equipment, specification change (Responden#1, interview date: 04/01/2021, line 22)*
>
> *Additional new military standards not mentioned earlier in main contract (Responden#2, interview date: 05/01/2021, line 19).*
>
> *Clients add new main equipment requirement in the main contract (Responden#3, interview date: 06/01/2021, line 23)*
>
> *Payment milestone changes, additional requirement, new additional military standards are required by main client to be added in, this all happens after the main contract is already agreed by both parties (Responden#4, interview date: 08/01/2021, line 21)*
>
> *Main clients add in new requirements, due to not clear understanding of the main contract (Responden#5, interview date: 11/01/2021, line 19)*
>
> *Additional work scope not relevant to project needs, just to please the clients need … Additional new requirement due to the changes of military specification (Responden#6, interview date: 12/01/2021, line 22).*

Universiti Utara Malaysia

Additional new requirement imposed by main client due to the changes of military specification (Responden#7, interview date: 13/01/2021, line 20)

Adding new work scope and material (Responden#8, interview date: 14/01/2021, line 20)

Change of ship building process, contractual schedule (Responden#10, interview date: 14/01/2021, line 22)

Changes in the building strategy after ship building process begins due to the existing building strategy clashes (Responden#12, interview date: 15/01/2021, line 21)

In addition to the reasons already mentioned, this study also found that changes in scope can occur when the main client's project team changes, particularly when a new officer is appointed, which can cause problems for the shipyard. Furthermore, the study found that the project management team does not have standard operating procedures in place for managing changes in scope. These changes are typically discussed in change configuration meetings, attended by the relevant personnel responsible for managing the variation orders. This lack of standard procedures can lead to inefficiency and confusion in managing the changes and can contribute to the increased occurrence of VO.

This study also found that the process of deciding to proceed with changes in scope is time-consuming and tedious. The respondents noted that the decision-making process takes a long time to complete and involves multiple stages of approval, including board of director approval. This is due to the large amounts of money involved with the changes. This can lead to delays in implementing the changes and can impact the project schedule and budget.

4.3.3 Delays in Decision Making

The third theme identified in this study is that delays in decision-making also contribute to the increased occurrence of variation orders (VO) in LCS projects. The respondents noted that delays in decision-making can be caused by a variety of factors such as lack of communication, lack of commitment, and lack of authority among the stakeholders. This can lead to delays in implementing changes to the project and can impact the project schedule and budget.

> *Project Director but still he needs approval from Board of Directors (BoD) this create delay in the decision making and ineffective way of project management (Responden#1, interview date: 04/01/2021, line 25)*

> *Project Director but still the final approval from BoD but sometimes needs approval from main client (Responden#4, interview date: 08/01/2021, line 26)*

> *Even though LCS project haves own Project Director, he has no approval to make decision need final approval from BoD, the approval takes long time (Responden#8, interview date: 14/01/2021, line 24)*

Universiti Utara Malaysia

The respondents stated that delays in decision-making can lead to a halt in the shipbuilding process due to unapproved variation orders (VO) which results in delays in the project schedule. This can also lead to increased project costs due to late charges imposed by the building subcontractors on the shipyard. Furthermore, there is no standard for the approval time of VO. The approval process can be delayed because final approval is required from the Board of Directors and there is no set timeframe for their approval. In one case, it took a year to approve a change of the main engine. This can have a significant impact on the project schedule and budget, and it's important to have standard procedures in place and set timeframes for approval process.

4.3.4 Insufficient Project Drawing

The fourth theme identified in this study is that insufficient project drawings can also contribute to the increased occurrence of variation orders (VO) in LCS projects. The study found that the factors that contribute to insufficient project drawings can be divided into two categories:

1. The shipbuilding process is started before the completion of detailed design drawings, which are not complete because they were done without actual design data.
2. The drawings are revised during the construction process when clashes are found by the design authority.

According to the respondents, this can lead to additional work and changes to the project scope, which can increase project costs and cause delays in the project schedule. Inadequate project drawing also leads to more frequent modification, rework, and additional costs which can be avoidable if the drawing is completed and checked for accuracy before proceeding with the project.

> *The ship is built on basic drawing and there are many clashes found that lead to increase of VO, because need to get approval from the main client for approval additional time delay (Responden#1, interview date: 04/01/2021, line 27)*

> *I am not sure how the shipyard can build a ship without the detail design drawing, even the cable routing is not completed, and shipyard already bought the cables for all six ships, wastage of project money (Responden#12, interview date: 18/01/2021, line 28)*

> *VO can create additional time for the LCS engineering department to create additional drawing and need to finalize the drawings. Nobody knows how many total drawings needed for the LCS Project, the design authority did not share to us these details. The project team need to go all again for the getting the client and ship class approval on the new drawings (Responden#9, interview date: 15/01/2021, line 27)*

Universiti Utara Malaysia

4.3.5 Other Factors

This study also found that the Engineering, Procurement, Construction, and Commissioning (EPCC) project management process can contribute to the occurrence of variation orders (VO) in LCS projects. Approximately half of the respondents agreed that the EPCC process, which is a standard shipbuilding project management process that must be followed in any shipbuilding project, can lead to additional work and changes to the project scope. This can increase project costs and cause delays in the project schedule.

> *The shipbuilding project needs to follow the Engineering, Procurement, Construction and Commissioning (EPCC) proses flow. LCS project build with no process flow reference, just build even when the detail design is not yet complete (Responden#1, interview date: 04/01/2021, line 31).*

Respondent 1 also highlighted that the LCS ship already started the construction phase eventhough the detail design phase is not completed.

Universiti Utara Malaysia

> *The EPCC proses must be followed, because we are building a ship not as construction of building, management need to know this (Responden#2, interview date: 05/01/2021, line 32)*

Respondent 2 highlighted that BNS management must follow the EPCC ship building process to avoid contruction problem that can occurs during the ship building process.

> *The EPCC proses must be followed by the shipbuilders to avoid any problem in managing the project management (Responden#2, interview date: 05/01/2021, line 31)*

Respondent 6 highlighted that key persons handling with LCS project must have EPCC traning due to the complexity naval warship building process.

> *Shipbuilding process must in accordance with EPCC phase, the project management team must be properly trained to handle this complex project (Responden#6, interview date: 12/01/2021, line 36)*

The study also found that the lack of shipbuilding project experience among the high management team of BNS can also contribute to the occurrence of variation orders (VO) in LCS projects. Almost half of the respondents agreed that this is a significant factor, as the lack of experience can lead to difficulties in managing the project, and can result in additional work and changes to the project scope, which can increase project costs and cause delays in the project schedule.

> *The LCS project director, and the top management don't know what to do when comes to design problem. I think this shows their lack of shipbuilding experience. (Responden#1, interview date: 04/01/2021, line 35).*

Universiti Utara Malaysia

> *BNS higher management must have good shipbuilding project management experience. Even to build a sampan needs to have a good building management (Responden#2, interview date: 05/01/2021, line 33)*

> *Shipbuilding is a complex project that needs special knowledge and experience, we cannot just simply give the project management responsibilities to the fresh graduate without any experience, total disaster for LCS Project (Responden#9, interview date: 15/01/2021, line 35)*

4.4 Research Objective Two: The Impacts of Variation Orders (VO) on Littoral Combat Ship (LCS) Project Management Team Efficiency (Costs and Schedules)

Research objective two aims to examine the impacts of variation orders (VO) on the project management team efficiency of Littoral Combat Ship (LCS) projects in terms of costs and schedules. According to the study, there are 4 major impacts were found. This can lead to inefficiency in cost and schedule management, with higher costs, longer project completion time and staffs with low morale. All of these impacts were illustrated in Figure 4.3.

1. The first impact is that VO can lead to a poor image of the Project Management Team (PMT) in the eyes of the high management of the Boustead Naval Shipyard (BNS) in terms of their ability to manage project costs and schedules.

   > *I think VO have very bad effect to the PMT efficiency due to cost increased and schedule delay, this delay gives a bad image to the PMT team because fail to manage VO properly, I think this will have a bad spot in our CV later, when I want to find other job opportunity it will be very hard for me due to the bad record (Responden#1, interview date: 04/01/2021, line 38)*

   > *I think the VO causes bad image on the LCS Project Management team, even LCS PMT have been negatively mentioned in the Malaysian news and even been negatively commented by Malaysian netizen in media social that they fail to manage the ship project (Responden#3, interview date: 06/01/2021, line 39)*

2. The second impact is that VO can have negative consequences for the working curriculum vitae of PMT staff, as their inability to deliver the LCS Project successfully can make it harder for them to find employment in the future.

> *Tarnish the professional image of LCS Project Management Team. LCS PMT morale effected due to salary cut percentage is more than other BNS workers. I fell this not fair. The failing of LCS Project is not mainly to the PMT but the BNS higher management poor management on the LCS Project overall (Responden#4, interview date: 08/01/2021, line 38)*

3. The third impact is the poor working morale of the PMT team due to being judged by the BNS high management that they are not able to manage the project cost and schedule efficiently.

> *I think PMT working efficiency is badly affected due to the increase of cost and delay schedule. PMT morale also effected caused being blamed directly on the LCS Project failure, even in the CEO townhall he clearly mentioned LCS failure is because LCS PMT cannot manage the VO cost and schedule efficiently (Responden#12, interview date: 18/01/2021, line 38)*

> *I think VO have a bad impact towards the management perception towards LCS PMT, even now the LCS PMT team is being punish by the BNS group, with salary cut percentage more than other BNS group workers. I think this shows the BNS management trying to push the fault to LCS PMT (Responden#2, interview date: 05/01/2021, line 37)*

> *PMT team is being punished in-fairly by the high management, salary cut, contracts not continued but, PMT don't have the proper training, proper documentation on VO management. I really felt that LCS Higher management don't support us (Responden#9, interview date: 15/01/2021, line 37)*

Universiti Utara Malaysia

4. Fourth impact is the extra workload for the PMT due to the retention of existing PMT staff.

> *PMT team has been punish and their working contract is not continued. To many systems to manage but very few of PMT to take care. How to manage this complex system with only a few lefts, can't the management think at all (Responden#5, interview date: 11/01/2021, line 38)*

Universiti Utara Malaysia

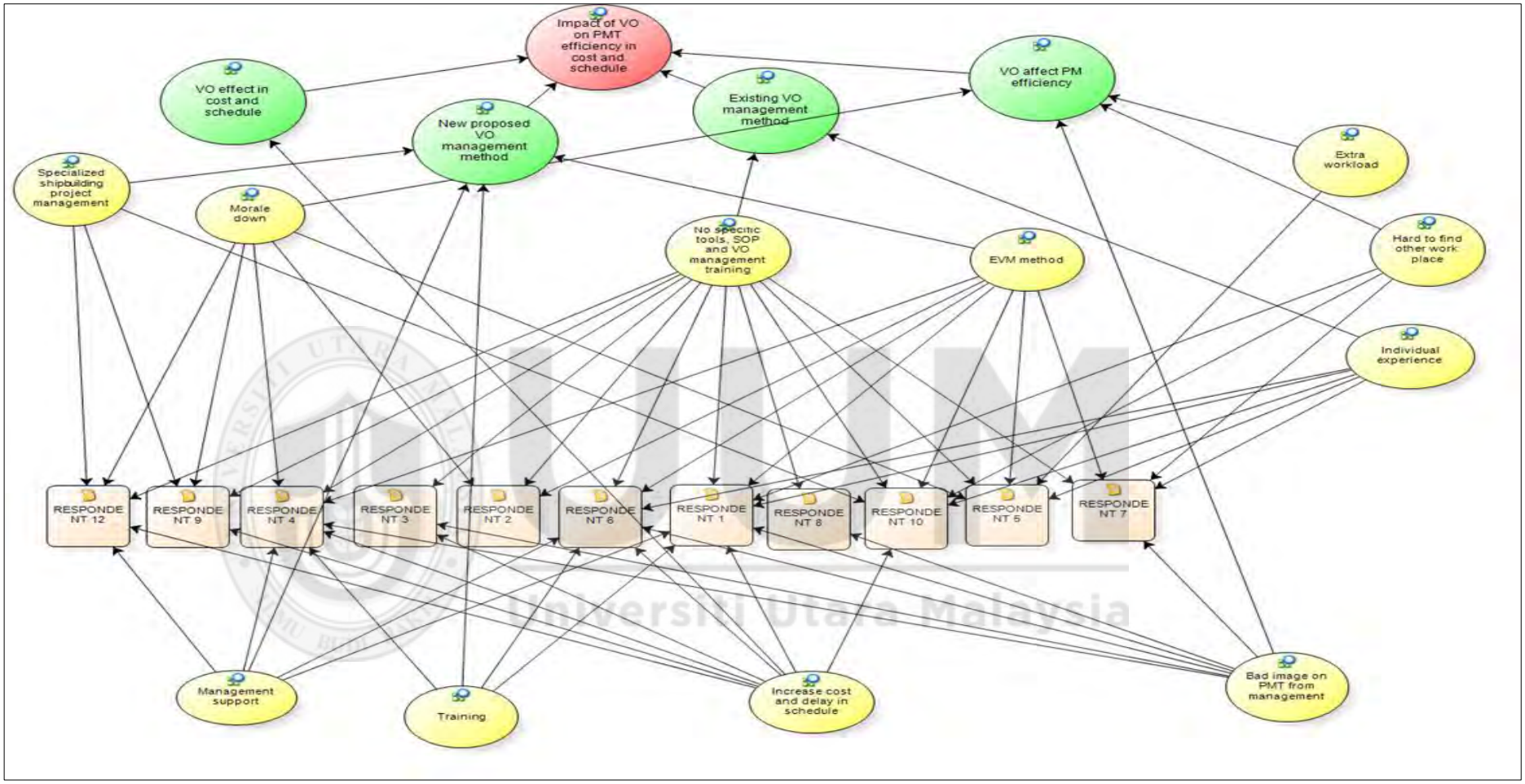


Figure 4.2
Nodes from NVIVO-Impact of VO on LCS PMT Efficiency
Source: Compiled by author

4.5 Research Objective Three: The Improvement Measures in Reducing Variation Orders (VO) in Littoral Combat Ship (LCS) Project

Research objective three aims to propose improvement measures for reducing variation orders (VO) in Littoral Combat Ship (LCS) projects. This study considered the ideas and suggestions from the respondents in proposing these improvement measures. The exact nature of these measures will depend on the specific findings and recommendations of the study, but they may include solutions such as setting clear guidelines for managing project budgets and scope changes, improving communication and decision-making processes, providing training in project management and cost management, and establishing standard operating procedures for handling VO.

Universiti Utara Malaysia

> *Management should take proper measures on the management of VO, PMT should been trained, and the VO's management SOP must be prepared. Shipbuilding is a complex process, where integration is important. VO must be controlled from earlier stage (Responden#12, interview date: 18/01/2021, line 40)*

> *Proper training, SOP and selection of experience PMT with shipbuilding. The manpower of PMT to be increased, now to many systems handled by each PMT (Responden#8, interview date: 14/01/2021, line 41)*

> *Good VO management training, on control tools how to manage VO, create SOP for PMT reference (Responden#2, interview date: 05/01/2021, line 40)*

> *Proper project management training, VO control measure training, Management support, Proper discussion with client and most important don't blame others (Responden#3, interview date: 06/01/2021, line 41)*

> *Proper training, SOP and the PMT with experience in shipbuilding is selected (Responden#7, interview date: 13/01/2021, line 41)*

> *Proper training, SOP and selection of experience PMT with shipbuilding. The manpower of PMT to be increased, now to many systems by each PMT (Responden#1, interview date: 04/01/2021, line 42)*

Proper project management training, VO control measure training, Management support, Proper discussion with client and most important don't blame others (Responden#4, interview date: 08/01/2021, line 42)

Working with reference to historical data and new solution purposed by OEM vendors (Responden#3, interview date: 06/01/2021, line 41)

Good contractual baseline understanding. Lack of high management direction, no clear strategy, impediment to prompt decision making proses (Responden#10, interview date: 14/01/2021, line 40)

The contractual documents cannot be change, limit client involvement, don't add to many class requirements, now the LCS Project have BV Class, Military Specification, and even civilian shipbuilding class (Responden#5, interview date: 11/01/2021, line 42)

Based on the respondents' ideas and suggestions, the study proposed 11 improvement measures to reduce the occurrence of variation orders (VO) in Littoral Combat Ship (LCS) projects. These measures are:

1. Providing training on VO management for the Project Management Team (PMT) by an experienced trainer.
2. Developing standard operating procedures for VO management.
3. Obtaining support from Boustead Naval Shipyard (BNS) management.
4. Following the standard shipbuilding process of Engineering, Procurement, Construction, and Commissioning (EPCC).
5. Ensuring that the design authority provides full support and engagement during the VO explanation with the primary client.
6. Reducing the number of ship class standards.
7. Integrating shipbuilding processes.
8. Having a clear understanding of the LCS contractual baseline.
9. Establishing a clear VO controlling process.
10. Limiting client involvement during the ship construction process.

Universiti Utara Malaysia

11. Hiring more PMO with shipbuilding experience.

These measures are aimed at addressing the various factors that contribute to the increased occurrence of VO in LCS projects, such as financial problems, changes to the project scope, delays in decision-making, insufficient project drawings and lack of experience. By implementing these measures, it is expected to improve the efficiency of the project management team in terms of costs and schedules. Figure 4.3 illustrates these ideas and suggestions based from respondents quotes.

Universiti Utara Malaysia

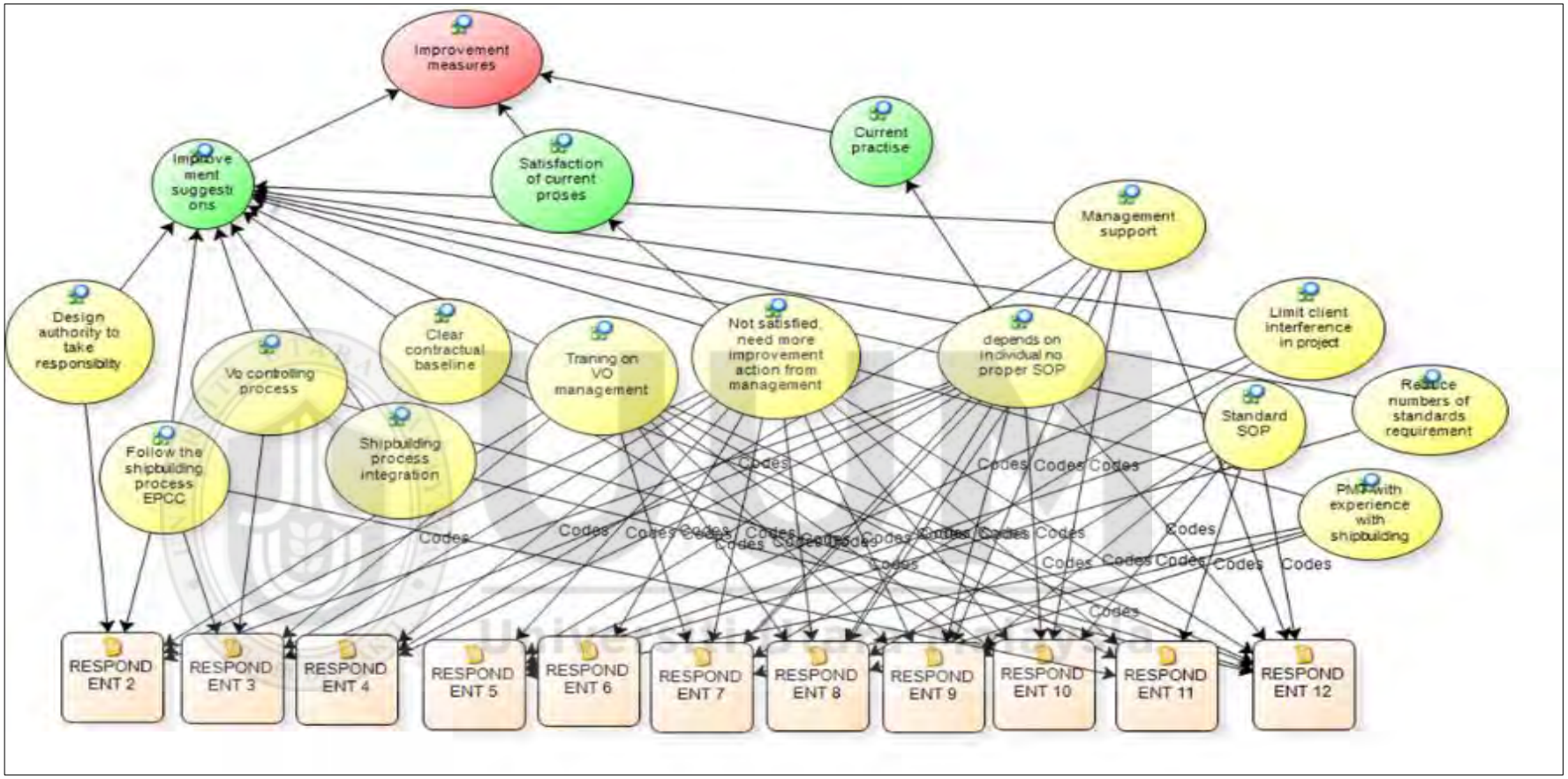


Figure 4.3
Nodes from NVIVO-Ideas and Suggestions to Reduce VO Occurrence in LCS Project
Source: Complied by author

4.6 Findings Summary

Table 4.2 summarised the findings based on the research objectives of the study. Research objective one aims to determine factors contributing to variation orders (VO) occurrence in the Littoral Combat Ship (LCS) project. Four factors have been identified, which are (i) project financial problems, (ii) change in project scope by client, (iii) delay in decision making, and (iv) insufficient project drawing. This study also found the additional factors, which are: (i) the Engineering, Procurement, Construction, and Commissioning (EPCC) project management process to be followed and (ii) the lack of shipbuilding experience management for shipbuilding projects.

Research objective two aims to examine the impacts of variation orders (VO) on Littoral Combat Ship (LCS) project management team efficiency (costs and schedules). Four impacts have been found, which are: (i) bad image of the Project Management Team (PMT) by the BNS high management in managing project cost and schedule; (ii) PMT team working morale down due to being badly judged by the BNS high management that they are not able to manage the project cost and schedule efficiently; (iii) staff of PMT working curriculum vitae record is tarnished due to being unable to deliver the LCS Project successfully and this contributes to a negative effect for them to find another working place; and (iv) extra workload for the PMT due to the retention of existing PMT staff.

Universiti Utara Malaysia

The third research objective is to propose improvements for reducing variation orders (VO) in the Littoral Combat Ship (LCS) project. By considering the ideas and suggestions from the respondents, this study concluded eleven measures that need to be considered in the VO in the LCS project. These measures are (i) Training on VO Management for PMT by an experienced trainer, (ii) To develop standard operating procedures for VO Management, (iii) Boustead Naval Shipyard (BNS) management support,(iv) To follow the standard shipbuilding process EPCC,(v) The design authority must provide full support and engagement during the VO explanation with the primary client, (vi) Reduce the number of ship class standards, (vii) Integration of shipbuilding processes, (viii) Clear understanding of the LCS contractual baseline, (ix) To have a clear VO controlling process, (x) Limit the client involvement during the ship construction process, (xi) To hire more PMO with shipbuilding experience.

Universiti Utara Malaysia

Table 4.2
Research Objectives and Findings

Research Objective (RO)	Findings
RO 1: To determine factors contributing to variation orders (VO) occurrence in the Littoral Combat Ship (LCS) project	Four factors: (i) Project financial problems (ii) Change in project scope by client (iii) Delay in decision making (iv) Insufficient project drawing Two additional factors: (i) The Engineering, Procurement, Construction, and Commissioning (EPCC) project management process to be followed (ii) The requirement for shipbuilding experience management for shipbuilding projects
RO 2: To examine the impacts of variation orders (VO) on Littoral Combat Ship (LCS) project management team efficiency (costs and schedules)	Impacts: (i) Bad image of the Project Management Team (PMT) by the BNS high management in managing project cost and schedule (ii) PMT team working morale down due to being badly judged by the BNS high management that they are not able to manage the project cost and schedule efficiently (iii) Staff of PMT working curriculum vitae record is tarnished due to being unable to deliver the LCS Project successfully and this contributes to a negative effect for them to find another working place (iv) Extra workload for the PMT due to the retention of existing PMT staff
RO3:To propose improvements for reducing variation orders (VO) in the Littoral Combat Ship (LCS) project	Eleven improvement measures: (i) Training on VO Management for PMT by an experienced trainer. (ii) To develop standard operating procedures for VO Management. (iii) Boustead Naval Shipyard (BNS) management support. (iv) To follow the standard shipbuilding process EPCC. (v) The design authority must provide full support and engagement during the VO explanation with the primary client. (vi) Reduce the number of ship class standards. (vii) Integration of shipbuilding processes. (viii) Clear understanding of the LCS contractual baseline. (ix) To have a clear VO controlling process. (x) Limit the client involvement during the ship construction process. (xi) To hire more PMO with shipbuilding experience.

Source: Compiled by author

4.7 Conclusion

This chapter has presented the findings of the study, which were attained from the responses of the 12 Project Management Team (PMT) respondents. The findings have been presented in accordance with the research objectives of the study, which aimed to determine the factors contributing to variation orders (VO) in Littoral Combat Ship (LCS) projects, examine the impacts of VO on the efficiency of the PMT in terms of costs and schedules, and propose improvement measures for reducing VO in LCS projects. The next chapter will discuss the findings in greater detail and provide improvement measures that can be implimented by BNS higher management.

Universiti Utara Malaysia

CHAPTER FIVE
DISCUSSION AND CONCLUSION

5.1 Introduction

This chapter provides the recapitulation of the study and the analysis process by emphasising the formation of the analytical categories and discussing the constructed analysis categories. This study divided this first category into two sub-categories, which are category 1 (a) and category 1 (b). Category 1(a) discussed the findings for the main contributing factors (RO 1), while Category 1(b) discussed the impact of VO on PMT work efficiency (RO 2). The second category of analysis discusses the improvement measures suggested by the respondent to reduce the VO (RO 3). Then, this study provides the suggestions by creating a framework for standard operating procedures (SOP) to VO management in shipbuilding projects. This chapter also highlights the implications of the study as well as some limitations and concludes the study.

Universiti Utara Malaysia

5.2 Recapitulation of the Study

As explained earlier, the primary purpose of this qualitative study is to understand the variation orders in a naval ship construction company and to improve the project management efficiency through a standard operating procedure (SOP) in accordance with the EPCC shipbuilding project management process flow for VO management. Three research questions motivate the exploration of this study. These research questions are: (i) what are the factors contributing to variation orders (VO) occurrence in the Littoral Combat Ship (LCS) project? (ii) what are the impacts of variation orders (VO) in terms of costs and schedules on the efficiency of the Littoral

Combat Ship (LCS) project management team? and (iii) what are the improvement measures required to reduce the variation orders (VO) occurrence in the Littoral Combat Ship (LCS) project?.

Following the primary aim and these three research questions, this study developed three research objectives. These research objectives are: (i) to determine factors contributing to variation orders (VO) occurrence in the Littoral Combat Ship (LCS) project, (ii) to examine the impacts of variation orders (VO) on Littoral Combat Ship (LCS) project management team efficiency (costs and schedules), and (iii) to propose the improvement measures in reducing variation orders (VO) in Littoral Combat Ship (LCS) project. To achieve these objectives, this study adopted a qualitative study design that adopted the semi-structured interview as data collection method with 12 respondents from the LCS PMT, the selection done using purposive sampling technique.

Universiti Utara Malaysia

5.3 Discussion

Based on the first research question, the findings show the main factors contributing towards the VO occurance in LCS Project are: (i) project financial problem, (ii) change project scope by client, (iii) delay in decision making, and (iv) insufficient project drawing. Additional factors were found and highlighted in these research findings, which are: (v) the EPCC project management process to be followed and (vi) a lack of shipbuilding experience for shipbuilding projects.

As for the second question, findings for the impact of VO in LCS PMT are (i) bad image on the Project Management Team (PMT) by the BNS high management in managing project cost and schedule, (ii) PMT team working morale down due to be badly judged by the BNS high management that they are not able to manage the project cost and schedule efficiently, (ii) Staffs of PMT working curriculum vitae record is tarnish due to unable deliver the LCS Project successfully and this contribute a negative effect for them to find other working place and, (iv) extra workload for the PMT due to the retention of existing PMT staffs. The relationship between the contributing factors and the impact of VO on the PMT efficiency practise factors is done to form the Category 1 Analysis, which is to find the main contributing factors and understand the impact of VO on the PMT work efficiency.

Based on the third question, the findings show that the BNS high management has an important role to provide: (i) Training on VO Management for PMT by an experienced trainer, (ii) To develop standard operating procedures for VO Management, (iii) Boustead Naval Shipyard (BNS) management support,(iv) To follow the standard shipbuilding process EPCC,(v) The design authority must provide full support and engagement during the VO explanation with the primary client, (vi) Reduce the number of ship class standards, (vii) Integration of shipbuilding processes,

Universiti Utara Malaysia

(viii) Clear understanding of the LCS contractual baseline, (ix) To have a clear VO controlling process, (x) Limit the client involvement during the ship construction process, (xi) To hire more PMO with shipbuilding experience. Table 5.1 provides the summary of the study discussion.

Universiti Utara Malaysia

Table 5.1
Research Questions, Findings and Results/Consequences

Research Question	Research Findings	Results/Consequences
1. What are the factors contribute towards Variation Orders (VO) occurrence in LCS project?	• Majority respondents (100%) highlighted the factors are: - Project financial problem. - Change project scope by client. - Delay in decision making. - Insufficient project drawing • Additional factors highlighted are: - Enigneering, Procurement, Construction and Control (EPCC) shipbuilding project management process to be followed. - Lack of shipbuilding experience management for shipbuilding projects	• Major factors contributing to the VO occurrence in LCS project are identified for the management to overcome.
2. What is the impact of VO on project management efficiency in LCS Project?	• Findings for the impact of VO in LCS PMT efficiency are: - Bad image on the Project Management Team (PMT) by the BNS high management in managing project cost and schedule, - PMT team working morale down due to be badly judged by the BNS high management that they are not able to manage the project cost and schedule efficiently. - Staffs of PMT working curriculum vitae record is tarnish due to unable manage the LCS Project successfully and this contribute a negative effect for them to find another working place. - Extra workload for the PMT due to the retention of existing PMT staffs.	• LCS high management need to support PMT and create conducive working environment
3. What are the improvement measures required in reducing the VO occurrence in LCS Project?	Based on the interview sessions, majority of the respondents highlighted as per detailed below for the improvement in reducing the VO occurrence in LCS Project: - To provide training on VO Management for LCS PMT by experienced trainer. - To develop standard operating procedure for VO Management, - BNS management support. - To follow the standard shipbuilding process EPCC. - Design authority to give full support and engagement during VO explanation with main client. - Reduce number of ship class approval standards. - Shipbuilding process integration. - Clear understanding of LCS contractual baseline.	• Importance of Top management support in reducing the VO occurrence in LCS Project

Source: Compiled by Author

Universiti Utara Malaysia

5.3.1 Discussion: Contributing Factors to Variation Orders (VO) (RO 1)

This study found that there are four main contributing factors and two additional factors that contribute towards the increase of VO in the LCS Project. First main factor is project fincial problem. Second main factor is the project scope changes by client. Third, main factor is delay in decision making by BNS high management in processing the VO. Fourth, main factor is insufficient project drawing. Additonal factor one is engineering, procurement, constuction and commissioning (EPCC) project management process to be followed by BNS and second additonal contributing factor is lack of shipbuidling process experice management by BNS for shibuilding. The following subsections will discuss these factors in more detail.

5.3.1.1 Main Factor 1: Project Financial Problem

The first contributing factor to the occurrence of VO in the Littoral Combat Ship (LCS) Project is the financial problem experienced by this project. According to the literature, the financial problems of any project can be classified into four different categories. The first category is late payment. Late payment, as described by Harris and McCaffer (2003), occurs when a paymaster fails to pay within the contract's certificate-honouring time this have an impact on the entire payment supply chain.

According to the Construction Industry Working Group on Payment (2007), delay in contractual payment will cause major cash flow issues farther down the contract chain. Clients' poor financial and business management, client withholding payment, and a contractor's invalid claim have all been recognised as underlying causes of late payment.

Other factors include consultant delays in valuing and certifying interim payments, valuation inaccuracies for completed work, and insufficient documentation and information for value. Not only that, but the involvement of too many parties in the process of payment, and the contractor's misinterpretation of the client's modification order requirement all contribute to late payment.

The second category is financial market instability. The external factors of weak economic conditions, such as currency and inflation rate, as indicated by Ahmed et al. (2003) and Alaghbari (2005), will have a substantial impact on the project's cash flow and hence hinder its timely performance. Increased interest rates in loan repayment, as well as inflation of material prices, labour wages, and transportation costs, are the fundamental reasons for financial market instability, which would eventually lead to cash flow problems in construction projects. In addition, an increase in the foreign exchange rate for imported materials is another factor contributing to financial market volatility.

Universiti Utara Malaysia

The third category is poor cash flow management. The practise of monitoring and analysing the cash flow of projects is known as cash flow management (Ward, nd). The most crucial part of cash flow management is avoiding long-term liquidity shortages produced by a large imbalance between cash inflows and outflows. According to the Construction Industry Working Group (2007), ease of cash flow in a project is the key aspect for completing a successful project.

As a result, having a well-managed cash flow is very important to the success of a project. This may be accomplished by doing a cash flow analysis on a regular basis to identify cash flow issues. Cash flow forecasting is an important tool for analysing a project's cash flow and preventing cash flow difficulties. The project's cash flow must then be maintained through the development and implementation of plans.

As a result, a well-managed cash flow will increase the project's cash flow and project's timely performance.

The fourth category is insufficient financial resources. According to Kaming et al. (1997), the paucity of resources is one of the most significant issues generating delays in high-rise projects. Furthermore, Noulmanee et al. (1999) researched the causes of highway construction delays in Thailand and determined the main causes of delays is an organization's lack of resources. According to a survey conducted by Ubaid (1991), the contractor's insufficient financial resources are the primary factors that create delays in project. Lack of finances, according to Abdul-Rahman et al. (2006), insufficient financial resources can disrupt the project's cash flow and cause delays in site possession, which can lead to delays in the entire project.

Therefore, the government of Malaysia as the LCS main client and the shipbuilder, Boustead Naval Shipyard Sdn Bhd, need to avoid, these four categories of financial problems. So that, the VO occurrence can be avoided, and the contract involves the construction of Littoral Combat Ship (LCS) can be completed according to the contract.

Universiti Utara Malaysia

5.3.1.2 Main Factor 2: Change Project Scope by Client

The second contributing factor to the occurrence of VO in the Littoral Combat Ship (LCS) project is change project scope by client. In this case, the government of Malaysia is the client to the shipbuilder, Boustead Naval Shipyard Sdn Bhd. Indeed, project scope adjustments can be challenging for project management team since they may be viewed as an admission that the previous scope of work were inadequate, throwing the project stakeholders abilities into question.

As a result, projects are usually labelled as failures when scope changes result in time delays, money increases, and quality issues.

When addressing the theory of constraints, Baca (2005) claims that change requests cause project interruptions and can be labelled as constraints. When a change request is received, the project management team must halt the project's progress to investigate the VO new change of scope as highlighted by a few scholars (Atkinson, 1999; Okorafor, 2008; Kezner, 2009; Nwachukwu, Echeme, & Okoli, 2010), emphasis should be given to the time and cost consequences of the new scope changes. According to Schwalbe (2010), additional scope of work created by VO requires additional time and cost into for closing the VO requirement.

According to Heldman (2011), when managing the change of scope, the project management team must be certain of the changes in the scope of work is not affecting the project total cost and schedule. According to Schwalbe (2014), project managers cannot effectively manage project scope without first gathering requirements.

Universiti Utara Malaysia

According to Heldman (2011) and Schwelbe (2010), highlighted the requirements needed to manage the project scope are: (i) creating a work breakdown structure (WBS) by defining and derailing the project's product's deliverables and requirements; (ii) verifying WBS by using measurement techniques; and (iii)controlling changes to the WBS.

Jones et al. (2011) explained the various reasons for scope changes in projects. Changes in the competitive landscape or adding new rule may prompt the stakeholders to reassess the scope of the project. The second reason is mistake in defining the project scope in the early stage; if a requirement was missed while defining the scope, the scope will have to be updated to incorporate the new requirement and this will cause loss of project time and increase cost.

The third reason is value added change. Occasionally, a team member discovers a better way to do the task or learns how to increase quality by doing things differently. Implementing a contingency plan or workaround is the fourth cause. If a risk event occurs and actions are required to respond, the actions may result in a modification to the project or product scope. The fifth reason is if clients are unhappy with the outcome and want it changed.

Scope management helps to avoid problematic projects with ever expanding scopes and disorganised requirements lists (Turner, 2009). Identification and management of project scope is critical since it entails gathering the information needed to begin a project as well as determining what features the final product should have to suit the needs of project stakeholders.

Schwalbe (2010) recommends five primary processes for PMT to consider while managing and controlling the project scope. The first process is to gather requirements, which entails identifying and documenting the features and functionalities of the

Universiti Utara Malaysia

products. As a result of the requirements gathering process, the project team produces stakeholder requirements documentation, a requirements management plan, and a requirements traceability matrix. The second process is to define scope, which entails analysing the project charter, requirements documents, and organisational process assets to establish a scope statement, which will be expanded when requirements are developed, and modification requests are accepted. The project scope statement and modifications to project documents are the key outputs of scope definition.

The third step is to create a work breakdown structure (WBS), which entails segmenting the project's core deliverables into smaller, more manageable components. Among the primary deliverables are a work breakdown structure, a work breakdown structure dictionary, a scope baseline, and revisions to project documents.

The fourth process is scope verification, which requires approving the project's deliverables in writing. The customer and sponsor, as well as other project stakeholders, inspect and then formally accept the deliverables at this phase. If the client or sponsor deems the deliverables inadequate, they often request modifications.

The fifth process is regulating scope, which entails monitoring changes to the project's scope throughout its duration. Scope modifications frequently influence the team's ability to meet project schedule and cost objectives. The costs and benefits of scope adjustments must be carefully weighed by PMT.

Meanwhile, according to Hill (2010), VO management must include three key components. The first component is accountability for VO management. Specification of each team member's responsibility for managing VO, including guidance for project team members to exercise reasonable judgement before processing the VO must be provided.

Universiti Utara Malaysia

The second component is authority for VO approval. Specification of who is permitted to approve changes of VO; this is typically the project director, but it may also be the project sponsor or another senior management. The third component is management of VO plans. Appointment of a change control manager (for larger projects) who will maintain the VO log, manage incoming VO requests, monitor and oversee approved VO implementations, and to negotiate change requests with the client.

Therefore, both the government as the client and the project management team of Boustead Naval Shipyard Sdn Bhd need to avoid the five primary reasons for scope changes in projects as highlighted by Jones et al. (2011) and consider five primary processes for project managers to consider while managing and controlling the project scope recommended by Schwalbe (2010). They also need to consider Hill (2010)'s three key components of how to manage change.

Universiti Utara Malaysia

5.3.1.3 Main Factor 3: Delay in Decision Making

The third contributing factor to the occurrence of VO in the Littoral Combat Ship (LCS) Project is delay in decision-making. Indeed, one of the most common challenges that PMT have while steering a decision-making process is getting alignment from several senior stakeholders with divergent agendas. Generally, the PMT will need to influence stakeholders to acquire buy-in, which may lengthen the decision-making process. Several ways of building alignment, in my experience, include reminding stakeholders of the objectives and providing information about what matters most to them.

The other strategy for achieving alignment among different stakeholders with divergent priorities is to employ group decision-making techniques. Group decision-making strategies are methods used by various stakeholders to reach consensus when a single alternative from a large number of options must be chosen. These strategies are well-known for assisting decision makers in prioritising, classifying, and selecting the best option from numerous alternatives. (Rose, 2013). Rose (2013) highlighted the first strategy is unanimity, for this strategy to work, all decision-makers must agree on a single proposed action. However, obtaining buy-in from all stakeholders may be time-consuming.

The second strategy is referred to as the majority. A decision is made when more than 50% of decision makers agree on a particular course of action. Plurality is the third strategy. This occurs when the greatest number of decision makers agree to take a particular action, even if a majority does not exist. Typically, this strategy recommends more than two possibilities.

Universiti Utara Malaysia

Rose, (2013) also mentioned dictatorship as the fourth strategy. A decision is made when one individual decides on behalf of the group. In some instances, the member assigned the decide (D) role may make the group's choice.

Previously, Grünig and Kuhn (2009) evaluated the complete decision-making process from a practical standpoint. They proposed a seven-step procedure dubbed "The General Heuristic Decision Making Process," which is depicted in Figure 5.1. It includes all the steps from problem identification to resolution, is simple to understand, and aims to provide a framework that can be applied in enterprises with relatively modest application costs. It describes a procedure that is broadly applicable and sufficiently precise to address critical issues without overemphasising minor details. The term "heuristic" is used as an adjective or noun to refer to a "rule of thumb," method, or simplification in this model, implying that when a heuristic process is applied, there are essentially no formal application limitations and cheap application costs (Grünig & Kuhn, 2009).

Universiti Utara Malaysia

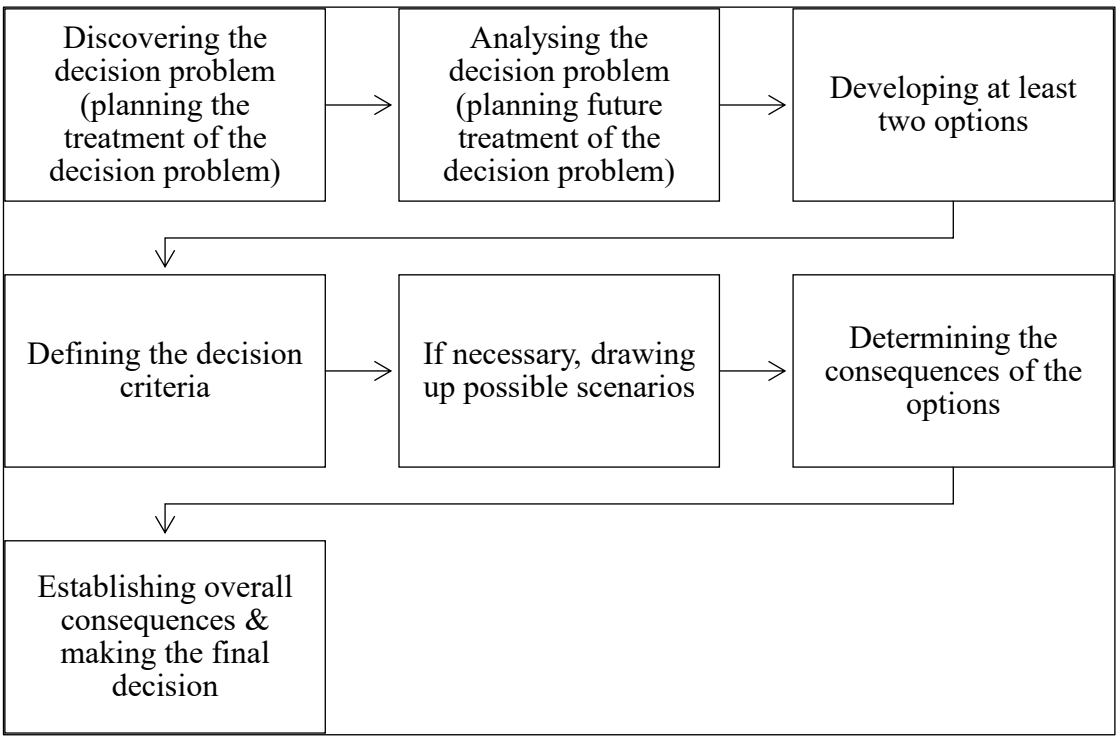


Figure 5.1
Heuristic Decision-making Process
Source: Grunig et al. (2009)

Apart from heuristic decision-making, a project management team can also employ "RAPID" (Recommend, Agree, Perform, Input, Decide) to define roles in complicated decision-making processes. Thus, the RAPID technique is most advantageous when making complicated decisions with a high degree of stakeholder impact. (Rogers & Blenko, 2006).

The letter “R” stands for “recommend”. Typically, the recommender will meet with the subject matter expert (SME) to solicit opinion on the decision and confirm that the SMEs support the recommendation (Rogers & Blenko, 2006). The letter “A” stands for “agree.” The agree job has the authority to say "yes" or "no" to recommendations. In most circumstances, individuals in the agree and recommend roles can ascend to the determine (D) role to make the final decision. The letter “P” is an abbreviation for “perform.”

The person playing the role is accountable for carrying out the decision reached. Occasionally, the recommenders are the individuals who carry out the decisions (Rogers & Blenko, 2006).

The letter “I” denotes “input”. Any decision requires information about the available options. As a result, the individuals with input roles are consulted for information regarding the choice. Recommenders frequently contact these people, as they may include those in the performing function. For instance, this may be the team's SMEs. “Decide” is represented by the letter “D”. The individual assigned the deciding role is the decision maker who is ultimately liable for the choice's outcome. This individual will ensure that the proposed solution is consistent with the organization's overall strategy (Rogers & Blenko, 2006). This function encompasses the majority of senior executives and vice presidents in an organisation.

With this power, the recommender may be required to align, provide input, or disagree with the recommender to provide the best recommendations possible.

In a circumstance in which no agreement can be achieved. Thus, the Boustead Naval Shipyard Sdn Bhd and the Malaysian government as the client need to take proactive actions to ensure all decisions made are reliable and accurate. They should at least consider all the strategies proposed by Rose (2013) or the Heuristic Decision-making Process by Grunig et al. (2009) that assist them as decision makers in prioritising, classifying, and selecting the best option from numerous alternatives, and then reducing the occurrence of VO.

Universiti Utara Malaysia

5.3.1.4 Main Factor 4: Insufficient Project Drawing

The fourth contributing factor to the occurrence of VO in the Littoral Combat Ship (LCS) Project is insufficient project drawing. Sunday et al. (2017) previously discovered that most of the causes of variance in cost are drawing-related. Previously, Langford, Fellows and Newcombe (1986) states that the design team initiates 72% of the variation orders. According to respondents' feedback, insufficient project drawing can be classified into two categories.

The first category of insufficient project drawings is that the shipbuilding process is initiated even before a comprehensive design drawing is completed. It is incomplete because the basic design drawing is created without the real design data. Errors in design and insufficient drawings are the primary causes of building project delays (Dosumu & Adenuga, 2013; Kikwasi, 2012; British Columbia Construction Association, 2011).

Numerous scholars stated that it has been extensively studied by researchers[1] from various countries. For example, Baloyi and Bekker (2011) found that design mistakes and incomplete drawings were the leading causes of construction cost and time overruns at the 2010 FIFA World Cup stadiums in South Africa. While current software tools and techniques such as three-dimensional modelling, automated material take-off, and change reference control have been developed to improve the

[1] These scholars include Love et al. (2014); Alia et al. (2014); Rajendran, Seow, & Goh (2014); Dosumu & Adenuga (2013); Kikwasi (2012); Ramanatham et al. (2012); Baloyi & Bekker (2011); British Columbia Construction Association (2011); Ren, Atout, & Jones (2008); Hao et al. (2008); Ekambaram, Muthukaruppan, & Chi-Ming (2007); Acharya, Lee & Kim (2006); National Research Council (1994);Construction Industry Institute (1987); National Society of Professional Engineers (n.d.).

efficiency of design outputs, these variables continue to be significant contributors to project delays.

According to a study conducted by Ebekozien, Uwadia, and Usman (2015), the five most significant factors that can result in design errors and incomplete drawings are unclear documentation, insufficient documentation, insufficient site investigation, insufficient design consultant staff, and a rush to meet an unrealistic deadline. Additionally, they discovered that the five most significant factors that contribute to design errors and incomplete drawings as perceived by clients are: ineffective communication and coordination, frequent interference, site topography changes after design, late or insufficient instructions, and an unrealistic control duration set by the client.

The second category of insufficient project drawings is that the drawing is revised during the construction process when clashes are found by the design authority. Numerous studies have established the incidence of design alterations and their cumulative detrimental influence on project performance (Yap & Skitmore, 2017, Yap, Abdul-Rahman, & Wang, 2017; Gde-Agung Yana et al., 2015; Peansupap & Cheang, 2015; Han, Lee & Pena-mora, 2012). Memon and Abdul-Rahman (2014) discovered that variance in design drawing is a significant source of variation in building projects. They also said that the consultant should focus on limiting design changes and avoiding insufficient design drawing.

Abdul-Rahman et al. (2016) defined design changes as routine additions, omissions, and adjustments to both design and construction work in a construction project that occur after the contract is awarded and influence the contract provisions and work conditions that contribute to the dynamic and unstable nature of construction.

Universiti Utara Malaysia

Similarly, Mohamad et al. (2012) defined a design change as any modification to the design or construction of a project made after the contract has been granted and signed.

According to Park (2002), errors in design work can result in subsequent adjustments in construction. Additionally, Akinsola et al. (1997) emphasises the revision or alteration of the design following the contract's award. As a result, changes have been made that are likely to cause a lot of problems, disputes, and claims.

Additionally, Arain et al. (2004) mentioned that local governments may have their own codes and regulations that must be incorporated into the design. Additionally, they stated that the unfamiliarity with government rules would complicate the project's execution. Environmental and labour codes were changed on a periodic basis to ensure compliance by the designer and contractor (Arain et al., 2004; Assaf & Al-Hammad, 1988). According to Sun and Meng (2009), changes in government legislation and regulations affecting health and safety, planning, employment, the environment, and taxation are a source of project change and may impair the smoothness of construction.

Universiti Utara Malaysia

Therefore, the government of Malaysia and the shipbuilder, Boustead Naval Shipyard Sdn Bhd, need to avoid the mentioned factors and lessons learnt discussed in previous literature in preparing a sufficient project drawing that can avoid the occurrence of VO and project delays. Even though design changes are natural outcomes of the design process, and complexity arises in multi-disciplinary design situations because changes in one discipline frequently influence design descriptions in the other disciplines involved (Zaneldin, 2000). Ndihokubwayo (2008) suggests that the clients to spend more time and money at the design stage to reduce VO. Thus, BNS should consider this suggestion.

5.3.1.5 Additional Factor 1: Engineering, Procurement, Construction, and Commissioning (EPCCPMP) Project Management Process to be Followed

The first additional factor contributing to the occurrence of VO in the Littoral Combat Ship (LCS) project is the EPCC project management process (EPCCPMP) that needs to be followed. In a nutshell, EPCC consists of four phases that need to be fulfilled. The engineering phase encompasses a comprehensive system-based planning and design approach that prioritises operational and maintenance effectiveness. Engineering responsibilities include fundamental engineering, request for quote estimation, planning, detail engineering, and construction engineering.

The procurement phase then covers the process of acquiring equipment and services for the project, beginning with the buying planning process, vendor selection, bid review, and vendor determination, all the way through to contracts with selected vendors. Following that, the construction phase is the step during which buildings or equipment are constructed or installed according to the requirements and materials established during the engineering stage.

Universiti Utara Malaysia

Finally, commissioning functions include operations that validate the engineering and performance of the system before it is handed over to the end user or operator. Along with delivering a full product to the client, an EPCC contract requires the contractor to do so at a fixed price, on a specific date, and to the stipulated degree of performance. It will be challenging to complete EPCC projects if the PMT and management is not well verse of EPCC in shipbuilding project. Therefore, a specific standard on integration of EPCCPMP in shipbuilding project need to be establish.

Previously, Kermanshachi et al. (2018) and the Construction Industry Institute (2012) emphasised that each EPCC phase's success may be evaluated from three distinct perspectives: schedule, cost, and quality. However, due to the complexity of the shipbuilding project, it is difficult to describe and quantify if there is no specific standard on EPCCPMP established. As a result, the time and cost overruns will occur in projects (Kermanshachi, Thakur, & Govan, 2018; Manavazhi & Xunzhi, 2011).

At all times, the management team is concerned with the cost and timeliness of the project (Cantarelli, 2012; Kermanshachi & Rouhanizadeh, 2019). Cost overruns and delays are significant challenges to the success of construction projects (Andri'c et al., 2019; Kermanshachi et al., 2018; Atkinson, 1999). Le-Hoai, Dai Lee, and Lee (2008) demonstrated that the unintended consequences of these unwanted performances are most obvious during the building phase, causes of poor schedule and cost performance.

The commissioning phase, which occurs after construction in industrial construction projects, is a key distinction between ordinary and EPCC projects. The success of commissioning and performance testing has an impact on the EPCC project's success. The most critical stage of the EPCC project has been regarded as commissioning. The adjustment and testing phases of the commissioning process are the most important. As a result, commissioning is the process via which most faults are discovered (Poeschl, Wirth, & Bauernhansl, 2018). Commissioning is a quality control procedure used in the construction industry to ensure that the project meets the owner's design, construction, and operation and maintenance criteria (Brito et al., 2015; Gillis & Cudney, 2015).

Universiti Utara Malaysia

5.3.1.6 Additional Factor 2: Lack of Shipbuilding Experience Management for Shipbuilding Projects

The second additional factor contributing to the occurrence of VO in the Littoral Combat Ship (LCS) Project is the lack of shipbuilding experience management for shipbuilding projects. Briefly, project management is used extensively by both civilian and military organisations. There are numerous similarities between them, including project inception, resource allocation, and project execution monitoring. Projects introduce new capabilities to the defence and security community, such as a new weapon system, a communication system, the computerization of business processes, the development of new or improved tactical and technical procedures, organisational changes, and the development of strategic documents, among others. The design, construction, and commissioning of new ships, which serve as the foundation for the operation and execution of naval operations, are among the navy's most important projects. As a result, knowledge and experience of shipbuilding projects is essential.

Universiti Utara Malaysia

Commercial shipbuilding relies heavily on meeting deadlines, staying within budget, and meeting technical specifications. However, it is good to realise from experience that shipbuilding projects might struggle to meet these objectives if best practises are not followed. Setting lofty goals, creating new designs that rarely include previous ship designs, and commencing construction without a stable design are all instances of wasteful practises that cause ships to cost more than they should (Francis, 2009).

Shipbuilding projects appear to be a particularly well-suited industry for knowledge transfer studies. There are often commonalities between the ships, and previous shipbuilding knowledge can be beneficial (Kim & Seo, 2009). Furthermore, greater information transfer may be beneficial in assisting businesses in improving

their operations and generating total value (Dwivedi & Maffioli, 2003). As a result, it is critical for individuals and teams working for project-based businesses to absorb and use knowledge developed by other individuals and teams (Ajmal et al., 2009). As a result, project-based businesses must consider features and methods that ease the transfer and sharing of newly acquired knowledge to other teams and organisational divisions.

According to Schindler and Eppler (2003), people do not write down their experiences during the project period because they do not perceive the value in doing so. As a result, coordinating post-project evaluation meetings is difficult, there is a lack of willingness to learn from others' mistakes, and knowledge is not archived in an easily accessible manner. A company's ability to compare its numerous projects more systematically and document its most efficient problem-solving techniques is enhanced by the systematic retention of project experiences.

Furthermore, systematic documentation of mishaps, errors, or prospective pitfalls aids in the reduction of project risks. Systematic project learning allows the company to develop project competencies over time, resulting in a lasting competitive advantage. Experiences, which are connected to the people who are intimately involved in the corresponding problem-solving processes, are frequently not documented in a project's documentation and are seldom transferred to other people during the project's life cycle. After completing their project tasks, project team members return to their line functions or are transferred to other functions and frequently bring their new experiences with them (Argyris, 1999; Kanter 1996). The only way to obtain these experiences is through informal networks (Argyris, 1999; Bowen et al., 1994).

Universiti Utara Malaysia

A few scholars stated that 'project post-mortem' is needed to do a more complete analysis at the end of the project and to describe the positive and negative experiences gained or a ‘retrospective’ (Collier, deMarco & Fearey, 1996; Collison & Parcell, 2001; Schindler, 2002, McMasters, 2000; PMBOK, 2000; Kerth, 2000). The term 'lessons learnt' is widely used in this context and has been added to the lexicon of the most recent edition of PMBOK) (PMBOK, 2000). Lessons learned are described as significant project experiences that have a broad business application for future initiatives. They have been approved by a project team and signify agreement on an important insight that should be incorporated in future initiatives.

In practise, the importance of documenting and reusing project experiences was also acknowledged, as evidenced by several management remarks about the codification of project experiences in project manuals, as the following authentic examples demonstrate. In the project method manual of UBS (the world's largest asset management firm), gathering lessons learned is required as part of the final project report for all types of projects, with the express purpose of knowledge transfer for future initiatives. Conclusions and recommendations should be included in these reports, highlighting what may be improved in future projects. The project manager is responsible for compiling the final project report.

Schindler and Eppler (2003) previously stated that project amnesia is related to the experience. One of these causes is the failure of the affected people to communicate their experiences owing to "wrong modesty" (with positive experiences) or the fear of negative punishments (in the case of mistakes). They also highlighted that project amnesia can be caused by a lack of awareness of debriefing methods and an underestimating of the process complexity that a methodical derivation of experiences delivers.

Universiti Utara Malaysia

Aside from that, there is a lack of integration of experience recording into project procedures, and team members do not see a (personal) use of coding experience and believe that directly addressing knowledge carriers is more efficient.

There are two examples of the necessity of experience in conducting project. The first example is the Royal Navy and Defence Equipment and Support of United Kingdom (UK). The National Shipbuilding Strategy: The Future of Naval Shipbuilding in the United Kingdom was published by the UK Ministry of Defence in 2017. (UK Ministry of Defence, 2017). The strategy's purpose was to build the groundwork for a modern and efficient defence and security sector capable of addressing the country's future needs. As a result, the Royal Navy and the UK's Defence Equipment and Support will add more independent and professional guidance to the portfolio. They'll hire private-sector project directors to bring in more project management, commercial, and technical expertise where it's needed.

The Sea 5000 Future Frigate programme in Australia is the second example. In Australia, the federal government has devised a bold plan to restore the country's naval fleet over the long term. The Naval Shipbuilding Plan (Australian Ministry of Defense, 2017) defines the Australian Government's vision for establishing a long-term, continuous national naval shipbuilding business, which is the country's largest-ever national-building project. The Australian Ministry of Defence (MoD) requires qualified Australian Public Service (APS) personnel to collaborate with industry in the construction, testing, and delivery of ships and submarines.

Universiti Utara Malaysia

The Australian Ministry of Defence's status of naval project management is illustrated through the Sea 5000 Future Frigate programme. Supporting the procurement of Australia's Sea 5000 Future Frigate programme, a RAND analysis (Schank et al., 2014) advocated the establishment of a Program office, which would reflect the government's primary involvement in an acquisition programme.

The program's office should be comprised of individuals with a variety of abilities and areas of experience. It begins with a few participants and develops as the programme progresses. Programs are successful when they have experienced and knowledgeable personnel in key management, supervision, and technical positions, among other criteria.

Therefore, the above examples add more justification to the necessity of experience in shipbuilding projects. As a result, management's lack of shipbuilding experience increases the likelihood of VO in the Littoral Combat Ship (LCS) Project.

Universiti Utara Malaysia

5.3.2 Discussion: Impacts of Variation Orders (VO) towards LCS PMT Work Efficiency (RO 2)

This study found that there are four main impacts of variation orders (VO) on the Littoral Combat Ship (LCS) Project Management Team (PMT). The first main impact is a poor image of the PMT in the eyes of the high management of the Boustead Naval Shipyard (BNS) in terms of their ability to manage project costs and schedules. This can lead to a lack of trust and confidence in the PMT's abilities, which can negatively impact the overall project performance.

The second main impact is a decrease in the working morale of the PMT team due to the perception that they are not able to manage the project cost and schedule efficiently. This can lead to low motivation and engagement among the team members, which can negatively impact the overall project performance.

The third main impact is that the working curriculum vitae of the PMT staff is tarnished due to their inability to deliver the LCS project successfully. This can negatively affect the PMT staff's ability to find another job in the future.

The fourth main impact is the extra workload for the PMT due to the retention of existing PMT staff. This can lead to burnout, high stress levels and decreased efficiency among the PMT staff which can negatively impact the overall project performance.

These impacts can have a significant effect on the LCS PMT efficiency in terms of cost and schedule management, and also have negative effect on PMT staffs morale, their career and the overall project performance.

Universiti Utara Malaysia

5.3.2.1 Main impact 1: Bad Image of the Project Management Team (PMT) by the BNS High Management in Managing Project Cost and Schedule.

This study found that one of the main impacts of variation orders (VO) on the Littoral Combat Ship (LCS) Project Management Team (PMT) is a poor image of the PMT in the eyes of the high management of the Boustead Naval Shipyard (BNS) in terms of their ability to manage project costs and schedules. This can lead to a lack of trust and confidence in the PMT's abilities, which can negatively impact the overall project performance.

To overcome this impact, it is important for the BNS high management to understand that project teams have a brand, an image, and a reputation in delivering a successful project. A large part of the perception is driven by how well the team delivers on project deliverables within the project budget and project schedule. Thus, BNS high management needs to make sure that the project team understands and takes responsibility for their roles in managing the project management.

Universiti Utara Malaysia

As highlighted by Kent (2021), one of the primary reasons for project problems comes from poor management leadership, such as unrealistic expectations from the high management that were not managed or poorly communicated, and project work planning based on insufficient data, missing items, insufficient details, or poor estimates. Project risk was also identified as a factor that was either unidentified or assumed and not managed efficiently.

Unrealistic expectations are a challenging part of a project, and there are several factors that lead to setting unrealistic expectations, such as a lack of careful planning, inaccurate estimation of costs, resources and time required, and ineffective communication between all the participants involved in the project. To overcome these unrealistic expectations, Viktoriya (2021) suggests several steps that can be taken by

BNS management to provide success: (i) Planning with detailed expectations; (ii) Systemic work with the team to clarify everyone's role and responsibilities; (iii) focus on reaching the project milestone to demonstrate progress, which will motivate the team and make things clear; and (iv) providing effective communication between all parties involved in the project.

5.3.2.2 Main impact 2: PMT team working morale down due to being badly judged by the BNS high management because LCS PMT unable to manage the LCS project cost and schedule efficiently.

This study found that one of the main impacts of variation orders (VO) on the Littoral Combat Ship (LCS) Project Management Team (PMT) is a poor morale among PMT staff due to being judged negatively by the high management of the Boustead Naval Shipyard (BNS) in terms of their ability to manage project costs and schedules efficiently. Low employee morale can limit productivity and affect the health and well-being of employees.

Universiti Utara Malaysia

To overcome this impact, it is important for the BNS high management to understand the importance of employee morale in terms of its link to employee engagement, job satisfaction, employee retention, and overall productivity. With good employee morale, employees are more likely to be engaged, productive, and have a better quality of life. Therefore, BNS high management must ensure that the LCS PMT has good working morale to ensure the success of the LCS project.

Lester (2022) highlighted three proven ways to increase PMT working morale and performance:

i. Developing the understanding of contractual requirements: PMT members work better when they understand what they should do. Management should clarify the work scope, project milestones already achieved, and what the next project milestones are to be achieved in the shortest time. They should also have a clear project charter prepared for the PMT to understand.

ii. Celebrating achievements: Encouragement is essential to continue working. Management should celebrate every important success and not only focus on problems and risks, as this can demotivate employees. A simple gesture, such as writing an email to the LCS PMT describing what has already been achieved and who the people and departments were involved in this process, can improve the LCS PMT morale.

Universiti Utara Malaysia

iii. Building a positive atmosphere: Management should create a comfortable working environment by providing fresh water, coffee, tea, comfortable workplaces, properly functioning computers and laptops, good chairs, and proper air conditioning. They should also keep the office clean and tidy and organize team-building activities to help maintain a positive atmosphere and make employees feel appreciated.

5.3.2.3 Main Impact 3: Staff of PMT working curriculum vitae record is tarnished due to being unable to deliver the LCS Project successfully and this contribute to a negative effect for them to find another working place.

Poor project management can have severe and lasting effects, such as damaging the company's reputation within the organization and industry. If the project management team fails to effectively manage projects, it can lead to a decline in the company's reputation over time. Additionally, a poor track record of project management can make it difficult for the company to acquire new clients or projects and may even lead to a loss of current or future employment opportunities.

Customers tend to steer clear of organizations that provide inferior products or services. Additionally, a poor reputation for project management can also make it harder for the team members to secure new employment opportunities. This is because other companies may be hesitant to hire individuals with a history of project failure, as reported by the Academy (2022). The widespread coverage of the LCS Project failure in news outlets and online, as noted by Carvalho et al. (2020), can make it more difficult for the project management team to secure new employment opportunities in the future.

The high management of BNS can implement the following strategies, as suggested by Project Management Guru (2021), to improve the skills of the project management team and ensure the successful completion of the LCS project:

i. Training courses: BNS management can enrol the PMT in training programs such as seminars and webinars that focus on specific skills that need to be developed, particularly in the areas of variation orders and their impact on the cost and schedule of the LCS project.

ii. Understanding project management methodologies: BNS management should be open to feedback from the PMT and consider different methodologies that may be suitable for the workplace. Agile and waterfall are two project management methods that can be adopted by BNS management. Agile project development method prioritizes customer feedback and allows the team to work either sequentially or on multiple parts of the project simultaneously to develop a draft and make changes as needed. On the other hand, the Waterfall project management method involves completing a linear process once to deliver a final product to the customer or client. In this method, the development team gathers all necessary information from the client or customer and work linearly until the project finishes and the team delivers it.

Universiti Utara Malaysia

5.3.2.4 Main Impact 4: Extra workload for the PMT due to retention of existing PMT staff

Employee retention refers to a company's ability to keep its employees over a long period of time. Companies that have low turnover rates often use strategies to retain their employees. High turnover rates can indicate that employee morale and job satisfaction are low within the company (Bilen Doğan & Helvacioğlu, 2017). Given the high turnover rate in the LCS project, BNS management needs to identify and address the underlying causes to prevent further turnover and its negative impact on the team.

One of the main reasons employees leave a company is poor leadership. How employees feel about their manager and the management style of the company is crucial, and employees are more likely to leave if they perceive their direct supervisors as performing poorly or if they do not connect with the company's management style. This can cause additional burden for the team and the organization as a whole.When an employee quits, the entire team now has to share the responsibilities to make up for the absence of their teammate.

When an employee leaves, they take with them all of their knowledge, skills and experience. The remaining employees may have some of that expertise, but not all of it, which can make it difficult for them to keep up with their workload and ultimately lower productivity levels (Barnet & Hall, 2021).

Universiti Utara Malaysia

To reduce staff turnover in the PMT, BNS management can implement the following strategies, as suggested by Project Management Guru (2021):

i. Enhancing employee engagement through regular communication and feedback.

ii. Offering competitive compensation and benefits packages.

iii. Providing opportunities for career development and growth.

iv. Ensuring a positive and supportive work environment.

v. Implementing an effective succession plan to ensure a smooth transition of knowledge and skills when an employee leaves.

Universiti Utara Malaysia

5.3.3 Discussion: Improvement Measures in Reducing Variation Orders (VO) in Littoral Combat Ship (LCS) Project (RO 3)

The prevalent interest in project success is due to the increasing efforts and resources that companies are expending to implement in the project management. (Anderson et al., 2006). This indicates that BNS high management need to find the best approach in managing the efficiency of the PMT. BNS high management must come out with a good approach to overcome the problem highlighted by PMT in these research, the highlighted problems are:

i. To provide training on VO Management for LCS PMT by experienced trainer.
ii. To develop standard operating procedure for VO Management.
iii. BNS management support.
iv. To follow the standard shipbuilding process EPCC.
v. Design authority to give full support and engagement during VO process.
vi. Reduce number of ship class approval standards.
vii. Shipbuilding process integration.
viii. Clear understanding of LCS contractual baseline.

Universiti Utara Malaysia

5.3.3.1 VO Management training for LCS PMT

The main goal of any Variation Order (VO) management training is to teach trainees how to evaluate and control the impact of VOs on a project. BNS management can consider providing VO management training for the LCS PMT, using a Knowledge Based Decision Support System (KBDSS) as proposed by John (2021).

The KBDSS is a system that contains two main components, a knowledge-base and a decision support system for selecting appropriate control techniques. The KBDSS can show variations and their relevant details, and provide various suggested control techniques for specific variations, helping the project management team to select the most appropriate controls for managing the variations in a timely manner, thereby increasing the overall productivity level.

5.3.3.2 Developing SOP for VO Management

Standard Operating Procedures (SOPs) are documented processes put in place by a company to ensure consistent delivery of services or products that meet minimum quality standards. SOPs are typically written as a step-by-step series of instructions that guide employees on how to perform a specific task. Their purpose is to ensure efficient and consistent output, regardless of who follows them. This study recommends a SOP formulation framework based on the Engineering, Procurement, Construction, and Commissioning (EPCC) process. The SOP is formulated by integrating the Project Management Body of Knowledge (PMBOK) knowledge areas and EPCC, and is described in detail in section 5.4.

5.3.3.3 Management Support

Top Management Support (TMS) is crucial for the success of a project. The involvement of top management can have a positive impact on the outcome of a project. Organizations should prioritize TMS, motivation alignment and monitoring and control strategies (John, 2021).

BNS top management can support the project by ensuring that the necessary human and financial resources are available, such as assembling an experienced team that can meet the project requirements. Top management plays a key role in the success of a project team by providing the necessary support and aligning resource management systems (human, financial, and technological) with the needs of the project.

Transparency and communication from top management is important in addressing issues and conflicts between the project management team and the client (Ljulj et al., 2021). Additionally, top management support also relates to effective decision-making to manage risks and authorize business process changes (Bilen Doğan & Helvacioğlu, 2017) and to support the project team to take prompt and proactive actions in problem-solving.

Universiti Utara Malaysia

5.3.3.4 Following EPCC shipbuilding process.

Engineering, Procurement, Construction and Commissioning (EPCC) is a unique approach to shipbuilding where the shipbuilder is responsible for all aspects of design, procurement, construction, testing, commissioning and delivery. Each phase of the process requires a specific approach in terms of project management, and integration management plays a vital role (Emblemsvag, 2021).

Hansen (2021) has proposed 11 improvement strategies for implementing the EPCC process in shipbuilding projects. These strategies can be adopted by BNS top management to enhance the LCS project:

i. Building a strong and experienced in-house engineering team.
ii. Implementing good risk management practices.
iii. Implementing good project management practices.
iv. Implementing good quality management practices.
v. Implementing good dispute management practices.
vi. Developing a corporate standard or procedure specifically focused on the EPCC process.
vii. Using concurrent engineering techniques.
viii. Ensuring that the variations and extension of time procedures are followed.
ix. Responding to design reviews and comments as soon as possible.
x. Understanding the commercial aspects of the contract and the basic principles of contractual arrangements.
xi. Maintaining simple and close relationships, and developing good communication and coordination among all parties.

Universiti Utara Malaysia

5.3.3.5 Design authority to give full support and engagement during VO process

Typically, the first contract within a shipbuilding project is between the prospective ship builder and a design consultancy also known as design authority. The shipbuilder approaches the ship designer with the requirements for building the ship, the mission capabilities, and the desire to have it built rapidly with minimal cost to increase the profit margin. Nevertheless, the design consultancy and the shipbuilder come to an agreement which is formalised through a design services contract.

One of the challenges of that design services contract is the definition of what the contract deliverables will be, schedule of deliverables, consultancy services during the vessel construction, which party owns the intellectual property rights of the consultancy's design deliverables, do the design authority must continue providing support services to the shipbuilder during ship construction, what are the support service needed from design authority. These questions and many more must be answered and agreed-upon by both parties. Otherwise at some later time a dispute may arise as to whether the design consultants fulfilled the contractual obligations.

Universiti Utara Malaysia

However, there are multiple non-technical aspects of a vessel designer's role as part of the process of going from conceptual design to delivery of the vessel and modification of the vessel many years into its lifetime. BNS management can consider to revise the design service contract with the LCS design authority using Good Shipbuilding Practice highlighted by Royal Institution of Naval Architects, (2021).

i. The design service contract include a clear definition as to where the design definition and the design authority obligation to detail the design for production begins.

ii. The shipyard provides timely acceptances of drawings and equipment and performs timely inspections based on the contractually defined standards of acceptability.

iii. The parties promote joint identification and cooperative resolution of problems arising from variation orders.

iv. The shipbuilder timely accomplishes fulfilment of all contractually required objectives, consistent with the contractually defined standards.

v. The owner's team similarly accomplishes timely fulfilment of all its contractually required responses from the shipbuilder.

vi. The owner's team accept the vessel, or its modifications, as contractually defined (not as wished-for by its representatives).

Universiti Utara Malaysia

5.3.3.6 Reduce number of ship class approval standards.

Classification societies are major players in the safe and quality shipping regulatory process because they serve the shipping industry as an internal regulatory system. Their authority is illustrated by the classification certificates they issue when ships are built and maintained by means of regular surveys throughout their life. Without a classification certificate, ships cannot obtain insurance and have little commercial value. The classification societies are also the shipping industry's largest technical resource (Goh & Yip, 2021).

The ship classification system begins at the ship's initial design and steel manufacture stages, and extends to block fabrication and installation of machinery systems. Ship classification aims at ensuring that ships remain fit to operate from the day of delivery when ships' first classification certificate is issued, until the day ships are taken out of service. In LCS project's there are main concern identified is LCS ship bulding has to comply with military standards and also with the civilian standards. In many cases, both standards are contracticting to each other. These requirements of class approval is stipulated in the LCS contract requirements.

BNS management can consider this special consideration agreement by Royal Institution of Naval Architects, (2006) for applying sepcial consideration related to the contraditing rules of military and civilian classification standards.

i. Special consideration may be given to applying new or modified class rules requirement when justified request is received from parties applying for classification.

ii. When the keel is not yet laid and more than one year has elapsed since the contract was signed.

iii. Where it is intended to use exisiting previously approved plans for a new contract.

iv. Where the design is already approved by the society on a ship with similar charateristics and operating conditions.

Universiti Utara Malaysia

5.3.3.7 Shipbuilding process integration.

Building a product as complex as a ship, with its hundreds of thousands of parts, and its constellation of OEMs, design offices, suppliers and subcontractors is a challenging endeavor. Recent years have seen a growing demand for high-tech and high value-added vessels. Navies are asking for adaptable, multi-role vessels that can deal with military operations other than war. For example, vessels providing humanitarian relief and emergency medical care after natural disasters or establishing a helicopter platform for replenishment or evacuation.

Those vessels require high-tech equipment and systems onboard. They need more sensors, more cables, more automation, and more controls. This increased level of complexity translates into unprecedented risks in the design and build processes. If shipbuilders want to remain competitive in today's saturated market, they must identify risks as early as possible in the project and find ways to keep those risks under control to deliver on time, on budget and on quality. The only way to manage those risks is to combine cost, schedule and technical requirements in a fully planned, resourced and budgeted end-to-end shipbuilding project intergration. This integrated solution must offer the three following features as higlighted by Deborah, (2022):

i. Integrated planning: Typically, in the marine industry, the work breakdown structure (WBS) forms the basis of the shipbuilding process. At all times the WBS needs to be connected to the technical requirements set by the customer. In that way, shipbuilders can keep track of how any change to the schedule will impact those requirements, and ensure that they are still able to comply with the contract. Having

Universiti Utara Malaysia

an integrated systems approach to planning and execution is critical for projects as complex as building a ship.

ii. Integrated bid & risk management: Requirements and risks must be connected from the very beginning of the shipbuilding project, when the shipyard is responding to an IFB (invitation for bids) or an RFP (request for proposals). This will ensure that risks are accurately assessed and clearly communicated to the customer during the bidding process.

iii. Closed-loop project management: Best practices and lessons learned need to be fed back into the work breakdown structure (WBS), so workflows and processes can be improved continuously.

5.3.3.8 Clear understanding of LCS contractual baseline

Shipyard projects involving ship construction, repair, conversion and modification, along with the associated design processes, involve a wide variety of contracts. Almost always multiple contracts are part of each shipyard project. Disputes often arise when potential risks within the accomplishment of the project were not adequately addressed within the project's contracts. Also, inconsistencies between related contracts often are the core reason for disputes. The management of projects under such circumstances constitutes a significant challenge to the success of the project.

Universiti Utara Malaysia

The foundation of any shipyard project is an assembly of multiple contracts, each of which has to be managed by the various contracting parties. The parties have to ensure the availability of the resources necessary to properly manage each of those contracts in order to avoid disputes, delays, cost overruns and unexpected compromises in form, function and capability of the ships. The challenges of managing shipyard projects begin with understanding the role of contracts in the projects that will lead to the construction, conversion, modification or repair of a ship at a shipyard.

Many of the contract agreements for shipyard projects are formed with the assistance of legal professionals. With their help, the resulting contract agreement addresses the responsibilities of the parties, the financial relationships, the insurance requirements, the allocation of financial damages if the need arises, among all the other matters typically addressed with the assistance of legal professionals. Later, once the contract has been executed, the day-today management of the project by the shipyard is in the hands of the engineering, production and testing departments, assisted by purchasing and subcontractors.

Universiti Utara Malaysia

This typical process often creates the likelihood of considerable risks. The problem is that the contract agreement has been formed with the assistance of legal professionals. But the persons who are managing the project day-to-day have little experience in reading the contract. These ‘information gaps’ create considerable risk that some costly aspects and schedule-extending aspects of the contract have been overlooked.

Due to the importance of contract management it is crucial that BNS management must give the people involve in LCS project training in contract management as highlighted by Kenneth, (2021).

i. Contract performance documentation.

ii. Change orders approval procedures.

iii. Critical path identifications

iv. Post delivery negotiations.

v. Delay, disruption and acceleration.

5.4 Recommendations: Standard Operating Procedure (SOP) in accordance with EPCC Shipbuilding Project Management Proses for Variation Orders (VO) Management

This study found that there is an urgent need for the BNS high management to come out with a standard operating procedure (SOP) in accordance with the EPCC shipbuilding project management proses flow for VO management. Even for building a single hull ship, the amount of change that needs to be managed is immense. Suppliers, materials, schedules, requirements, labor resources, and finances all fluctuate. To compound the problem, each of those activities also produces information in a unique format.

Effectively managing those parts, and every change they go through, is not just important; it is essential. Key aspects of VO management, like identifying the VO, determining the additional cost of different solutions, assigning and scheduling the change, communicating the change to stakeholders, and managing the changes across sister ships occur at different stages of design construction, and maintenance. The best shipbuilders have visibility across every stage of the vessel's lifecycle.

This study integrated the PMBOK project management process group with the Engineering, Procurement, Construction, and Commissioning (EPCC) shipbuilding project management process group as highlighted in Table 5.2. In other words, engineering (E) and procurement (P) belong to initiating and planning groups, while construction (C) belongs to executing as well as monitoring and controlling groups. Then, the commission (C) belongs to the closing group. Figures 5.2 to 5.11 depict these integrations, which can be regarded as study recommendatios. These recommendatios can be a blueprint for BNS high management to develop the SOP for each phase.

Universiti Utara Malaysia

Table 5.2

Integration of Project Management Group Process Group With EPCC Shipbuilding Project Management Process Group

Knowledge Areas	**Project Management Process Groups**					**Related Departments**
	Initiating	**Planning**	**Executing**	**Monitoring and controlling**	**Closing**	
	Engineering (E) & Procurement (P)		**Construction (C)**		**Commissioning (C)**	
	Shipbuilding Project Management Process Groups					
Project Integration Management	a. Develop Project Charter b. Develop Engineering check list -List of drawing for basic and detail design	a. Develop project Management Plan b. Develop equipment list -List of material by basic and detail design drawing (BoM) -List of suppliers preferably local.	a. Direct and manage project. work b. Project status.	a. Monitor and control project work. b. Perform integrated change control.	a. Closing project phase. b. Lesson learn. c. Record keeping.	a. Engineering b. Finance c. Procurement d. PMT e. Main client project team
Project Scope Management		a. Plan scope management b. Collect requirements c. Define scope d. Create WBS		a. Validate scope. b. Control Scope		a. PMT b. Engineering c. Production
Project Schedule Management		a. Plan schedule management. b. Define activities. c. Sequence activities. d. Estimate activity durations e. Develop schedule		a. Control schedule		a. PMT b. Engineering c. Production
Project Cost Management		a. Plan cost management b. Estimate cost.		a. Control cost		a. PMT b. Procurement c. Finance

Universiti Utara Malaysia

		c. Determine budget			
Project Quality Management		a. Plan quality management	a. Manage quality	a. Control quality	a. PMT b. Engineering c. Production
Project Resource Management		a. Plan resource management. b. Estimate activity resources	a. Acquire resources.	a. Control resources	a. PMT b. Finance c. Procurement d. Production
Project Communications Management		a. Plan communication management	a. Manage communications	a. Monitor communications	a. PMT
Project Risk Management		a. Plan risk management. b. Identify risk. c. Perform analysis. d. Plan risk responses	a. Implement risk responses	a. Monitor risk	a. PMT
Project Procurement management		a. Plan procurement management	a. Conduct procurements	a. Control procurements	a. PMT b. Finance c. Procurement
Project Stakeholder management	a. Identify stakeholders	a. Plan stakeholder engagement	a. Manage stakeholder engagement	a. Monitor stakeholder engagement	a. PMT

Source: Compiled by author

Universiti Utara Malaysia

The first knowledge area is project integration management, and Figure 5.2 illustrates the shipping project management phase for this knowledge area. This study suggests that the involvement of a few departments in reducing the occurrence of VO, which are the engineering department, finance department, procurement department, PMT, and main client project team, may be sufficient. These are two tasks that need to be conducted by these parties during the initiating phase (engineering), which are developing a project charter and engineering check list. It includes the list of drawings for basic and detailed design.

During the planning phase (procurement), they need to develop a project management plan and develop an equipment list that includes a list of materials (BoM) and detailed design drawing list as well as a list of suppliers, preferrably local. Then, this study suggests they direct as well as manage project work and project status during the executing phase (construction). They also need to monitor and control project work, followed by performing integrated control during the monitoring and controlling phase. During the closing phase (commissioning), these parties need to close the project phase, list out the lessons learned, and perform record keeping.

Universiti Utara Malaysia

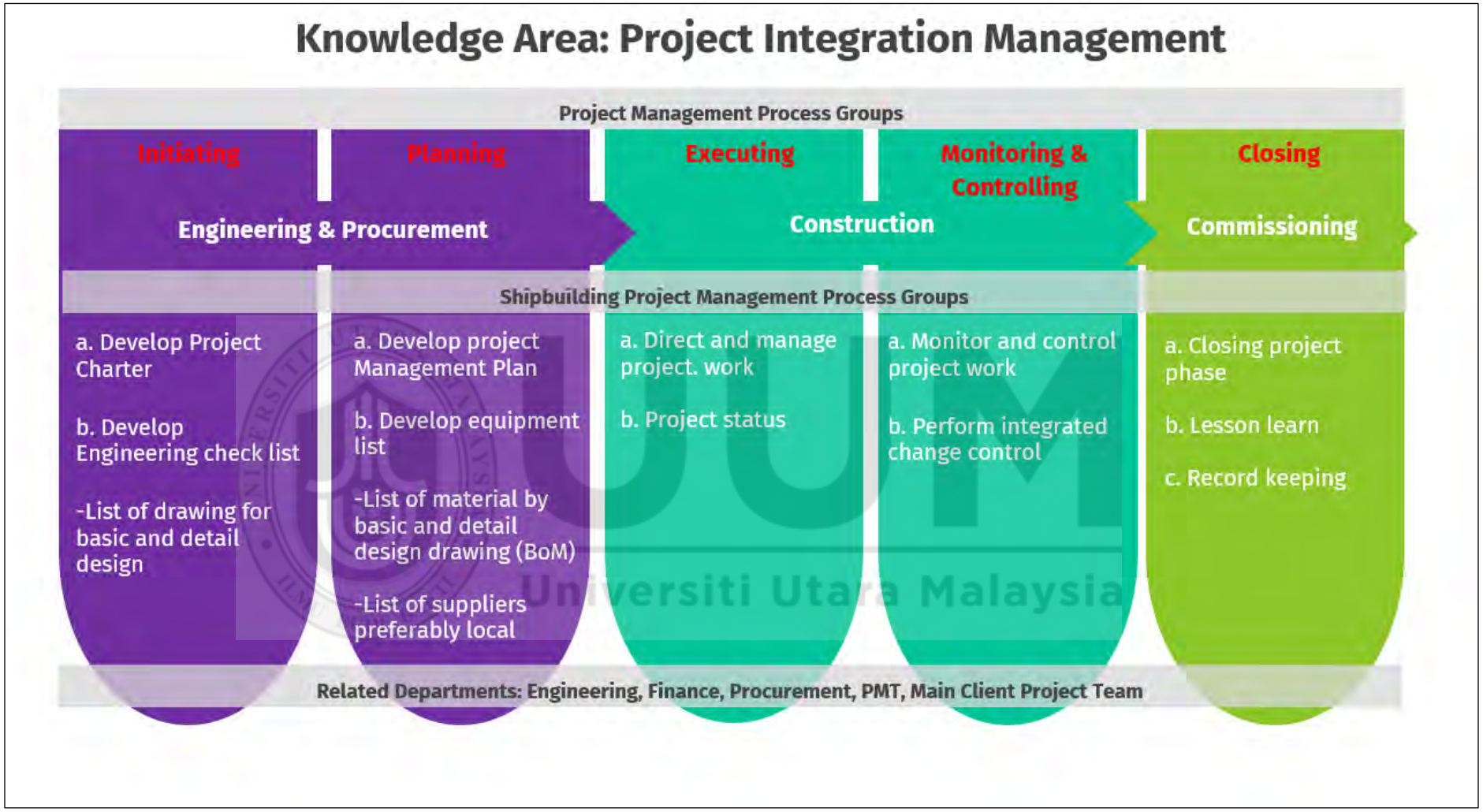


Figure 5.2
Shipbuilding Project Management Phase: Project Integration Management (Recommendation 1)
Source: Complied by author

The second knowledge area is project scope management, and Figure 5.3 illustrates the shipping project management phase for this knowledge area. This study suggests that the involvement of three departments in reducing the occurrence of VO, which are PMT, engineering department and production department. During the planning phase (procurement), they need to plan scope management, collect requirement, define scope and create WBS. Then, this study also suggests them to validate and control scopes during the monitoring and controlling phase.

Universiti Utara Malaysia

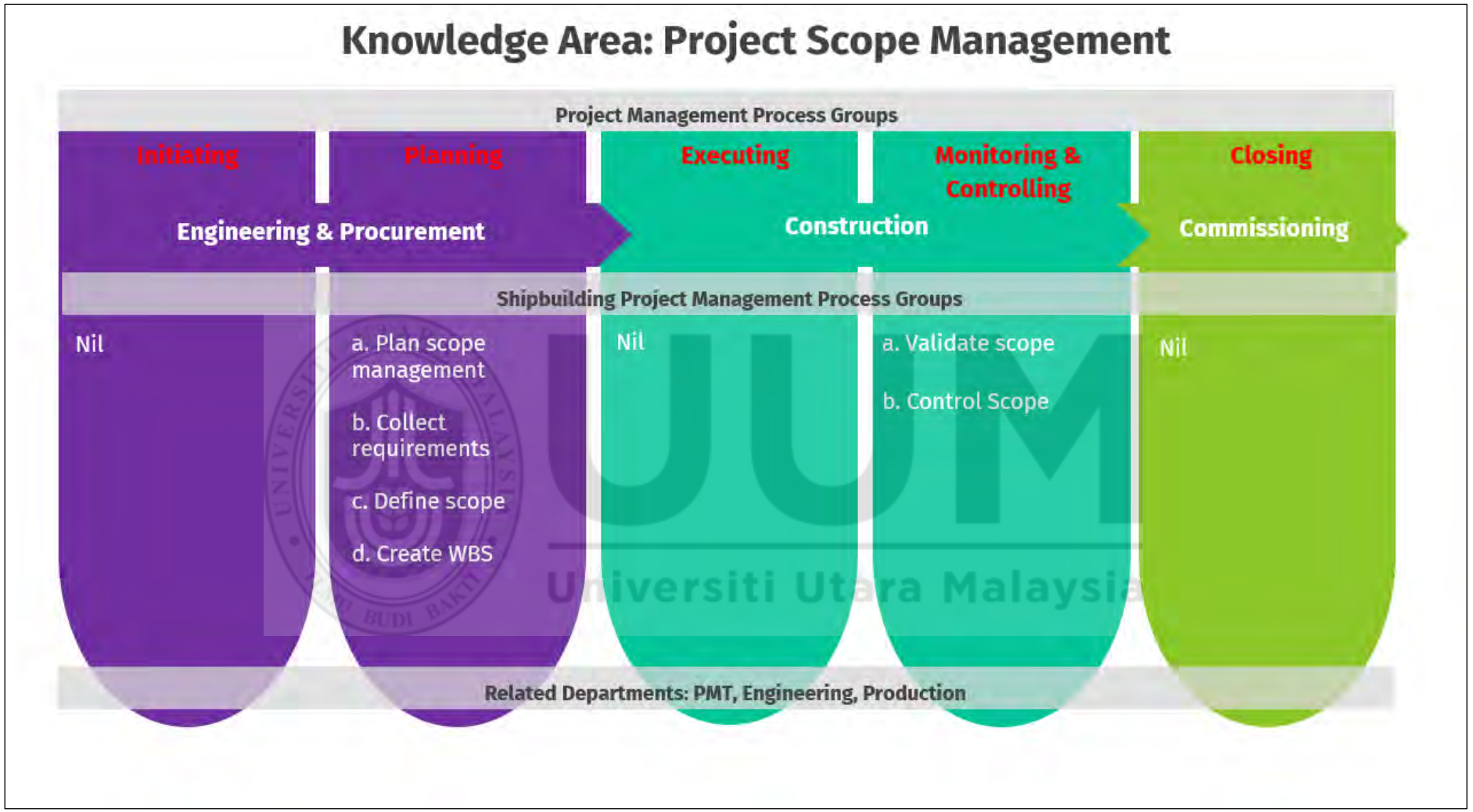


Figure 5.3
Shipbuilding Project Management Phase: Project Scope Management (Recommendations 2)
Source: Compiled by author

The third knowledge area is project schedule management, and Figure 5.4 illustrates the shipping project management phase for this knowledge area. This study suggests that the involvement of three departments in reducing the occurrence of VO, which are PMT, the engineering department, and the production department. There are four tasks that need to be conducted by these parties during the planning phase, which are plan schedule management, defining activities, sequencing these activities, and developing the schedule. They also need to control the schedule during the monitoring and controlling phase.

Universiti Utara Malaysia

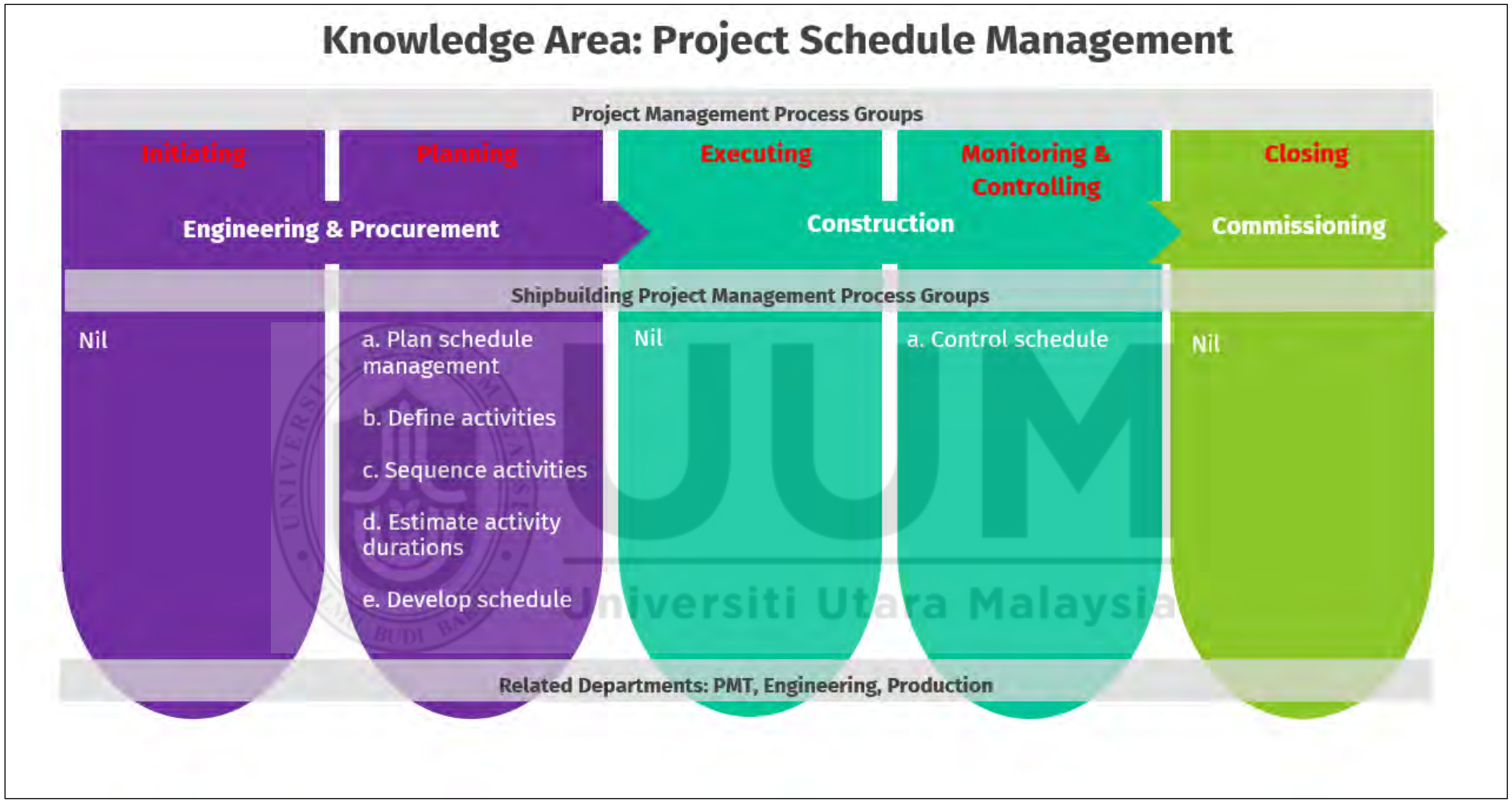


Figure 5.4
Shipbuilding Project Management Phase: Project Schedule Management (Recommendations 3)
Source: Compiled by author

Universiti Utara Malaysia

The fourth knowledge area is project cost management, and Figure 5.5 illustrates the shipping project management phase for this knowledge area. This study suggests that the involvement of three departments in reducing the occurrence of VO, which are PMT, procurement department and finance department. During the planning phase (procurement), they need to plan cost management, estimate cost and determine budget. Then, this study suggests them to control cost during the monitoring and controlling phase.

Universiti Utara Malaysia

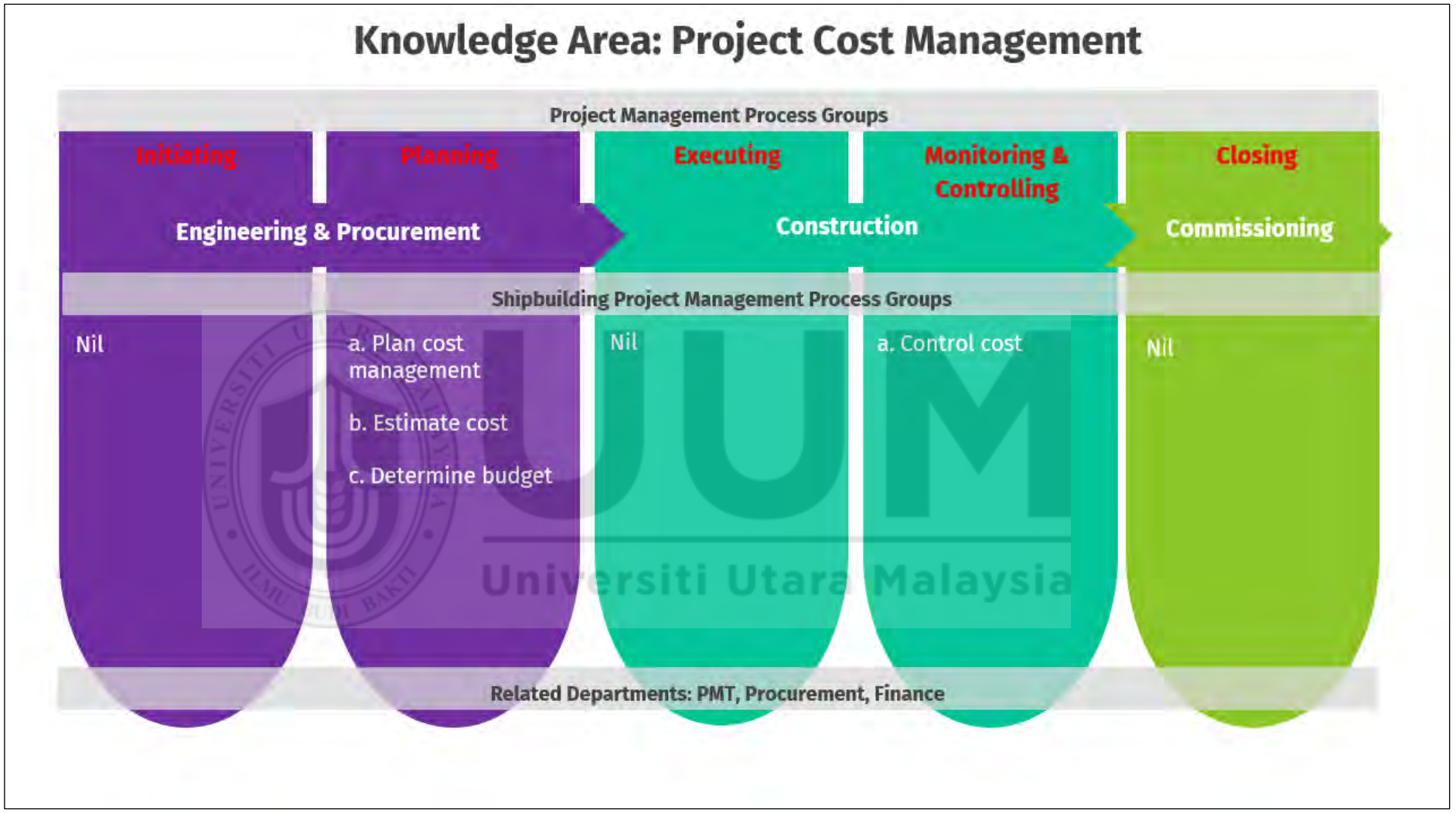


Figure 5.5
Shipbuilding Project Management Phase: Project Cost Management (Recommendations 4)
Source: Compiled by author

The fifth knowledge area is project quality management, and Figure 5.6 illustrates the shipping project management phase for this knowledge area. This study suggests that the involvement of three departments in reducing the occurrence of VO, which are PMT, the engineering department, and the production department. Plan quality management is one task that needs to be conducted by these parties during the planning phase (procurement). Then, this study suggests them to manage quality during the execution phase (construction). They also need to control the quality during the monitoring and controlling phases.

Universiti Utara Malaysia

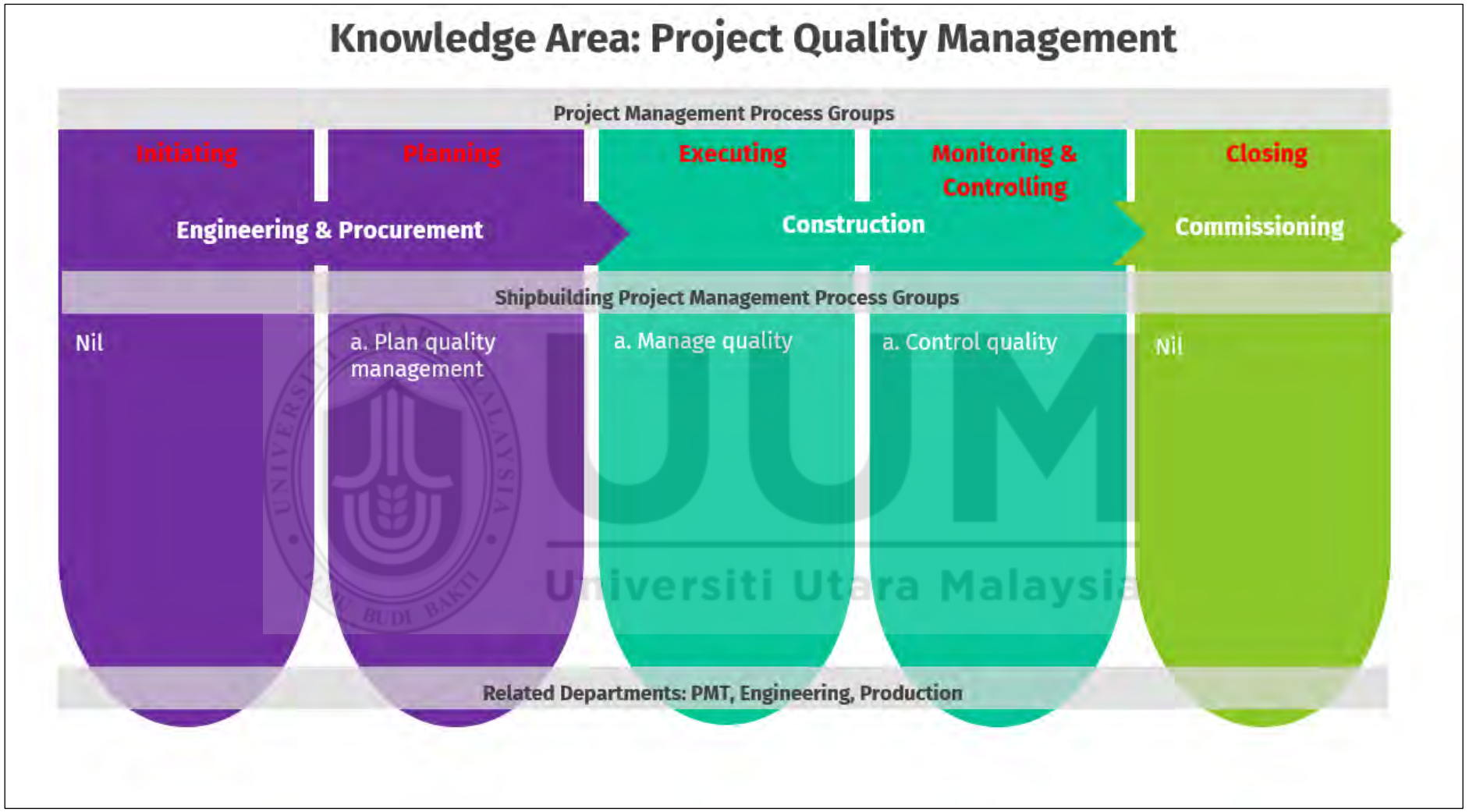


Figure 5.6
Shipbuilding Project Management Phase: Project Quality Management (Recommendations 5)
Source: Compiled by author

The sixth knowledge area is project resource management, and Figure 5.7 illustrates the shipping project management phase for this knowledge area. This study suggests that the involvement of four departments in reducing the occurrence of VO, which are PMT, the finance department, procurement department, and production department. During the planning phase (procurement), they need to plan resource management and estimate activity resources. Then, this study suggests these departments acquire resources during the executing phase (construction). They also need to control these resources during the monitoring and controlling phase.

Universiti Utara Malaysia

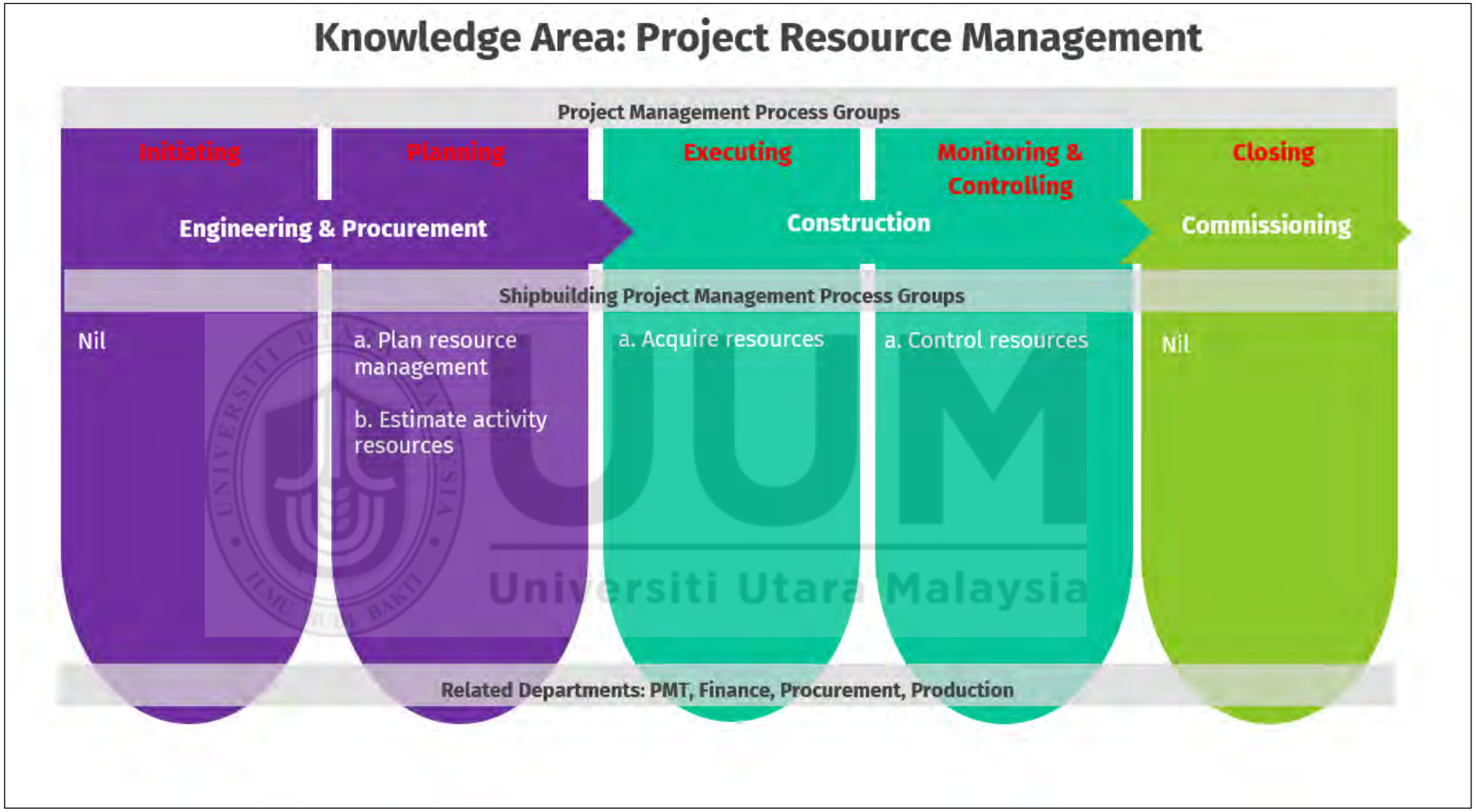


Figure 5.7
Shipbuilding Project Management Phase: Project Resource Management (Recommendations 6)
Source: Compiled by author

The seventh knowledge area is project communication management, and Figure 5.8 illustrates the shipping project management phase for this knowledge area. This study suggests that the involvement of PMT in reducing the occurrence of VO. Plan communication management is one task that needs to be conducted by PMT during the planning phase (procurement). Then, this study suggests PMT be used to manage communication during the executing phase (construction). They also need to monitor communication during the monitoring and controlling phase.

Universiti Utara Malaysia

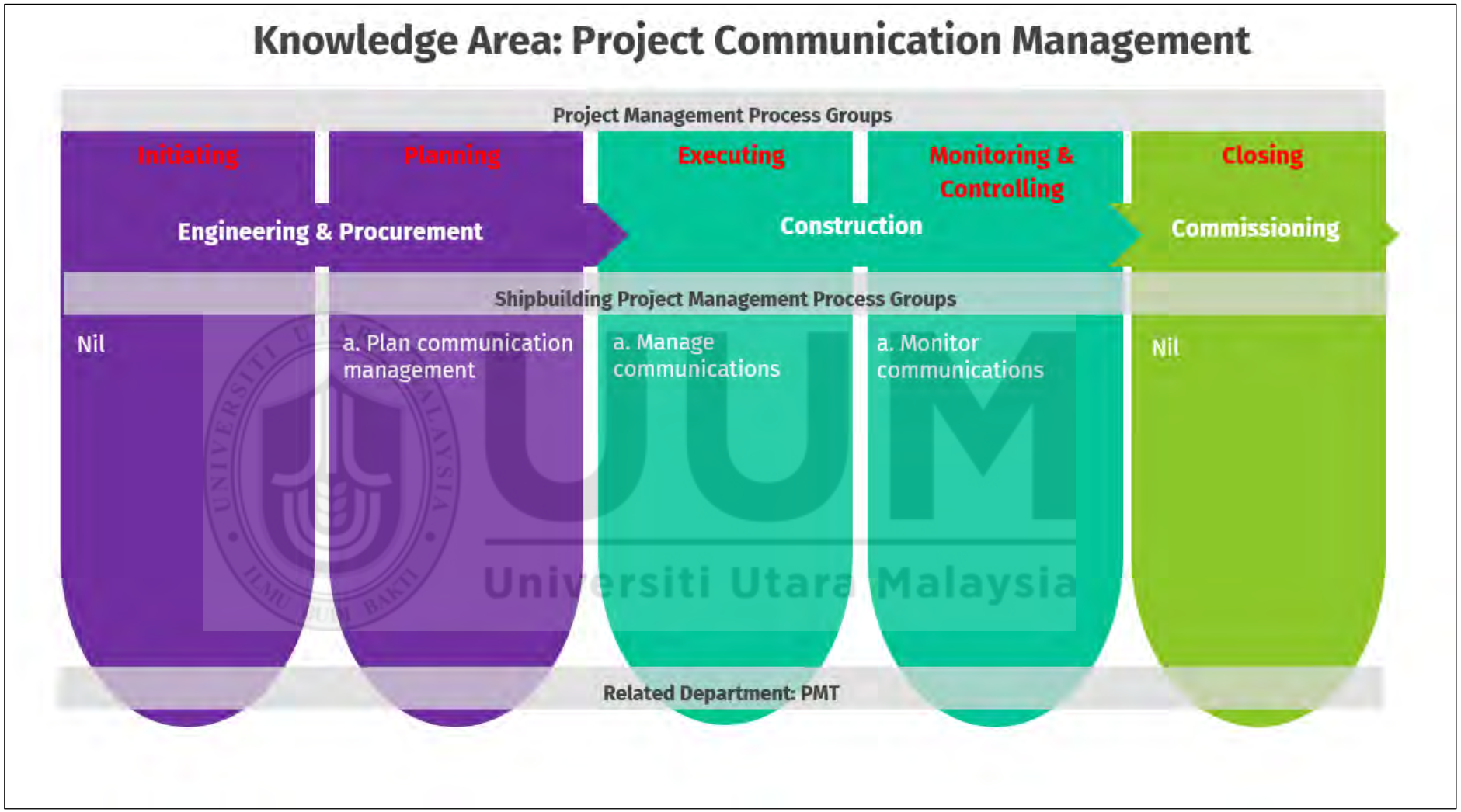


Figure 5.8
Shipbuilding Project Management Phase: Project Communication Management (Recommendations 7)
Source: Compiled by author

The eighth knowledge area is project risk management, and Figure 5.9 illustrates the shipping project management phase for this knowledge area. This study suggests that the involvement of one department in reducing the occurrence of VO, which is PMT. During the planning phase (procurement), this study suggests PMT to plan risk management, identify risk, perform analysis and plan risk responses. Then, this study suggests PMT to implement risk responses during the executing phase (construction). They also need to monitor these risks during the monitoring and controlling phase.

Universiti Utara Malaysia

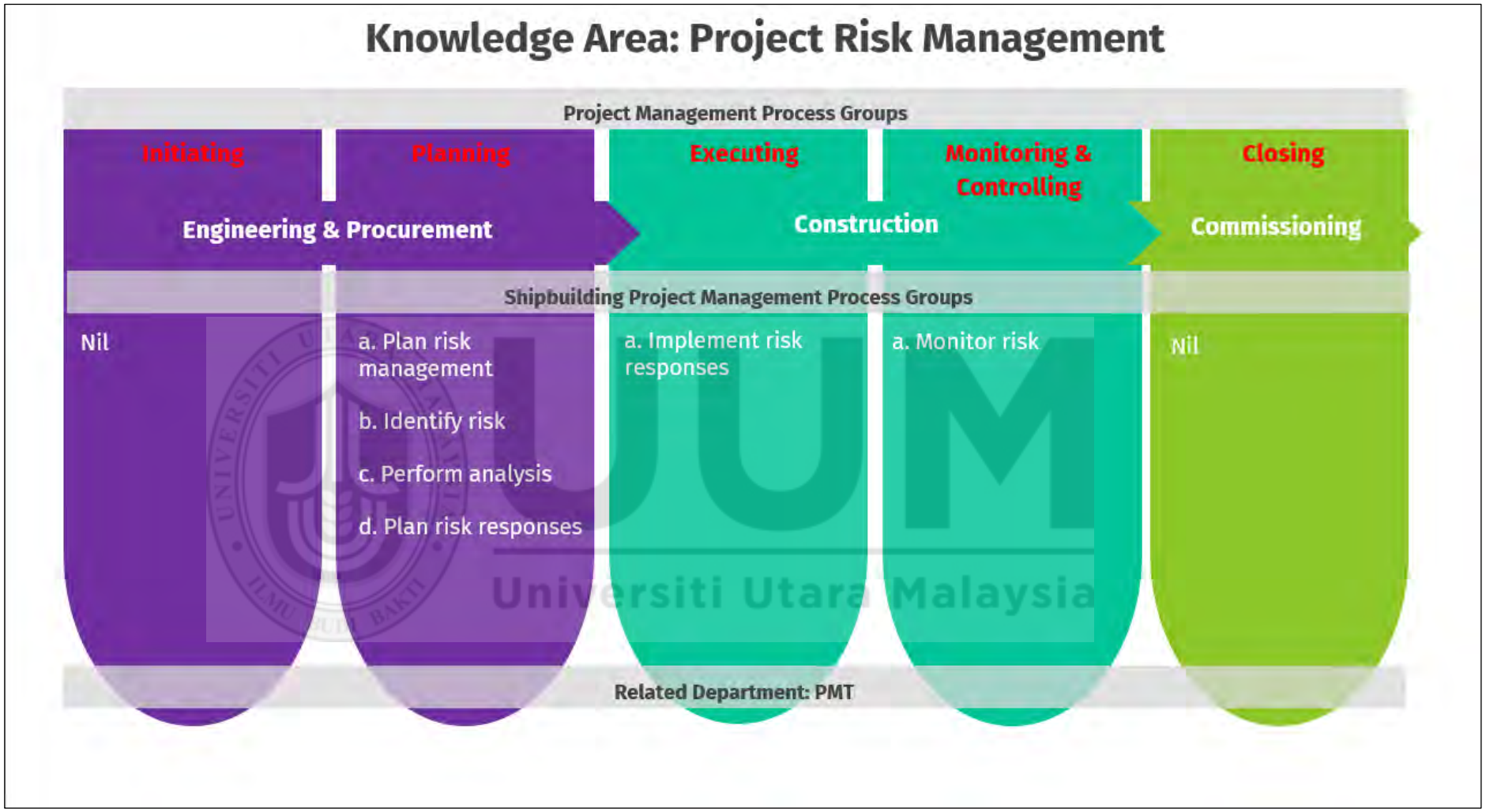


Figure 5.9
Shipbuilding Project Management Phase: Project Risk Management (Recommendations 8)
Source: Compiled by author

Universiti Utara Malaysia

The nineth knowledge area is project procurement management, and Figure 5.10 illustrates the shipping project management phase for this knowledge area. This study suggests that the involvement of three departments in reducing the occurrence of VO, which are PMT, finance department and procurement department. During the planning phase (procurement), they need to plan procurement management. Then, this study suggests them to conduct procurements during the executing phase (construction). They also need to control the procurement during the monitoring and controlling phase.

Universiti Utara Malaysia

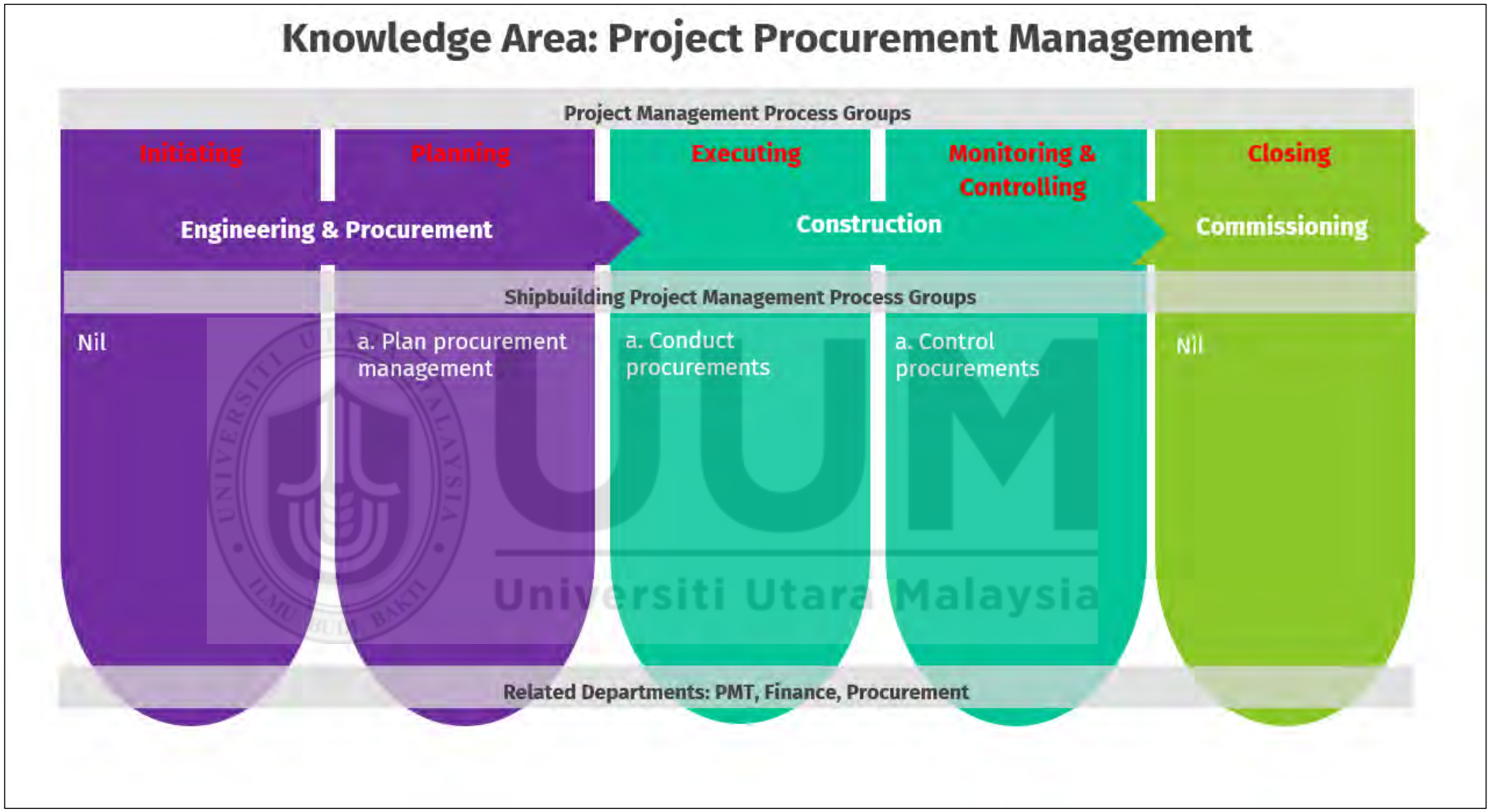


Figure 5.10
Shipbuilding Project Management Phase: Project Procurement Management (Recommendations 9)
Source: Compiled by author

Universiti Utara Malaysia

The tenth knowledge area is project stakeholder management, and Figure 5.11 illustrates the shipping project management phase for this knowledge area. This study suggests that the involvement of one department in reducing the occurrence of VO, which is PMT. One task that needs to be conducted by these parties during the initiating phase (engineering) is identifying stakeholders. During the planning phase (procurement), PMT needs to plan stakeholder engagement. Then, this study suggests PMT manage stakeholder engagement during the executing phase (construction) besides monitoring this engagement during the monitoring and controlling phase.

Universiti Utara Malaysia

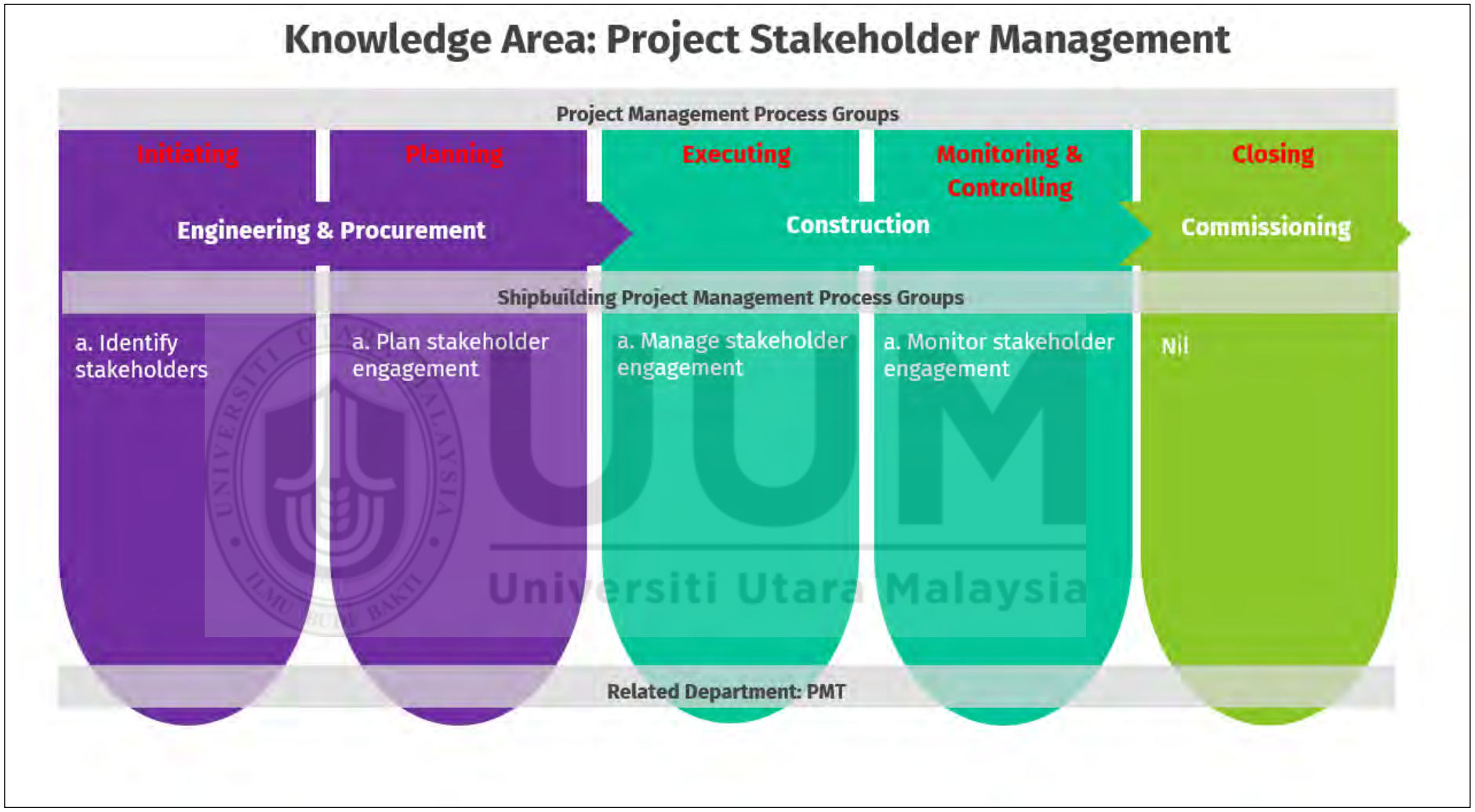


Figure 5.11
Shipbuilding Project Management Phase: Project Stakeholder Management (Recommendations 10)
Source: Compiled by author

Universiti Utara Malaysia

5.5 Practical Contribution

Malaysia government must take decisive action to stimulate the economy, particularly the construction sector, which is vital for infrastructure development and has a strong positive correlation with Gross Domestic Product (GDP). Malaysia is pursuing high income status, the goal of which is to become a developed and high-income country by 2024 to 2028.

Previously, Cruz et al. (2019) claimed that the construction industry is vital to every economy since it provides jobs, cashflows, and infrastructure. According to Alalule et al. (2021a), the construction industry has a significant impact on global economic development. Musarat, Alaloul, and Liew (2020) as well as Muller and Veser (2020) also claimed that a country's prosperity is connected to its economic growth, and that all sectors, including primary, secondary, tertiary, and quaternary, contribute to the economy's stabilisation. Alaloul et al. (2021b) and Lean (2001) also added the construction industry is extremely important since it represents the country's economy, health, and quality of life.

Universiti Utara Malaysia

Developing countries rely heavily on the construction industry to carry out their long-term development plans (Pradip & Pitroda, 2016; Rafiq et al., 2021). Any variation in the construction industry will have an immediate impact on all other industries (Khan, 2008; Lopes, 2008; Rameezdeen, 2021). Because the construction industry plays such a large role in the economy, its influence on a country's economy is linked to its forward and backward links with other industries (Geadah, 2003).

Currently, LCS project have been the concerted efforts of Malaysian government toward modernizing the Royal Malaysia Navy (RMN) assests. LCS project has been the basis of RMN recent restructuring agenda 15 to 5 Transformation Programme. This program focuses on acquiring new ships to replace aging ones, reducing cost and logistics problems, and building an efficient fleet, in part by reducing the number of ship classes down from the current 15 to just 5. RMN needs to LCS ships in order to maximize its options to remain relevant and increase readiness. The LCS ship would enable RMN to respond to a wide variety of challenges at Malaysian waters.

LCS project also have been fleet recapitalization effort by the Malaysian government to provide efficient platforms for operational requirements at sea. Currently, existing RMN ships are aging in terms of its capabilities as well as sustainability most of RMN ships are over 25 years old and are reaching a point of diminishing returns when it comes to maintenance costs. With the growing mismatch in capabilities, this procurement project is a much-needed modernization component as it can provide an advanced platform to achieve combat effectiveness that the existing RMN is lacking.

While this qualitative study aims to understand the VO in a naval ship construction company and to improve the project management efficiency through a standard operating procedure (SOP) in accordance with the EPCC shipbuilding project management process flow for VO management, the study also has positive implications for the construction industry and the nation.

Universiti Utara Malaysia

Through the reccomendations of this study BNS management can formulate a suitable standard operating procedures for LCS PMT to follow to reduce the VO occurance in LCS Project and finally BNS can complete all six LCS ships within the stipulated time and cost.

5.6 Theoretical Contribution

This research contributes to the understanding of the factors that contribute to variation orders in shipbuilding. By identifying the underlying causes of variation orders, shipbuilders can take steps to mitigate their occurrence and prevent cost and schedule overruns.

One key theoretical contribution of this research is the identification of specific factors that contribute to variation orders in shipbuilding, such as , (i) change of project scope by client, (ii) project financial problem, (iii) delay in project decision making, and (iv) insufficient project drawing. Additonally two other factors were also found from this study namely (i) EPCC project management process to be followed and (ii) lack of shipbuilding experience management for shipbuilding projects. By understanding these factors, shipbuilders can take steps to prevent them from occurring and better plan for potential changes.

Another theoretical contribution of this research is the development of a standard operating procedure framework for mitigating variation orders. This framework can be used by shipbuilding companies to take steps for preventing variation orders from occurring. Additionally, by providing a structured approach for identifying and addressing variation orders, the framework can help shipbuilders to improve cost and schedule management in the projects.

Universiti Utara Malaysia

The research also contributes in understanding the relationship between project management and variation order, by highlighting the important role of communication and planning in preventing variations. Additionally, the research provides an insight in the role of cost management in reducing the number of variation orders.

Overall, this research offers theoretical contributions to the field of shipbuilding by identifying the specific factors that contribute to variation orders and developing a standard operating procedure framework for mitigating the variation orders. These contributions can be used by shipbuilders to improve their project management and reduce the occurrence of variation orders.

5.7 Limitations of the Study and Recommendations for Future Studies

This study is subject to four limitations. The first limitation is that the findings of this study cannot be generalised to the whole nation. As mentioned earlier, the primary aim of this study is to understand the variation orders in a naval ship construction company and to improve the project management efficiency through a standard operating procedure (SOP) in accordance with the EPCC shipbuilding project management process flow for VO management, particularly regarding the shipbuilding activity contracted by the Malaysian government to the shipbuilder, Boustead Naval Shipyard Sdn Bhd.

Therefore, second limitation while the study findings have been attained from the respondents who are the project management supervisory group known as the project management team LCS, the findings cannot represent the perspective of the project management team in the whole nation. Therefore, this study recommends future studies consider the respondents in more expansive geographical areas.

Universiti Utara Malaysia

The third limitation is that the findings of the study only cover the feedback of the respondents in relation to the factors contributing to VO occurrence in the LCS project and the impacts of VO in terms of costs and schedules on the efficiency of the LCS project management team. As a result, the scope of this study is limited to these parameters. Future studies should consider exploring the other scopes of adding rich data pertaining to project management efficiency. The fourth limitation is that the data restriction due this project involves Royal Malaysian Navy ships involving to national security restrictions.

5.8 Conclusion

VO refers to the routine operations related to a naval shipbuilding project. These processes are unavoidable because they commonly occur during the renovation and modification of shipbuilding structures. In determining factors contributing to VO occurrence in the LCS project, this study found four factors have been identified. These factors are: project financial problems, client change in project scope by client, delay in decision-making, and insufficient project drawing. This study also found the additional factors, which are the Engineering, Procurement, Construction, and Commissioning (EPCC) project management process to be followed and the lack of shipbuilding experience management for shipbuilding projects.

Thus, the management needs to consider these factors in minimising the occurrence of VO. This is because the occurrence of VO caused negative consequences for the company. For example, as found by this study, the VO caused a bad image for the Project Management Team (PMT) by the BNS high management in managing project cost and schedule. The occurrence also led the PMT team's working morale down due to being badly judged by the BNS high management that they were

Universiti Utara Malaysia

not able to manage the project cost and schedule efficiently. Not only that, but the staff of PMT's working curriculum vitae record is tarnished due to being unable to deliver the LCS Project successfully, and this has a negative effect on their ability to find another working place. Finally, the occurrence of VO caused extra workload for the PMT due to the retention of existing PMT staff.

Thus, the management team for the shipbuilding project must take fundamental safeguards to minimise VO's and undesirable impacts. Among the measures that can be undertaken, as suggested by the respondents in this study, are: (i) training on VO management for PMT by an experienced trainer; (ii) developing standard operating procedures for VO management; (iii) BNS management support; (iv) following the standard shipbuilding process EPCC; (v) design authority to give full support and engagement during VO explanation with the main client; (vi) reducing the number of ship class standards; (vii) shipbuilding process integration; and (viii) clear understanding of the LCS contractual baseline.

Universiti Utara Malaysia

REFERENCES

Abdul Kadir, M. (2018). Framework to reduce variation processing time in public. A published thesis from the Universiti Teknologi Malaysia http://eprints.utm.my/id/eprint/78885/1/MunirahAbdulMalikMFAB2018.pdf

Abdullah, A. A., Abdul-samad, Z., Abdul-rahman, H., & Salleh, H. (2021). Project management standards, guides and methods: a critical overview. *Journal of Project Management Practice*, 1(1), 35-51.

Abdul-Rahman, H., Berawi, M. A., Berawi, A. R., Mohamed, O., Othman, M., & Yahya, I. A. (2006). Delay mitigation in the Malaysian construction industry. *Journal of Construction Engineering and Management,* 132(2), 125–133.

Abdul-Rahman, H., Wang, C., & Yap, J. B. H. (2016). Impacts of design changes on construction performance: insights from a literature review. *Journal of Quantity Surveying and Construction Business*, 7(1), 31-54.

Acharya, N., Lee, Y., & Kim, J. (2006). Design errors: in efficiency or carelessness of designer. *Perform Construction Facilities*, 2(192), 192-195.

Academy, M. of P. (2022). *Consequences of Poor Project Management*. Agile Training. https://blog.masterofproject.com/consequences-of-poor-project-management/

Ade, N., & Sarwono, H. (2015). Penyebab dan dampak variation order (VO) pada pelaksanaan proyek konstruksi. *Konstruksia*, 63-77.

Ahlemann, F. (2009). Towards a conceptual reference model for project management information systems. *International Journal of Project Management*, 27(1), 19–30. https://doi.org/10.1016/j.ijproman.2008.01.008

Ahmed, S.M., Azhar, S., Kappagntula, P. and Gollapudial, D. (2003). Delays in construction: a brief study of the Florida Construction Industry. Proceeding of the 39th Annual ASC Conference, Clemson University, Clemson, SC, pp. 257–266.

Ai, S., Du, R., Straub, D. W., Maruping, L. M., & Miao, Y. (2019). Measuring creolization in IT outsourcing: instrument development and validation. *International Journal of Information Management*, 47, 16–30.

Ajmal, M. M., Kekäle, T., & Koskinen, K.U. (2009). Role of organisational culture for knowledge sharing in project environments. *International Journal of Project Organisation and Management*, 1(4), 358–374.

Akinsola, A. O., Potts, K. F., Ndekugri, I., & Harris, F. C. (1997). Identification and evaluation of factors influencing variations on building projects. *International Journal of Project Management*, 15(4), 263-267.

Akinyode, B., & Khan, T. (2018). Step by step approach for qualitative data analysis. *International Journal of Built Environment and Sustainability*, 5.

Alaghbari, W. (2005). Factors affecting construction speed of industrialized building system in Malaysia. Master's thesis, University Putra Malaysia, Serdang.

Alaloul, W., Altaf, M., Musarat, M., Javed, M. F., & Mosavi, A. (2021b). Systematic review of life cycle assessment and life cycle cost analysis for pavement and a case study. *Sustainability,* 13, 4377.

Alaloul, W. S., Musarat, M. A., Liew, M., Qureshi, A. H., & Maqsoom, A. (2021a). Investigating the impact of inflation on labour wages in Construction Industry of Malaysia. *Ain Shams Engineering Journal.* 12(4).

Alaloul, W. S., Musarat, M. A., Rabbani, M. B. A., Iqbal, Q., Maqsoom, A., & Farooq, W. (2021a). Construction sector contribution to economic stability: Malaysian GDP distribution. *Sustainability*, 13, 5012.

Alaloul, S. W., & Musarat, M. A. (2020). *Impact of zero energy building: sustainability perspective. in sustainable sewage sludge management and resource efficiency*. IntechOpen: London, UK.

Aliyu, A. A., Bello, M. U., Kasim, R., & Martin, D. (2014). Positivist and non-positivist paradigm in social science research: conflicting paradigms or perfect partners? *Journal of Management and Sustainability*, 4(3), 79–95.

Alessandrini, M. (2012) Non-positivist approaches to research in the third sector: empowered policy making. ISTR 10th International Conference, Universita Degli Studi Di Siena, Siena, Italy, 10-13 July 2012, 1-17.

Al-Dubaisi, A. H. (2000). Change orders in construction projects in Saudi Arabia. MS Thesis. King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia.

Alia, A., Emad, E., Ashraf, E., & Mahmoud, D. (2014). Causes and effects of change orders on construction projects in Kuwait. *International Journal of Engineering Research and Application*, 4(2), 1-8.

Aliman, K. H. (2019, July). BHIC defends its financial reporting. *Edge Weekly*. https://www.theedgemarkets.com/article/special-report-bhic-defends-its-financial-reporting

Al-Momani, A. H. (2000). Construction delay: a quantitative analysis. *International Journal of Project Management*, 18(1), 51–59.

Al-Nuaimi, A., Taha, R., Al Mohsin, M., & Al-Harthi, A. (2010). Causes, effects, benefits, and remedies of change orders on public construction projects in Oman. *Journal of Construction Engineering and Management*, 136, 615–622.

Al-suliman, J. A. (2014). Effective Stakeholder Engagement in Variation Order Management at the Design Stage of Public Sector Construction Projects in Saudi Arabia. A published thesis from the School of the Built Environment, Heriot-Watt University, London.

Anderson, J., Narus, J., & Rossum, W. (2006). Customer value propositions in business markets. *Harvard Business Review*, 84, 90-99.

Andri´c, J. M., Mahamadu, A. M., Wang, J., & Zou, P. X. W. (2019). The cost performance and causes of overruns in infrastructure development projects in Asia. *Journal of Civil Engineering and Management*, 25, 203–214.

Arain, F. M., Assaf, S., & Low, S. P. (2004). Causes of discrepancies between design and construction. *Architectural Science Review*, 47(3), 239-249.

Arain, F. M., Assaf, S., & Pheng, L. S. (2004). Causes of discrepancies between design and construction. *Architectural Science Review*, 47(3), 237–249.

Arain, F. M., & Pheng, L. S. (2005). The potential effects of variation orders on institutional building projects. *Facilities*, 23(11-12), 496-510

Archibald, R. D. (2013). A Global System for Categorizing Projects. IPMA Project Perspectives, 7. Available online: http://russarchibald.com/GLOBAL%20SYSTEM%20FOR%20CATEGORIZING%20PROJECTS.pdf

Argyris, C. (1999). *On organizational learning*. Cambridge, Oxford: Blackwell Publishers.

Asamaoh, R. O., & Offei-Nyako, K. (2013). Variation determinants in building construction: Ghanaian professionals perspective. *Journal of Construction Engineering and Project Management*, 3(4).

Aspers, P., & Corte, U. (2019). What is qualitative in qualitative research. *Qualitative Sociology*, 42.

Assaf, S.A., & Al-Hammad, A.M. (1988). The effect of economic changes on construction cost. *American Association of Cost Engineers Transactions, Morgantown, West Virgina*, 63-67.

Atkinson, R. (1999). Project management: cost, time and quality, two best guesses and a phenomenon, its time to accept other success criteria. *International Journal of Project Management*, 17, 337–342.

Atkinson, R. W. (1999). *Effective organizations, re-framing the thinking for information systems project success*. London: Cassel Press.

Australian Ministry of Defense. (2017). Naval shipbuilding plan. Australian Ministry of Defense, Canberra, Australia.

Ayas, K. (1996). Professional project management: a shift towards learning and a knowledge creating structure. *International Journal of Project Management*, 14(3), 131–136.

Baca, M. C. (2005). *Project manager's spotlight on change management*. New York: Sybex. Inc.

Barnet, & Hall. (2021). How to use reduced workload to win the war for talent. *Organizational Dynamics*, *29*(3), 192–210.

Bajari, P., & Tadelis, S. (2001). Incentives versus transaction costs: a Theory of Procurement Contracts. *RAND Journal of Economics*, 32, 387–407. https://doi.org/10.2139/ssrn.193121Baloyi, L. & Bekker, M. (2011). Causes of construction cost and time overruns: the 2010 FIFA World Cup Stadia in South Africa. *Acta Structilia*, 18(1), 51-67.

Bazeley, P. (2007). *Qualitative data analysis with NVivo*. London: Sage.

Baxter, P., & Jack, S. (2010). Qualitative case study methodology: study design and implementation for novice researchers. *Qualitative Report*, 13.

Bernard, H. R. (1988). *Research methods in cultural anthropology* (2nd ed.). SAGE Publication, Inc.

Universiti Utara Malaysia

Bilen Doğan, Ü., & Helvacioğlu, H. (2017). *CUSTOMISED PROJECT MANAGEMENT METHODS AND THEIR APPLICATIONS IN SHIPBUILDING PROJECTS 3 CUSTOMISED PROJECT MANAGEMENT METHODS AND THEIR APPLICATIONS IN SHIPBUILDING PROJECTS*.

Bloomberg, L., & Volpe, M. (2008). *Completing your qualitative dissertation: a Roadmap from beginning to end*. SAGE Publications, Inc.

Bowen, G. (2009). Document analysis as a qualitative research method. *Qualitative Research Journal*, 9, 27–40. Braun, V., Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3, 77–101.

Bowen, H. K., Clark, K. B., Holloway, C. A., & Wheelwright, S. C. (1994). *The perceptual enterprise machine—seven keys to corporate renewal through successful product and process development*. New York: Oxford University Press.

Bowen, P. A., Cattel, K. S., Hall, K. A., Edwards, P. J., & Pearl, R. G. (2012). Perceptions of time, cost and quality management on building projects. *Australasian Journal of Construction Economics and Building*, 2(2), 48–56.

Bridges, J. (2019). Cost management basics. https://www.projectmanager.com/training /basics-project-cost-management

British Columbia Construction Association. (2011). The pitfalls of incomplete contract documents. *Construction File*, 9(1).

Brito, M. E., Lopes, R. de O. A., Rocha, L., & Qualharini, E. L. (2016). Beyond buildability: operability and commissioning of industrial facilities. *Procedia Social and Behavioral Sciences*, 226, 67-74.

Bryman, A., & Bell, E. (2003). *Business research methods* (2nd ed.). Oxford University Press Inc.

Burr, A. (2016). Delay and disruption in construction contracts. https://www.bookdepository.com/Delay-Disruption-Construction-Contracts-Andrew-Burr/9781138940666

Cantarelli, C. C., Molin, E. J., van Wee, B., & Flyvbjerg, B. (2012). Characteristics of cost overruns for Dutch transport infrastructure projects and the importance of the decision to build and project phases. *Transport Policy*, 22, 49–56.

Carvalho, M., Sivanandam, H., & Tan, T. (2020, August 4). Ministry mulling options for LCS project. *TheStar*. https://www.thestar.com.my/news/nation/2020/08/04 /ministry-mulling-options-for-lcs-project

Charoenngam, C., Coquinco, S. T., & Hadikusumo, B. H. W. (2003). Web-based Application for Managing Change Orders in Construction Projects, *Construction Innovation*, 3(4), 197-215

Chu, N., Nie, X., Xu, J., & Li, K. (2021). A systematic approach of lean supply chain management in shipbuilding. *SN Applied Sciences*, 3(5), 572.

Cloughand, R. H., & Sears, G. A. (1991). *Construction project management*. Canada: John Willey & Sons Inc.

Universiti Utara Malaysia

Collier, B., DeMarco, T., & Fearey, P. (1996). A defined process for project postmortem review. *IEEE Software*, 13(4), 65–72.

Collison, C., & Parcell, G. (2001). *Learning to fly—practical lessons from one of the world's leading knowledge companies*. Oxford: Capstone Publishing.

Contruction Industry Institute (CII). (1990). *Scope definition and control* (CII (ed.); 6th–2nd ed.). University of Texas.

Construction Industry Institute. (2012). CII best practices guide: improving project performance. Construction Industry Institute (CII): Austin, TX, USA.

Construction Industry Institute. (1987). Costs of quality in design and construction. Source document. 29, RS-10-2, University of Texas, Austin, TX.

Construction Industry Working Group on Payment (WG10). (2007). The importance of payment in the construction industry. Report on Enactment of Construction Industry Payment and Adjudication Act (CIPAA).

Clough, R. H. (Richard H., & Sears, G. A. (1994). *Construction contracting*. John Wiley and Sons Inc.: NYCreswell, J. W. (2012). *Educational research Planning, conducting, and evaluating quantitative and qualitative research* (4th ed.). Boston, MA Pearson.

Cruz, Oliveira, C., Gaspar, P., & Brito, J. (2019). On the concept of sustainable sustainability: an application to the Portuguese construction sector. *Journal of Building Engineering*, 25, 100836.

Creswell, J. W., & Creswell, J. D. (2018). *Research design qualitative, quantitative, and mixed methods approaches.* Los Angeles: Sage.

Dansoh, A., Oteng, D., & Frimpong, S. (2017). Challenges associated with project teams in managing variations on construction projects. Paper presented at 6th International Conference on Infrastructure Development in Africa (ICIDA 2017). http://ir.knust.edu.gh/handle/123456789/10882

DeJonckheere, M., & Vaughn, L. M. (2019). Semi structured interviewing in primary care research: a balance of relationship and rigour. *Family Medicine and Community Health*, 7(2), e000057. https://doi.org/10.1136/fmch-2018-000057

Deborah, S. (2022). Steer your shipbuilding project management to success. *Project Smart*, *10*(16), 56–69. https://blogs.sw.siemens.com/marine/2022/02/18/steer-your-shipbuilding-project-management-to-success/

Doğan, Ü., & Helvacioğlu, H. (2017). Customised project management methods and their applications in shipbuilding projects. *GİDB Dergi*, 10, 3-20.

Dosumu, O. S., & Adenuga, O. A. (2013). Causes, effects and remedies of errors in Nigerian construction documents. *Organization, Technology and Management in Construction*, 5(1), 676-686.

Du, J., Mohamed, E. G., & Zhao, D. (2016). Optimization of Change Order Management Process with Object-Oriented Discrete Event Simulation: Case Study. *Journal of Construction Engineering and Management*, 142(4).

Durdyev, S., & Hosseini, R. (2019). Causes of delays on construction projects: a comprehensive list. *International Journal of Managing Projects in Business*, 13(1), 20–46.

Dwivedi, S. N., & Maffioloi, P. (2003). Total value management in shipbuilding. *Total Quality Management*, 14(5), 549.

Dwivedi, U. (2015, April 10). Earned value management explained. Project Smart. https://www.projectsmart.co.uk/earned-value-management-explained.php

Ebekozien, Q. S. A., Uwadia, Q. S. F., & Usman, D. M. (2015). The impact of design errors and incomplete drawings on construction project delivery in Nigeria. *Proceedings of The Academic Conference of African Scholar Publications & Research International on Sub-Sahara African Transformation and National Development*, 7(1).

Ekambaram, P., Muthukaruppan, R., & Chi-Ming, G. (2007). Rework in projects: learning from errors. *Surveying and Built Environment*, 18(2), 47-58.

Ekhator, O. J. (2016). Identifying factors causing variations in private residential building projects in Lagos state, Nigeria. *International Journal of Science, Environment ISSN and Technology*, 5(5), 3583–3595.

Enshassi, A., Arain, F., & Al-Raee, S. (2010). Causes of variation orders in construction projects in the Gaza Strip. *Journal of Civil Engineering and Management*, 16(4), 540–551. https://doi.org/10.3846/jcem.2010.60

Emblemsvag, J. (2021). Lean project planning in shipbuilding. *Journal of Ship Production and Design*, *30*(2), 79–88. https://doi.org/10.5957/JSPD.30.2.130054

Field, B., & Ofori, G. (1988). Construction and economic development: a case study. *Third World Planning Review*, 10, 41.

Fisk, E. R. (2005). *Construction project administration* (8th ed.). Prentice Hall.

Fleming, Q. W., & Koppelman, J. M. (2002). Using earned value management. *Cost Engineering*, 44, 32–36.

Flyvbjerg, B. (2011). Case study. In Norman, K. D., & Yvonna, S. L. *The sage handbook of qualitative research* (94th ed.). Thousand oaks, CA: Sage.

Flyvbjerg, B., Skamris, M., H., & Buhl, S. (2004). What causes cost overrun in transport infrastructure projects? *Transport Reviews*, 24, 3–18.

Francis, P. L. (2009). High levels of knowledge at key points differentiate commercial shipbuilding from navy shipbuilding. Government Accountability Office, US.

Gaal, O. H., & Afrah, N. (2017). Lack of infrastructure: the impact on economic development as a case of Benadir region and Hir-shabelle, Somalia. *Developing Country Studies,* 7, 212581063.

Gasparotti, C. (2006). Shipbuilding process from project management perspective. Proceedings of the. 15th International Conference on Manufacturing, 26–27. http://icmas.eu/ Journal_archive_files/Vol_1_2006/10-12-539-542.pdf

Universiti Utara Malaysia

Gde Agung Yana, A.A., Rusdhi, H.A., & Agung Wibowo, M. (2015). Analysis of factors affecting design changes in construction project with Partial Least Square (PLS). *Procedia Engineering*, 125, 40-45.

Geadah, A. N. K. (2003). Financing of construction investment in developing countries through capital markets. Master Thesis, Massachusetts Institute of Technology, Department of Civil and Environmental, Cambridge, MA, USA,

Gerring, J. (2004). What is a case study and what is it good for? *American Political Science Review*, 98(2), 341–354.

Gillis, W. L., & Cudney, E. A. (2015). A standard for the commissioning process. *Frontiers of Engineering Management*, 2(1).

Goh, L.-B., & Yip, T. L. (2021). A Way Forward for Ship Classification and Technical Services. *The Asian Journal of Shipping and Logistics*, *30*, 51–74. https://doi.org/10.1016/j.ajsl.2014.04.003

Grünig, R., & Kühn, R. (2009). *Successful decision-making: a systematic approach to complex problems* (2nd ed.). Springer.

Hales, L. (2017). Project cost management techniques. Project Management Institute. https://study.com/academy/lesson/project-cost-management-techniques.html

Halwatura, R. U., & Ranasinghe, N. P. N. P. (2013). Causes of variation orders in road construction projects in Sri Lanka. *ISRN Construction Engineering*, 2013, 1–7. https://doi.org/10.1155/2013/381670

Hansen, S. (2021). *Study on the Management of EPC Projects*. *7*(21), 4494–4502. https://doi.org/10.19026/rjaset.7.826

Hameed Memon, A., Abdul Rahman, I., & Faris Abul Hasan, M. (2014). Significant causes and effects of variation orders in construction projects. *Research Journal of Applied Sciences, Engineering and Technology*, 7(21), 4494–4502. https://doi.org/10.19026/rjaset.7.826

Hammarberg, K., Kirkman, M., & De Lacey, S. (2016). Qualitative research methods: when to use them and how to judge them. *Journal Human Reproduction*, 31(3), 498–501.

Han, S., Lee, S., & Pena-Mora, F. (2012). Identification and quantification of non-value-adding effort from errors and changes in design and construction projects. *Journal of Construction Engineering and Management*, 138(1), 98-109.

Hanif, H., Khurshid, M. B., Lindhard, S. M., & Aslam, Z. (2016). Impact of variation orders on time and cost in mega hydropower projects of Pakistan. *Journal of Construction in Developing Countries*, 21(2), 37–53.

Hanna, A., & Gunduz, M. (2004). Impact of change orders on small labor-intensive projects. *Journal of Construction Engineering and Management*130. https://doi.org/10.1061/(ASCE)0733-9364(2004)130:5(726)

Hanna, A. S., Camlic, R., Peterson, P. A., & Nordheim, E. V. (2002). Quantitative definition of projects impacted by change orders. *Journal of Construction Engineering and Management*, 128(1).

Universiti Utara Malaysia

Harbans Singh, K. S. (2003). *Engineering and construction contracts management: post-commencement practice*. Singapore: Lexis Nexis

Harris, F., & McCaffer, R. (2003). *Modern Construction Management* (5th ed.). UK: Blackwell Science.

Harrison, H., Birks, M., Franklin, R., & Mills, J. (2017). Case study research: foundations and methodological orientations. *Qualitative Social Research Forum*, 18(1), Art 19.

Hao, Q., Shen, W., Neelamkavil, J, & Thomas, R. (2008). Change management in construction projects. *Proceedings of CIB W78 2008 International Conference on Information Technology in Construction*, Santiago, Chile.

Heale, R., & Forbes, D. (2013). Understanding triangulation in research. *Evidence-Based Nursing*, 16.

Heldman, K. (2011). *PMP project management professional exam study guide*. San Francisco: John Wiley & Sons.

Hibberd, R. (1986). *Variations in construction contracts*. Collins, London.

Hill, G. M. (2010). *The complete project management methodology and toolkit*. New York: Taylor & Francis group.

Hillebrandt, P. M. (1985). *Economic Theory and the construction industry*. Springer: Berlin/Heidelberg, Germany.

Hirschmann, R. (2020). Value of construction work in Malaysia from 2011 to 2019. https://www.statista.com/statistics/665028/value-of-construction-workmalaysia

Howard, R. (1988). Decision analysis: practice and promise. *Management Science*, 34(6), 679-695.

Huang, A. H. (2020). Advantages of qualitative research methods. Globalstats Academic. https://www.en.globalstatistik.com/advantages-of-qualitative-resear ch -methods/

Hyvari, I. (2012). *Modern construction management.* Helsinki School of Economics.

Hyvari, I. (2016). Project management effectiveness in project-oriented business organizations. *International Journal of Project Management*, 24(3), 216–225

Ibbs, C. (2005). Impact of change's timing on labor productivity. *Journal of Construction Engineering and Management* 131.

Ismail, A., Pourrostam, T., Soleymanzadeh, A., & Ghouyounchizad, M. (2012). Factors causing variation orders and their effects in roadway construction projects. *Research Journal of Applied Sciences, Engineering and Technology*, 4, 4969–4972.

Izmailov, A., Korneva, D., & Kozhamiakin, A. (2016). Effective project management with theory of constraints. *Procedia - Social and Behavioral Sciences*, 229, 96 – 103.

Jamshed, S. (2014). Qualitative research method-interviewing and observation. *Journal of Basic and Clinical Pharmacy*, 5(4), 87–88.

Jane, B. B. T., Lizelle, F., & Herman, S. (2018). Linking trust and collaboration in project teams to project management success. *International Journal of Managing Projects in Business*, 11(2), 432–457.

John, S. (1993). Project management in naval shipyards. Project Management Institute. https://www.cio.com/article/2441862/what-is-a-project-management-office-pmo-and-do-you-need-one.html

Jones, E. G., Snyder, C., Stackpole, C., & Lambert, L. (2011). *PMP certification all-In- One desk reference for dummies*. New Jersey: John Wiley & Sons, Inc.

John, M. (2021). Strategic management of variation orders for institutional buildings leveraging on information technology. In Project Management Institute (Ed.), *PMI Global Congress*. https://www.pmi.org/learning/library/strategic-management-variation-orders-institutional-buildings-7443

Jugdev, & Muller, R. (2015). A retrospective looks at our evolving understanding of project success. *Project Management Journal*, 36(4), 19–31.

Kaming, P., Olomolaiye, P., Holt, G., & Harris, F. (1997). Factors influencing construction time and cost overruns on high-rise projects in Indonesia. *Construction Management and Economics*, 15, 83–94.

Kanter, R. M. (1996). When a thousand flowers bloom: structural, collective, and social conditions for innovation in organizations. In: Myers PS, editor. *Knowledge management and organizational design* (p. 93–131). Boston: Butterworth-Heinemann.

Kenny, C. (2007). *Construction, corruption, and developing countries*. The World Bank: Washington, DC, USA.

Keane, P., Sertyesilisik, B., & Ross, A. (2010). Variations and change orders on construction projects. *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction*, 2.

Kenneth, W. (2021). *CONTRACT MANAGEMENT FOR SHIP CONSTRUCTION, REPAIR & DESIGN*. ROYAL INSTITUTION OF NAVAL ARCHITECTS.

Kent, C. (2021). Why project managers fail and how to help them succeed. In Project Management Institute (Ed.), *PMI Global Congress* (pp. 26–29). https://www.pmi.org/learning/library/project-managers-fail-help-succeed-8019

Kermanshachi, S., Anderson, S., Molenaar, K. R., & Schexnayder, C. (2018). Effectiveness assessment of transportation cost estimation and cost management workforce educational training for complex projects. In Proceedings of the ASCE International Conference on Transportation & Development, Pittsburgh, PA, USA, 15–18 July 2018

Kermanshachi, S., Dao, B., Rouhanizadeh, B., Shane, J., & Anderson, S. (2018). Development of the project complexity assessment and management framework for heavy industrial projects. *International Journal of Construction Education and Research*, 29, 1–19.

Kermanshachi, S., & Rouhanizadeh, B. (2019). Robustness analysis of design phase performance predictors using Extreme Bounds Analysis (EBA). In Proceedings of the ASCE International Conference on Computing in Civil Engineering, Atlanta, GA, USA, 17–19 June 2019.

Kermanshachi, S., Thakur, R., & Govan, P. (2018). Discovering the impact of late change orders and rework on labor productivity: a water treatment case study analysis using System Dynamics Modeling. In Proceedings of the Construction Research Congress, New Orleans, LA, USA, 2–4 April 2018.

Kerth N. (2000). The ritual of retrospectives—how to maximize group learning by understanding past projects. *Software Testing & Quality Engineering*, 2(5), 53-57.

Kerzner, H. (2013). Project management: a systems approach to planning, scheduling, and controlling. New York: John Wiley & Sons.

Kerzner, H. (2009). *Project management a system approach to planning, scheduling and control* (10th ed.). Wiley, John.

Kezner, H. (2009). *Project management: A systems approach to planning, scheduling, and controlling*. John Wiley & Sons, Inc, New Jersey.

Khan, R. A. (2008). Role of construction sector in economic growth: Empirical evidence from Pakistan economy. In Proceedings of the First International Conference on Construction in Developing Countries (ICCIDC), Karachi, Pakistan, 4–5 August.

Khan, R. A., Liew, M. S., & Ghazali, Z. (2014). Malaysian construction sector and Malaysia Vision 2020: developed nation status. *Procedia Social and Behavioral Sciences*, 109, 507–513.

Kikwasi, J. G. (2012). Causes and effects of delays and disruptions in construction projects in Tanzania. *Australasian Journal of Construction Economics and Building Conference Series*, 1(2), 52-59.

Kim, I., & Seo, H. L. (2009). Depreciation and transfer of knowledge: an empirical exploration of a shipbuilding process. *International Journal of Production Research*, 47(7), 1857–1876.

Kjersem, K., Halse, L. L., Kiekebos, P., & Emblemsvåg, J. (2015). Implementing lean in engineer-to-order industry: a case study. In: Umeda, S., Nakano, M., Mizuyama, H., Hibino, H., Kiritsis, D., von Cieminski, G. (eds) *Advances in production management systems: innovative production management towards sustainable growth*. APMS 2015. IFIP Advances in Information and Communication Technology, 460. 460, 248–255

Koushki, P. A., Al-Rashid, K., & Kartam, N. (2005). Delays and cost increases in the construction of shipbuilding projects in Kuwait. *Construction Management & Economics*, 23, 285–294.

Kumaraswamy, M., & Yogeswaran, K. (1998). Significant sources of construction claims. *International Construction Law Review*, 15 (1), 144-16

Langford, V., Fellows, R. F. and Newcombe, R., (1986) Variations in building contracts: the role of the social system. CIB 86 Advancing Building Technology, *Translating Research into Practice*, 8, 3522-3530.

Langley, M. A. (2017). Includes: the standard for project management. *International Journal of Production Research,* 53(9).

Lean, C. S. (2001). Empirical tests to discern linkages between construction and other economic sectors in Singapore. *Construction Management and Economics*, 19, 355–363.

Le-Hoai, L., Dai Lee, Y., & Lee, J. Y. (2008). Delay and cost overruns in Vietnam large construction projects: A comparison with other selected countries. *KSCE Journal of Civil Engineering*, 12, 367–377.

Lester, L. (2022). *5 Proven Ways To Increase Team Morale And Performance*. Project Management.Com. https://project-management.com/5-proven-ways-to-increase-team-morale-and-performance/

Li, C., Xin, K., Tao, T., Liu, S., & Zhang, S. (2012). Study on mathematical model of functional quantitative of water distribution systems based on value engineering. Water Distribution Systems Analysis 2010 - Proceedings of the 12th International Conference, WDSA 2010, 1066–1073.

Lim, C. S., & Mohamed, M. Z. (2009). Criteria of project success: an exploratory re-examination. *International Journal of Project Management*, 17(4), 243–248.

Lindhard, S. (2014). Understanding the effect of variation in a production system. *Journal of Construction Engineering and Management*, 140(11).

Ljulj, A., Slapnicar, V., & Grubisic, I. (2021). Current approaches to the management of naval shipbuilding projects. *Brodogradnja,* 72, 95–107. Luis, F. A. & Daniel, A. M. (1998). Improving the design-construction interface. *Proceedings IGLC*.

Loch, C. H., & Terwiesch, C. (1999). Accelerating the process of engineering change orders: capacity and congestion effects. *Journal of Product Innovation Management,* 16(2), 145-159.

Lopes, J. (2008). Investment in construction and economic growth. *In Economics for the Modern Built Environment*. Taylor & Francis: Oxford, UK, pp. 94–112.

Lopes, J. P. (1997). Interdependence between the construction sector and the national economy in developing countries: a special focus on Angola and Mozambique. Ph.D. Thesis, University of Salford, Salford, UK,

Love, P. E. D., Lopez, R., Kim, J. T., & Kim, M. J. (2014). Probabilistic assessment of design error costs. *Journal of Performance of Constructed Facilities*, 28, 518-527.

Machado, F, Duarte, N., Amaral, A., & Barros, T. (2021). Project management maturity models for construction firms. *Journal of Risk and Financial Management*, 14, 571.

Malhotra, N. (2005). *Marketing research: an applied approach - European* (2 ed.). Financial Times Management.

Manavazhi, M. R., & Xunzhi, Z. (2011). Productivity oriented analysis of design revisions. *Construction Management and Economics*, 19, 379–391.

Martínez-Mesa, J., González-Chica, D., Duquia, R., Bonamigo, R., & Bastos, J. (2016). Sampling: how to select participants in my research study? *Anais Brasileiros de Dermatologia,* 91, 326–330.

Matos, S., & Lopes, E. (2013), Prince2 or PMBOK – a question of choice. *Procedia Technology,* 9, 787-794.

Universiti Utara Malaysia

Mechanda, P. (2005). A framework for reducing change order processing time in university construction projects. Master's thesis, School of Planning, Design and Construction, Michigan State University, East Lansing, MI.

McClelland, D. C. (1998). Identifying competencies with behavioral-event interviews. *Psychological Science*, 9(5), 331–339.

McMasters, G. (2000). Can we learn from project histories? *PM Network*, 14(7), 66-67.

Memon, A. H., Abdul Rahman, I., Akram, M., & Md Ali, N. (2014). Significant factors causing time overrun in construction projects of Impact of Design Chang Peninsular Malaysia. *Modern Applied Sciences*, 8(4), 16-28.

Memon, A. H., Rahman, I. A., & Hasan, M. F. A. (2014). Significant causes and effects of variation orders in construction projects. *Research Journal of Applied Sciences, Engineering and Technology*, 7, 4494-4502.

Mills, A. J., Durepos, G., & Wiebe, E. (2010). *Encyclopedia of case study research* (vol. I & II). Thousand Oaks, CA: Sage.

Mohammad, N., Che Ani, A., Rakmat1, R. A. O. K., & Yusof2, M. A. (2010). Investigation on the causes of variation orders in the construction of building project: a study in the state of Selangor, Malaysia. *Journal of Building Performance*, 1(1), 73–82.

Mokhtar A., Bedard, C., & Fazio, P. (2000). Collaborative Planning and Scheduling of Interrelated Design Changes. *Journal of Architectural Engineering*, 6 (2), 66-75.

Molina, A., Ponce, P., Miranda, J., & Cortés, D. (2021). *Enabling systems for intelligent manufacturing in industry 4.0 (1st ed.).* Springer: Berlin/Heidelberg, Germany.

Morris, P. W. G., Pinto, J. K., & Soderlund, J. (2011). *The Oxford handbook of project management*. Oxford University Press.

Mohammad, N., Hamzah, Z., & Mokhtar, N. A. (2022). CONTROL OF VARIATION ORDERS IN THE CONSTRUCTION OF RESIDENTIAL PROJECTS IN MALAYSIA. *Planning Malaysia*, *20*(2), 14–21. https://doi.org/10.21837/pm.v20i21.1088

Mubarak, S. A. (2010). *Construction project scheduling and control*. New Jersey: John Wiley & Sons.

Muhamad, N. H., Mohammad, M. F., Che Ahmad, A., & Ibrahim, I. H. (2016). Delay analysis methodologies (DAMS) in delivering quality projects: contractors and consultants' perceptions. *Procedia – Social and Behavioral Sciences*, 222, 121-131.

Muhammad, N. Z., Keyvanfar, A., Abd Majid, M. Z., Magana, A. M., & Dankaka, N. S. (2015). Causes of variation order in building and civil engineering projects in Nigeria. *Journal Technology UTM*, 77(16), 91–97.

Muller, R., & Turner, R. (2007). The influence of project managers on project success criteria and project success by type of project. *European Management Journal*, 25(4), 298–309.

Müller, R., & Veser, M. (2020). The current state of nonfinancial reporting in Switzerland and beyond. *Die Unternehm*, 74, 296–311.

Universiti Utara Malaysia

Murdoch, J., & Hughes, W. (2000). *Construction Contracts: Law and Management*. (3rd ed.). London: Spon Press

Musarat, M. A., Alaloul, W. S., & Liew, M. (2020). Impact of inflation rate on construction projects budget: A review. *Ain Shams Engineering Journal*, 12, 407–414.

Musarat, M. A., Alaloul, W. S., Liew, M., Maqsoom, A., & Qureshi, A. H. (2020). Investigating the impact of inflation on building materials prices in construction industry. *Journal of Building Engineering*, 32, 101485.

Mustapha, Z., Akomah, B., Mensah, J., & Kottey, S. (2018). Cost impacts of variations on building construction projects. *MOJ Civil Engineering*, 4, 403–408.

National Research Council. (1994). On the responsibilities of architects and engineers and their clients in federal facilities development, commission on engineering and technical systems. National Academics Press, Washington DC.

National Society of Professional Engineers. (n.d.). Incomplete plans and specifications. Engineers, government and contractor responsibilities. Retrieved on 1st May 2015, from http://www.nspe.org.

Naval Technology. (2014). Maharaja Lela Class Littoral Combat ships. https://www.naval-technology.com/projects/maharaja-lela-class-littoral-combat-ships/

Ndekugri, I., & Rycroft, M. (2019). Variations in construction contracts. Designing Buildings. https://www.designingbuildings.co.uk/wiki/Variations_in_construc tion_contracts

Ndihokubwayo, R. (2008). An analysis of the impact of variation orders on project performance. A published dissertation for the Cape Peninsula University of Technology https://core.ac.uk/download/pdf/148364967.pdf

Ndihokubwayo, R., & Haupt, T. (2009). Variation orders on construction projects: value adding or waste? *International Journal of Construction Project Management*, 1(2), 1-17.

Neuman, W. L. (2011). *Social Research Methods Qualitative and Quantitative Approaches*. 7th Edition, Pearson, Boston.

Nicholas, J. M., & Steyn, H. (2012). Project *management for engineering, business, and technology* (4th ed.). Routledge: London.

Nikjow, Ajmal, M., Liang, L., Qi, X., & Sepasgozar, S. (2021). engineering procurement construction in the context of belt and road infrastructure projects in West Asia: A SWOT Analysis. *Journal of Risk and Financial Management*, 14, 92.

Noulmanee, A., Wachirathamrojn, J., Tantichattanont, P., & Sittivijian, P. (1999) Internal causes of delays in highway construction projects in Thailand, http://www.sciencedirect.com/science?_ob=RedirectURL&_method=externObjLink&_locator=url&_plusSign=%2B&_targetURL=http%253A%252F%252Fwww.ait.c1et.com, accessed 22 September 2007.

Nwachukwu, C. C., Echeme, I. I., & Okoli, M. N. (2010). Project management factor indexes; a constraint to project implementation success in the construction sector of a developing economy. *European Journal of Scientific Research*, 43(3), 392.

O'Brien, J. J. (1998). *Construction change orders: impact, avoidance, documentation.* McGraw Hill: Chicago.

Odeck, J. (2013). Cost overruns in road construction--what are their sizes and determinants? *European Journal of Political Economy*, 11(1), 43–53.

Ofori, G. (1988). Construction industry and economic growth in Singapore. *Construction Management and Economics*, 6, 57–70.

Oishi, S. M. (2003). *How to conduct in-person interviews for surveys* (2nd ed.). SAGE Publications, Inc.

Okorafor, G. F. (2008). *Project and national development, project management: an exploration* (2nd ed.). Published by Skillmark Media Ltd, Owerri.

Okubo, Y., & Mitsuyuki, T. (2022). Ship production planning using Shipbuilding System Modeling and discrete time process simulation. *Journal of Marine Science and Engineering*10, 176.

Oladapo, A. A. (2007). A quantitative assessment of the cost and time impact of variation orders on construction projects. *Journal of Engineering, Design and Technology*, 5(1), 35-48

Oy, K. (2013). Market research on the Turkish shipbuilding industry. https://www.theseus.fi/bitstream/handle/10024/64651/Tetri_Anna.pdf?sequence=1

Oyekunle, O. L., Richard, J., Olanrewaju, G. B., & Adewale, S. A. (2016). Analysis of causes and impact of variation order on educational building projects. *Journal of Facilities Management*, 14(2), 139–164.

Paelke, V., Büttner, S., Mucha, H., & Röcker, C. (2018). In S. Trzcielinski (Ed.). Advances in ergonomics of manufacturing: managing the enterprise of the future (pp. 225–234), Springer, Cham.

Park, M. (2002). Dynamic change management for fast-tracking construction projects. *Procedings of the 19th ISARC*, Washington, U.S.A., 81-89.

Patton, M. Q. (2002). Qualitative research and evaluation methods. Sage Publications: London.

Peansupap, V., & Cheang, L. (2015). Identifying issues of change leading to cost conflicts: case study in Cambodia. *Procedia Engineering*, 123, 379-387.

Philippine, G. (2016). Implementing rules and regulations of republic act no. 9184, otherwise known as the government procurement reform act. Division of the Presidential Communication Operations Office (PCOO). https://www.official gazette.gov.ph/2016/08/29/implementing-rules-and-regulations-of-republic-act-no-9184/

PMBOK. (2000). *A guide to the project management body of knowledge—2000 edition.* Newtown Square, Pennsylvania: Project Management Institute.

Poeschl, S., Wirth, F., & Bauernhansl, T. (2018). Strategic process planning for commissioning processes in mechanical engineering. *International Journal of Production Research*, 67.

Poland, B. D. (2003). Transcription quality. In J. A. Holstein (Ed.), *Inside interviewing: New lenses, new concerns* (pp. 267-287). Thousand Oaks, CA: Sage.

Pollack, J. (2007). The changing paradigm of project management. *International Journal of Project Management*, 266–274.

Pradip-Ajugiya, J. J. B., & Pitroda, J. (2016). Comparison of modern and conventional construction techniques for next generation: a review. In Proceedings of the 21st ISTE State Annual Faculty Convention and National Conference on "Emerging Trends in Engineering", Tolani Foundation Gandhidham Polytechnic, Adipur, India, 27 December 2016.

Project Management Institute. (2017). *A guide to the project management body of knowledge* (PMBOK) (6th ed.). Project Management Institute, Inc.

Project Management Guru. (2021). How To Improve Project Management Skills. *Performance Improvement*, *3*, 37–49. https://www.indeed.com/career-advice/career-development/how-to-improve-project-management-skills

Rafiq, W., Musarat, M., Altaf, M., Napiah, M., Sutanto, M., Alaloul, W., Javed, M., & Mosavi, A. (2021). Life cycle cost analysis comparison of hot mix asphalt and reclaimed asphalt pavement: a case study. *Sustainability*, 13, 4411.

Rajendran, P., Seow, W. T., & Goh, C. K. (2014). Building information modeling (BIM) tools in design stage to assist in time for construction project success. *International Journal of Conceptions on Management and Social Sciences*, 2(3), 52-55.

Rahmat, R. (2019, November). Malaysia's littoral combat ship project faces MYR1.4 billion cost overrun, delays. Jane's Navy International. https://www.janes.com/article/92335/malaysia-s-littoral-combat-ship-project-faces-myr1-4-billion-cost-overrun-delays

Rajoo, S., & Harbans Singh K. S. (2012), *Construction law in Malaysia*. Sweet and Maxwell Asia.

Ramanathan, C., Narayanan, S. P., & Idrus, B. A. (2012). Construction delays causing risks on time and cost- a critical review. *Australasian Journal of Construction Economics and Building*, 12(1), 37-57.

Rameezdeen, R. (2005). Study of linkages between construction sector and other sectors of the Sri Lankan Economy. Sri Lanka. Available online: https://www.iioa.org/conferences/15th/pdf/rameezdeen.pdf

Randa, S. M. J., Abdulkader, M. R., & Abang Ali, A. A. (2009). Variation orders in construction projects. *Journal of Engineering and Applied Sciences*, 4 (3), 170-176

Ranney, M., & Zachary, M. (2015). Interview-based qualitative research in emergency care part II: data collection, analysis and results reporting. *Academic Emergency Medicine: Official Journal of the Society for Academic Emergency Medicine,* 22(9), 1103–1112.

Reichelt, K., & Lyneis, J. (1999). The dynamics of project performance: benchmarking the drivers of cost and schedule overrun. *European Management Journal*, 17(2), 135–150.

Ren, Z., Atout, M., & Jones, J. (2008). Root causes of construction project delays in Dubai. *Proceedings of 24th Annual ARCOM Conference*, 1-3 September, 749-757.

Universiti Utara Malaysia

Rogers, P., & Blenko, M. W. (2006). *Who has?: How clear decision roles enhance organizational performance*. Harvard Business Review.

Rose, K. H. (2013). *A guide to the project management body of knowledge (PMBOK® guide)* (5th ed.). *Project management Journal*, 44(3).

Royal Institution of Naval Architects. (2006). RINAMIL Rules for FREMM Frigates Consolidated Edition. In *RINAMIL Rules for FREEM Frigates* (pp. 19–25). RINA.

Royal Institution of Naval Architects. (2021). CHALLENGES OF MANAGING SHIPYARD PROJECTS. *International Journal Maritime Engineering*, *163*, 1–10. https://doi.org/10.5750/ijme.v163iA4.794

Rubin, H. J., & Rubin, I. S. (2005). *Qualitative interviewing the art of hearing data* (2nd ed.). Thousand Oaks, CA Sage.

Ryan, G., & Bernard, H. (2000). Data management and analysis methods. In: Denzin NK, Lincoln YS (eds). *Handbook of Qualitative Research* (2nd ed.)., pp. 769–802. London: Sage Publications.

SAICE. (2010). General conditions of contract for construction qorks: general conditions of contract for construction works. https://saice.org.za/saice-publications/

Sambasivan, M., & Soon, Y. W. (2007). Causes and effects of delays in Malaysian construction industry. *International Journal of Project Management*, 25(5), 517–526.

Schank, J. F., Arena, M. V., Kramarck, K. N., Lee, G. T., Birkler, J., Murphy, R. E., & Lough, R. (2014). Naval ship acquisition on course: key considerations for managing Australia's Sea 5000 Future frigate program. RAND.

Schaufelberger, J. E., & Holm, L. (2002). *Management of construction projects: a constructor's perspective*. New Jersey: Prentice Hall.

Schindler, M. (2002). *Wissensmanagement in der projektabwicklung—grundlagen, determinanten und gestaltungsempfehlungen eines ganzheitlichen projektwissensmanagements*. Lohmar/Ko¨ln: Josef Eul Verlag.

Schindler, M., & Eppler, M. J. (2003). Harvesting project knowledge: a review of project learning methods and success factors. *International Journal of Project Management*, 21(3), 219–228.

Schwalbe, K. (2010). Information technology project, Mexico. *Cengage Learning*, 121-124.

Schwalbe, K. (2014). *Information technology project management*. Boston: Cengage Learning, 43-45.

Scotland, J. (2012). Exploring the philosophical underpinnings of research: relating ontology and epistemology to the methodology and methods of the scientific, interpretive, and critical research paradigms. *English Language Teaching*, 5(9), 9-16.

Scott-Young, C., & Samson, D. (2008). Project success and project team management: Evidence from capital projects in the process industries. *Journal of Operations Management*, 26, 749–766.

Universiti Utara Malaysia

Seng, H. (2017). *Quantity surveying pengantar manajemen biaya dan kontrak konstruksi (quantity surveying introduction to cost management and construction contracts).* Jakarta: PT. Gramedia Pustaka Utama.

Serdar, D. (2019). Causes of delays on construction projects: a comprehensive list. *International Journal of Managing Projects in Business*, 13(1), 20–46.

Shahhosseini, V., Afshar, M. R., & Amiri, O. (2018). Value engineering practices in infrastructure projects: a case study of Ilam Gas Refinery's water transmission system at Reno Mountain, Iran. *International Journal of Construction Management*, 18(5), 351–363.

Shehu, Z., Endut, I., & Akintoye, A. (2014). Factors contributing to project time and hence cost overrun in the Malaysian construction industry. *Journal of Financial Management of Property and Construction*, 19.

Shrestha, P., Burns, L., & Shields, D. (2013). Magnitude of construction cost and schedule overruns in public work Projects. *Journal of Construction Engineering*, 2013, 1–9.

Slight, S., Cresswell, K., Robertson, A., Huby, G., Avery, T., & Sheikh, A. (2011). The case study approach. *BMC Medical Research Methodology*, 11, 100.

Smith, W. (2016). The effect of variation orders on project cost and schedule overruns. *Journal of Project Management*, 5(2), 234–250.

Soeharto. (2005). *Manajemen konstruksi (construction management).* Penerbit Rosdakarya: Bandung.

Sun, M., Fleming, A., Senaratne, S., Motawa, I.A. & Yeoh, M. L (2006). A change management toolkit for construction projects. *Architectural Engineering and Design Management*, 2(4), 261-271.

Sun, M., & Meng, X. (2009). Taxonomy for change causes and effects in construction projects. *International Journal of Project Management*, 27(6), 560-572.

Sunday, O. A. (2010). Impact of variation orders on public construction projects. 101–110. http://www.arcom.ac.uk/-docs/proceedings/ar2010-0101-0110_Sunday.pdf

Sunday, O., Dosumu, H., & Aigbavboa, C. O. (2017). Impact of design errors on variation cost of selected building project in Nigeria. *Procedia Engineering*, 196, 847-856.

Suri, H. (2011). Purposeful sampling in qualitative research synthesis. *Qualitative Research Journal*, 11, 63–75.

Tanko, B. L., Abdullah, F., Mohamad Ramly, Z., & Enegbuma, W. I. (2018). An implementation framework of value management in the Nigerian construction industry. *Built Environment Project and Asset Management*, 8(3), 305–319.

Taylor, T., & Ford, D. (2006). Tipping point failure in single development projects. *System Dynamics Review*, 22, 51–71.

Terwiesch, C., & Loch, C. (1999). Managing the process of engineering change orders: the case of the climate control system in automobile development. *Innovation Management*, 16(2), 160–172.

Universiti Utara Malaysia

Thakar, S. J. (2020). A study on impacts of variation order in construction projects. *International Research Journal of Engineering and Technology*, 7(5), 5365-5373.

Thomas, H., Horman, M., Souza, U., & Završki, I. (2002). Reducing variability to improve performance as a lean construction principle. *Journal of Construction Engineering and Management*, 128.

Thomas, H. R., & Napolitan, C. L. (1995). Quantitative effects of construction changes on labor productivity. *Journal of Construction Engineering and Management*, 121(3), 290–296.

Trigunarsyah, B., & Hamzeh, K. Z. (2017). Implementing value engineering study for temporary facilities. *Proceedings of the Institution of Civil Engineers: Municipal Engineer*, 170(3), 165–174.

Trisanto & Wardhan, H. (2021). Analysis of cost control and project time in performance process with earned value method, case study: improvement of Maliku-Bantanan Road in Pulang Pisau District, Indonesia. *International Journal of Innovative Science and Research Technology*, 6(1), 101-107.

Turner, L. (2009). Scope in project management. *Journal of Science, Management and Technology*, 3(2), 26-31.

Ubaid, A. G. (1991). Factors affecting contractor performance. Master thesis, CEM Department, KFUPM, Dhahran, Saudi Arabia.

UK Ministry of Defence. (2017). *National shipbuilding strategy: the future of naval shipbuilding in the UK*. London, UK: MoD.

Vaishmoradi, M., & Snelgrove, S. (2019). Theme in qualitative content analysis and thematic analysis. *Qualitative Social Research Forum*, 20(3), 23.

Vanhoucke, M. (2013). *Project management with dynamic scheduling: baseline scheduling, risk analysis and project control*. Berlin: Springer.

Verschuren, P. J. M. (2003). Case study as a research strategy: Some ambiguities and opportunities. *International Journal of Social Research Methodology: Theory & Practice*, 6(2), 121–139.

Villanova University. (2020). Project team roles and responsibilities. https://www.villanovau.com/resources/project-management/project-team-roles-and-responsibilities/

Viter, I. (2018). Shipbuilding trends in 2018 and how project managers can adapt https://www.epicflow.com/blog/shipbuilding-trends-in-2018-and-how-project-managers-can-adapt/

Viktoriya, S. (2021). Dealing with Unrealistic Expectations in Project Management. Project Management Institute, 3(15), 27–29. https://www.epicflow.com/blog/dealing-with-unrealistic-expectations-in-project-management/

Welsh, E. (2002). Dealing with data: using NVivo in the qualitative data analysis process. *Forum: Qualitative Social Research*, 3.

Universiti Utara Malaysia

Widias, S. (2020). Enhancing Malaysian Shipbuilding and Repair (SBSR) industry through localisation activities. Malaysian Industry Government Group for High Technology (MiGHT). https://www.might.org.my/enhancing-malaysian-shipbuilding-and-repair-sbsr-industry-through-localisation-activities/

Wirth, I., & Tryloff, D. (1995). Preliminary comparison of six efforts to document the project-management body of knowledge. *International Journal of Project Management*, 13, 109–118.

World Maritime News. (2018). Forum: industry needs to design ships differently. https://worldmaritimenews.com/archives/236231/forum-industry-needs-to-design-ships-differently/

Wrike Inc. (2017). What is cost management in project management? https://www.wrike.com/project-management-guide/faq/what-is-cost-management-in-project-management/

Wulan M., Bulo, L., Balaka, R., & Sriyani, R. (2013). Pengaplikasian Metode Earned Value pada pengendalianwaktu terhadap biaya (application of the Earned Value Method to controlling time to costs). *Jurnal Stabilita*, 1(3), 359−372.

Wysocki, R. K. (2011). *Effective project management: traditional, agile, extreme (6th edition)*. Hoboken, NJ, USA: Wiley.

Xia, B., & Gong, P. (2014). Review of business intelligence through data analysis. *Benchmarking: An International Journal*, 21, 300–311.

Yadeta, A. E. (2016). The impact of variation orders on public building projects. *International Journal of Construction Engineering and Management*, 5(3), 86–91.

Yap, J. B. H., Abdul-Rahman, H., & Wang, C. (2017). Design change dynamics in building project: from literature review to a conceptual framework formulation. *Journal of Surveying, Construction and Property*, 8(1), 13-33.

Yap, J. B. H., & Skitmore, M. (2017). Investigating design changes in Malaysian building projects. *Architectural Engineering and Design Management*, 1-21.

Yin, R. K. (2014). *Case study research design and methods* (5th ed.). Thousand Oaks, CA: Sage.

Yin, R. K. (2003). *Case study research: design and methods* (3rd ed.). Thousand Oaks, CA: Sage.

Zaneldin, E., (2000). An information model for improving design coordination in building projects. A published thesis from the Department of Civil Engineering, University of Waterloo.

Zakaria, Z. (2014). Final account closing framework in construction contract. doctor of philosophy. UTM Razak School of Engineering and Advanced Technology. Universiti Teknologi Malaysia. Johor.

APPENDICES

Universiti Utara Malaysia

APPENDIX A – Research Interview Questionnaire

Universiti Utara Malaysia

INTERVIEW PROTOCOL

A QUALITATIVE CASE STUDY ON VARIATION ORDERS OF PROJECT MANAGEMENT EFFICIENCY IN A NAVAL SHIP CONSTRUCTION COMPANY

Date : ----------

Time : ----------

Department : ----------

Instruction for the interview session

The research identifies the contributing factors for the increment of Variation Order (VO) in BNS Shipbuilding project for Littoral Combat Ship (LCS) Project. The aim is to improve the current work practices in the Project Management Team (PMT) by controlling the issuance of VO through the development of a standard working procedure for the PMT. The objectives of this research are listed in the following:

a) To determine the contributing factors on VO occurrence in LCS Project.
b) To examine the impact of VO on project management efficiency in term of cost and schedule in LCS project.
c) To purpose the improvement measures in reducing VO in LCS project.

Universiti Utara Malaysia

The semi-structured interview is partitioned into five sections:

Section	Item
1	Introduction and Profiles of the interviewees.
2	Factors contributing to the occurrence of VO in the LCS project.
3	The impact of VO on the project management efficiency in cost and schedule.
4	Improvement measures in reducing VO in LCS Project
5	Several additional questions are posed to capture open suggestions by the interviewee in reducing the occurrence of VO in shipbuilding projects, especially in the LCS Project.

The transcript is verified with all the respective interviewees. All confidential information is only used for this research purpose due to the project nature in relation with Military confidentiality.

Section 1: Demographic profile

1. Age

a.	25 - 29	( )
b.	30 – 35	( )
c.	36 – 40	( )
d.	41 – 45	( )
e.	46 – 50	( )
f.	Above 50	( )

2. Gender

a.	Male	( )
b.	Female	( )

3. Highest academic Qualification

a.	Diploma	( )
b.	Bachelor's degree	( )
c.	Master's Degree	( )
d.	PhD and above	( )

4. Shipbuilding project management experience

a.	1 – 5 years	( )
b.	6 – 10 years	( )
c.	11 – 15 years	( )
d.	16 – 20 years	( )
e.	21 – 25 years	( )
f.	26 – 30 years	( )
g.	Above 30 years	( )

5. Previous employment experience (based on sector)

a.	Shipbuilding	( )
b.	Oil and gas industry	( )
c.	Civil building	( )
d.	Others	……

6. How many equipment contracts do you manage?

a.	1 – 5 equipment's	( )
b.	6 – 10 equipment's	( )
c.	11 – 15 equipment's	( )
d.	16 – 20 equipment's	( )

7. What section of equipment contracts do you manage?

a.	Platform system	( )
b.	Combat system	( )

Universiti Utara Malaysia

Section 2: Research Question 1

1. What are the factors contribute towards VO occurrence in LCS project?

RQ1a. What do you think are the factors contributing to the occurrence of VO's in the LCS project? Please rate the factors by percentage (100% highest)

a. Change of project scope by client	( )
b. Project financial problems	( )
c. Change of design by the design authority	( )
d. Insufficient project drawing	( )
e. Delay in project decision making	( )
f. Project material	( )
g. Inadequate skilled labour	( )
h. Financial issues faced by contractual workers	( )
i. Changes in contractual documents	( )

RQa. Change of project scope by client

i. What types of project scope changes that are always required by clients?

ii. When do the clients change the project scope?

iii. How do you manage the changes of project scope by clients?

RQb. Project financial problems

i. What types of project financial problem always occurs in LCS Project?

ii. How does VO occurrence can contribute to project financial problem?

iii. At what stage of shipbuilding project financial will be at the worst?

iv. How to manage the project financial problem?

v. Does external factors such as economic uncertainties contribute to project financial problems?

RQc. Change of design by the design authority

i. What types of design changes that are always done by design authority?

ii. When does the design authority change the project scope?

iii. How do you manage the design changes made by design authority?

iv. How can design changes contribute to the occurrence of VO in LCS Project?

RQd. Insufficient project drawing

i. What types of project drawing required in naval warship shipbuilding projects?

ii. How can VO occurrence create insufficient drawing?

iii. How to manage the insufficient drawing?

Universiti Utara Malaysia

RQe. Delays in project decision making

i. What types of project decision making is required for a ship building process?

ii. Who do you think makes the project decision in LCS Project?

iii. How VO occurrence can affect the decision-making process?

iv. How decision making is important for the shipbuilding process?

RQf. Project Material

i. What is meant by project material for shipbuilding process?

ii. Why VO occurrence affect the project material in LCS Project?

iii. How to manage the project material in LCS Project?

RQg. Inadequate skilled labour

i. What is meant by inadequate skilled labour for shipbuilding process?

ii. How does VO occurrence can affect inadequate skilled labour in LCS Project?

iii. What are the causes for inadequate skilled labour?

iv. How to manage the inadequate skilled labour in LCS Project?

RQh. Financial Issues Faced by Contractual Workers

i. What is meant by financial issues faced by contractual workers for shipbuilding process?

ii. How does VO occurrence can affect financial issues faced by contractual workers labour in LCS Project?

iii. What are the causes for financial issues faced by contractual workers?

iv. How to manage financial issues faced by contractual workers in LCS Project?

Universiti Utara Malaysia

RQi. Changes is contractual documents

i. What is meant by changes is contractual documents for shipbuilding process?

ii. How does VO occurrence can affect changes is contractual documents in LCS Project?

iii. What are the cause for changes is contractual documents?

iv. How often changes happens in LCS Project contractual documents?

v. How to manage financial issues faced by contractual workers in LCS Project?

RQ1b. In your opinion, what are other factors from Question 1 contributes to the occurrence of VO in LCS project?

Section 3: Research Question 2

2. What are the impacts of VO on project management efficiency in terms of cost and schedule in LCS project?

RQ2a. Do you have any experience in managing VO?

RQ2b. What is Project Cost?

RQ2c. What is Project Schedule?

RQ2d. How VO affects between Project Cost and Schedule?

RQ2e. Do you use any programme to control scheduling and cost?

RQ2f. Do you foresee any other techniques can be used for LCS project schedule and cost control?

RQ2g. In your opinion how does VO can affect the efficiency of project management team in the LCS project?

RQ2i. What approach have been taken by the Project Management Team (PMT) to measure the impact of VO in LCS project efficiency?

Section 4: Research Question 3

3. What are the improvement measures in reducing the Variation Order (VO)?

RQ3a. How is VO managed in this project?

RQ3b. Do you satisfy with the VO management in this company?

If Yes please elaborate the reason

If No please elaborate the reason

RQ3c. Are you aware of the any improvement measure in reducing VO in this company?

RQ3d. Is there any work instruction or procedure in this company regarding the preparation of VO? Please list out.

RQ3e. How to reduce the occurrence of VO in the LCS project?

RO3e. Which of the following approaches can reduce occurrence of VO?

i. Limiting number of changes customers can request. How to manage this contract control?

ii. Limiting kind of changes customers can request. How to manage this contract control?

iii. Other approaches required?

RO3i. Can you please provide suggestions on improvement measures in reducing VO occurrence?

Section 5: Closing of the Interview

a. Can you please provide some suggestions or ideas to overcome the occurrence of VO in shipbuilding project?

Universiti Utara Malaysia

b. In your opinion, how could Project Management Team control the impact of VO in shipbuilding project?

It is my pleasure to thank you for spending your valuable time to participate in this interview session. All information gathered from this interview is crucial to the success of this research endeavour. If you have any suggestion pertaining to this topic, kindly contact me at 013-2043398 (Anizan bin Ali).

Thank you.