ISTANBUL TECHNICAL UNIVERSITY ★ GRADUATE SCHOOL OF SCIENCE ENGINEERING AND TECHNOLOGY

PMI METHODOLOGY UTILIZATION IN SHIPBUILDING PROJECT MANAGEMENT

M.Sc. THESIS

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Department of Naval Architecture and Marine Engineering

Naval Architecture and Marine Engineering Programme

JUNE 2012

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JUNE 2012

İSTANBUL TEKNİK ÜNİVERSİTESİ ★ FEN BİLİMLERİ ENSTİTÜSÜ

GEMİ İNŞAATI PROJE YÖNETİMİNDE PMI METODOLOJİSİ KULLANIMI

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Date of Submission : 04 May 2012
Date of Defense : 07 June 2012

To my husband TOLGA,

for his love, trust, encouragement, support, patience, …

FOREWORD

This thesis was written for my Master degree in Naval Architecture and Marine Engineering at Istanbul Technical University.

I would like to thank the following people, without whose help and support, this thesis would not have been possible. First I like to show my gratitude to my supervisors Prof. Dr. Mustafa Insel and Assoc. Prof. İsmail Hakkı Helvacıoğlu for their encouragements and guidance in writing the thesis. I would like to thank to Assistant Prof. Şebnem Helvacıoğlu for her encouragement and support starting from the very first day of my master program.

Secondly, I would like to thank to the industry experts whose experience and knowledge guided me about the shipbuilding practices in Turkey. I would like to thank to Gemak Group for providing me the chance of having my own shipbuilding experience during my work in their shipyard. I sincerely thank to the following people who shared their valuable time and experience; Mr. Ercüment Kafalı, Mr. Coşar Büyükdığan, Mr. Tanju Köse, Mr. Hayrettin Şahin, Mr. Osman Kaya Turan, Mr. Murat Çakmak, Mr. Barkın Sunay, Mr. Kaya Yaşar, Mr. Hakan Tufan, Mr. Nedim Sukas, Mr. Emre Koray Gençsoy, Ms. Özlem Yurdakul, Mr. Ercan Sargın, Mr. Taştan Ersan Güresen, Mr. Genco Armağan, and Mr. Ayhan Bilgin.

Finally I would like to thank my husband Tolga Doğan , my parents Ülker & Muharrem Bilen, my brother Ümit Bilen, and my friend Özlem Tüzüner for their constant support during the time I studied.

June 2012

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TABLE OF CONTENTS

Page

FOREWORD ..... **ix**
TABLE OF CONTENTS ..... **xi**
ABBREVIATIONS ..... **xv**
LIST OF TABLES ..... **xvii**
LIST OF FIGURES ..... **xix**
SUMMARY ..... **xxi**
ÖZET ..... **xxiii**
1. INTRODUCTION **1**
1.1 Purpose of The Thesis 1
1.2 Literature Review 2
1.3 Scope of The Thesis 3
2. PROFESSIONAL PROJECT MANAGEMENT STANDARDS **5**
2.1 Project Management 5
2.1.1 Project 5
2.1.2 Project management 6
2.1.3 History of project management 7
2.2 Standard 8
2.3 PMI – PMBOK 9
2.4 IPMA – ICB 11
2.5 APM – APMBOK 14
2.6 AIPM – PCSPM 15
2.7 PMAJ – P2M 16
2.8 OCG – PRINCE2 19
3. PMI PROJECT MANAGEMENT STANDARD – PMBOK **21**
3.1 Key concepts 21
3.1.1 Project life cycle 21
3.1.2 Stakeholders 22
3.1.3 Enterprise environmental factors 24
3.1.4 Organizational structures 25
3.1.5 Organizational process assets 29
3.2 Process Groups 30
3.2.1 Initiating 31
3.2.2 Planning 32
3.2.3 Executing 32
3.2.4 Monitoring and control 33
3.2.5 Closing 33
3.3.1 Project integration management 34
3.3.2 Project scope management 34
3.3.3 Project time management 35
3.3.4 Project cost management 35

3.3.5 Project quality management 35
3.3.6 Project human resources management 36
3.3.7 Project communication management 36
3.3.8 Project risk management 36
3.3.9 Project procurement management 37
3.4 Processes 37
3.4.1 Develop project charter 39
3.4.2 Identify stakeholders 39
3.4.3 Develop project management plan 40
3.4.4 Collect requirements 41
3.4.5 Define scope 41
3.4.6 Create WBS 42
3.4.7 Define activities 43
3.4.8 Sequence activities 43
3.4.9 Estimate activity resources 44
3.4.10 Estimate activity durations 45
3.4.11 Develop schedule 45
3.4.12 Estimate costs 46
3.4.13 Determine budget 47
3.4.14 Plan quality 48
3.4.15 Develop human resource plan 48
3.4.16 Plan communications 49
3.4.17 Plan risk management process 49
3.4.18 Identify risks 50
3.4.19 Perform qualitative risk analysis 51
3.4.20 Perform quantitative risk analysis 52
3.4.21 Plan risk responses 52
3.4.22 Plan procurements 53
3.4.23 Direct and manage project execution 53
3.4.24 Perform quality assurance 54
3.4.25 Acquire project team 55
3.4.26 Develop project team 56
3.4.27 Manage project team 57
3.4.28 Distribute information 57
3.4.29 Manage stakeholder expectations 58
3.4.30 Conduct procurements 59
3.4.31 Monitor and control project work 59
3.4.32 Perform integrated change control 60
3.4.33 Verify scope 61
3.4.34 Control scope 62
3.4.35 Control schedule 62
3.4.36 Control costs 63
3.4.37 Perform quality control 63
3.4.38 Report performance 64
3.4.39 Monitor and control risks 64
3.4.40 Administer procurements 65
3.4.41 Close project or phase 65
3.4.42 Close procurements 66
4. PROJECT MANAGEMENT IN SHIPBUILDING 67
4.1 World Shipbuilding Industry 67

4.2 Turkish Shipbuilding Industry 69
4.2.1 Overview 69
4.2.2 Organization structures 72
4.2.3 Labor force and equipment supply 73
4.2.4 Industry analysis and needs 75
4.3 Project Management in Turkish Shipbuilding 77
4.4 PMI Utilization in Turkish Shipbuilding Projects 81
4.4.1 Develop project charter for shipbuilding 82
4.4.2 Identify stakeholders for shipbuilding 83
4.4.3 Develop project management plan for shipbuilding 84
4.4.4 Collect requirements for shipbuilding 84
4.4.5 Define scope for shipbuilding 85
4.4.6 Create WBS for shipbuilding 85
4.4.7 Define activities for shipbuilding 86
4.4.8 Sequence activities for shipbuilding 86
4.4.9 Estimate activity resources for shipbuilding 87
4.4.10 Estimate activity durations for shipbuilding 87
4.4.11 Develop schedule for shipbuilding 88
4.4.12 Estimate cost for shipbuilding 88
4.4.13 Determine budget for shipbuilding 89
4.4.14 Plan quality for shipbuilding 89
4.4.15 Develop human resource plan for shipbuilding 89
4.4.16 Plan communications for shipbuilding 90
4.4.17 Plan risk management for shipbuilding 90
4.4.18 Identify risks for shipbuilding 91
4.4.19 Perform qualitative risk analysis for shipbuilding 91
4.4.20 Perform quantitative risk analysis for shipbuilding 91
4.4.21 Plan risk response for shipbuilding 91
4.4.22 Plan procurements for shipbuilding 92
4.4.23 Direct and manage project execution for shipbuilding 92
4.4.24 Perform quality assurance for shipbuilding 92
4.4.25 Acquire project team for shipbuilding 93
4.4.26 Develop project team for shipbuilding 94
4.4.27 Manage project team for shipbuilding 94
4.4.28 Distribute information for shipbuilding 94
4.4.29 Manage stakeholder expectations for shipbuilding 95
4.4.30 Conduct procurements for shipbuilding 95
4.4.31 Monitor and control project work for shipbuilding 96
4.4.32 Perform integrated change control for shipbuilding 96
4.4.33 Verify scope for shipbuilding 97
4.4.34 Control scope for shipbuilding 98
4.4.35 Control schedule for shipbuilding 98
4.4.36 Control costs for shipbuilding 98
4.4.37 Perform quality control for shipbuilding 99
4.4.38 Report performance for shipbuilding 99
4.4.39 Monitor and control risks for shipbuilding 99
4.4.40 Administer procurements for shipbuilding 100
4.4.41 Close project or phase for shipbuilding 100
4.4.42 Close procurements for shipbuilding 101
4.5 Additional Processes for Shipbuilding 101

5. CONCLUSION AND RECOMMENDATIONS 103
REFERENCES 109
CIRRICULUM VITAE 113

ABBREVIATIONS

AIPM	: Australian Institute for Project Management
ANSI	: American National Standards Institute
APM	: Association for Project Management
APMBOK	: APM Body of Knowledge
BSI	: British Standards Institute
CERN	: European Organization for Nuclear Research
CGT	: Compensated Gross Tonnage
DWT	: Deadweight Tonnage
ERP	: Enterprise Resource Planning
ICB	: IPMA Competence Baseline
IPMA	: International Project Management Association
ISO	: International Standards Organization
OCG	: Office of Government Commerce
OECD	: Organization for Economic Co-operation and Development
PCSM	: Professional Competency Standards for project Management
PERT	: Program Evaluation and Review Technique
PMAJ	: Project Management Association of Japan
PMBOK	: Project Management Body of Knowledge
PMI	: Project Management Institute
PMIS	: Project Management Information System
PMP	: Project Management Professional
PRINCE2	: Projects in Controlled Environment 2
WBS	: Work Breakdown Structure

LIST OF TABLES

Page

Table 3.1 : Comparison of Projects and Operations 25
Table 3.2 : Organizational Influences on Projects 26
Table 3.3 : Project Management Process Groups and Knowledge Area Mapping ... 38
Table 5.1 : Summary of Findings 106

LIST OF FIGURES

	Page
Figure 2.1 : IPMA Competences.	12
Figure 2.2 : IPMA Certification.	14
Figure 2.3 : APM Knowledge Areas.	17
Figure 2.4 : Evaluation of Project Management.	18
Figure 3.1 : Typical Cost and Staffing Levels Across the Project Life Cycle.	22
Figure 3.2 : Impact of Variable Based on Project Time.	22
Figure 3.3 : Functional Organization.	27
Figure 3.4 : Weak Matrix Organization.	27
Figure 3.5 : Balanced Matrix Organization.	27
Figure 3.6 : Strong Matrix Organization.	28
Figure 3.7 : Projectized Organization.	28
Figure 3.8 : Composite Organization.	28
Figure 3.9 : Project Management Process Groups.	30
Figure 3.10 : Process Groups Interact in a Phase or Project.	31
Figure 3.11 : Project Boundaries.	32
Figure 3.12 : Develop Project Charter Overview.	39
Figure 3.13 : Identify Stakeholders Overview.	40
Figure 3.14 : Develop Project Management Plan Overview.	40
Figure 3.15 : Collect Requirements Overview	41
Figure 3.16 : Define Scope Overview	42
Figure 3.17 : Create WBS Overview.	42
Figure 3.18 : Define Activities Overview.	43
Figure 3.19 : Sequence Activities Overview.	44
Figure 3.20 : Estimate Activity Resources Overview.	45
Figure 3.21 : Estimate Activity Durations Overview.	45
Figure 3.22 : Develop Schedule Overview.	46
Figure 3.23 : Estimate Costs Overview.	47
Figure 3.24 : Determine Budget Overview.	47
Figure 3.25 : Plan Quality Overview.	48
Figure 3.26 : Develop Human Resource Plan Overview.	48
Figure 3.27 : Plan Communications Overview.	49
Figure 3.28 : Plan Risk Management Overview.	50
Figure 3.29 : Identify Risks Overview.	51
Figure 3.30 : Perform Qualitative Risk Analysis Overview.	52
Figure 3.31 : Perform Quantitative Risk Analysis Overview.	52
Figure 3.32 : Plan Risk Responses Overview.	53
Figure 3.33 : Plan Procurements Overview.	53
Figure 3.34 : Direct and Manage Project Execution Overview.	54
Figure 3.35 : Perform Quality Assurance Overview.	55
Figure 3.36 : Acquire Project Team Overview.	56

Figure 3.37 : Develop Project Team Overview. 57
Figure 3.38 : Manage Project Team Overview. 57
Figure 3.39 : Distribute Information Overview. 58
Figure 3.40 : Manage Stakeholder Expectations Overview. 59
Figure 3.41 : Conduct Procurements Overview. 59
Figure 3.42 : Monitor and Control Project Work Overview. 60
Figure 3.43 : Perform Integrated Change Control Overview. 61
Figure 3.44 : Verify Scope Overview. 61
Figure 3.45 : Control Scope Overview. 62
Figure 3.46 : Control Schedule Overview. 62
Figure 3.47 : Control Costs Overview. 63
Figure 3.48 : Perform Quality Control Overview. 64
Figure 3.49 : Report Performance Overview. 64
Figure 3.50 : Monitor and Control Risks Overview. 65
Figure 3.51 : Administer Procurements Overview. 65
Figure 3.52 : Close Project or Phase Overview. 66
Figure 3.53 : Close Procurement Overview. 66
Figure 4.1 : CGT Completed and Delivered From 1970 To 2008. 68
Figure 4.2 : World Shipbuilding 35 Year Cycle. 69
Figure 4.3 : Regional Distribution of Shipyards in Turkey. 70
Figure 4.4 : Ship and Yacht Export by Year. 70
Figure 4.5 : World's Top Ten Producers of New Ships (in CGT). 71
Figure 4.6 : Total World Newbuilding Orderbook. 71
Figure 4.7 : Employment Status in Turkish Shipbuilding Industry. 73
Figure 4.8 : Comparative Employment/Output Data. 73
Figure 4.9 : Shipbuilding Industry Growth - Variables and Policy Scale. 74
Figure4.10 : Shipbuilding Relationship Complexity. 78

PMI UTILIZATION IN SHIPBUILDING PROJECT MANAGEMENT

SUMMARY

Shipbuilding is a project type production, which creates a unique product. Ships are mobile structures that are like sailing cities in the oceans. Building such a global product requires many processes to be managed carefully. Therefore, a systematic project management methodology might be considered as a convenient management approach.

In this thesis, the utilization, practicality and usefulness of PMI (Project Management Institute) project management methodology, in shipbuilding project management is investigated. The first chapter of the thesis includes the purpose, scope and related literature review. In the second chapter, the general knowledge is given about the project management standards. The third chapter explains the project management methodology based on PMBOK (Project Management Body of Knowledge), published by PMI. The shipbuilding industry in the world and in Turkey are briefly introduced in the fourth chapter. This chapter also covers the discussion of each project management process for shipbuilding projects in Turkish shipyards. The conclusion and recommendations are given in the final chapter.

Neither shipbuilding, nor the project management standards are new. Several studies exist in the literature, related to managing specific processes or process groups of a shipbuilding project. However, no studies were found on application of a systematic project management methodology for shipbuilding in Turkey. Therefore, in this study, it is aimed to give a brief overview on utilization of an internationally known project management standard in shipbuilding.

There are several global standard giving organizations for project management, such as ISO (International Standards Organization), PMI (Project Management Institute), IPMA (International Project Management Association), AIPM (Australian Institute for Project Management), OCG (British Office of Government Commerce), APM (Association for Project Management), PMAJ (Project Management Association of Japan), etc. Some of the project management methodologies by subject organizations are briefly explained in this thesis. The project management methodology given by PMI as PMBOK is selected for this study, due to its common recognition.

The PMI project management standard includes 42 processes, which are classified under process groups and knowledge areas. There are five process groups namely; initiating, planning, executing, monitoring and control, and closing. The knowledge area covers the management of integration, scope, time, cost, quality, human resources, communication, risk, and procurement. Each process belongs to a process group and a knowledge area at the same time.

Turkish shipyards achieved a good reputation in building of small and medium tonnage chemical tankers. By January 2011, Turkey is on the 4th place among the countries, which take tanker orders.

According to tonnage basis in CGT (Compensated Gross Tonnage), Turkish yards are on the 11th place in world ranking. However, the total share of Turkish shipyards from the global market is less than 2%, which is getting lower with the effects of global crisis as well as the competitive prices of other emerging shipbuilders. Most of the Turkish shipyards suffer from over budget and over time projects resulting even bankruptcies. Therefore, effective project management is essential for shipbuilding projects in Turkey.

The method of this study is based on interviews with experts. In fact, the project management standards are not known in Turkish shipbuilding industry. Therefore, the interviews cover a brief presentation of PMI project management standard and discussion over the utilization, practicality and usefulness of each process for shipbuilding projects in Turkey. Expert view is also investigated for the necessity of additional processes, process groups or knowledge areas other than the ones mentioned in PMI. In addition, the general comments from the experts are gathered related with the usual practices in Turkish shipbuilding projects.

Shipbuilding project is considered as a new ship production project based on a turnkey contract that takes place in a Turkish shipyard. The beginning of the project is assumed as the contract signing with the owner of the vessel. While the end of the project is assumed as the delivery of the vessel to the owner. Therefore, the processes during the bidding period before the contract signature and guarantee period after the delivery of the vessel are not included in the project boundaries.

In general, the experts believe most of the processes will be practical and useful for shipbuilding projects, although several of the processes are not utilized properly. The processes related with communication management and risk management are definitely not utilized.

The processes related with scope management, time management, and procurement management is generally utilized by Turkish shipyards. However, most experts believe that the processes are not utilized and documented properly resulting in over budget and over time in the project.

The utilization of other processes related with integration management, cost management, quality management, and human resources management are partly applied in shipbuilding projects. Some experts claimed that the project budget and scope are mainly defined during the bidding stage and approved by the shipyard and the owner, as building technical specification and contract which is before the project start. Based on the interviews, some additional process for following knowledge areas were found to be required in shipbuilding projects; health-safety-environment management, sub-contractor management, contract management, shipyard layout and equipment management, finance management.

To sum up, most of the processed defined in PMI project management standard (PMBOK) would be useful if utilized. However, it would not be practical to start applying all processes at the same because of the maturity level of the organizations, availability of skilled and educated personnel, cultural reasons and changing market conditions. Considering that most of the workmanship, equipment and material are outsourced, Turkish shipyards need to increase their management skills, either by use of project management systems or other applicable systematic means. As a further study, each process may be studied in detail with an applicable model for Turkish shipyards including standardized forms, checklists and flow charts to determine the extent of application.

GEMİ İNŞAATI PROJE YÖNETİMİNDE PMI METODOLOJİSİ KULLANIMI

ÖZET

Gemi inşaatı proje tipi bir üretimdir ve oldukça özel bir ürün ortaya çıkarır. Nihai ürün olan gemiler, dünyanın herhangi bir yerine gidebilen, kendi kendilerini sevk edebilen ve her türlü donanıma sahip yapılardır. Böylesine uluslararası nitelikli ve karmaşık bir yapının inşaatı ile ilgili süreçlerin çok özenli bir şekilde yönetilmesi gerekmektedir. Bu nedenle, sistematik bir proje yönetim metodolojisi, uygun bir yönetim aracı olarak kullanılabilir.

Bu çalışmada, PMI (Proje Yönetim Enstitüsü) tarafından verilen proje yönetim standardının, gemi inşaatı projelerindeki kullanımı, uygulanabilirliği ve faydası araştırılmıştır. İlk bölümde, tezin amacı, kapsamı ve ilgili literatür taramasına yer verilmiştir. İkinci bölümde, dünyada kabul gören proje yönetim standartlarından kısaca bahsedilmiştir. Üçüncü bölümde, PMI tarafından yayınlanan PMBOK (Proje Yönetimi Bilgi Birikimi Kılavuzu) geniş bir kapsamda özetlenmiştir. Dördüncü bölümde dünyada ve Türkiye'de gemi inşa sanayinin durumuna yer verilmiş ve gemi inşaatı projelerinin özelliklerinden bahsedilmiştir. Bu bölümde ayrıca, PMI'da yer alan her bir proje yönetim sürecinin, gemi inşaatında kullanımı incelenmiştir. Son bölümde, çalışmanın sonucuna ve önerilere yer verilmiştir.

Gemi inşaatı da, proje yönetim standartları da yeni değildir. Literatürde, proje yönetim süreçlerinin veya süreç gruplarının, gemi inşaatındaki uygulamalarına ilişkin çalışmalar bulmak mümkündür. Ancak, sistematik bir proje yönetim metodolojisinin Türkiye'deki gemi inşaatı projelerine uygulanması ile ilgili bir çalışma bulunamamıştır. Bu nedenle, bu tez kapsamında, uluslararası tanınırlığı olan bir proje yönetim standardının, gemi inşaatı projelerinde kullanımına ilişkin genel bir bakış verilmesi amaçlanmıştır.

Dünyaca tanınmış pek çok proje yönetim standardı oluşturan kuruluş vardır. Bunlardan bazıları; ISO (Uluslararası Standartlar Teşkilatı), PMI (Proje Yönetim Enstitüsü), IPMA (Uluslararası Proje Yönetimi Birliği), AIPM (Avusturalya Proje Yönetim Enstitüsü), OCG (İngiliz Hükümeti Ticaret Ofisi), APM (Proje Yönetim Birliği), PMAJ (Japon Proje Yönetim Birliği), vb. Bu kuruluşlar tarafından oluşturulan proje yönetim sistemlerinin bazıları bu tez kapsamında kısaca özetlenmiştir. Bu çalışmada, uluslararası anlamda en çok kabul gören ve yaygın olarak kullanılan, PMI - PMBOK standardı seçilmiştir.

PMI 1969 yılında Amerika Birleşik Devletlerinde gönüllüler tarafından kurulan bir organizasyondur. Özellikle, mühendislik, savunma sanayi ve inşaat projelerinde yaşanılan yönetimsel sıkıntıların giderilmesi, ortak bir dil oluşturulması ve sistematik bir yaklaşım oluşturulması amacıyla ilk kez 1987'de bildiri yayınlamışlardır. 1996 yılında ilk versiyonu yayınlanan PMBOK için şu an yürürlükte olan sürüm 2008 yılında yayınlanmış olan 4. versiyondur.

PMI her 4 senede bir PMBOK ‘nin geliştirilmesini ve yeni bir versiyonunun yayınlanmasını amaç edinmiş olup, 5. Versiyonun 2012 yılı sonunda yayınlanması beklenmektedir.

PMI, proje yönetimine temel oluşturduğunu ileri sürdüğü PMBOK dışında, 11 farlı standart daha yayınlamıştır. Ayrıca proje yönetimini bir ihtisas alanı haline getirmek adına, proje yönetim profesyoneli (PMP – Project Management Profesyoneli) dahil olmak üzere toplam 6 sertifika vermektedir. Bu sertifikalar şahısların metodolojiler ile ilgili bilgilerinin ölçüldüğü bir sınav ve proje yönetimi ile ilgili tecrübelerine dayalı olarak verilmekte olup, dünyada pek çok firma tarafından kabul gören sertifikalardır.

PMBOK içerisinde proje yönetimine temel oluşturan bilgi birikimine ağırlık verilmektedir. Daha çok bir rehber niteliği taşıyan bu standardın ilk iki bölümünde proje yönetiminde kullanılan terminolojiye -proje kavramı, proje yönetimindeki paydaşların tanımları, organizasyon yapıları vb.- yer verilmiştir. Üçüncü bölümde proje yönetim standardı süreçler, süreç grupları ve bilgi alanları üzerinden açıklanmıştır. Dördüncü bölümden başlayarak on ikinci bölüm dahil olmak üzere her bir sürecin uygulaması ile ilgili girdileri, araç ve teknikleri ve çıktı oluşturan dokümanların detaylı anlatımı yapılmıştır.

PMI proje yönetim standardında 42 süreç yer almaktadır. Bu süreçler, süreç grupları ve bilgi alanları altında gruplanmıştır. Her bir süreç, hem bir süreç grubu, hem de bir bilgi alanı altında bulunmaktadır. Süreç grupları 5 adet olup; başlatma, planlama, uygulama, izleme ve kontrol, ve kapatma olarak isimlendirilmiştir. Bilgi alanları 9 adet olup, şu alanlardaki yönetim konularını içermektedir; entegrasyon, kapsam, zaman, maliyet, kalite, insan kaynakları, iletişim, risk, ve tedarik.

Türk tersaneleri, küçük ve orta tonajlı kimyasal tanker üretimi konusunda dünyada iyi bir yer edinmiştir. Türkiye, 2011 Ocak ayı itibarıyla, tanker siparişi alan ülkeler arasında 4. Sırada yer almıştır. Kompanse gros ton (CGT) bazında bakıldığında ise, 11. sıradadır. Ancak, dünya genelindeki toplam pazarın sade %2’lik bir kısmına sahiptir. Hatta bu oran, küresel kriz ve gelişmekte olan yeni üreticilerin uyguladığı rekabetçi fiyat politikaları sebebiyle hızla azalmaktadır. Türk tersanelerinin büyük çoğunluğu bütçeyi ve süreyi aşan projelerle sebebiyle sıkıntı yaşamaktadır. Bu yüzden, etkili bir proje yönetim uygulaması Türk tersaneleri için elzemdir.

Türk tersanelerinin en büyük avantajı, denizcilik piyasasında büyük paya sahip Avrupa kaynaklı firmalara olan coğrafi yakınlığır. Özellikle, siparişe dayalı gemi üretimi talebi olan Avrupalı armatörler için, Türkiye hem mesafe anlamında, hem de kültürel anlamda, uzak doğudaki gemi üreticilerine iyi bir alternatif olabilmektedir. Ancak, Türkiye’deki tersanelerin rekabet edebilirliğini önemli ölçüde etkileyen pek çok faktör vardır. Bunların başında, tersanelerin dışa bağımlı yapısı gelmektedir. Maalesef en büyük masraf kalemlerini oluşturan ekipman ve malzemelerin yerli üretimleri bulunmamaktadır. Dolayısıyla, ekipman/malzeme maliyetleri gerek nakliye/gümrük işlemleri ve gerekse elleçlemede kaybedilen işgücü anlamında yüksektir. Üstelik, toplam maliyeti kısmak anlamında yapılan toplu alımlar nedeniyle de finansal maliyetler artmaktadır. Tersaneler işgücü gereksinimini taşeronlar vasıtasıyla sağlamakatadır ve genelde tersane personelinin toplam sayısı 300 ‘ün altında kalmaktadır. Özellikle fiziki işlerde kendi personelini çalıştıran tersanelerin sayısı oldukça azdır. İşçilik ücretleri uzakdoğu alternatiflerine göre pahalı kalmakta, verimlilik ise rakiplerden oldukça düşük kalmaktadır. Devlet desteği sınırlı olan gemi inşa sektöründe tersanelerin büyük kısmı aile şirketleri olarak organize olmuştur.

Bu nedenle, genel olarak, kurumsal bir yapıdan söz etmek pek mümkün değildir. Tersane yerlerinin uzun süreli kiralama yöntemiyle kullandırılması da muhtemel anlaşmalar esnasında, teminat verme anlamında tersane sahiplerini zor durumda bırakmaktadır. Bu nedenlerle, Türkiye'deki tersanelerin en önemli işi süreçlerin uygun şekilde yönetilmesi ile ilgilidir.

Bu çalışmada kullanılan araştırma metodu, endüstride gemi inşaatı süreçleri konusunda uzmanlaşmış kişilerle yapılan birebir görüşmelere dayanmaktadır. Aslında, proje yönetim standartları Türkiye gemi inşaatı sektöründe pek fazla bilinmemektedir. Bu nedenle, yapılan görüşmeler sırasında, PMI metodoloji ile ilgili kısa sunumlara yer verilmiştir. Sonrasında, PMI' da bahsi geçen her bir sürecin gemi inşaatı projelerindeki kullanımına, uygulanabilirliğine ve faydasına ilişkin olarak uzmanların görüşleri alınmıştır. Ayrıca, gemi inşaatı için faydalı olabilecek ek süreç önerileri sorgulanmış ve genel olarak gemi inşaatı projelerindeki genel uygulamalarla ilgili yorumlar istenmiştir.

Bu tez kapsamında değerlendirilen gemi inşaatı projeleri, anahtar teslim kontrat ile anlaşması yapılmış, yeni gemi inşaatı projeleridir. Proje başlangıcı armatör ile kontrat imzalanması olarak belirlenmiştir. Projenin bitişi ise geminin armatöre teslim edilmesi olarak kabul edilmiştir. Bu nedenle, teklif verme aşamasında kontrat imzasına kadar olan süreçler ile teslimden sonraki garanti periyodu süreçleri proje sınırları içerisinde yer almamaktadır.

Entegrasyon yönetimi ile ilgili süreçlerin pek az uygulandığı saptanmıştır. Gemi inşaatı projelerindeki karmaşık yapıyı göz önünde bulunduran uzmanlar, enteagrasyon süreçlerini uygulamanın faydalı olacağını belirtmişlerdir.

Kapsam yönetimi ile ilgili süreçlerin genel olarak Türkiye'deki tersanelerde uygulandığı belirtilmiştir. Gerçekte, nihai ürün özellikleri sözleşme aşamasında ve sözleşmeye ek olacak şekilde teknik şartname ve ilgili teknik resimlerle belirlenmektedir. Genel olarak uzamanlar, kapsam yönetiminin kritik bir konu olduğunu ve sistematik bir şekilde yönetilmesinin ticari kayıpları önleyebileceğini belirtmişlerdir.

Zaman yönetimi ile ilgili süreçler genel olarak Türk tersanelerinde uygulanmaktadır. Ancak, uzmanlar uygulanmakta olan süreçlerin başarısız olduğunu ve bu nedenle pek çok gemi tesliminin sözleşmede belirtilen tarihlerden geç yapıldığını belirtmişlerdir.

Maliyet yönetimi ile ilgili süreçler, Türkiye'deki tersanelerde kısmen uygulanmaktadır. Uzmanlar oluşan maliyetlerin başta verilen bütçeye göre kontrolünün sadece tedarik işlemleri/taşeron sözleşmeleri sırasında ve proje bitiminde yapıldığını belirtmişlerdir. Dolayısıyla, proje süresince oluşan ek işler, hatalı işler, ve gecikmelerden kaynaklanan maliyetlerin yeterince kontrol edilemediği saptanmıştır. Sözleşme öncesi hazırlanan bütçenin, proje zaman programına temel oluşturan iş paketleri bazında revizyonu ve proje süresince güncellenmesi ve takibi yapılmalıdır.

Kalite yönetimi ile ilgili süreçler kısmen uygulanmaktadır. Uzmanlar kalitenin sadece kontrol edildiğini ancak planlanmadığını ve güvence altına alınmadığını belirtmektedirler. Pek çok tersane, kalite yönetim standartları çerçevesinde sertifika almış olmasına rağmen, gemi inşaatı projelerindeki uygulamaları oldukça zayıftır. Nihai ürünü tarafsız kuruluşlar tarafından her aşamada kontrol edilen gemi inşaatında kalite ile ilgili süreçlerin efektif şekilde uygulanması kaçınılmazdır.

İletişim yönetimi ile ilgili süreçler Türkiye'deki tersanelerde uygulanmamaktadır. Bazı uzmanlar, iletişim ihtiyaçlarının sözleşmelerde açıkça yer aldığını ve ek olarak uygulanacak süreçlerin, tersanedeki evrak yükünü artıracağı için gereksiz olduğunu düşünmektedirler. Bazı uzmanlar ise, iletişim gereksinimleri oldukça yüksek olan gemi inşaatı projelerinde sistematik bir iletişim yönetiminin gerekli ve faydalı olabileceğini düşünmektedir.

İnsan kaynakları yönetimi ile ilgili süreçler kısmen uygulanmaktadır. Her ne kadar dokümente edilmiş bir sistem olmasa da, genellikle departman yöneticileri, proje ihtiyaçları doğrulsunda gerekli görevlendirmeleri yapmaktadır. Proje yöneticisinin, proje ekip üyelerinin seçimi ile ilgili çok az bir etkisi olabilmektedir. Genel olarak, uzmanlar, insan kaynakları yönetimi ile ilgili süreçlerin uygulanabilir ve faydalı olduğu görüşündedir.

Risk yönetimi ile ilgili süreçler Türkiye'deki tersanelerde proje bazlı riskler için uygulanmamaktadır. Çalışma ve Sosyal Güvenlik Bakanlığı'nın son dönemde yapmış olduğu çalışmalar neticesinde, tersanelerde oluşan kazaların önlenmesine yönelik, operasyonel risk yönetimi çalışmaları yürüten tersaneler olduğu bilinmemektedir. Bazı uzmanlar, ana proje risklerinin sözleşme aşamasında yönetilmesi gerektiğini savunmaktadır. Genel olarak, risk yönetimi konusunda sektördeki bilgi birikimi oldukça zayıftır ve ilgili süreçlerin hayata geçirilmesi önem arz etmektedir.

Tedarik yönetimi ile ilgili süreçler genel olarak uygulanmaktadır. Türkiye'deki tersanelerin genel olarak dışa bağımlı yapıları sebebiyle, bu süreçlerin bir şekilde uygulanması kaçınılmazdır. Ancak, pek çok uzman, özellikle sözleşme yönetimi konusunda tersanelerin oldukça zayıf kaldıklarını belirtmiştir.

Yapılan birebir görüşmelere dayanarak, PMI tarafından verilen bilgi alanları dışında bazı ek yönetim alanlarına ihtiyaç vardır. Bunlar; iş sağlığı – iş güvenliği – çevre yönetimi, taşeron yönetimi, sözleşme yönetimi, tersane yerleşimi yönetimi, ve finans yönetimi başlıkları altında gruplanabilir.

Özet olarak, PMI tarafından açıklana pek çok proje yönetim süreci, gemi inşaatı projelerinde uygulanması durumunda fayda sağlayacaktır. Ancak, tüm süreçlerin bir anda uygulanmaya başlanması mümkün değildir. Bunu nedeni, mevcut organizasyonların olgunluk seviyesi, eğitimli ve kalifiye personel eksikliği, kültürel sebepler ve değişken pazar şartları olarak belirtilebilir. İşçilik, ekipman ve malzemenin ağırlıklı olarak dışarıdan temin edildiği Türkiye tersanelerinde, yönetim becerileri ön plana çıkmaktadır. Dolayısıyla, küresel gemi inşaatı piyasasında rekabet etmek isteyen Türk tersanelerinin, proje yönetim standartları veya başka sistematik yönetim uygulamaları vasıtasıyla rekabet edebilirliklerini artırmaları kaçınılmazdır.

Gemi inşaatında proje yönetim standartlarının kullanımı ile ilgili yapılacak sonraki çalışmalarda, her bir sürecin, süreç grubunun veya bilgi alanının detaylı çalışmaları bir uygulama modeli ile birlikte verilebilir. Bu model kapsamında, standart formlar, kontrol listeleri, akış diyagramlarına yer verilerek, çalışmanın mevcut işletmelerde uygulanabilir hale getirilmesi sağlanabilir.

1. INTRODUCTION

1.1 Purpose of The Thesis

Shipbuilding is a project type production. Therefore, management of shipbuilding projects could be performed by common project management practices. Ships are also defined as make-to-order products, which makes the project management more and more complicated.

Shipbuilding is a global market. Every shipyard in the world, especially in commercial ship market, are fighting against each other, besides the local and global crisis.

Since the ships are sailing all around the world, they should comply with several rules and regulations in order to be classified by independent classification societies. Therefore, to build a classified ship, shipbuilders should carry out all processes considering the quality of the final product. (Hameri and Nitter, 2002)

The importance of management of shipbuilding is increasing; including delivery times, cost, productivity, performance, etc. Projects are getting more complex in naval vessels and offshore units with additional rules and regulations, owner demands, etc. Therefore, naval architects and marine engineers are required to know how to manage the different processes of shipbuilding projects with modern tools and techniques.

Turkish shipyards are organized to utilize subcontractors for workmanship supply and rely on global market for the material and equipment supply. Therefore, the major issue of a Turkish shipyard is to manage the resources and organize the work.

Although the history of modern shipbuilding reaches to 1980s in Turkey, the modern techniques of project management are rarely used.

All those circumstances require a systematic approach for managing the shipbuilding projects. In this thesis, it is aimed to investigate the utilization of a globally known project management standard in Turkish shipbuilding industry.

1.2 Literature Review

Neither shipbuilding, nor the project management standards are new. There are several studies in ship production time and cost planning and control. However, no researches were found in ship production for utilizing a project management standard as a management approach.

The major constraint is generally the limited time for completing of a shipbuilding project. Some of the studies on scheduling problems of shipbuilding are listed below:

1. Koenig et al. (1999), studied the modern work break down structures.
2. Hameri and Nitter (2002), worked on different work breakdown structures of shipbuilding for engineering data management benchmarking with CERN project.
3. Prasad et al. (2003), studied the resource constraint shop level scheduling in a shipyard.
4. Saraçoğlu (2005), studied PC based project management. This study is about on software selection for scheduling needs in shipbuilding projects.
5. Dalton et al. (2005), investigated the job shop scheduling problems.
6. Alkan (2006), worked on the project management effects in ship production on time and cost. Alkan (2009), mentioned that it is not possible to see an overall project management system in Turkish shipbuilding industry. However, according to Alkan (2009), critical path method is used for process planning and control in way of time management.
7. Özyiğit (2006), studied on ship production planning with detailed definitions of processes and process flow diagrams.
8. Akıncı (2008), studied shipyard production time planning based on critical path method for a specific platform supply vessel.
9. Kocabıyık (2009), studied PERT (Program Evaluation and Review Technique) in order to calculate the cost and time for a shipbuilding project.
10. Wei et al. (2010) studied the scheduling of outfitting processes in shipbuilding industry.
11. Sharma and Kim (2010), introduced a logic based planning for design and production processes in shipbuilding.

Few studies were found in the literature related with other processes of shipbuilding project management rather than scheduling:

1. Lee et al. (2007), worked on the engineering risks in Korean shipbuilding industry.
2. Ahola et al. (2007), studied the buyer - supplier relations in turnkey shipbuilding projects in way of value creation.
3. Karabağ (2009), made a comparison of ERP (Enterprise Resource Planning) systems vs. project management software for shipbuilding industry.

1.3 Scope of The Thesis

This research and assumptions in this thesis are limited with a specific part of Turkish shipbuilding industry. The shipbuilding project is considered as a new building project with a turnkey contract, where the project starts with contract signing and end with the delivery of the vessel to the owner.

The methodology for project management is a general body of knowledge, namely a guide. Therefore, the specific needs of shipbuilding projects are not involved in subject methodology. The selected project management standard is published by PMI (Project Management Institute) as “A Guide to the Project Management Body of Knowledge” (PMBOK).

The thesis covers general information on international project management standards, project management standard published by PMI in detail, and the shipbuilding industry. The thesis includes a discussion with industry experts, for each process mentioned in PMI project management standard, in way of utilization, practicality and usefulness. General comments and findings related with processes are summarized in knowledge area basis.

Interviews were performed with 16 industry experts who are experienced majorly in shipyard management, project management, project planning, design planning and production planning areas in Turkish shipyards. Mainly the university degrees of the experts are the naval architecture, marine engineering, ocean engineering or a combination of those degrees. The experience years are starting from 10 years to reaching over 40 years.

2. PROFESSIONAL PROJECT MANAGEMENT STANDARDS

2.1 Project Management

2.1.1 Project

There are several definitions for project concept. PMI (2008), gives the definition as "Project is a temporary endeavor undertaken to create a unique product, service, or result". The word temporary is not used to mean a short duration of time, but to underline the fact that each project has a beginning and an end. Each project is performed in order to reach its objectives and either completed successfully or terminated (PMI, 2008).

Project is also defined as series of multifunctional activities that require resources with limited budget and have a specific objective within certain specifications (Kerzner, 2009).

P2M booklet (2012) defines the project as "Activities that can actualize desires and dreams within a specific time limit".

Lester (2007) gives the project definition based on the British Standards as "A unique set of coordinated activities, with definite starting and finishing points, undertaken by an individual or organization to meet specific objectives within defined schedule, cost and performance parameters".

Although similar projects may consist of similar or repetitive activities, the result of each project is unique (PMI, 2008). Shipbuilding industry is one good example for unique products. Even two vessels are built in accordance with same design and at the same shipyard; each construction will face with different problems, use different resources, managed in a different way, etc.

Projects could also be performed to improve a company in way of market positioning, complying with legal/environmental requirements or to meet specific customer demands (PMI, 2008).

In order to sum up the major properties, each project:

- Has a specific beginning and end,
- Provides a unique result,
- Is performed to achieve specific objectives or desires,
- Contains complicated set of interrelated tasks,
- Requires resources, and,
- Has limited time and budget.

2.1.2 Project management

Project management is a scientific approach that follows and applies the modern management techniques in order to achieve the complicated objectives.

PMI (2008), defines project management as “The application of knowledge, skills, tools, and techniques to project activities to meet the project requirements”.

Another definition for project management is given by Lester (2007) “The planning, monitoring and control of all aspects of a project and the motivation of all those involved in it, in order to achieve the project objectives within agreed criteria of time, cost and performance”.

Several tools and techniques are available in the project management practice. Each project team should evaluate the tools and techniques of the project management processes. Then, the level of application of each tool/technique/process shall be designated for each specific project (PMI, 2008).

Major activities of the project team includes detailed analysis of the project scope, preparing the project management plan, executing the necessary activities to provide project deliverables and make changes necessary during monitoring and controlling. .

Projects should be considered as living organisms, which shall evolve due to the changing circumstances or requirements. Therefore, the project management plan should be detailed and improved continuously as the project progresses (PMI, 2008)

In developed organizations, projects are managed under program and / or portfolio management systems. In a program, a group of projects are managed and coordinated in order to obtain better benefits than managing each project separately. Similarly, in a portfolio, group of projects or programs are managed together in order to achieve same strategic aims (PMI, 2008).

2.1.3 History of project management

When the recent definitions of project are considered, it could be said that the history goes back to ancient constructions.

Lester (2007), considers Noah as one of the earliest person who needs to manage the project of building an ark, aiming to save people and animals from the flood, within a limited time.

According to Weaver (2007), the basis of project management lies back to the protestant reformation in the 15th century. However, the importance of modern project management is understood in the last 50 years and supported by several organizations by defining bodies of knowledge and approving individuals as professional project managers. (Weaver, 2007)

The need for assigning an individual or an organization as a project manager occurred in 1950's. At that time the project management concerns were limited with time planning including critical path method (Stretton, 2007).

Weaver (2007), suggests the critical path method, which is a part of operational research, is the most important development that supports the rise of project management. Although operational research is not a management discipline, it helped decision making by use of scientific methods and computer power. Operational research was a one step further to Taylor's scientific management approach since the overall system was considered instead of a single process. (Weaver, 2007)

In 1960s, cost management and relevant resource management were included in project management. In 1970s, the project management was used by several industries and with new focus areas such as; responsibility assignment matrices, earned value technique, conflict management. (Stretton, 2007).

By the end of 1990s several associations were already formed all around the world in order to improve the project management knowledge. By that time the management areas such as risk, human resources, and communication are included in the project management concept. In addition, the standardization and approving the knowledge of project management were spread all around the world (Stretton, 2007).

2.2 Standard

A standard is defined as a formal document, which describes norms, methods, processes and practices (PMI, 2008)

Standards are mentioned as repeatable way of doing something, which are agreed formal documents such as a rule, guideline or definition. In order to prepare the standards all available experience, knowledge and expertise are brought together related with the product or service that is subject to standardization (Url-2).

Standards are designed to create a common understanding of making systems that are safe, reliable and in good quality. Standards could be in the form of codes, specifications, handbooks, guidelines, bodies of knowledge, etc. There are over 1000 globally recognized standard developing organizations in the world, providing over half a million documented standards (Url-5).

Some of the major standard/rule developing/approving organizations in shipbuilding and marine construction industry could be listed as follows:

- IMO (International Maritime Organization)
- IACS (International Association of Classification Societies)
- ISO (International Standard Organization)
- ILO (International Labor Organization)
- European Committee for Standardization
- TSE (Turkish Standards Institution)
- DIN (German: Deutches Institut für Norming)
- Norwegian shipbuilding standards
- JIS (Japanese Industrial Standards
- ANSI (American National Standards Institute
- API (American Petroleum Institute)
- OCIMF (The Oil Companies International Marine Forum)

There are standards for almost everything including products, services, business, information, technology, human services, energy, water, environment, safety, health, etc. The standards are aimed to provide applicable ways of performing the tasks, producing the product or providing services (Url-5).

As mentioned in the previous section, the structure of standards for project management is highly improved by the last 20 years. Having differences between each other, the major items covered within the project management standards are as follows (Ahlemann et al., 2009):

- Terminology is used to provide a common language,
- Functions are defined for what should be done
- Process descriptions are given in order to sequence and detail the functions together with necessary inputs and outputs,
- Organizational models are described in order to understand how the project will be managed within the company.

2.3 PMI – PMBOK

The PMI (Project Management Institute) was established in 1969. PMI is the largest professional community working on promotion, maintenance, and advancement of project management practices worldwide. The certification department of PMI holds the International Standards Organization (ISO) 9001Certification. Therefore, the quality of PMI certification is approved (Lopez, 2005).

PMI is a non-profit organization with about 500.000 members in over 185 countries. PMI combined the knowledge, experience and common practices to set the basis of project management and related activities and certifies the eligible members. There are six certification offered by PMI (Url-4):

- Certified Associate in Project Management (CAPM)®
- Project Management Professional (PMP)®
- Program Management Professional (PgMP)®
- PMI Agile Certified Practitioner (PMI-ACP)SM
- PMI Risk Management Professional (PMI-RMP)®
- PMI Scheduling Professional (PMI-SP)®

PMP credential is a stand-alone professional credential and considered as the most important certification that is accepted by global market. A PMP may provide project management services in different sectors within different positions such as project managers, project team leaders, project team members, project office managers, and project schedulers (Lopez, 2005).

PMI issued 12 standards that are developed and updated by thousands of volunteered project professionals all around the world (Url-4):

- A Guide to the Project Management Body of Knowledge (PMBOK Guide) Fourth Edition
- The Standard for Program Management - Second Edition
- The Standard for Portfolio Management - Second Edition
- Organizational Project Management Maturity Model (OPM3) - Second Edition
- Practice Standard for Project Risk Management
- Practice Standard for Project Configuration Management
- Project Manager Competency Development Framework - Second Edition
- Practice Standard for Earned Value Management - Second Edition
- Practice Standard for Work Breakdown Structures - Second Edition (Reaffirmed)
- Practice Standard for Project Estimating
- Construction Extension to the PMBOK® Guide - Third Edition
- Government Extension to the PMBOK® Guide - Third Edition

The PMBOK Guide (A Guide to the Project Management Body of Knowledge) is the foundational project management reference for its professional development programs and certifications. The PMBOK Guide is an approved American National Standard and identified as ANSI/PMI 99-001-2008 PMBOK Guide (PMI, 2008).

The PMBOK Guide is formed by project management knowledge that is generally recognized as good practice. The definition “generally recognized” is used to mention that this knowledge could be applicable to most of the projects. On the other hand, the term “good practice” is used to define the tools and techniques that are agreed to be successfully applied to several projects. However, even a tool or a technique is a good practice, it does not mean that it should be applied to every project in the same way, but they should be modified as per the project and organization needs (PMI, 2008).

In addition, the PMBOK Guide defines a common language for discussing and improving the professional project management discipline. The PMBOK Guide includes 12 chapters. In the first and second chapters the key concepts are given.

The third chapter defines the standard for project management, summarizing the good practices of processes, inputs and outputs. In the last eight chapters the details of each process together with related input, tools and techniques, and outputs are described with examples as a guide (PMI, 2008).

The PMBOK Guide is improved within the years. After it was first released as a white paper in 1987, the first edition was released in 1996. Thereafter the PMBOK Guide is improved and published with other editions in every four year.

In this thesis, the PMBOK Guide Fourth edition that was released in 2008 is studied. However, the fifth edition is expected to be released in 2012 or 2013.

2.4 IPMA – ICB

The basis of IPMA (International Project Management Association) lies back to 1965 as the earliest global union in this field. Several national organizations came together in order to develop a role-specific guideline for an improved project and program success. The union called themselves as Internet in 1967, then changed to their recent name as IPMA in 1997 (Url-3).

In 1992, IPMA developed a certification program based on APM's (Association of Project Management) competence based knowledge in United Kingdom. This first certification program was developed and adopted to other nations. IPMA describes the objectives and certification requirements in the IPMA Competence Baseline, shortly ICB (Lopez, 2005).

ICB (IPMA Competence Baseline) document is prepared in order to make sure that all IPMA Member Associations and Certification Bodies follow the same standards for project management and certification. The document describes competence elements in detail (Url-3).

In the ICB document, 46 competence elements are defined for project management profession. There are 20 elements related with the technical competence for project management; 15 elements related with the professional behavior of project management personnel and 11 elements related with the context of the projects, program and portfolios. Subject three major group of competence elements are illustrated as an eye (see Figure 2.1) representing the project manager when evaluating a specific situation.

According to IPMA, the eye also represents the clarity and vision that a project manager should make necessary evaluations and take an appropriate action (Url-3).

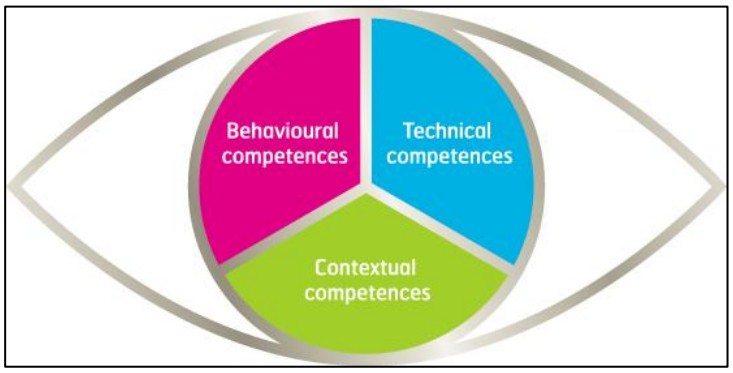


Figure 2.1 : IPMA Competences.

The competence elements of ICB are listed below:

Behavioral competences:

- Leadership
- Engagement & motivation
- Self-control
- Assertiveness
- Relaxation
- Openness
- Creativity
- Results orientation
- Efficiency
- Consultation
- Negotiation
- Conflict & crisis
- Reliability
- Values appreciation
- Ethics

Contextual competences:

- Project orientation
- Program orientation
- Portfolio orientation
- Project program & portfolio implementation
- Permanent organization
- Business

	• Systems, products & technology
	• Personnel management
	• Health, security, safety & environment
	• Finance
	• Legal
Technical competences:	• Project management success
	• Interested parties
	• Project requirements & objectives
	• Risk & opportunity
	• Quality
	• Project organization
	• Teamwork
	• Problem resolution
	• Project structures
	• Scope & deliverables
	• Time & project phases
	• Resources
	• Cost & finance
	• Procurement & contract
	• Changes
	• Control & reports
	• Information & documentation
	• Communication
	• Start-up
	• Close-out

ICB is the common document that is also used by the country based member associations for certification. Where necessary the cultural differences are compensated by including additional competence elements in ICB. National Competence Baselines are validated by IPMA to confirm compliance with ICB and for the global recognition of certificates awarded by the national certification systems (Url-3).

The certification program of IPMA is a four-level role based certification program promoting an ongoing competence development process. Different names could be used for roles at some levels by member associations. The basic role-based certification approach model is shown in Figure 2.2. (Url-3):

Figure 2.2 : IPMA Certification.

2.5 APM – APMBOK

(APM) (Association for Project Management) was formed in 1972 as a registered charity in United Kingdom with recent members of 19.000 individuals and 500 companies. The main objective of APM is to develop and promote the professional project and program management disciplines (Url-11).

APM defines the five dimensions of professionalism in order to support its members through their professional career development. Five dimensions are mentioned below (Url-11):

- Breadth: “APM Body of Knowledge (APMBOK)” provides the necessary knowledge to manage projects.
- Depth: “APM Competence Framework” is a guide for related competences.
- Achievement: APM certifies professionals in compliance with IPMA (International Project Management Association) certification program.
- Commitment: “Continuing Professional Development” develops the project management practice of members.

- Accountability: “APM Code of Professional Conduct” outlines the ethical practice expected of a professional.

The APMBOK was formed to support all those working in the project management profession with seven sections covering 52 knowledge areas. The list of knowledge areas could be seen in Figure 2.3 (Url-11).

APM issues the following certificates for different specific needs and qualification levels of individuals (Url-11) :

- APM Introductory Certificate (SCQF Level 6): for a fundamental awareness of project management terminology.
- APMP (IPMA Level D, SCQF Level 7): for people with some project management experience.
- Practitioner Qualification (IPMA Level C): a practical assessment of project management skills.
- Certificated Project Manager (IPMA Level B): this qualification is closed to new applications with effect from 31 December 2011.
- APM Project Risk Management Certificates: APM offers level one and level two certificates for project and program managers involved in project risk assessment in any way.

2.6 AIPM – PCSPM

AIPM (Australian Institute of Project Management) was established in 1976 in order to improve the project management professionalism in Australia (Url-1).

The national secretariat of AIPM is in Sydney with divisions in New South Wales, Victoria, Queensland, South Australia, Western Australia, the Australian Capital Territory and Northern Territory. (Lopez, 2005).

AIPM developed the “Competency Standards” in order to meet the project management profession requirements called the PCSPM (Professional Competency Standards for Project Management). The main objective of this standard is to support a wide range of industries and enterprises in project management. The Competency Standards are defined in terms of units of project management. The elements of competency and related performance criteria, knowledge, and skills are described in each unit. The units are listed as follows (Url-1):

- Unit 1 – Plan, Manage and Review Scope
- Unit 2 - Plan, Manage and Review Time
- Unit 3 - Plan, Manage and Review Cost
- Unit 4 - Plan, Manage and Review Quality
- Unit 5 - Plan, Manage and Review Project Human Resources
- Unit 6 - Plan, Manage and Review Communications
- Unit 7 - Plan, Manage and Review Project Risk
- Unit 8 - Plan, Manage and Review Procurement
- Unit 9 - Plan, Manage and Review Integration

It could be said that the units of Competency Standard of AIPM is similar with the knowledge areas of the A Guide to Project Management Body of Knowledge of PMI.

Registered Project Manager (RegPM) is the project management certification program of AIPM. It includes a specially created competency-based workplace assessment program requiring the applicants to compile evidence that displays their competence in project management.

This certification is awarded in three different levels (Url-1):

- Certified Practicing Project Practitioner (CPPP)
- Certified Practicing Project Manager (CPPM)
- Certified Practicing Project Director (CPPD)

2.7 PMAJ – P2M

PMAJ (Project Management Association of Japan) was established in 2005 as a union of two different project management formations in Japan: PMCC

(Project Management Professionals Certification Center and JPMF (Japan Project Management Forum) (Url-6).

P2M is body of knowledge framework with the main purpose of innovation and value creation for an enterprise by project and program management. This guidebook is prepared with the expertise of Japanese companies and project experts and known globally (Url-7). The target oriented project management approach was mentioned as the first generation; while the process oriented approach is shown as the second generation.

Figure 2.3 : APM Knowledge Areas.

P2M is claimed to be the third generation in project management with its mission oriented structure. Figure 2.4 represents the evaluation of project management according to P2M (Ohara, 2003):

There are four levels in the P2M framework as; entry, project management, program management and individual management. The individual management frames are as follows (Ohara, 2003):

- Project strategy management
- Project finance management
- Project system management
- Information management
- Relationship management
- Value management
- Project organization management
- Project target management
- Project resource management
- Risk management
- Communication management

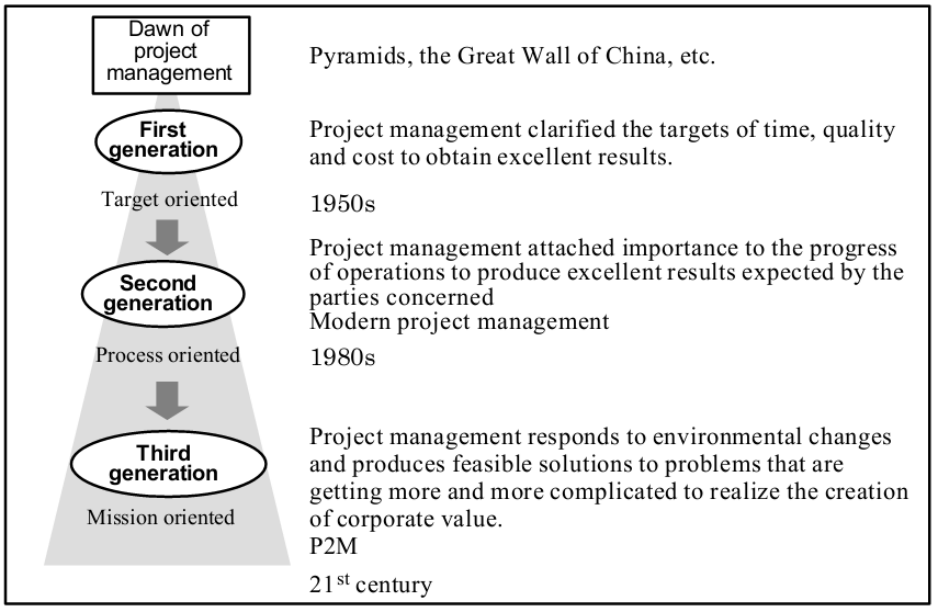


Figure 2.4 : Evaluation of Project Management.

Currently the Project Management Professionals Certification System provided by the PMCC consists of the following four levels of certification (from highest to lowest):

- Project Management Architect (PMA),
- Project Manager Registered (PMR),
- Project Management Expert (PMS) and,
- Project Management Coordinator (PMC).

2.8 OCG – PRINCE2

PRINCE2 stands for PRojects IN Controlled Environments and the "2" refers to its re-launch in October 1996. The Ownership of PRINCE2 belongs to the Office of Government Commerce (OCG) of United Kingdom. PRINCE2 was first developed for projects related with information technologies. Then it was improved by OCG and supporting experts in order to serve different sectors both public and private (Lopez, 2005).

PRINCE2 is formed with best and proven best practices in project management and is widely used by government of United Kingdom. PRINCE2 considers six aspects of project performance (cost, time, quality, scope, risk, and benefit) to be managed (Url-8).

The PRINCE2 method addresses project management with four integrated elements of principles, themes, processes and the project environment (Url-8).

- The Principles of PRINCE2:
    1. Continued business justification
    2. Learn from experience
    3. Defined roles and responsibilities
    4. Manage by stages
    5. Manage by exception
    6. Focus on products
    7. Tailor to suit the project environment
- The Themes of PRINCE2:
    1. Business Case
    2. Organization

3. Quality
4. Plans
5. Risk
6. Change
7. Progress

- The Processes of PRINCE2:

1. Starting up a Project
2. Directing a Project
3. Initiating a Project
4. Controlling a Stage
5. Managing Product Delivery
6. Managing a Stage Boundary
7. Closing a Project

- Tailoring PRINCE2 to the Project Environment chapter addresses the need to tailor PRINCE2 to the specific context of the project.

There are two certifications in PRINCE2 system; the foundation and the practitioner. The Foundation level exams measure capability of acting as a team member within a project managed by PRINCE2. The Practitioner level measures the capability of managing a project by PRINCE2 (Lopez, 2005).

3. PMI PROJECT MANAGEMENT STANDARD – PMBOK

3.1 Key concepts

In order to evaluate the project management standards set by PMI (Project Management Institute), it would be helpful to understand the approach and assumptions regarding the basic and key concepts of project management.

3.1.1 Project life cycle

Projects are divided into phases in order to perform a better control on the major deliverables. It is necessary to mention that the project phases are different from the project process groups. Although the project phases are usually in a sequential relation, there are three types of relationships between phases (PMI, 2008).

- A sequential relationship, where a phase can only start once the previous phase is complete.
- An overlapping relationship, where the phase starts prior to completion of the previous one.
- An iterative relationship, where only one phase is planned at any given time and the planning for the next is carried out as work progresses on the current phase and deliverables.

A project life cycle is composed of project phases that are determined by the management based on the organizational needs, project needs and requirements in the specific field of application (PMI, 2008).

A typical structure for a project life cycle could be given as follows (PMI, 2008):

- Starting the project
- Organizing and preparing
- Carrying out the work
- Closing the project

Figure 3.1 illustrates the time and cost relation in a project life cycle. Also Figure 3.2 shows the impact of variables in a project lifecycle (PMI, 2008).

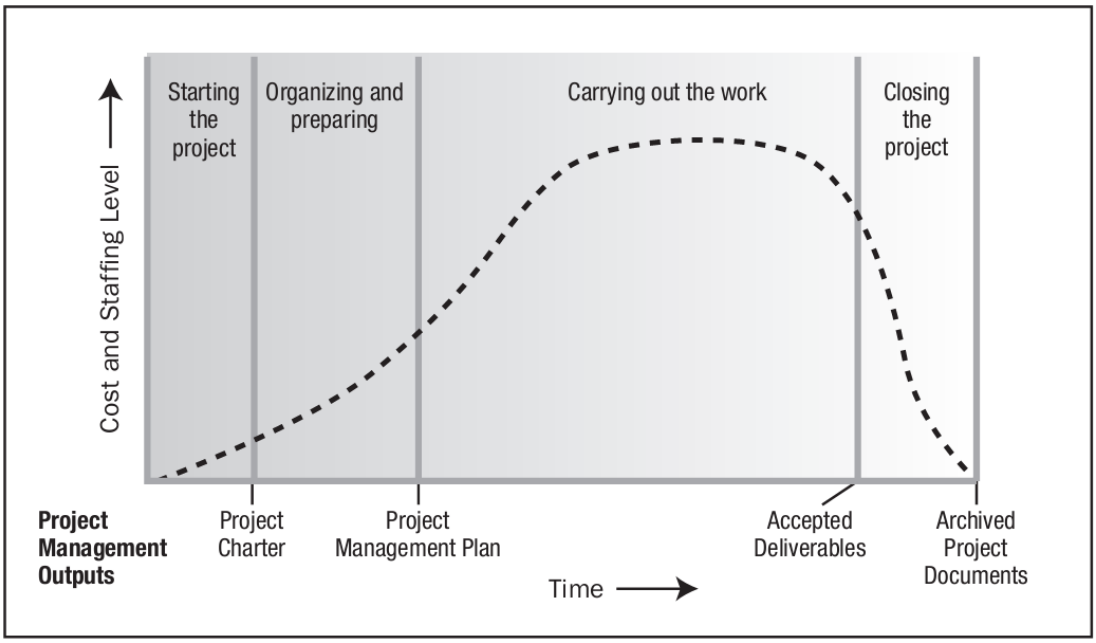


Figure 3.1 : Typical Cost and Staffing Levels Across the Project Life Cycle.

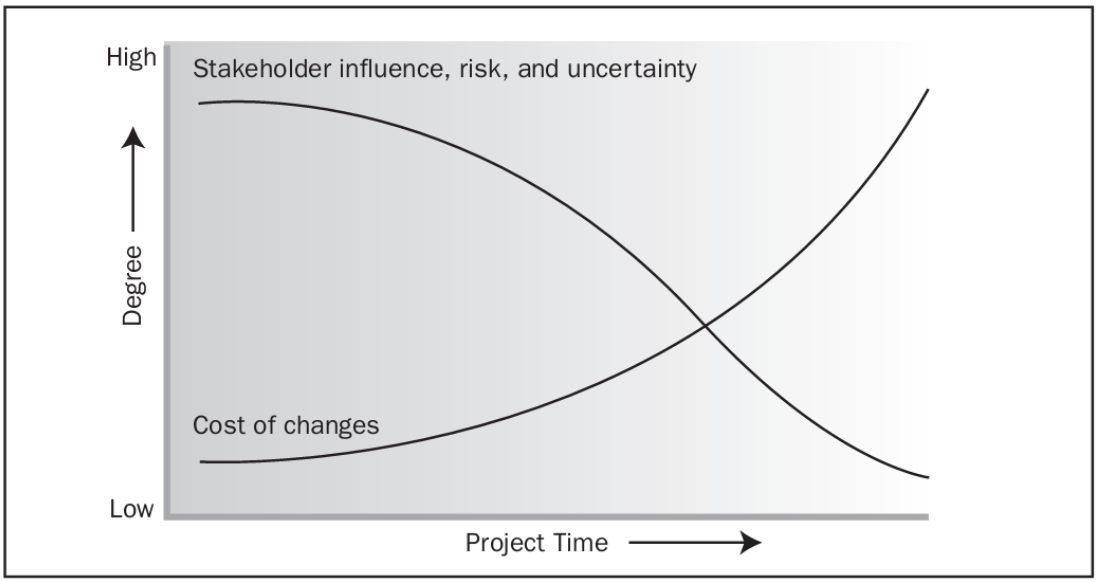


Figure 3.2 : Impact of Variable Based on Project Time.

3.1.2 Stakeholders

PMI (2008) defines the stakeholders as "persons or organizations who are actively involved in the project or whose interests may be positively or negatively affected by the performance or completion of the project".

Every enterprise has its own way of segmentation for stakeholders, but a typical system could be as follows (Kerzner, 2009):

- Organizational stakeholders
- Executive officers
- Line managers
- Employees
- Unions
- Product/market stakeholders
- Customers
- Suppliers
- Local committees
- Governments (local, state, and federal)
- General public
- Capital market stakeholders
- Shareholders
- Creditors
- Banks

In order to execute the project management in accordance with PMBOK, some of the stakeholders shall be defined (PMI, 2008):

- Customers/users are the end users of the final product, service or the result of the project
- A sponsor provides the financial resources, in cash or in kind, for the project
- Portfolio managers govern a collection of projects or programs, which may or may not be related
- Program managers are coordinating the related projects for better control and benefits,
- A project management office (PMO) is an organizational body or entity assigned various responsibilities related to the centralized and coordinated management of those projects under its domain
- Project managers are the individuals who are assigned by the performing organization to achieve the project objectives. Project managers are required

to have several skills and knowledge and are responsible for the success of the project.

A project manager should complete as a minimum; developing a project management plan, tracking the project time and cost, managing the risks, and reporting the project metrics.

- A project team is comprised of team members who carry out the work but who are not necessarily involved with management of the project,
- Functional managers holds a management role in an administrative or functional area, such as human resources, finance, accounting, or procurement,
- Operations managers holds a management role in a core business area such as research and development, design, manufacturing, provisioning, testing, or maintenance,
- Sellers/vendors/suppliers/contractors are the external component or service providers for the project.

3.1.3 Enterprise environmental factors

The project success could be influenced by several internal or external enterprise environmental factors such as (PMI, 2008):

- Organizational culture, structure, and processes;
- Government or industry standards
- Infrastructure
- Existing human resources
- Personnel administration
- Company work authorization systems;
- Marketplace conditions;
- Stakeholder risk tolerances;
- Political climate;
- Organization’s established communications channels;
- Commercial databases
- Project management information systems

3.1.4 Organizational structures

Organizations handle either project or operation type of work in order to succeed in their aims. The major differences between project type work and operation type work are given in Table 3.1 Comparison of Projects and Operations (PMI, 2008).

Table 3.1: Comparison of Projects and Operations.

	Project	**Operation**
Process	Temporary	Ongoing
Result	Unique	Repetitive
Aim	Specific objectives	Provide sustainability
Finish	When the objectives are achieved	New objectives are set during the process

On the other hand, projects and operations are common in way of below listed characteristics (PMI, 2008):

- Performed by individuals,
- Limited by constraints, including resource constraints,
- Planned, executed, monitored and controlled, and
- Performed to achieve organizational objectives or strategic plans.

Organizational structures could be in several different forms; from functional to projectized. The structure of the organization could affect the utilization of resources and the way projects are managed (PMI, 2008).

Table 3.2 summarizes the influences of organizational structures over the project manager's role and authority, resource availability, budget control and project management administrative staff involvement (PMI, 2008).

Functional, matrix and project type organizational structures are shown in Figures 3.3 to 3.8 (PMI, 2008).

In the functional organizations, individuals report to their department managers only, within a perfect hierarchy. Employees are grouped based on specialties such as production, marketing, accounting, engineering, etc. In a functional organization,

departments are performing the project work independently from the others. The resources are used efficiently in functional organizations (PMI, 2008).

Table 3.2: Organizational Influences on Projects.

Organization Structure& Project Characteristics	**Functional**	**Matrix**			**Project Type**
		Weak Matrix	**Balanced Matrix**	**Strong Matrix**	
Project manager's Authority	Little or None	Limited	Low to Moderate	Moderate to High	High to Almost Total
Resource Availability	Little or None	Limited	Low to Moderate	Moderate to High	High to Almost Total
Who Controls the Budget	Functional Manager	Functional Manager	Mixed	Project Manager	Project Manager
Project Manager's Role	Part-time	Part-time	Full-time	Full-time	Full-time
Project Management Administrative Staff	Part-time	Part-time	Part-time	Full-time	Full-time

In the projectized organizations, the project manager holds the full authority on the project. The project team performs the project work all together. The resources are not used very effectively and level of personnel specialization is weak (PMI, 2008)

Matrix organizations are a combination of functional and projectized organizations. Although the structure of matrix organizations look similar with the functional organization, the role of project manager is differs. In the weak matrix organization there is a project coordinator who is only reporting to overall condition of the project. In the balanced matrix organizations, there is a project manager, but not fully authorized in funding of the project. Strong matrix organization can have full-time project managers with considerable authority and full-time project administrative staff (PMI, 2008). Enterprises that are performing project type work are organized in several different ways depending on their background, maturity level and adaptation requirements between different type of works.

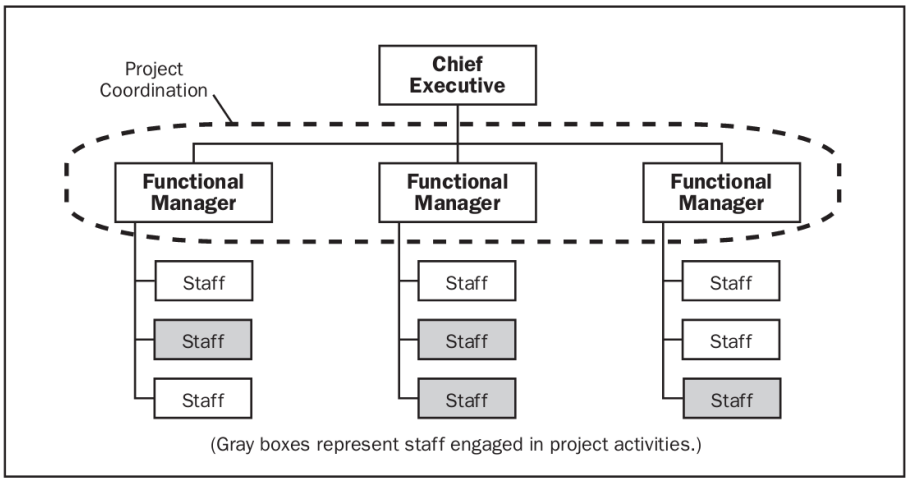


Figure 3.3 : Functional Organization.

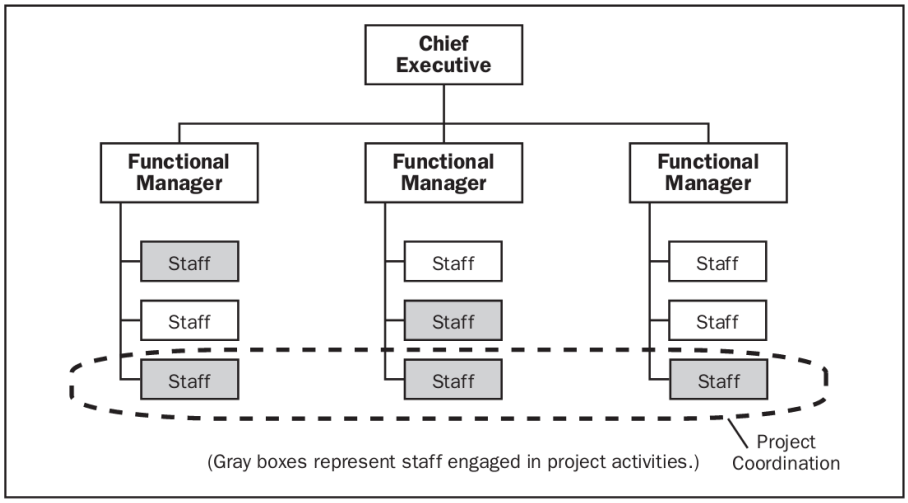


Figure 3.4 : Weak Matrix Organization.

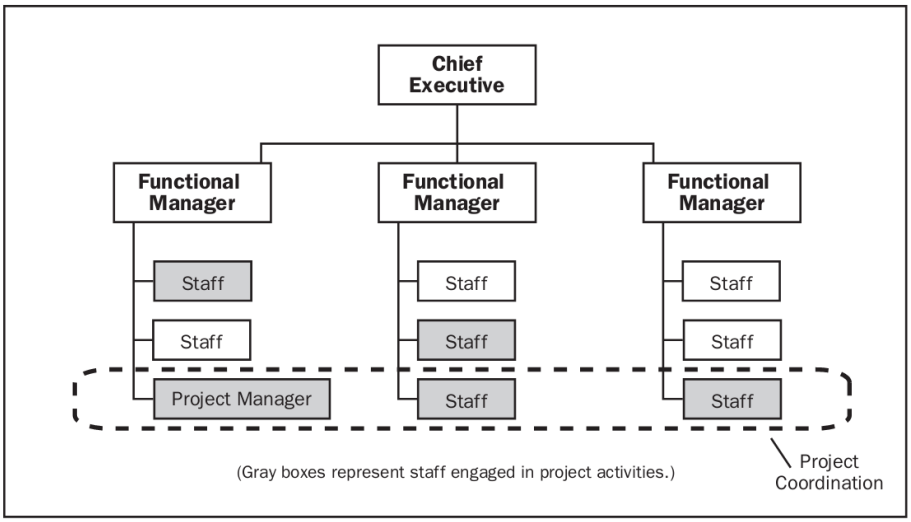


Figure 3.5 : Balanced Matrix Organization.

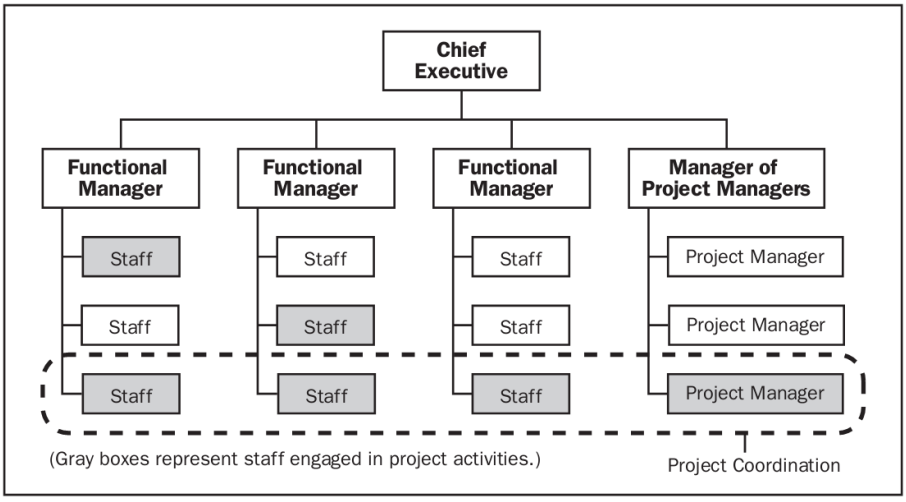


Figure 3.6 : Strong Matrix Organization.

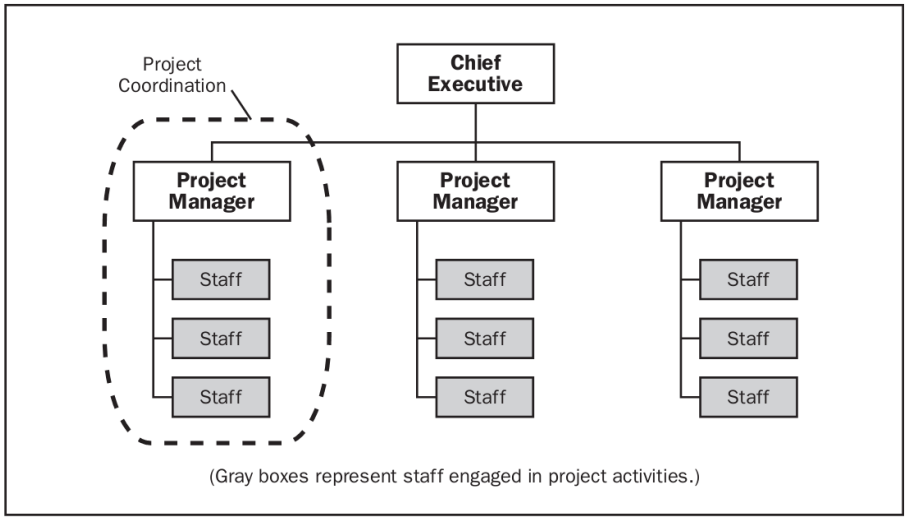


Figure 3.7 : Projectized Organization.

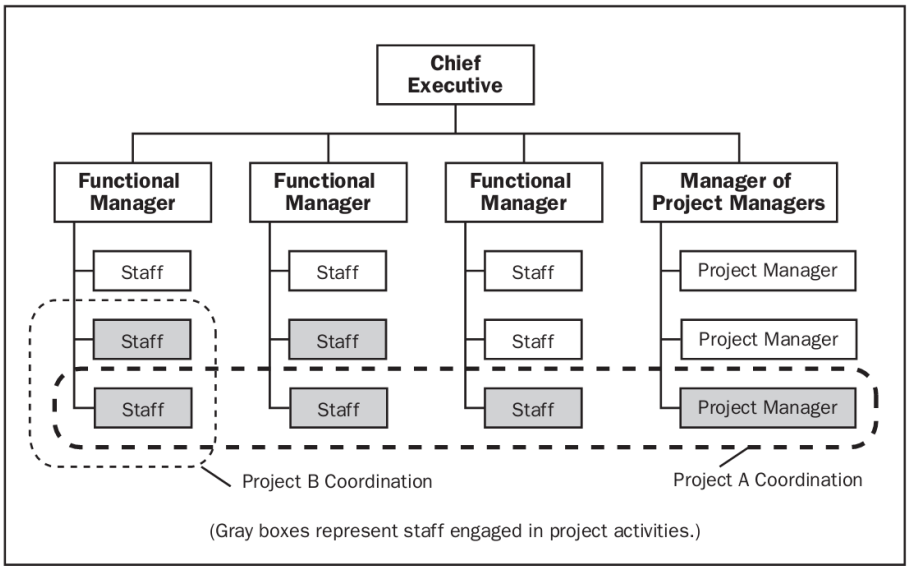


Figure 3.8 : Composite Organization.

3.1.5 Organizational process assets

Organizational process assets include process related assets of the organizations involved in the project that can be used to influence the project's success. Organizational process assets may be grouped into two categories as process & procedures and corporate knowledge base (PMI, 2008):

The processes and procedures that could be used for conducting the work are listed as follows (PMI, 2008):

- Organizational standard processes such as standards, policies, standard product and project life cycles, and quality policies and procedures,
- Standardized guidelines, work instructions, proposal evaluation criteria, and performance measurement criteria;
- Templates;
- Guidelines and criteria for tailoring the organization's set of standard processes to satisfy the specific needs of the project;
- Organization communication requirements;
- Project closure guidelines or requirements;
- Financial controls procedures;
- Issue and defect management procedures defining issue and defect controls, issue and defect identification and resolution, and action item tracking;
- Change control procedures, including the steps by which official company standards, policies, plans, and procedures—or any project documents—will be modified, and how any changes will be approved and validated;
- Risk control procedures, including risk categories, probability definition and impact, and probability and impact matrix; and
- Procedures for prioritizing, approving, and issuing work authorizations.

The organizational corporate knowledge base for storing and retrieving information includes (PMI, 2008):

- Process measurement databases used to collect and make available measurement data on processes and products,
- Project files,
- Historical information and lessons learned knowledge bases,

- Issue and defect management databases containing issue and defect status, control information, issue and defect resolution, and action item results,
- Configuration management knowledge bases containing the versions and baselines of all official company standards, policies, procedures, and any project documents, and
- Financial databases containing information such as labor hours, incurred costs, budgets and any project cost overruns.

3.2 Process Groups

Five process groups are defined in PMBOK (PMI, 2008):

1. Initiating
2. Planning
3. Executing
4. Monitoring and Controlling
5. Closing

Planning, executing and monitoring and controlling process groups interact with each other.

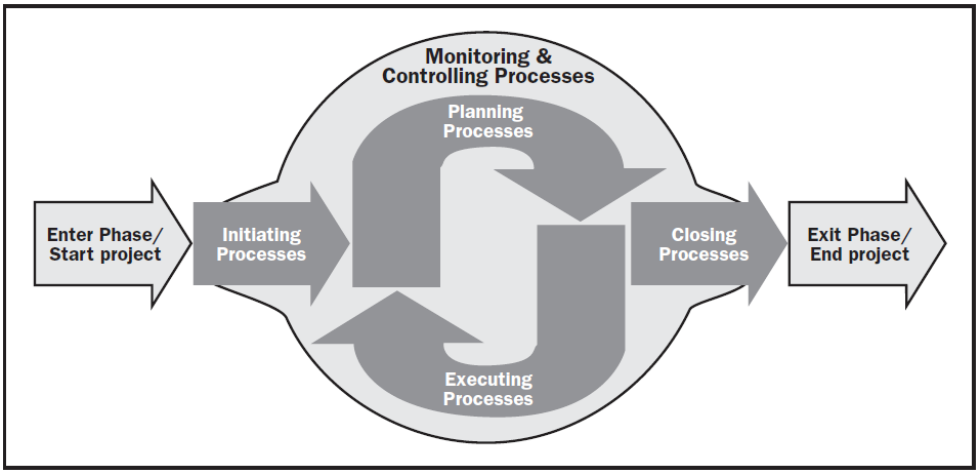


Figure 3.9 : Project Management Process Groups.

In practice, process groups overlap and interact. Figure 3.9 illustrates how the process groups interact and Figure 3.10 shows the level of overlapping at various times (PMI, 2008).

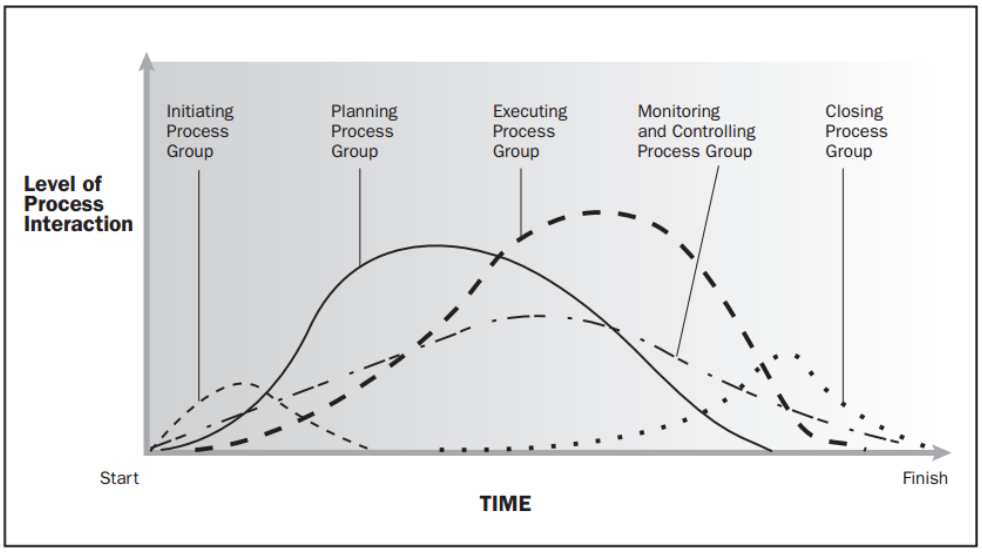


Figure 3.10 : Process Groups Interact in a Phase or Project.

3.2.1 Initiating

The Initiating Process Group contains the processes that are completed in order to define and obtain authorization to start to a new project or phase. Within the initiating processes, followings are accomplished (PMI, 2008):

- The initial scope is defined,
- Initial financial resources are committed,
- Internal and external stakeholders are identified,
- The project manager will be selected (if not already assigned),
- Project charter is approved and project becomes officially authorized,
- Large or complex projects may be divided into separate phases,
- The success criteria are verified, and
- It is decided whether the project should be continued, delayed or discontinued.

It is better to involve customers and other stakeholders during the initiating processes in order to increase the chance of acceptance and satisfaction over the project work (PMI, 2008).

Usually project manager is delegated to write the project charter with or without the help of the project team. However, the approval and funding of the project are beyond the project lines (see Figure 3.11) (PMI, 2008).

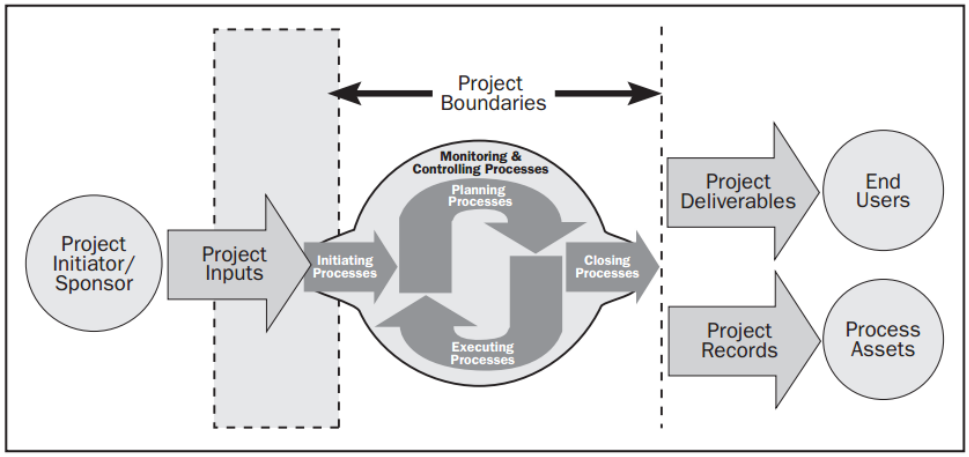


Figure 3.11 : Project Boundaries.

3.2.2 Planning

The Planning Process Group contains the processes related with defining the scope of the work, determining and improving the aims and clarifying how to achieve the objectives. Within the planning processes, followings are accomplished (PMI, 2008):

- Project management plan is developed,
- The project documents are developed, which will be used to carry out the project,
- The project team encourages the involvement from all appropriate stakeholders when planning the project and developing the project management plan and project,
- As the project progresses the plan is improved and iterations are made if necessary,
- The results of the iterations are documented as updates to the project management plan or project documents.

3.2.3 Executing

The Executing Process Group contains the processes that are performed to complete the as specified in the scope. Within the executing processes, followings are accomplished (PMI, 2008):

- People and resources are coordinated,
- The activities of the project in accordance with the project management plan are integrating and performed,

- Planning updates and re-baselining requirements are evaluated, including changes to expected activity durations, changes in resource productivity and availability, and unanticipated risks, and
- A large portion of the project's budget will be expended.

3.2.4 Monitoring and control

The Monitoring and Controlling Process Group contains the processes of tracking, reviewing, regulating and changing the progress where necessary. Within the monitoring and controlling process group, followings are accomplished (PMI, 2008):

- Project performance is observed and measured regularly and consistently to identify variances from the project management plan,
- Changes are controlled and preventive action in anticipation of possible problem is recommend,
- The ongoing project activities against the project management plan and the project performance baseline are monitored,
- The factors that could circumvent integrated change control are influenced, so only approved changes are implemented,
- The project effort is monitored and controlled, and
- In multi-phase projects, project phases are coordinated in order to implement corrective or preventive actions to bring the project into compliance with the project management plan.

3.2.5 Closing

The Closing Process Group contains processes that are finalizing all activities for formal completion of the project, phase, or contractual obligations. Within the closing process group, followings are accomplished (PMI, 2008):

- The defined processes are completed within all the Process Groups are verified in order to close the project or a project phase,
- Acceptance by the customer or sponsor is obtained,
- Post-project or phase-end reviews are conducted,
- Impacts of tailoring to any process are recorded,
- Lessons learned are documented,
- Appropriate updates to organizational process assets are applied,

- All relevant project documents are archived in the Project Management Information System (PMIS) to be used as historical data, and
- Procurements are closed-out.

3.3 Knowledge Areas

There are nine knowledge areas in PMBOK (PMI, 2008):

1. Project Integration Management
2. Project Scope Management
3. Project Time Management
4. Project Cost Management
5. Project Quality Management
6. Project Human Resource Management
7. Project Communications Management
8. Project Risk Management
9. Project Procurement Management

3.3.1 Project integration management

Project Integration Management consists of the processes and activities that are required to define, unite, classify, and coordinate the various processes and project management activities within the Project Management Process Groups. Project Integration Management is aimed to complete the followings (PMI, 2008):

- Characteristics of unification, consolidation, articulation, and integrative actions, which are crucial to project completion, successfully managing stakeholder expectations, and meeting requirements.
- Making choices about resource allocation, making trade-offs among competing objectives and alternatives, and managing the interdependencies among the project management Knowledge Areas, and
- The activities needed to manage project documents to ensure consistency with the project management plan and product deliverables.

3.3.2 Project scope management

Project Scope Management is concerned with defining and controlling what is and is not included in the project (PMI, 2008).

In the project context, the term scope can refer to either the product scope or the project scope. The product scope defines the details of the product, service or result of the project (PMI, 2008).

The scope management processes are a part of the project life cycle together with the belonging tools and techniques. The scope statement and work break down structure is a baseline for the project scope which is monitored, controlled and verified during the project lifecycle (PMI, 2008).

3.3.3 Project time management

Project Time Management contains the process, which interacts with other processes and is issued to make sure the project is finished on time.

Perhaps the critical path method is one of well-known scheduling methodology with rules and approaches to scheduling process (PMI, 2008).

3.3.4 Project cost management

Project Cost Management includes estimating, budgeting, and controlling costs. The aim of cost management is to finish to project within the approved budget. The scope definition is a critical issue that needs to be finalized in the very beginning of the project, since the affects to cost would be huge as the project progresses (PMI, 2008).

The cost management plan can establish the following (PMI, 2008):

- Level of accuracy,
- Units of measure,
- Organizational procedures links,
- Control thresholds which are typically expressed as percentage deviations from the baseline plan,
- Rules of performance measurement,
- Reporting formats, and
- Process descriptions.

3.3.5 Project quality management

Project Quality Management includes determining quality policies, objectives, and responsibilities. Every product has specific quality requirements depending on the

project. However, quality management is applied to all projects regardless the product (PMI, 2008).

Modern quality management and project management are both focusing on the importance of customer satisfaction, prevention over inspection, continuous improvement and management responsibility (PMI, 2008):

3.3.6 Project human resources management

Project Human Resource Management organizes, manages, and leads the project team. The project team should be involved in the planning stages as early as possible in order to improve the plan and increase the commitment of staff to the project. (PMI, 2008).

The project management team is a part of the project team including the team members responsible for leading and managing the project. The project management team is assisted by the project sponsor regarding the funding, scope clarification (PMI, 2008).

3.3.7 Project communication management

Project Communications Management is related with the project information flow. The project manager spends most of her effort to generate, collect, distribute, store and dispose the project information in time and to correct stakeholders (PMI, 2008).

3.3.8 Project risk management

Project Risk Management processes include conducting risk management planning, identification, analysis, response planning, and monitoring and control on a project. The major aim of risk management is to decrease the possibility and impact of negative events (PMI 2008).

Project risks are uncertain events or conditions that could happen in the project. In case a risk occurs, minimum one objective of the project will be affected such as scope, time, cost, quality (PMI, 2008).

The most important process of risk management may be the risk identification since it is not possible to manage an unknown risk. For several reasons, enterprises accept risks considering the possible outcome (PMI, 2008).

3.3.9 Project procurement management

Project Procurement Management is related with the supply of products or services from external sources. Contract management and change control processes are performed within the project procurement management. The Project Procurement Management deals with legal documents where the terms and conditions of procurement between the buyer and supplier are defined (PMI, 2008).

The seller should consider the following project management concepts in case the provided good is not a standard unit (PMI, 2008):

- The buyer becomes the customer, and is thus a key project stakeholder for the seller.
- The seller's project management team is concerned with all the processes of project management, not just with those of this Knowledge Area.
- Terms and conditions of the contract become key inputs to many of the seller's management processes. The contract can actually contain the inputs e.g., major deliverables, key milestones, cost objectives), or it can limit the project team's options (e.g., buyer approval of staffing decisions is often required on design projects).

3.4 Processes

PMI (2008) defines a process as "A set of interrelated actions and activities performed to achieve a pre-specified product, result, or service". Every process is specified with its tools & techniques and inputs & outputs (PMI, 2008).

The project processes are grouped as project management processes and product-oriented processes. Project management processes are performed in order to ensure the effective flow of the project. Product-oriented processes are defined with the specific tools and techniques that are performed to create the required product (PMI, 2008).

Table 3.3 illustrates the mapping of 42 processes in way of knowledge areas and process groups (PMI, 2008).

Table 3.3: Project Management Process Groups and Knowledge Areas Mapping.

Knowledge Areas	Process Groups				
	Initiating	**Planning**	**Executing**	**Monitoring & Control**	**Closing**
Integration Management	1.Develop Project Charter	3.Develop Project Man. Plan	23.Direct and Manage Project Execution	31.Monitor and Control Project Work 32.Perform Integrated Change Control	41.Close Project or Phase
Scope Management		4.Collect Requirements 5.Define Scope 6.Create WBS		33.Verify Scope 34.Control Scope	
Time Management		7.Define Activities 8.Sequence Activities 9.Estimate Activity Resources 10.Estimate Activity Durations 11.Develop Schedule		35.Control Schedule	
Cost Management		12.Estimate Costs 13.Determine Budget		36.Control Costs	
Quality Management		14.Plan Quality	24.Perform Quality Assurance	37.Perform Quality Control	
Human Resources Management		15.Develop Human Resource Plan	25.Acquire Project Team 26.Develop project Team 27.Manage Project Team		
Communication Management	2.Identify Stakeholders	16.Plan Comm.	28Distribute Information 29.Manage Stakeholder Expectation	38.Report Performance	
Risk Management		17.Plan Risk Management 18.Identify Risks 19.Perform Qualitative Risk Analysis 20.Perform Quantitative Risk Analysis 21.Plan Risk Responses		39.Monitor and Control Risks	
Procurement Management		22.Plan Procurements	30.Conduct Procurement	40.Administer Procurements	42.Close Procurements

3.4.1 Develop project charter

"Develop project charter" is a process in Initiating Process Group and in Project Integration Management knowledge area.

Project charter is a document that gives a formal authorization to start a project or a phase stating the primary needs and requirements of the stakeholders. The authorization for starting a project is beyond the project boundaries which is approved by a project sponsor, a portfolio steering committee, or a project management office. Therefore, developing the project charter is the responsibility of one of those approving authority. However, the authority could delegate this task to project manager (PMI, 2008).

Preparation of project charter requires special expertise knowledge. In order to create the project charter one should collect the necessary information related with the project work, contract and the business case as well as the organizational knowledge base and environmental factors affecting the project.

Figure 3.12 shows the inputs, tools and techniques, and outputs of "develop project charter" process (PMI, 2008).

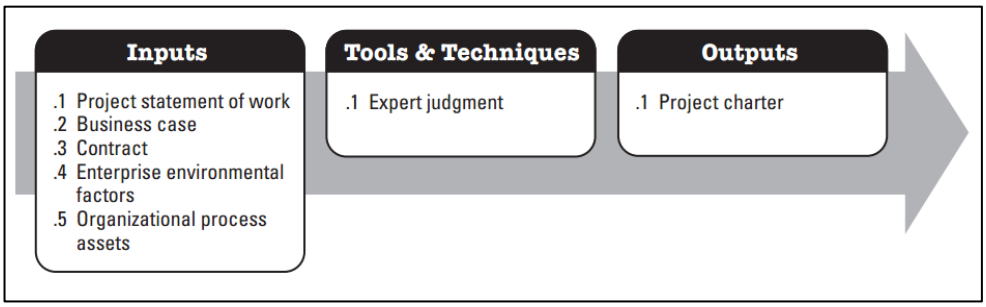


Figure 3.12 : Develop Project Charter Overview.

3.4.2 Identify stakeholders

"Identify stakeholders" is a process in Initiating Process Group and in Communications Management knowledge area.

Stakeholders are either individuals or companies that could impact the project in positive or negative ways. Identifying stakeholders is a process of documenting all stakeholders with definitive information such as name, organization, contact details, etc. All stakeholders should be identified as early as possible when the project starts in order to manage their needs, improve the positive impacts and decrease the

negative ones. During the “identify stakeholders” process, it would be helpful to create a strategy for managing each stakeholder regarding the time and level of their involvement (PMI, 2008).

The project charter and procurement documents are the main inputs of this process. With expert judgment and stakeholder analysis, a stakeholder register and a stakeholder management strategy could be created.

Figure 3.13 shows the inputs, tools and techniques, and outputs of “identify stakeholders process” (PMI, 2008).

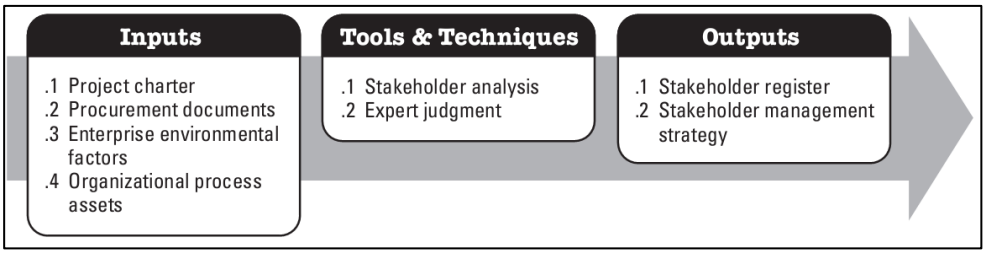


Figure 3.13 : Identify Stakeholders Overview.

3.4.3 Develop project management plan

“Develop project management plan” is a process in Planning Process group and in Integration Management knowledge area.

The main issue of project management plan is to define how to execute, monitor, control and close the project. In this process, all tasks necessary for defining, preparing, integrating and coordination of sub plans are documented (PMI, 2008).

Project charter and planning process outputs are the main inputs for project management plan. Figure 3.14 shows the inputs, tools and techniques, and outputs for “develop project management plan” process (PMI, 2008).

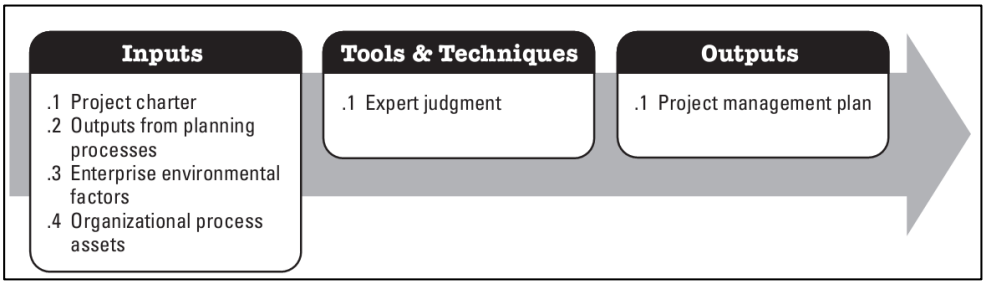


Figure 3.14 : Develop Project Management Plan Overview.

3.4.4 Collect requirements

"Collect requirements" is a process in Planning Process group and in Scope Management knowledge area. "Collect requirements" is a process of documenting the stakeholder needs and expectations in order to comply with the project objectives. Each stakeholder need shall be recorder and analyzed starting from the very beginning of the of the project, since those requirements have a great impact on the project success. Collected requirements are most important data used for creating the project schedule, cost and quality planning (PMI, 2008)

Project charter and stakeholder register are the inputs for collect requirement process. Several tools and techniques are used to "collect requirements" such as interviews, observations, making prototypes, etc. The result of this process provides the requirements documentation, requirement management plan ad requirement traceability matrix.

Figure 3.15 shows the inputs, tools and techniques, and outputs for "collect requirements" process (PMI, 2008).

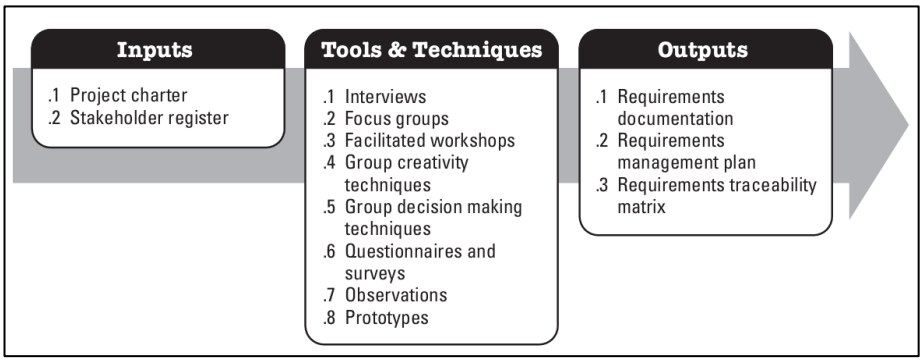


Figure 3.15 : Collect Requirements Overview

3.4.5 Define scope

"Define scope" is a process in Planning Process group and in Scope Management knowledge area. In the "define scope" process, the specification of project and product are made in detail. Scope definition is very important considering the project success. Scope definition is created based on the assumptions, constraints and major deliverables that were previously analyzed during the project initiation. Project scope is better defined in the planning stage when more information is available in the project. Therefore, "define scope" process may add new risks and constraints to the project (PMI, 2008).

The project charter and the requirements documentation are the inputs of “define scope” process. Using the product analysis, alternatives identification and facilitated workshops, project scope statement and project document updates are prepared. Figure 3.16 shows the inputs, tools and techniques, and outputs for the “define scope” process (PMI, 2008).

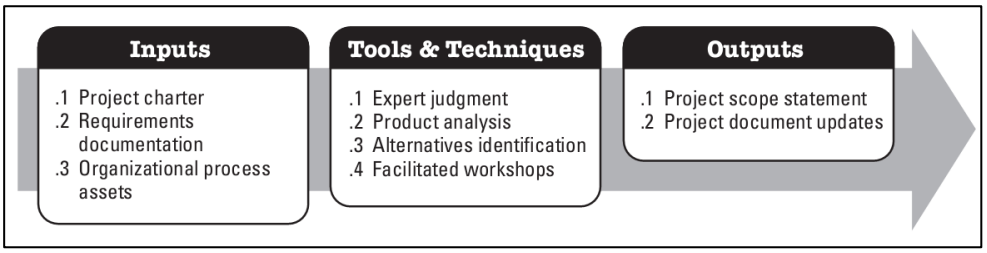


Figure 3.16 : Define Scope Overview

3.4.6 Create WBS

Create WBS (work break down structure) is a process in Planning Process group and in Scope Management knowledge area.

Work breakdown structure is considered as a deliverable-oriented hierarchal decomposition of the project work. In each detailed level of WBS, the project is divided into manageable components and the work packages are developed. The WBS should be capable of showing the scope of the project that is approved in the project scope statement. Therefore, the main input of “create WBS” process is the project scope statement that is prepared within the “define scope” process (PMI, 2008).

The requirements document and the organizational process assets are the other inputs of “create WBS” process where decomposition technique is used to create the WBS, WBS dictionary, scope baseline and project document updates.

Figure 3.17 shows the inputs, tools and techniques, and outputs of “create WBS” process (PMI, 2008).

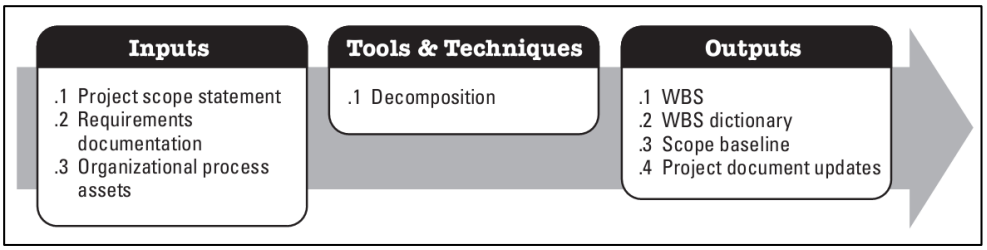


Figure 3.17 : Create WBS Overview.

3.4.7 Define activities

"Define activities" is a process in Planning Process group and in Time Management knowledge area.

The deliverables and consequently the work packages defined in WBS are then usually decomposed into smaller physical actions, called the activities. In the "define activities" process, each activity is defined to prepare a basis for time and cost estimations as well as a basis for monitoring and controlling the project work execution (PMI, 2008).

Scope baseline is the major input of this process where decomposition, rolling wave planning, templates of the organization are used to provide the activity list, activity attributes and milestone list. Rolling wave planning is a progressive elaboration technique while detailing the project work. Rolling wave planning is an ongoing work during the project planning, execution, monitoring, and controlling processes.

Figure 3.18 shows the inputs, tools and techniques, and outputs of "define activities" process (PMI, 2008).

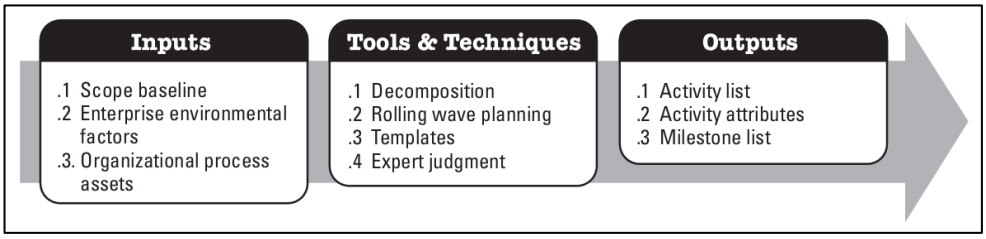


Figure 3.18 : Define Activities Overview.

3.4.8 Sequence activities

"Sequence activities" is a process in Planning Process group and in Time Management knowledge area.

In the "sequence activities" process, the logical relationship between the activities are defined and documented. Each activity, rather than the first and last one, shall be identified with a predecessor and successor. Lead and lag time times should be considered when it is necessary to start a successor activity earlier or later (PMI, 2008).

Activity list, activity attributes and milestone list are the major inputs for sequence activity process. Precedence diagrams, dependency determination and scheduling

templates are the tools and techniques in order to provide the outputs of “sequence activities” process.

While preparing the precedence diagram the following activity relations could be used (PMI, 2008):

- Finish-to-start (FS): The successor activity starts when the predecessor activity is completed.
- Finish-to-finish (FF): The successor activity finishes when the predecessor activity is completed.
- Start-to-start (SS): The successor activity starts when the predecessor activity is started.
- Start-to-finish (SF). The successor activity finished when the predecessor activity is started.

Figure 3.19 shows the inputs, tools and techniques, and outputs of “sequence activities” process (PMI, 2008).

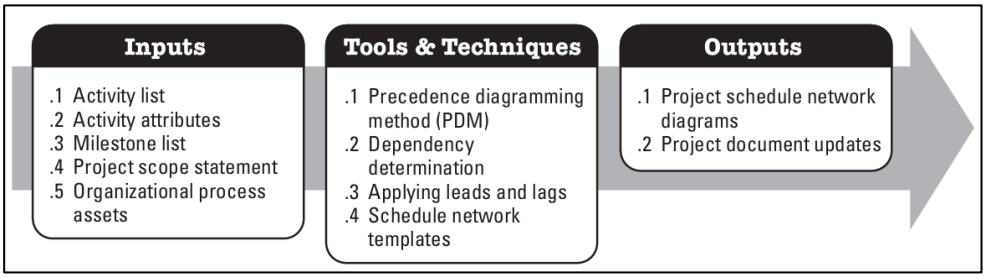


Figure 3.19 : Sequence Activities Overview.

3.4.9 Estimate activity resources

“Estimate activity resources” is a process in Planning Process group and in Time Management knowledge area.

“Estimate activity resources” process is defined as the "Estimating the type and quantities of material, people, equipment, or supplies required to perform each activity" (PMI, 2008).

Figure 3.20 shows the inputs, tools & techniques, and outputs of “estimate activity resources” process (PMI, 2008).

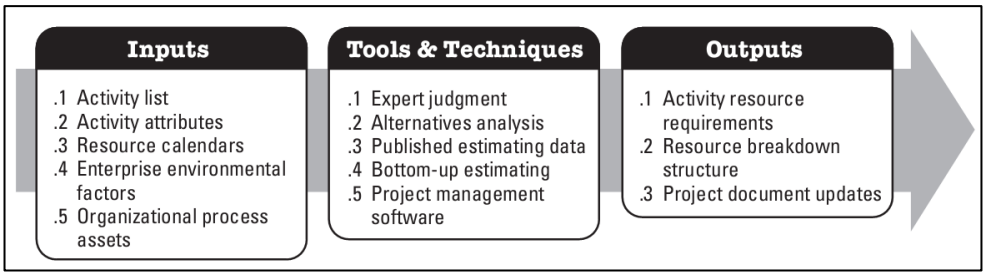


Figure 3.20 : Estimate Activity Resources Overview.

3.4.10 Estimate activity durations

"Estimate activity durations" is a process in Planning Process group and in Time Management knowledge area.

In the "estimate activity durations" process, the duration for each activity is estimated considering the estimated resources. Duration of the activity depend on the quantity of available resources, resource calendars and mainly on the scope of the work. Therefore, the duration estimation is based on the expertise knowledge of the team member who is involved with the performing of subject task. However, the duration estimation should also be improved as the project progresses (PMI, 2008).

Analogous estimating, parametric estimating and three-point estimating are the major tools used in the "estimate activity durations" process.

Figure 3.21 shows the inputs, tools & techniques, and outputs of "estimate activity durations" process (PMI, 2008).

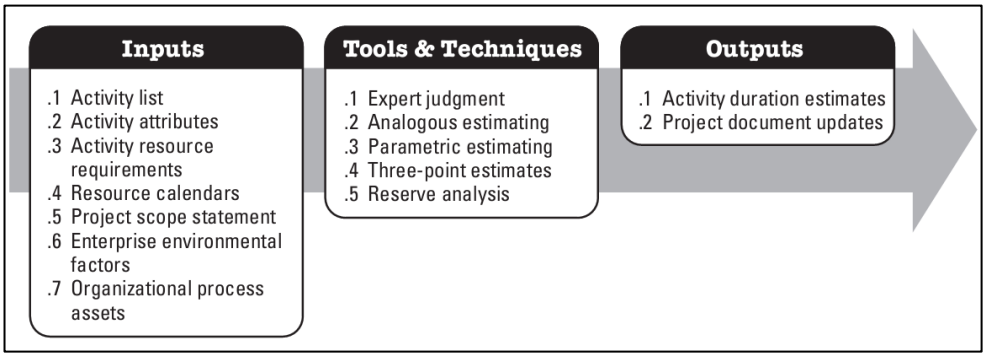


Figure 3.21 : Estimate Activity Durations Overview.

3.4.11 Develop schedule

"Develop schedule" is a process in Planning Process group and in Time Management knowledge area.

“Develop schedule” process includes the analysis of activity sequences, durations, resource requirements and schedule constraints. A scheduling tool could be used to define the start and finish dates of each activity as well as the overall project or phase. Schedule development shall be iterative process leading to necessary changes in the previous resource and duration estimates in order to be used efficiently when controlling the project progress (PMI, 2008).

Critical path method, critical chain method, resource leveling, what-is scenarios and a scheduling tool are the most used tools and techniques to the create the outputs of “develop schedule” process.

Figure 3.22 shows the inputs, tools & techniques, and outputs of “develop schedule” process (PMI, 2008).

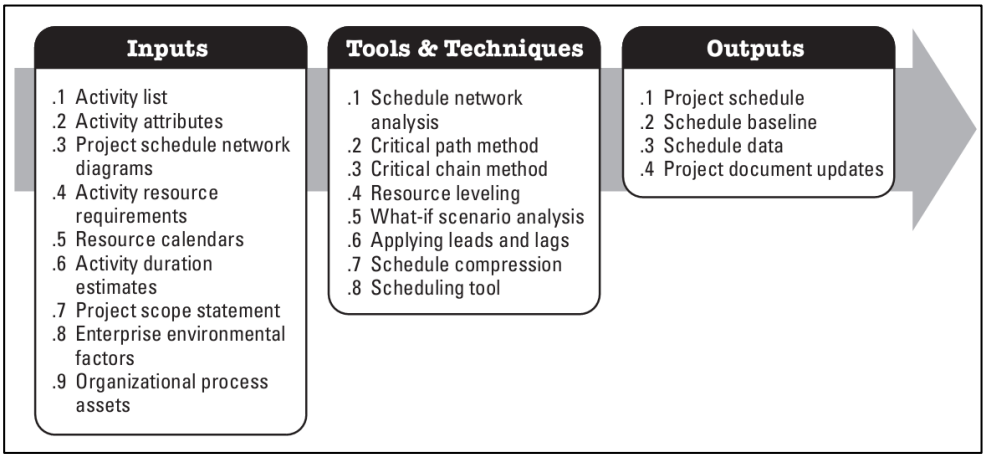


Figure 3.22 : Develop Schedule Overview.

3.4.12 Estimate costs

“Estimate costs” is a process in Planning Process group and in Cost Management knowledge area.

“Estimate costs” process the related with the cost of all resources that will be charged for the project including labor, material, equipment, service, facility, etc. Cost estimation is performed with available information at the time of estimation. As the project progresses the accuracy of the estimation increases. Therefore, cost estimation is also progressively elaborated. During the cost estimation, providing resources in alternatives ways shall be considered such as making or leasing instead of buying or sharing resources with other projects or organizations (PMI, 2008).

Determining the cost of quality supports the budget and prevents from over budget conditions in the later stages of the project.

Figure 3.23 shows the inputs, tools & techniques, and outputs of "estimate costs" process (PMI, 2008).

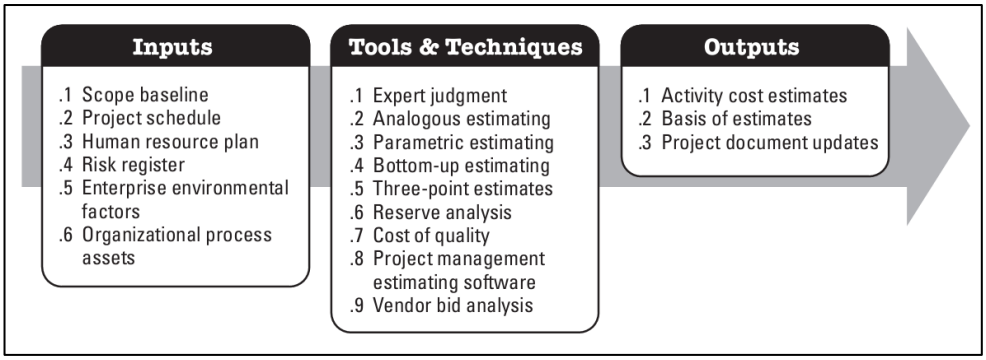


Figure 3.23 : Estimate Costs Overview.

3.4.13 Determine budget

"Determine budget" is a process in Planning Process group and in Cost Management knowledge area. Figure 3.24 shows the inputs, tools & techniques, and outputs of "determine budget" process (PMI, 2008).

In the "determine budget" process the budget baseline set in accordance with the cost estimations. From activity cost estimations, the work package costs are determined. Finally from the work package costs, the authorized project budget is determined. However, the budget here does not include the management reserves if any (PMI, 2008).

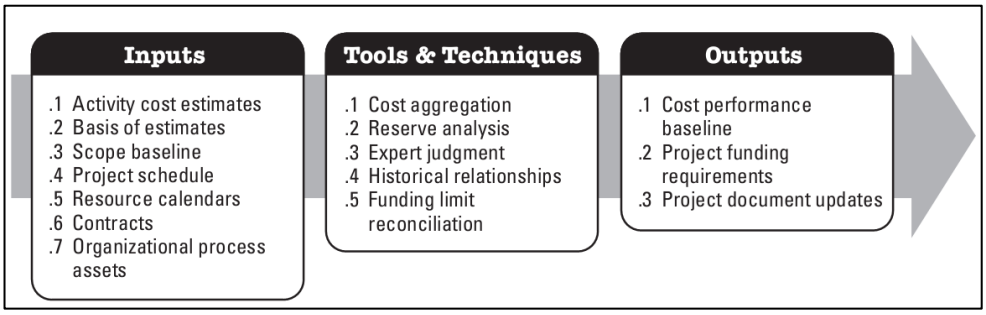


Figure 3.24 : Determine Budget Overview.

3.4.14 Plan quality

"Plan quality" is a process in Planning Process group and in Quality Management knowledge area. In the "plan quality" process the requirements and or standards for the quality of the project and product of the project are defined and documented.

The way of complying with the standards should also be mentioned in the plan quality process. Figure 3.25 shows the inputs, tools & techniques, and outputs of "plan quality" (PMI, 2008).

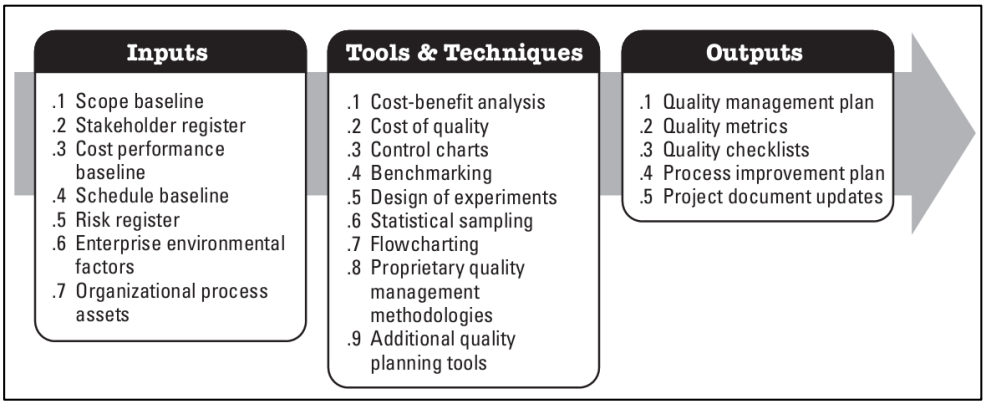


Figure 3.25 : Plan Quality Overview.

3.4.15 Develop human resource plan

"Develop human resource plan" is a process in Planning Process group and in Human Resource Management knowledge area.

In the "develop human resource plan" process, project roles, responsibilities, required skills, reporting relationships, staffing management, project organization chart and timetable for staff acquisition are identified and documented (PMI, 2008).

Organizational theory, organization chart and networking are the tools and technique that are used to create the human resource plan. Figure 3.26 shows the inputs, tools & techniques, and outputs of "develop human resource plan" process (PMI, 2008).

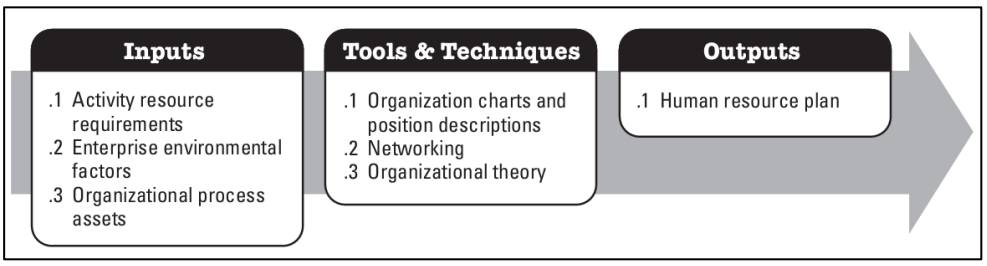


Figure 3.26 : Develop Human Resource Plan Overview.

3.4.16 Plan communications

"Plan communications" is a process in Planning Process group and in Communication Management knowledge area.

"Plan communications" process deals with the questions of who needs what information, when they will need it, how it will be given to them, and by whom. The communication shall be effective and efficient between the stakeholder. Effective communication means that the information is provided in the right format, at the right time, and with the right impact. Efficient communication means providing only the information that is needed. The project manager should ensure the documentation of all communication, which might be necessary in the later stages of the project. (PMI, 2008).

Stakeholder register and stakeholder management strategy are the most important tools to create the communication management plan. Communication requirements analysis, communication technology, communication methods and models are used in this process.

Figure 3.27 shows the inputs, tools & techniques, and outputs of "Plan communications" (PMI, 2008).

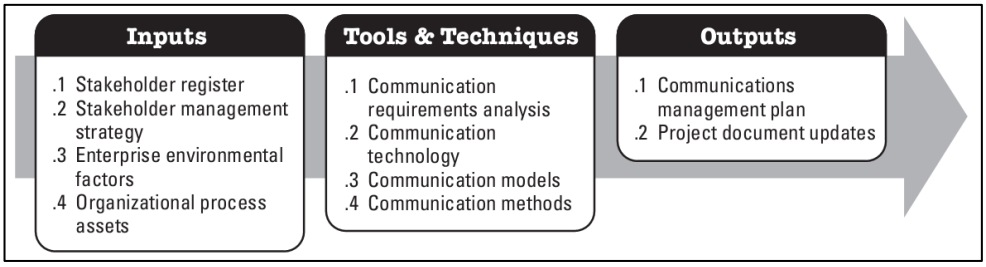


Figure 3.27 : Plan Communications Overview.

3.4.17 Plan risk management process

"Plan risk management" is a process in Planning Process group and in Risk Management knowledge area.

"Plan risk management" process describes the conducting of other risk management processes, namely "identify risks", "perform qualitative risk analysis", "perform quantitative risk analysis", "plan risk responses", "monitor and control risks". This process ensures the degree, type, and visibility of risk management is sufficient considering importance of the project to the organization. During the project

planning sufficient resources and time for risk management activities should be considered PMI, 2008).

Figure 3.28 shows the inputs, tools & techniques, and outputs of “plan risk management” process (PMI, 2008).

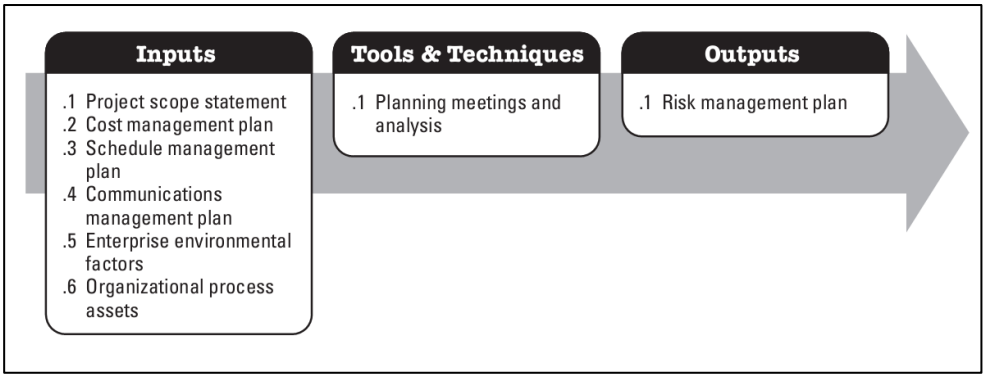


Figure 3.28 : Plan Risk Management Overview.

3.4.18 Identify risks

“Identify risks” is a process in Planning Process group and in Risk Management knowledge area.

“Identify risks” process involves determining, describing and documenting the risks that may positive or negative effect on the project. As the project progresses new risks may arise. Therefore, risk identification is an iterative process (PMI, 2008).

Stakeholders’ involvement and using extended inputs would result a better risk identification. Risk management plan, time and cost estimates, scope baseline, stakeholder register with related management plans to be considered during identify risks process. Strength, weakness, opportunities and threads (SWOT) analysis techniques is one of the common tools to determine the risks. Risk register is the output of identify risks process. Figure 3.29 shows the inputs, tools & techniques, and outputs of “identify risks” process (PMI, 2008).

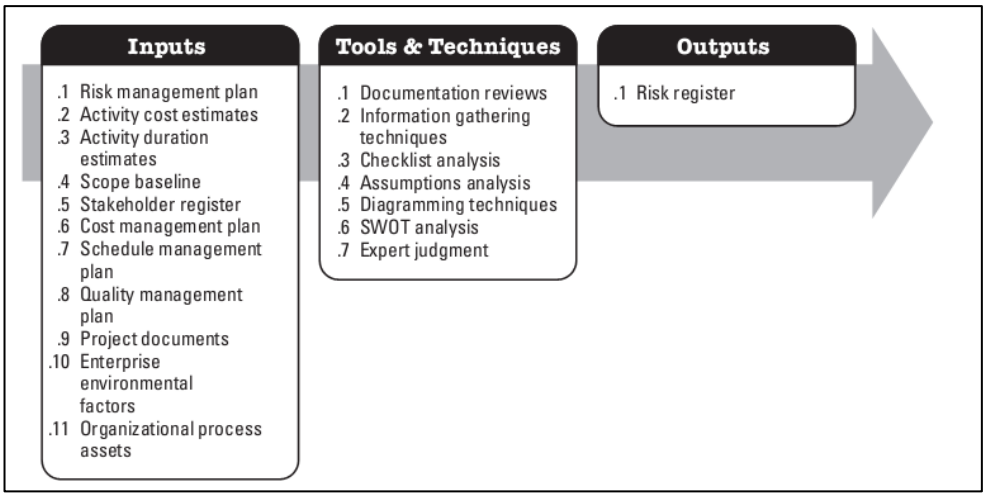


Figure 3.29 : Identify Risks Overview.

3.4.19 Perform qualitative risk analysis

"Perform qualitative risk analysis" is a process in Planning Process group and in Risk Management knowledge area.

"Perform qualitative risk analysis" process prioritizes the risks for further analysis or action by assessing and combining their probability of occurrence and impact (PMI, 2008).

The major aim of this process is to determine which of the risks in the risk registry should be evaluated in a more careful manner. Risk register, risk management plan and project scope statement are the major inputs of "perform qualitative risk analysis" process. Qualitative risk analysis depends on subjective considerations. Therefore, expert judgment could be helpful. Risk categorization, probability, and impact matrix tools are commonly used to determine the most critical risks. Because of the performed work within the "perform qualitative risk analysis", risk register is updated.

Figure 3.30 shows the inputs, tools & techniques, and outputs of "perform qualitative risk analysis" (PMI, 2008).

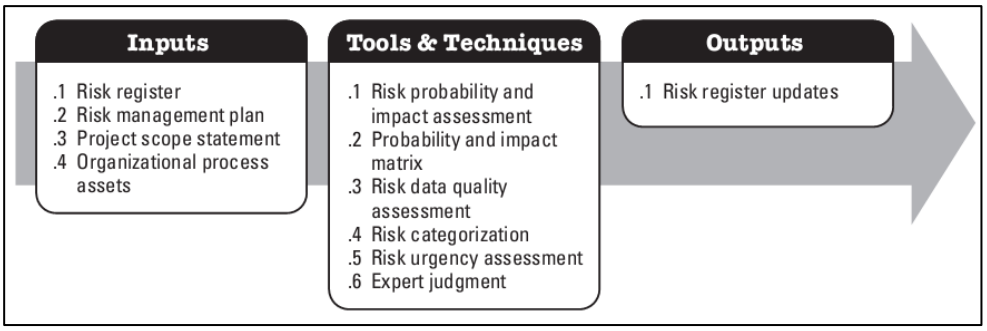


Figure 3.30 : Perform Qualitative Risk Analysis Overview.

3.4.20 Perform quantitative risk analysis

"Perform quantitative risk analysis" is a process in Planning Process group and in Risk Management knowledge area. Figure 3.31 shows the inputs, tools & techniques, and outputs of "perform quantitative risk analysis" process (PMI, 2008).

"Perform quantitative risk analysis" process analysis the overall project risks in a numerical way. Usually quantitative risk analysis is performed for the critical risks that were previously defined in the "perform qualitative risk analysis" process (PMI, 2008).

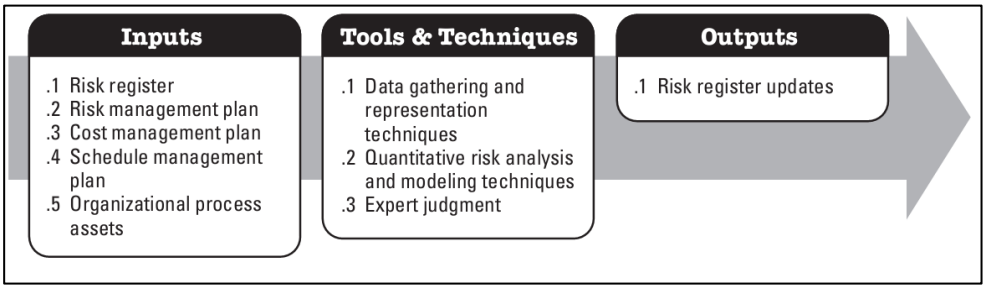


Figure 3.31 : Perform Quantitative Risk Analysis Overview.

3.4.21 Plan risk responses

"Plan risk responses" is a process in Planning Process group and in Risk Management knowledge area. In the "plan risk responses" process, the preventive actions are determined in order to reduce the probability and or the impact of the negative risks. In the risk response plan, a risk owner is assigned to take the necessary actions related with the subject risk (PMI, 2008).

Risk register should be updated upon performing this process. Figure 3.32 shows the inputs, tools & techniques, and outputs of "plan risk responses" process (PMI, 2008).

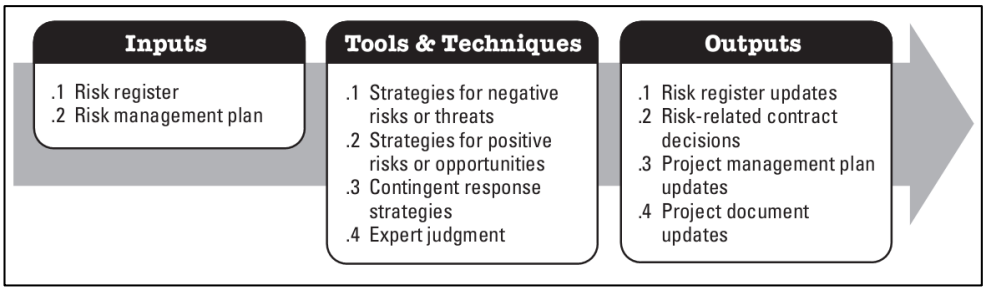


Figure 3.32 : Plan Risk Responses Overview.

3.4.22 Plan procurements

"Plan procurements" is a process in Planning Process group and in Procurement Management knowledge area. In the "plan procurements" process the purchasing decisions, seller determination and the approach of buying are determined (PMI, 2008).

It is decided whether to buy or make the products or services that are required for the project. Procurement management plan, procurement statements of work, make-or-buy decisions, procurement documents, selection criteria and change request documents are developed as the outputs of this process. Figure 3.33 shows the inputs, tools and techniques, and outputs of "plan procurements" process (PMI, 2008).

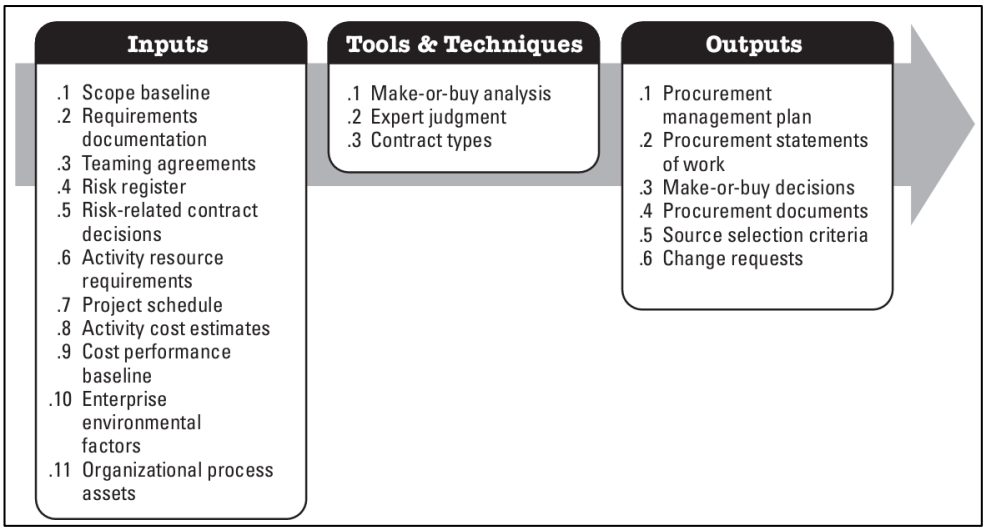


Figure 3.33 : Plan Procurements Overview.

3.4.23 Direct and manage project execution

"Direct and manage project execution" is a process in Executing Process group and in Integration Management knowledge area.

“Direct and manage project execution” is the process of performing the work defined in the project management plan to achieve the project’s objectives including the following activities (PMI, 2008):

- Perform activities to accomplish project requirements;
- Create project deliverables;
- Staff, train, and manage the team members assigned to the project;
- Obtain, manage, and use resources including facilities;
- Implement the planned methods and standards;
- Establish and manage project management communication channels
- Generate project data, and status to facilitate forecasting;
- Issuechangerequestsandadaptapprovedchangesintotheproject’sscope,plans,an denvironment;
- Manage risks and implement risk response activities;
- Manage sellers and suppliers; and
- Collect and document lessons learned, and implement approved process improvement activities.

“Direct and manage project execution” process implements the approved changes as corrective actions, preventive action or defect repair. Figure 3.34 shows the inputs, tools and techniques, and outputs for this process (PMI, 2008).

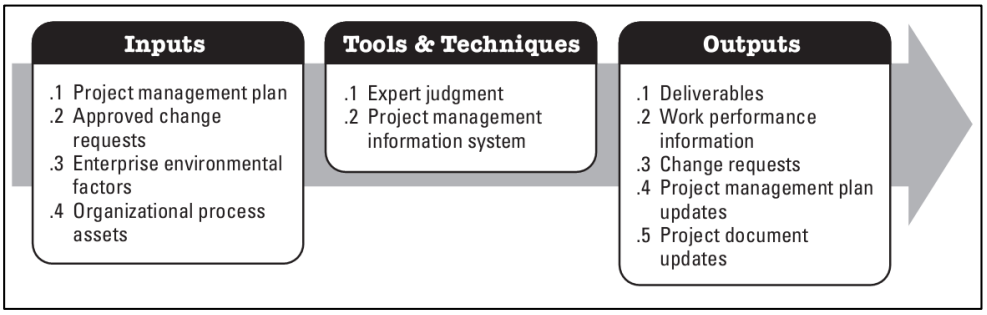


Figure 3.34 : Direct and Manage Project Execution Overview.

3.4.24 Perform quality assurance

“Perform quality assurance” is a process in Executing Process Group and in Quality Management knowledge area.

In the “perform quality assurance” process, the quality requirements and results of quality control are audited. The quality of processes is continuously improved during

the project. Therefore, the waste and unnecessary activities are eliminated providing efficiency and efficiency (PMI, 2008).

“Perform quality assurance” process may result with needs to update the organizational process assets. In addition, change requests could arise for the projects.

Figure 3.35 shows the inputs, tools & techniques, and outputs of “perform quality assurance” process (PMI, 2008).

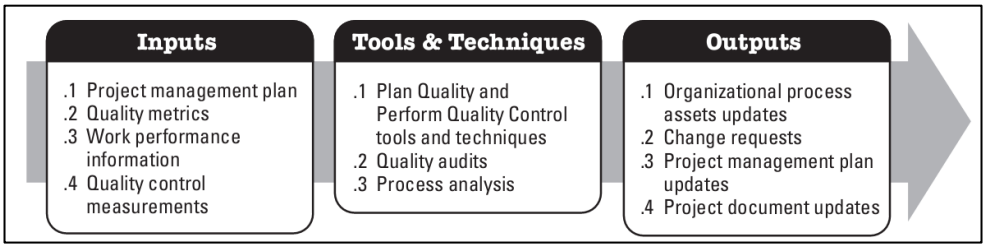


Figure 3.35 : Perform Quality Assurance Overview.

3.4.25 Acquire project team

“Acquire project team” is a process in Executing Process Group and in Human Resources Management knowledge area.

Project team assignment is performed within this process. Selection of staff depends on the availability of human resources. Project manager may not have authorization to select team members due to the structure of the organization, utilization of sub-contractors, etc. Either or that way the project team should be selected with at least the following considerations (PMI, 2008):

- The project manager or project management team should effectively negotiate and influence others who are in a position to provide the required human resources for the project.
- Failure to acquire the necessary human resources for the project may affect project schedules, budgets, customer satisfaction, quality, and risks. It could decrease the probability of success and ultimately result in project cancellation.
- If the human resources are not available due to constraints, economic factors, or previous assignments to other projects, the project manager or project team may be required to assign alternative resources, perhaps with lower

competencies, provided there is no violation of legal, regulatory, mandatory, or other specific criteria.

Figure 3.36 shows the inputs, tools & techniques, and outputs of “acquire project team” process (PMI, 2008).

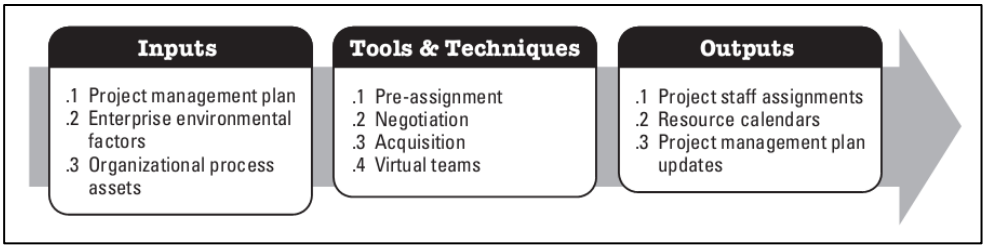


Figure 3.36 : Acquire Project Team Overview.

3.4.26 Develop project team

“Develop project team” is a process in Executing Process Group and in Human Resources Management knowledge area.

In “develop project team” process the competencies, team interaction, and the overall team environment are improved in order to increase the project performance. This objective is mainly under the responsibility of project managers.

The major objectives of developing a project team are listed below (PMI, 2008):

- Improve knowledge and skills of team members in order to increase their ability to complete project deliverables, while lowering costs, reducing schedules, and improving quality;
- Improve feelings of trust and agreement among team members in order to raise morale, lower conflict, and increase team work; and
- Create a dynamic and cohesive team culture to improve individual and team productivity, team spirit, and cooperation, and to allow cross training and mentoring between team members to share knowledge and expertise.

Figures 3.37 shows the inputs, tools and techniques and outputs of “develop project team” process (PMI, 2008).

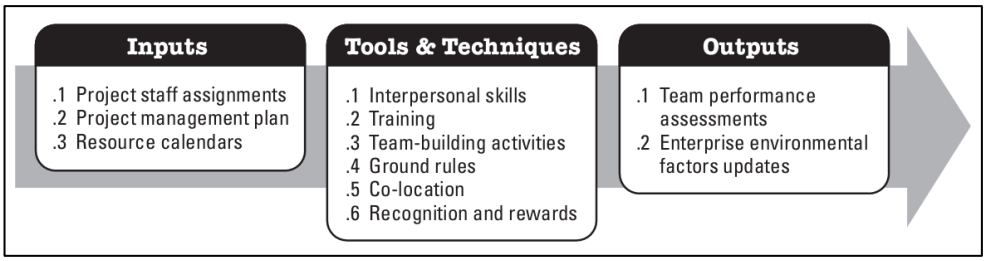


Figure 3.37 : Develop Project Team Overview.

3.4.27 Manage project team

"Manage project team" is a process in Executing Process Group and in Human Resources knowledge area.

"Manage project team" process tracks team member performance, provides feedback, resolves issues, and manages changes. Special management skills are necessary while performing this process such as communication, conflict management, negotiation and leadership (PMI, 2008).

Figure 3.38 shows the inputs, tools and techniques and outputs of "manage project team" process (PMI, 2008).

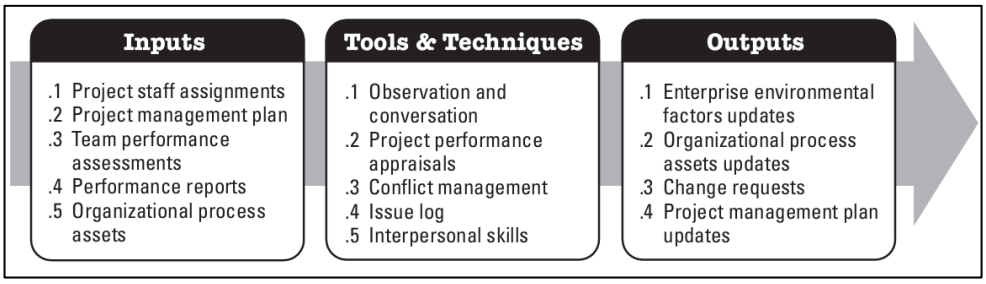


Figure 3.38 : Manage Project Team Overview.

3.4.28 Distribute information

"Distribute information" is a process in Executing process group and in Communication Management knowledge area. "Distribute information" process consists of providing the required information to requesting stakeholder on planned time. During the project, the major information distribution is done during the execution process of the project. Some of the techniques used for appropriate information distribution are listed below (PMI, 2008):

- Sender-receiver models. Feedback loops and barriers to communication.

- Choice of media. Situation specifics of when to communicate in writing versus orally, when to write an informal memo versus a formal report, and when to communicate face-to-face versus by e-mail.
- Writing style.
- Meeting management techniques.
- Presentation techniques. Body language and design of visual aids.
- Facilitation techniques. Building consensus and overcoming obstacles.

Figure 3.39 shows the inputs, tools and techniques and outputs of "distribute information" process (PMI, 2008).

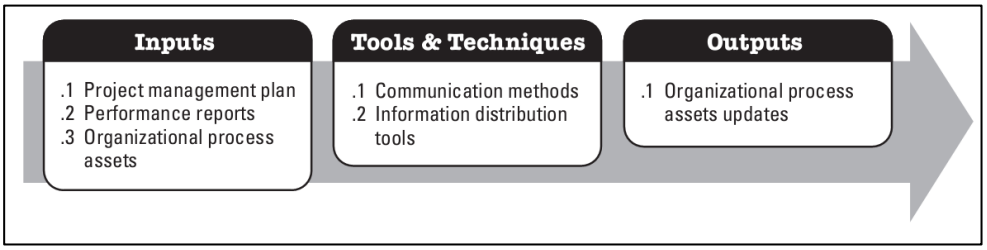


Figure 3.39 : Distribute Information Overview.

3.4.29 Manage stakeholder expectations

"Manage stakeholder expectations" is a process in executing process group and in Communications Management knowledge area.

"Manage stakeholder expectations" process depends on good communication with stakeholders in order to meet their requirements. Major activities of this process include the following (PMI, 2008):

- Actively managing the expectations of stakeholders to increase the likelihood of project acceptance by negotiating and influencing their desires to achieve and maintain the project goals,
- Addressing concerns that have not become issues yet, usually related to the anticipation of future problems. These concerns need to be uncovered and discussed, and the risks need to be assessed, and
- Clarifying and resolving issues that have been identified. The resolution may result in a change request or may be addressed outside of the project, for example, postponed for another project or phase or deferred to another organizational entity.

Figure 3.40 shows the inputs, tools and techniques and outputs of "manage stakeholder expectations" process (PMI, 2008).

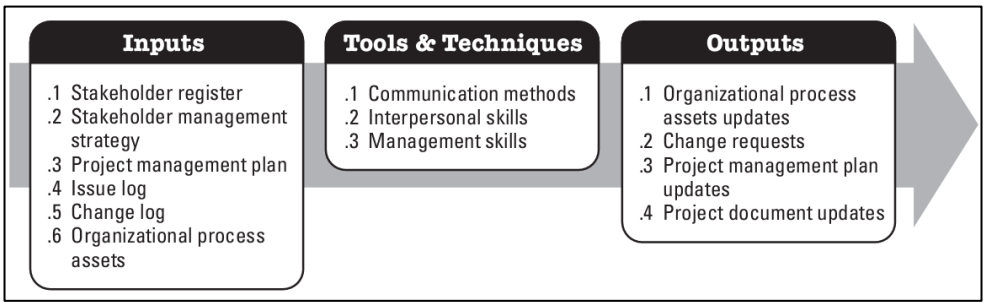


Figure 3.40 : Manage Stakeholder Expectations Overview.

3.4.30 Conduct procurements

"Conduct procurements" is a process in executing process group and in Procurement Management knowledge area.

In the "conduct procurements" process receiving quotations from the sellers, selecting a seller, and awarding a contract are performed. The project team is expected to apply the previously set selection criteria to select the appropriate seller and product.

Figure 3.41 shows the inputs, tools, techniques, and outputs of "conduct procurements" process (PMI, 2008).

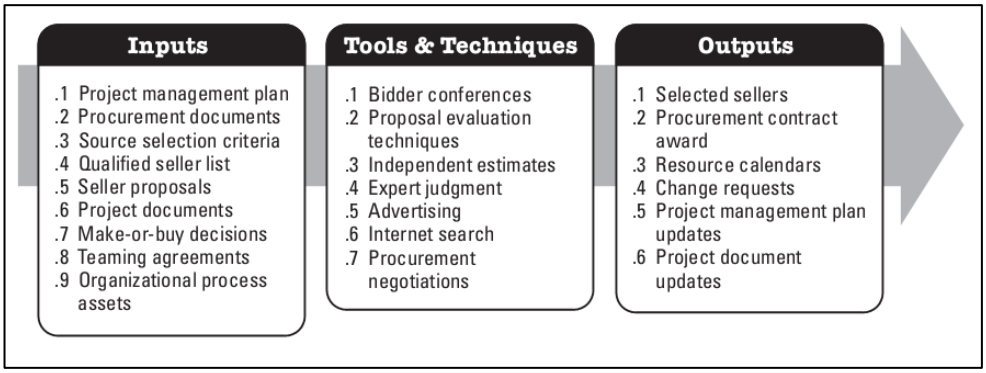


Figure 3.41 : Conduct Procurements Overview.

3.4.31 Monitor and control project work

"Monitor and control project work" is a process in monitoring and controlling process group and in Integration Management knowledge area. "Monitor and control project work" process is concerned with the followings (PMI, 2008):

- Comparing actual project performance against the project management plan;

• Assessing performance to determine whether any corrective or preventive actions are indicated, and then recommending those actions as necessary;

• Identifying new risks and analyzing, tracking, and monitoring existing project risks to make sure the risks are identified, their status is reported, and that appropriate risk response plans are being executed;

• Maintaining an accurate, timely information base concerning the project's product(s) and their associated documentation through project completion;

• Providing information to support status reporting, and forecasting;

• Providing forecasts to update current cost and current schedule information;

• Monitoring implementation of approved changes as they occur.

Figure 3.42 shows the inputs, tools and techniques, and outputs for this process.

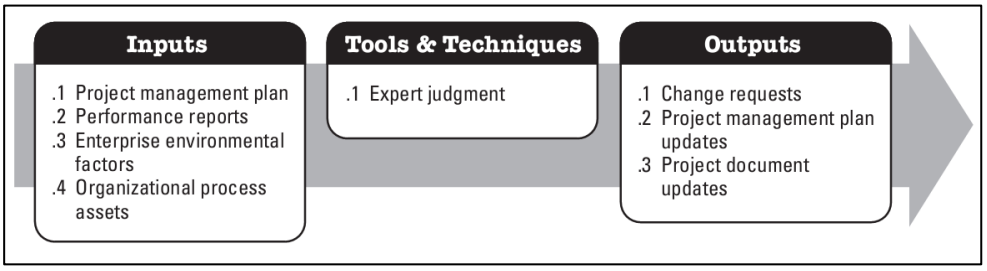


Figure 3.42 : Monitor and Control Project Work Overview.

3.4.32 Perform integrated change control

"Perform integrated change control" is a process in Monitoring and Controlling process group and in Integration Management knowledge area. "Perform integrated change control" is the process of reviewing all change requests, approving changes and managing changes to the deliverables, organizational process assets, project documents and the project management plan. The main objective is to ensure that only approved changes are made (PMI, 2008).

A configuration management system could be applied to overall project to accomplish three main objectives related with change control (PMI, 2008):

• Establishing an evolutionary method to consistently identify and request changes to established baselines, and to assess the value and effectiveness of those changes,

• Providing opportunities to continuously validate and improve the project by considering the impact of each change, and

• Providing the mechanism for the project management team to consistently communicate all approved and rejected changes to the stakeholders.

The major activities of configuration management within the integrated change control process are; configuration identification, configuration status accounting and configuration verification and audit. Figure 3.43 shows the inputs, tools and techniques, and outputs for "perform integrated change control" process (PMI, 2008).

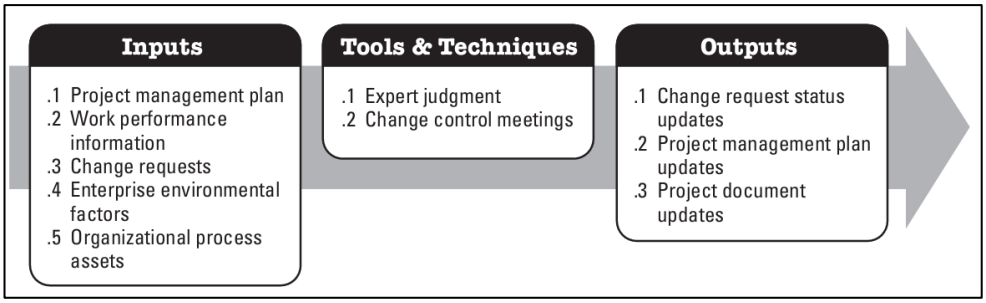


Figure 3.43 : Perform Integrated Change Control Overview.

3.4.33 Verify scope

"Verify scope" is a process in monitoring and controlling process group and in Scope Management knowledge area. "Verify scope" process is the receipt of formal acceptance for the project deliverables, which is generally performed before scope verification (PMI, 2008). Figure 3.44 shows the inputs, tools and techniques, and outputs of "verify scope" process (PMI, 2008).

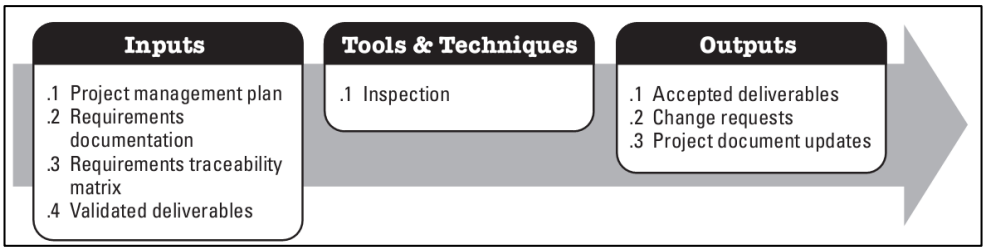


Figure 3.44 : Verify Scope Overview.

3.4.34 Control scope

"Control scope" is a process in monitoring and controlling process group and in Scope Management knowledge area. Figure 3.45 shows the inputs, tools and techniques, and outputs of "control scope" process (PMI, 2008).

"Control scope" process monitors the status of the project and product scope and manages the changes to the scope baseline. Controlling the project scope ensures all requested changes and recommended corrective or preventive actions are processed. Uncontrolled changes are often referred to as project scope creep (PMI, 2008).

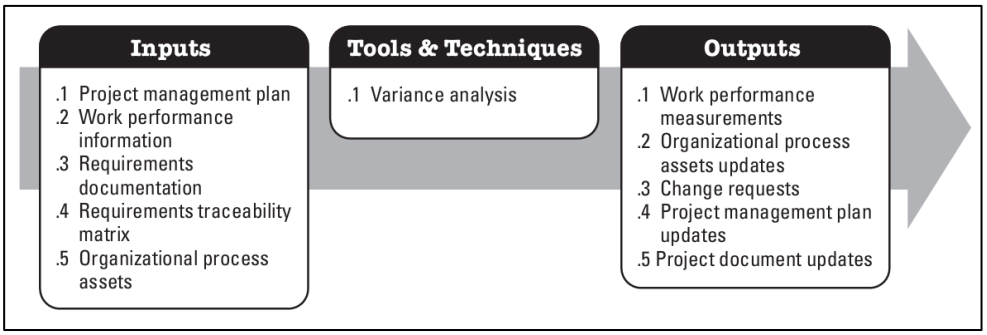


Figure 3.45 : Control Scope Overview.

3.4.35 Control schedule

"Control schedule" is a process in monitoring and controlling process group and in Time Management knowledge area. "Control Schedule" is the process of monitoring the status of the project to update project progress and manage changes to the schedule baseline (PMI, 2008). Figure 3.46 shows the inputs, tools and techniques, and outputs of "control schedule" process (PMI, 2008).

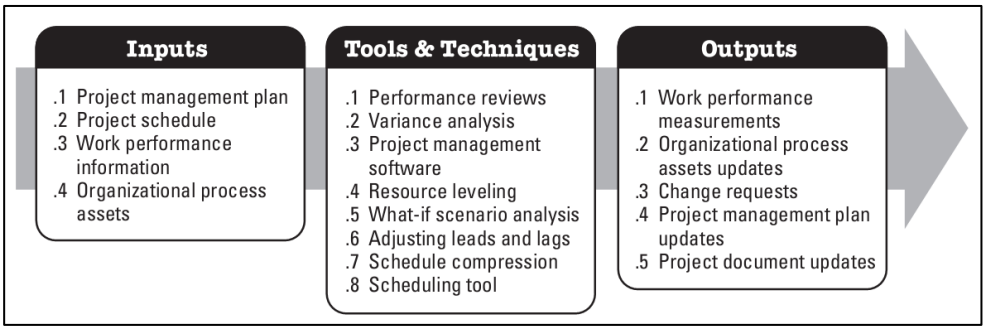


Figure 3.46 : Control Schedule Overview.

3.4.36 Control costs

"Control costs" is a process in monitoring and controlling process group and in Cost Management knowledge area.

"Control costs" process is updating the budget and revising the cost baseline by monitoring the status of the project. Project cost control includes the followings (PMI, 2008):

- Influencing the factors that create changes to the cost baseline,
- Ensuring that all change requests are acted on in a timely manner,
- Managing the actual changes when and as they occur,
- Ensuring that cost expenditures do not exceed the funding,
- Monitoring cost performance to isolate and understand variances from the approved cost baseline,
- Monitoring work performance against funds expended,
- Preventing unapproved changes from being reported,
- Informing approved changes and associated cost, and
- Acting to bring expected cost overruns within acceptable limits.

Figure 3.47 shows the inputs, tools and techniques, and outputs of "control costs" process (PMI, 2008).

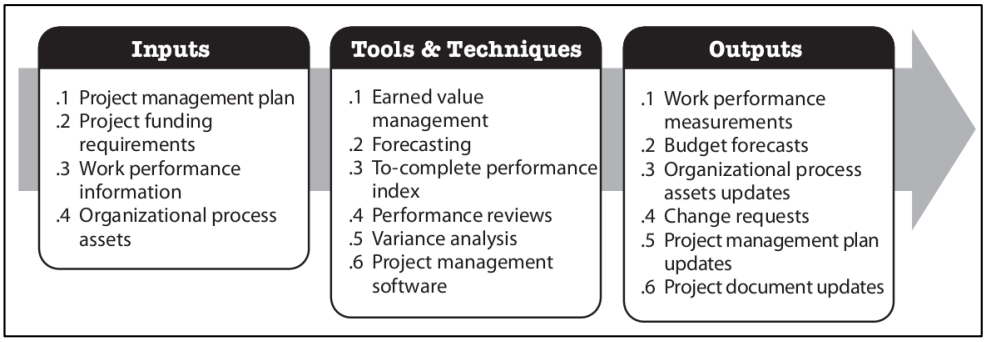


Figure 3.47 : Control Costs Overview.

3.4.37 Perform quality control

"Perform quality control" is a process in Monitoring and Controlling process group and in Quality Management knowledge area. Figure 3.48 gives an overview for "perform quality control" process. Monitoring, recording and analyzing the results of

executing the quality activities by use of statistical quality control, especially sampling and probability, to help evaluate quality control outputs are performed (PMI, 2008).

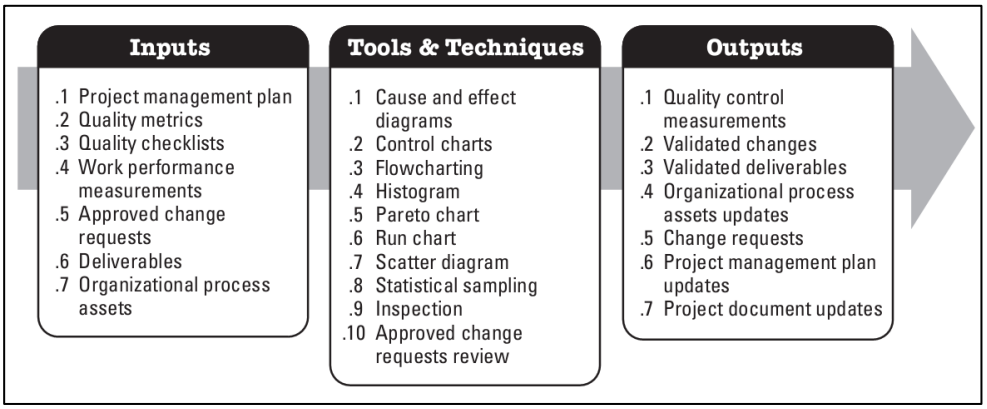


Figure 3.48 : Perform Quality Control Overview.

3.4.38 Report performance

"Report performance" is a process in monitoring and controlling process group and in Communications Management knowledge area. In this process, performance information such as status reports and forecasts are collected and distributed. In order to understand and communicate the project performance, periodic collection and analysis of baseline versus actual data shall be made (PMI, 2008). Figure 3.49 shows the inputs, tools & techniques, and outputs of "report performance" process (PMI, 2008).

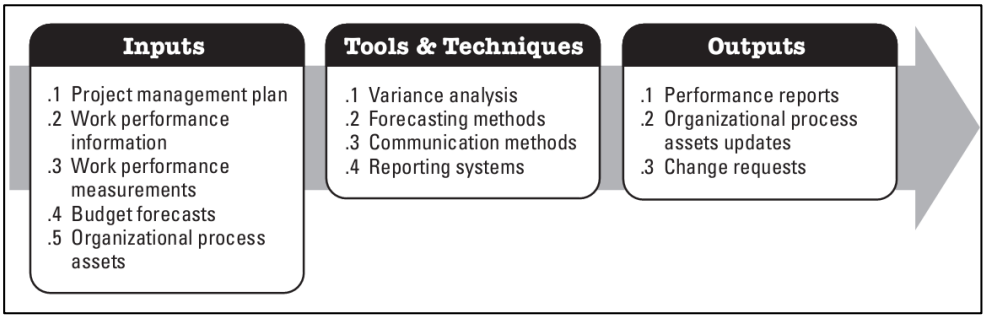


Figure 3.49 : Report Performance Overview.

3.4.39 Monitor and control risks

Monitor and control risk is a process in executing process group and in risk management knowledge area. Figure 3.50 shows the inputs, tools & techniques, and outputs of "monitor and control risks" process (PMI, 2008). "Monitor and control risks" process consists of implementing risk response plans, tracking identified risks,

monitoring residual risks, identifying new risks, and evaluating risk process effectiveness. During the life cycle of the project, planned risks shall be handled as per risk management plan considering the possibility of undefined new risks (PMI, 2008).

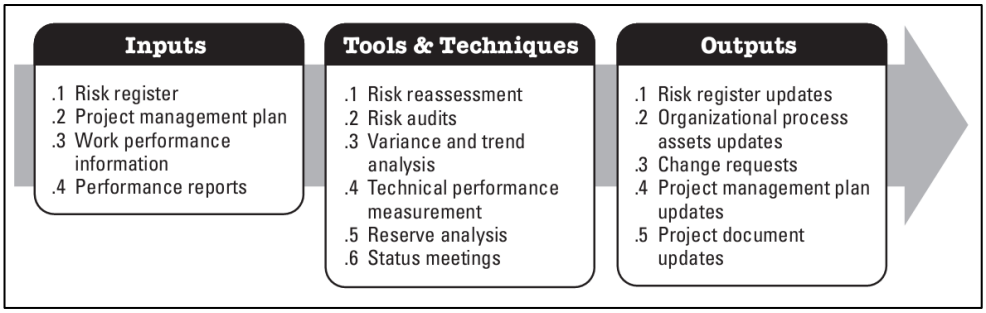


Figure 3.50 : Monitor and Control Risks Overview.

3.4.40 Administer procurements

"Administer procurements" is a process in executing process group and in Procurement Management knowledge area.

Figure 3.51 shows the inputs, tools & techniques, and outputs of "administer procurements" process (PMI, 2008).

In this process, procurement relationships, monitoring contract performance, and making changes and corrections are performed. Both the buyer and the seller shall ensure that both parties meet their contractual obligations and that their own legal rights are protected. (PMI, 2008).

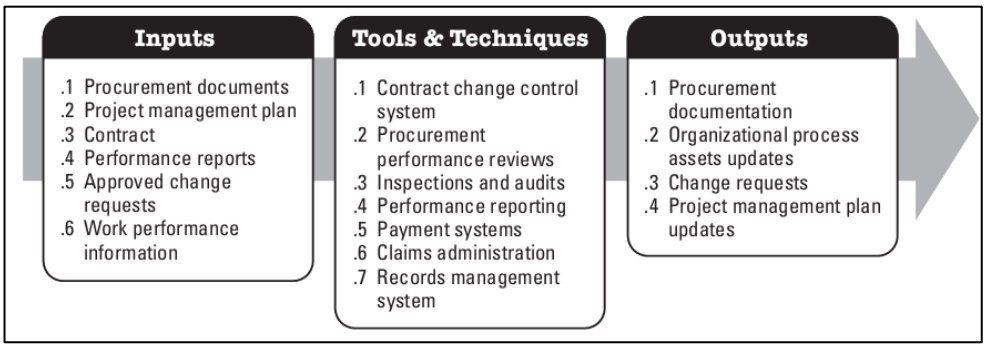


Figure 3.51 : Administer Procurements Overview.

3.4.41 Close project or phase

"Close project or phase" is a process in closing process group and in Integration Management knowledge area. Figure 3.52 shows the inputs, tools and techniques,

and outputs for this process (PMI, 2008). It is the process of formally finalizing all activities within the project management process groups. The project manager shall check the scope definition document to ensure the closure of the project. It is performed when the project objectives are achieved or when the project is terminated.

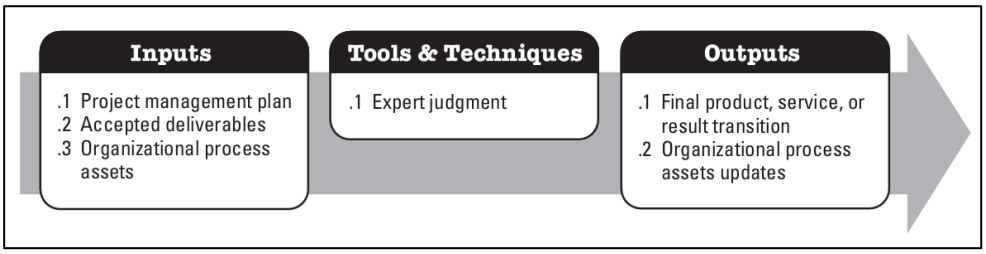


Figure 3.52 : Close Project or Phase Overview.

3.4.42 Close procurements

"Close procurements" is in closing process group and in procurement management knowledge area. This process completes each project procurement. It verifies the acceptance of deliverables and supports the "close project or phase" process. Figure 3.53 shows the inputs, tools & techniques, and outputs for this process (PMI, 2008).

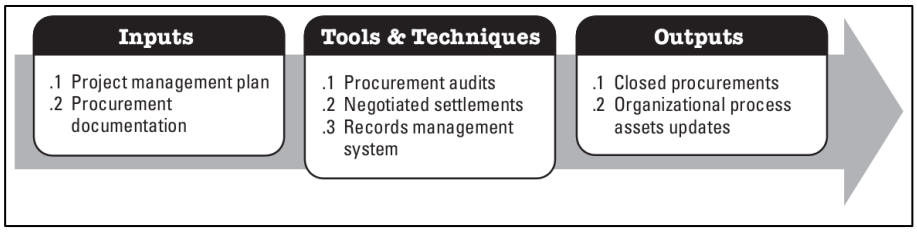


Figure 3.53 : Close Procurement Overview.

4. PROJECT MANAGEMENT IN SHIPBUILDING

4.1 World Shipbuilding Industry

Shipbuilding is one of the oldest professions of humankind dating back to thousands of years. From wooden boats to welded steel hulls, the shipbuilding industry has been developing to meet the human needs such as discovering new lands, conquering new resources, wars, pleasure, fishing, trading over the oceans, etc. Use of steel as the hull material, welding instead of rivet for construction and invention of Diesel engines may be considered as the major developments that shape the basics of recent shipbuilding.

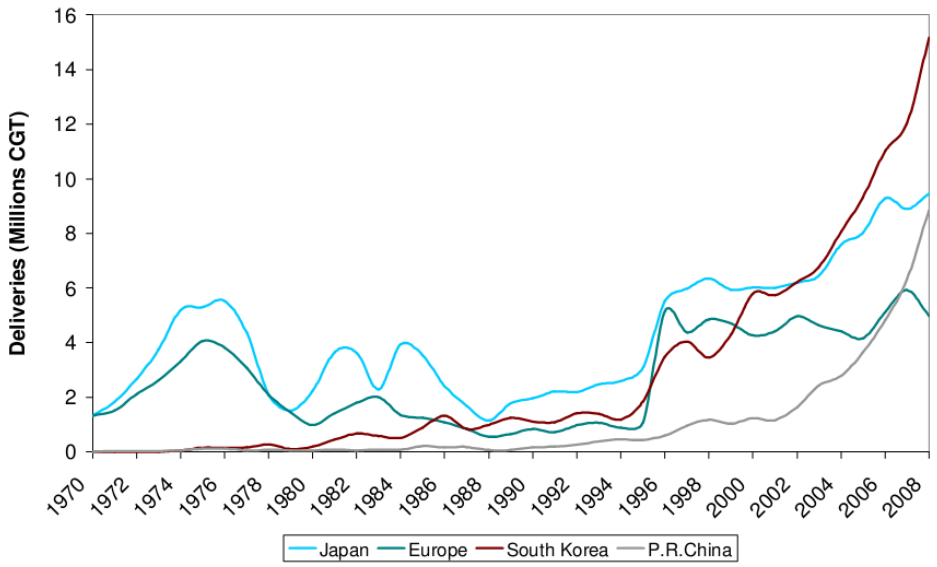
On the other hand, there are several disasters resulting in great loss of human, environmental pollution, and economic losses due to shipwrecks. Therefore, several global rules and regulations have been applied into shipping and shipbuilding businesses, in order to increase the safety and quality.

Ships are mobile units and may be capable of sailing all around the world. Shipping is the leading transportation method for goods in the world, covering almost 90% of the world trade. For those reasons, shipbuilding is a global business forcing shipyards to compete in a challenging market.

In general, shipbuilding industry involves building of new ships, repairing and conversion of existing vessels (ships, platforms, etc.) to serve commercial, naval or leisure purposes. Due to the special rules, regulations and requirements, the shipbuilding industry also covers the related marine equipment. In this thesis, the term shipbuilding refers to commercial or naval shipbuilding activities.

Within the years, the leader of shipbuilding regions has changed. European shipbuilders handed over their dominance to Asian builder (Ecorys, 2009). However, the largest investor region is still Europe, with $51 billion in 2006 (Url-12).

Figure 4.1 shows the major shipbuilding regions and consequent compensated gross tonnage delivered by each region (Url-12).



Source: Clarkson (2009), calculations ECORYS

Figure 4.1 : CGT Completed and Delivered From 1970 To 2008.

Although South Korea is shown as the industry leader by 2008, China surpassed South Korea to become the world's largest shipbuilder in 2010 in terms of shipbuilding capacity and new orders, according to recently released statistics from China's Ministry of Industry and Information (Url-9). Most researchers consider the rise of Chinese shipbuilding is related with the low labor costs and government subsidies.

Since the shipbuilding is very much related with the world trade, the global economic crisis affects the industry directly. When the last century was evaluated, there has always been a cycle in new shipbuilding with rises and falls. Figure 4.2 represents the total gross tonnage of delivered ships from 1902 to 2002 (Stopford, 2011).

After the recent global economic crisis in 2008, most of the shipyards face several order cancellations, bankruptcies and stagnation. Shipbuilders chose different strategies to lower the impact of the crisis. Some shipyards choose to become the owners of the vessels they build, some choose to diversify in repair business, some choose to unite forces by merging shipyards and some shipyards try their chances in high value added marine structures such as offshore platforms.

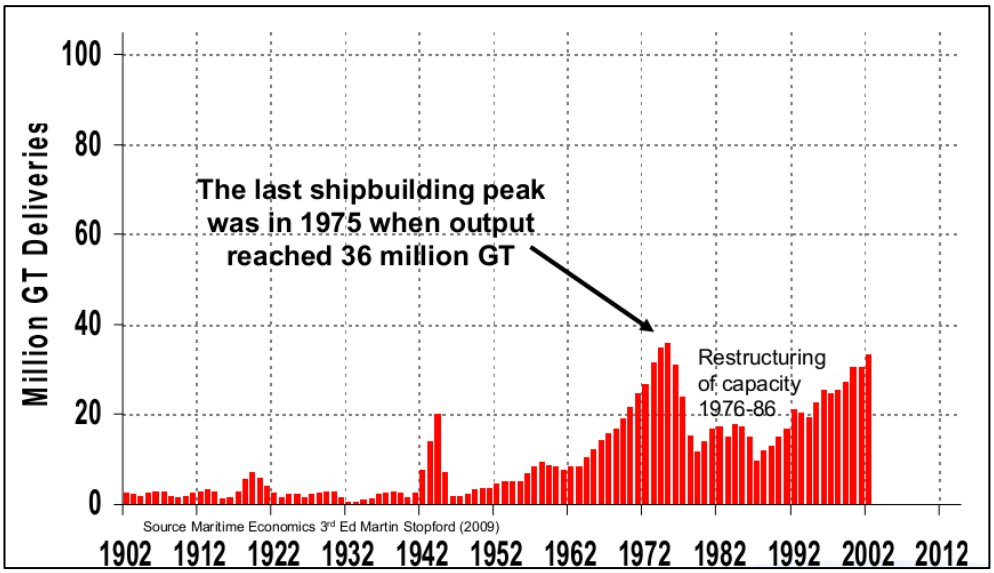


Figure 4.2 : World Shipbuilding 35 Year Cycle.

4.2 Turkish Shipbuilding Industry

4.2.1 Overview

Based on the local regulations and as of January 2011, there are 70 established shipyards and 56 shipyards under construction in Turkey. In addition, 21 shipbreaking facilities exist in İzmir (Turkish Chamber of Shipping, 2010). Figure 4.3 show the regional distribution of established shipyards in Turkey (OECD, 2011).

From 2002 to 2010 the total capacity in Turkish shipyards increased more than six times; from 550.000DWT to 3,55 million DWT. Turkish Shipyards delivered 166 ships, with DWT of 836.000, between 1995-2001. With the global increase in ship demand and increased capacity, Turkish shipyards delivered 443 ships with total DWT of 3.051.000 from 2002 to 2007. The total number of delivered ships in 2010 is 68 with 350.000 DWT in total. The Turkish shipbuilding industry serves to global market and most of the ships are constructed for foreign customers mainly from Europe. Figure 4.4 shows the total value of exported ships and yachts (Turkish Chamber of Shipping, 2010).

Turkish shipyards achieved a good reputation in building of small and medium tonnage chemical tankers. By January 2011, Turkey is on the 4th place among the countries, which take tanker orders. According to tonnage basis in CGT, Turkish yards are on the 11th place in world ranking (Turkish Chamber of Shipping, 2010).

Province/Region	Number of Shipyards
Istanbul (Tuzla)	27
Yalova	19
Zonguldak	8
Izmit	6
Canakkale	2
Trabzon	2
Ordu	1
Samsun	1
Kastamonu	1
Sakarya	1
Hatay	1
Adana	1
Total	**70**

Figure 4.3: Regional Distribution of Shipyards in Turkey.

Years	Export Amount in US Dollars (Thousand)
1996	62.730
1997	132.217
1998	152.385
1999	166.588
2000	121.317
2001	308.647
2002	290.222
2003	440.511
2004	686.334
2005	1.251.573
2006	1.398.516
2007	1.818.572
2008	2.646.321

Figure 4.4: Ship and Yacht Export by Years.

Figure 4.5 shows the top ten new ship builders in years 2008 and 2010 where Turkey has the fifth and eighth rank (OECD, 2011).

However, the total share of Turkish shipyards from the global market is less than 2%, which is getting lower with the effects of global crisis as well as the competitive prices of other emerging shipbuilders. Figure 4.6 summarizes the total new ship building orders that each country took by the end of 2010.

RANK	2010		2008	
		%		%
1	China	35.56%	Korea	34.59%
2	Korea	28.94%	Japan	23.08%
3	Japan	19.04%	China	21.88%
4	Germany	1.66%	Germany	2.77%
5	Italy	1.50%	**Turkey**	**1.93%**
6	Philippines	1.19%	Italy	1.77%
7	Vietnam	1.09%	Poland	1.37%
8	**Turkey**	**0.90%**	Romania	1.26%
9	Romania	0.88%	Chinese Taipei	0.91%
10	Chinese Taipei	0.72%	Croatia	0.87%

Source: IHS Fairplay World Fleet Statistics 2009 and 2011.

Figure 4.5: World's Top Ten Producers of New Ships (in CGT).

Rank		No of ships	CGT (000s)	
1	China	2 967	48 922	38.22%
2	South Korea	1,357	39,145	30.58%
3	Japan	1,105	19,856	15.50%
4	Philippines	108	2,686	2.10%
5	India	257	1,927	1.51%
6	Vietnam	252	1,877	1.47%
7	Germany	55	1,449	1.13%
8	Italy	47	1,386	1.08%
9	Brazil	116	1,278	1.00%
10	Chinese Taipei	42	1,050	0.82%
11	***Turkey***	***162***	***963***	***0.75%***
12	Romania	80	832	0.65%
13	Indonesia	136	563	0.44%
14	Spain	83	541	0.42%
15	The Netherlands	70	461	0.36%
	Rest of the World	985	5,167	3.97%
	Total	**7 822**	**128 013**	**100.00%**

Source: IHS Fairplay "World Shipbuilding Statistics" (December 2010).

Figure 4.6: Total World Newbuilding Oderbook.

4.2.2 Organization structures

Due to the clustering effects, the organizational structures are similar in most of the Turkish shipyards. The sizes of shipyards are not so large, resulting several different small or medium sized privately owned shipyards. Some of the shipyards belong to individuals who are relatives.

The characteristics of the Turkish shipbuilding industry are given below (Çelik, 2008):

- Trade related dependencies
- Intense social capital (citizenry, relationship, etc.)
- Centralist industry typology
- Labor – intense
- Market organization based on flexible production relations
- Ownership structure

The organizational structure in Turkish shipyards has the following properties (Karabağ, 2009):

- The shipyard staff is normally below 500,
- Sub-contractors perform most of the site work,
- Chemical tankers, dry cargo ships, general cargo ships, container ships, tug boats, fishing boats, and yachts are main product types,
- All shipyards have a production department,
- Planning department is existing in 90% of the shipyards,
- Most of the shipyards have purchasing department and accounting and finance department,
- More than half of the shipyards have a quality control department,
- Only 30% of the shipyards have a design department and human resources department.
- Over 60% of the shipyards use a software tool for planning. 30% of those shipyards prefer Enterprise Resource Planning (ERP) systems, about 40% prefer project management software, 6% prefer Material Resource Planning (MRP) and 24% chose production-scheduling software.
- About 90% of the shipyards not using planning software do have a planning department.

Although Turkish Government and local industry unions are enthusiastic and open for foreign investment, there has been no evidence of any significant foreign investments for shipyards in Turkey (OECD, 2011)

In Turkish shipyards, the organizational structure is generally functional or matrix, based on definitions in PMBOK. Projectized organizations do not exist in Turkish shipbuilding industry.

4.2.3 Labor force and equipment supply

Although the number of permanently employed staff is low, the shipbuilding industry has a value adding position in Turkish economy with employee rates reaching up to 33.000. Figure 4.7 illustrates the employment status (Url-10).

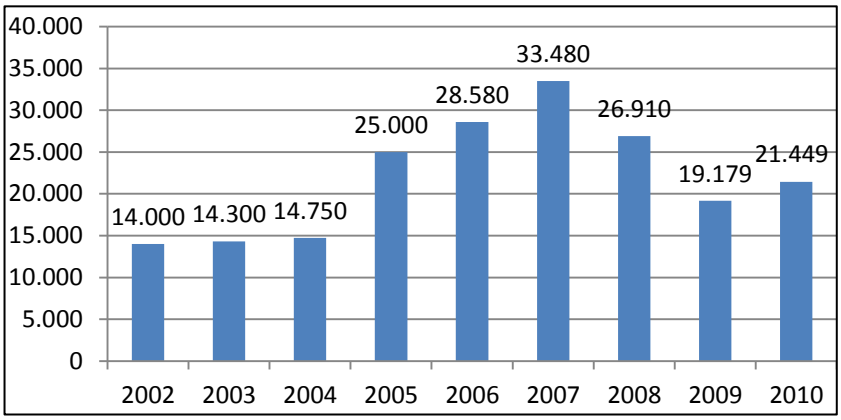


Figure 4.7 : Employment Status in Turkish Shipbuilding Industry.

However, the productivity rate of employee is low compared to other shipbuilding nations based on compensated gross tonnage (cgt) values per employee. Figure 4.8 shows the comparative employment/output data in 2007 (OECD, 2011).

Economy	Shipbuilding Employees	Output ('000 cgt)	Output Cgt/employee
Japan	50,000	8,965	179.3
Korea	119,000	11,91	94.9
European 14[15]	114,000	4,620	40.5
Chinese Taipei	11,000	369	33.6
Turkey	33,000	663	20.1
China	260,000	6,766	18.8

Figure 4.8: Comparative Employment/Output Data.

Turkish shipyards choose to outsource most of the work in order to reduce the risk by use of experts, increase flexibility in resource supply and reduce the costs compared to permanent employment. Some of the outsourced workmanship items are: follows:

- Steel hull construction;
- Outfitting;
- Manufacturing, installation and testing of piping lines,
- Painting and surface preparation;
- Machinery and equipment installations;
- Insulation;
- Electrical systems including design, production and installation
- Furniture in accommodation area.

Turkish shipbuilding industry is highly dependent on the foreign supply for materials and equipment. There is a lack of local manufacturers in major marine equipment and materials such as steel plates (local suppliers are not very competitive), paint material, main engine, propulsion systems, auxiliary engine, cargo related equipment (pumps, valves, cranes, hatch covers, etc.), boilers, navigation equipment, etc. However, there are several local producers serving shipbuilding industry, including welding consumables, cranes, mooring equipment, steering gear pumps, valves, pipefittings, sanitary units, doors, hatches, windows, etc. Based on the research on growth dynamics of Turkish shipbuilding industry, use of outsourcing and subcontracting is found to be the only variable that the shipyards could control. Figure 4.9 shows the different variables affecting the industry growth (Sartaş, 2010).

Variable	**Rele-vance**	**Degree**	**Shipyard Control**	**Industry Control**	**Public Policy Control**
Existence of A Cluster in Tuzla, Istanbul	Yes	High	No	No	Yes
World Trade Growth and GDP Growth	Yes	High	No	No	No
Change in the Trade Pattern of World Trade	Yes	Low	No	No	No
Dollar Exchange Rate	Yes	Low	No	No	Yes
Use of Outsourcing and Subcontracting	Yes	High	Yes	Yes	Yes

Figure 4.9: Shipbuilding Industry Growth - Variables and Policy Scale.

4.2.4 Industry analysis and needs

The SWOT (strength, weakness, opportunities and threads) gives the following results (T.R. Prime Ministry Under secretariat of State Planning Organization, 2007).

Strengths:

- Low labor costs with good quality,
- Geological closeness to major investors in the market,
- Delivered vessels,
- Specialization in chemical tankers and container ships.

Weakness:

- Insufficient equity capital,
- Inability to produce large tonnage vessels,
- Insufficiently trained staff,
- Insufficient sub-industry,
- Problems in credit guarantee.

Opportunities:

- Enterprising spirit of Turkish people,
- Increase global demands,
- Renewal of Turkish coaster ship fleet,
- Geographical location for repair and maintenance.

Threads:

- Decrease in global demand,
- Government subsidies in other nations,
- Increased competitiveness of other shipbuilding countries,
- Negative movements in exchange rates,
- Increased costs for energy supply.

Since the above analysis were performed before the global economic crisis in 2008, several modifications are necessary. For instance, the labor costs are no longer low, not even competitive when compared to the rates in China. Turkish shipbuilding industry faced to a fatal decrease in the total orders and deliveries. Moreover, its

market share and rank has also dropped. In other words, Turkish shipbuilding industry is having a bigger crisis than the other shipbuilding nations.

The importance of management functions were investigated through industry experts for the shipbuilding following processes (Karabağ, 2009):

- First step process including bidding, proposal, technical specification preparation and contract;
- Design process as concept design, preliminary design and detailed design;
- Material supply;
- Pre-production;
- Block assembly;
- Transportation within the shipyard or between the shipyard facilities;
- Block erections on slipway;
- Piping installations;
- Outfitting;
- Painting;
- Tests, trials and delivery.

Based on the research, the management functions are listed in order of importance as follows (Karabağ, 2009):

1. Strategic planning and project control-reporting-analyzing;
2. Production management;
3. Documentation management;
4. Material supply and stock management;
5. Quality and maintenance management;
6. Human resource and safety management;
7. Supplier relations and contract management;
8. Financial management.

In order to increase the market share of Turkish shipbuilders, following items should be considered (OECD, 2011):

- Focusing on traditional areas of strength, while continuing to expand its product market

- Strengthening technological base through greater R&D, and by promoting and seeking joint ventures and other foreign participation;
- Rationalization of the industry to seek economies of scale in operations, and strengthen technological capabilities to improve productivity; and
- Continue current efforts to improve the skill base of the workforce through education at vocational high schools and at higher education establishments.

One of the most important process group in PMI project management methodology is the planning process group. However, the planning processes are poorly and weakly applied in Turkish shipyards. Köse (2012), gives the possible reasons as follows:

- Ships are complex and sophisticated products that require thousands of materials and operations to be conducted,
- Changes in project are often occur and with huge effects to the projects,
- The production is very much dependent on the weather conditions,
- Production is started as soon as possible, in order to receive the down payment from the owners,
- Planning and organization tasks are not in the main interest of Turkish people due to the education system, and
- Preparation before starting the work is poorly performed. Usually it is considered that the work should start immediately in order to be finished in fastest way.

4.3 Project Management in Turkish Shipbuilding

The final products of shipbuilding industry have a long product life - cycle reaching over 30 years. In addition, the vessels are required to be operated all around the world by complying several rules and regulations. Therefore, shipbuilding projects are complicated, multi - disciplined and long - term projects, involving large number of stakeholders. Figure 4.10 illustrates the relationship complexity of shipbuilding projects (Sharma, 2009).

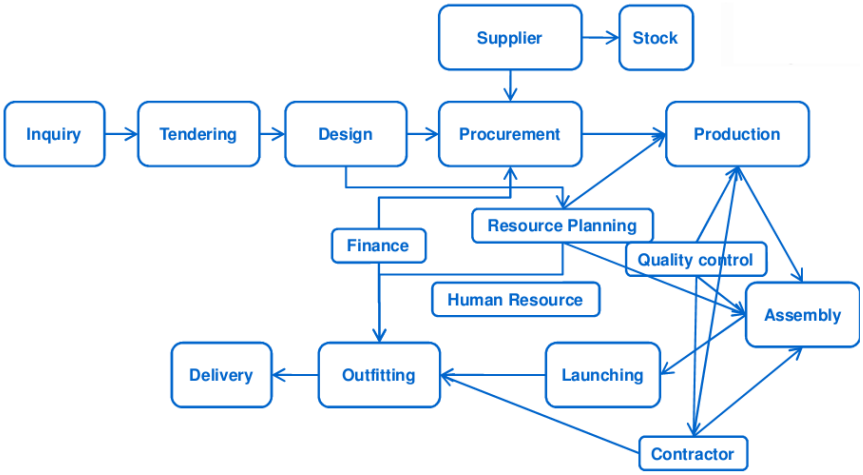


Figure 4.10 : Shipbuilding Relationship Complexity.

In order to have an understanding of the Turkish shipbuilding projects, the basic concerns and constraints; namely environmental factors and organizational process assets will be summarized.

Some of the enterprise environmental factors in Turkish shipbuilding industry could be listed as follows:

- Shipyard standards, processes, organizational structure, and culture;
- Location, capacity and layout of shipyard facilities;
- International rules, regulations and standards as listed in section 2.2
- The balance of power between contractor and the owner
- Financial abilities and background of the contractor shipyard;
- Availability of trained manpower;
- Utilization of management software and tools;
- Ease of access to suppliers;
- Availability of qualified sub - contractors.

Some of the organizational process assets could be listed as follows:

- Authorization and responsibilities of the shipyard staff,
- Safety and health procedures,
- Method statement for ship production,
- Work order and progress payment system,
- Quality standards and procedures,
- Standard forms, check-lists and guidelines for production and control,
- Deliverable definitions,

- Procedures for delivery to owner and classification society representatives,
- Production tolerances,
- Procedures for procurement and product acceptance,
- Communication and approval requirements,
- Special considerations about building contract and technical specification,
- Correction and change procedures,
- Delivery requirements, and
- Cost decision procedures.

Major Turkish shipyards are building the vessels based on turnkey contracts. Usually the owner asks for a quotation from the shipyard with a ready technical specification of a required vessel with basic design. Therefore, in this thesis, the shipbuilding projects are considered to be started with obtaining the contract and technical specification; and ends with the delivery of the vessel to the owner.

The main accomplishments of each process group according to PMI methodology could be listed as follows for shipbuilding industry:

Initiating process group:

- The initial scope definition based on contract and technical specification,
- Financial resources and cash flow is determined
- Internal and external stakeholders are identified,
- The project manager or representative will be selected,
- Project charter is approved and published
- The success criteria for the project are defined.

Planning process group

- Project management plan is developed,
- Major outsourcing activities are completed due to their great impact on project planning; such as designer, classification society, etc.
- Proposals for major material and equipment supply (steel plates, main engine, cargo equipment, etc.) are collected for use in time estimations.
- The project design drawings and other documents are developed and continuously improved with new information, and

- The project schedule is developed and continuously improved with new information.

Executing process group:

- The physical process is usually started with a steel cutting ceremony where generally a portion of payment is received,
- Procurement and sub-contractor contracts are completed,
- Shipyard staff are assigned and coordinated for operation work
- The ship building activities are performed,
- Project schedule is updated and improved,
- Main part of the project cost is spent.

Monitoring and control process group:

- Building processes are controlled and usually deliveries are performed to owner and classification society representative in a step-by-step manner,
- Project progress is monitored and controlled, where necessary precautions are made,
- Additional work requirements and claims from the owner are evaluated, changes and defects are controlled, and preventive action in anticipation of possible problem is recommended,
- Project progress is monitored compared to the baseline

Closing process group:

- Certification and documents related with the building completion are received from the classification society,
- Acceptance by the owner is received,
- Lessons learned are documented,
- Appropriate updates to organizational process assets are applied,
- All relevant project documents are archived, and
- Procurements and contracts are either closed-out or transferred to guarantee related shipyard staff. Usually shipyards are required to provide a 12 months guarantee after the delivery of the vessel.

4.4 PMI Utilization in Turkish Shipbuilding Projects

In this section, the processes defined in PMI project management standard will be evaluated for Turkish shipbuilding industry. Each process will be evaluated for Turkish new shipbuilding projects, specifically for commercial vessels with a turnkey contract. The workflow until the contract signature is briefly explained below.

Generally, the owner seeks for a ready design with a technical specification. There are several design offices, which analyze the market trend and prepare a preliminary design with technical specifications for potential customers. Once the owner finds a convenient vessel that would satisfy his business needs, he asks for a proposal from the shipyard. A broker generally maintains the contact between the shipyard and the owner. The proposal period could last for several months since the owners usually request changes on the specification that is prepared by the design office. Indeed, the major reason that the global owners are choosing Turkish shipyard, is that they require their vessel to be built as custom made. Afterwards shipyard provides its offer based on the revised technical specification including the delivery time, payment conditions, guarantee period, etc. In case the both parties are satisfied with the conditions, usually a letter of intent is being signed. Once the shipyard and the owner arrange the bank guarantees, the contract is officially signed.

As mentioned in the introduction part of this thesis, several interviews with industry experts were held in order to investigate the project management applications in Turkish shipbuilding industry. Interviews were performed with 16 industry experts who are experienced majorly in shipyard management, project management, project planning, design planning and production planning areas in Turkish shipyards. Mainly the university degrees of the experts are the naval architecture, marine engineering, ocean engineering or a combination of those degrees. The experience years are starting from 10 years to reaching over 40 years. Some industry experts consider the beginning of the project as the date of first down payment. In addition, some industry experts consider the project finish as the end of guarantee period which is usually (12) months after the delivery of the vessel. However, in this study, the projects are considered to be started upon the contract signing and end with the delivery of the vessel to the owner.

In the following sections, the utilization of each process for a shipbuilding project in Turkish shipyards will be evaluated. In addition, the opinions of sector experts will be summarized related with the practicality and usefulness of subject processes.

4.4.1 Develop project charter for shipbuilding

The inputs of “develop project charter” are; project statement of work, business case, contract, enterprise environmental factors and organizational process assets.

Project statement of work could be considered as the contractual building technical specification which specifies the ship to be built and the related standards and requirements.

The business case is usually the customer demand, in this case the ship owner`s requirement. However, some shipyards build the vessels speculatively based on the market trend. In addition, some shipyards build their vessels for a shipping company that is usually owned by the same group as the shipyard.

Contract could be considered as the official document signed by the shipyard and the owner, in which the commercial and legal items are mentioned.

For developing the project charter, the expert judgment within the organization could be used. Considering the functional and matrix organizational structure of the Turkish shipyards, the marketing department or the planning department could perform this process with approval of the top management of the shipyard.

The extent of the project charter and the staff to be published may depend on the information policies of the shipyard. Shipyards may keep the contract winning as a secret within the organization for commercial reasons.

Although some of the experts think that the development of project charter process is already used in Turkish shipyards, a majority of the projects are started without such an official announcement. Some of the experts even claim that shipyard staff hears about the new project from other parties outside of their organization. Some experts think that project charter is better performed by a meeting rather than a document. Either utilized or not, all experts consider that this process will be practical and useful for shipbuilding projects.

4.4.2 Identify stakeholders for shipbuilding

The major stakeholders and their influence in a shipbuilding project would be more or less the same. Therefore, the shipyards may study all possible stakeholders and define strategies without depending on the project. Thereafter, the related project work for the project manager could be limited with collecting company/contact name details during the project execution. As a reference, some of the major stakeholder groups for shipbuilding projects are listed below:

- Owner
- Owner representative
- Broker
- Financial partner
- Banks
- Designer
- Classification Society
- International rules and regulations
- Potential rule giving private authorities (Exxon Mobil, OCIMF, etc.)
- Local government
- Equipment and material suppliers
- Sub-contractors

Considering the functional or matrix structure of shipyards, stakeholder groups could be identified and analyzed by related departments. For instance the equipment and material suppliers by the purchasing department, the owner/broker by the marketing department, subcontractors by the planning department, etc.

Most of the industry expert think that “identify stakeholders” process is practical and useful in shipbuilding projects. In general, the experts do not believe this process is being utilized in Turkish shipbuilding industry. However, some experts declared that in certain shipyards, a broader project file is documented covering the needs of this process.

4.4.3 Develop project management plan for shipbuilding

The project management plan is developed in order to integrate the plans related with the project and provides a baseline from the planning processes including the followings (PMI, 2008):

- The life cycle of the project and phases
- The processes to be applied and level of application
- How to execute the work
- Change management plan
- A configuration management plan
- Communication needs
- Key management review for the project

The project management plan gives reference to other subsidiary management plans such as scope, requirements, schedule, cost, quality, process improvement, human resources, communication, risk, and procurement (PMI, 2008).

Since there is no significant systematic approach for project management in Turkish shipbuilding industry, it is difficult to mention the utilization of this process. Supporting this idea, all of the sector experts think that this process is not performed by the shipyards. However, some experts think that developing a project management plan will be practical and useful for better integration. However, there are also some experts, who believe preparing a plan of plans will be waste of time and increases the documentation work without any use. They also believes that the shipbuilding projects are already have a lot of documentation work.

4.4.4 Collect requirements for shipbuilding

The outputs of the “collect requirements” process are; requirements documentation, requirements management plan, and requirements traceability matrix.

The beginning of a project is assumed as the contract signing stage with turnkey shipbuilding contracts. Considering these constraints, the product requirements and major requirements of the project should have been defined before the project commences. Therefore, according to the experts’ opinion, this process is not applied. However, considering huge amount of the stakeholders, defining the owner requirements may not be an easy task according to the experts.

Experts think that this process could be applied and could be useful in shipbuilding industry. A expert thinks that, building technical specification could be evaluated and each necessary work could be defined based on the requirements mentioned in the specification.

4.4.5 Define scope for shipbuilding

Likewise the "collect requirements" process for shipbuilding, in this thesis, the scope of the project is assumed to be defined before the project commences.

Although not exactly covering the definition of project scope statement according to PMI, the building technical specification could be considered as a ready document for scope statement in turnkey projects.

However, some of the experts consider the "define scope" process is necessary, practical and useful in shipbuilding. Because the technical specification may define the product and the way of building it, but it would not mention the additional equipment and lay out change requirements. Therefore, some experts even consider the shipyard capacity evaluation; lay out convenience, workshop availabilities, etc. should be considered as another process additional to the ones mentioned in PMI.

This process also covers the kick-off meeting. It may be a useful process for a shipyard, to get the major stakeholders together in order to analyze the different point of views.

4.4.6 Create WBS for shipbuilding

According to PMI, creating a work break down structure is the process of subdividing the project deliverables into some manageable components (PMI, 2008).

There have been several studies on how to create a WBS in shipbuilding industry. However, those studies mainly focus on naval shipbuilding projects while assuming the commercial shipbuilders are more flexible in using their own WBS. In this thesis, it is assumed that each shipyard should have its own WBS template considering the similarity of the project deliverables. The inspection test plans (ITP) issued by the major classification societies could be considered as a good reference for the project deliverables.

A turnkey shipbuilding contract generally covers an exact delivery date. Therefore, most of the industry expert consider the “create WBS” process should have been handled before the contract signature including a project schedule without much detail. Therefore, this process is generally considered as partly utilized and useful in shipbuilding projects according to the experts. However, there are some experts who claim that there are several shipyards in Turkey, who does not create a WBS and or a project schedule, but gives full authority to department managers for organizing their own work in daily or weekly basis.

4.4.7 Define activities for shipbuilding

Some of the Turkish shipyards define project activities seriously, resulting over thousands of activities for each project. However, according to the experts, most Turkish shipyards do not define the project work in activity basis, but prefer listing the major steps in a simple list of about 50 items and detailing each work daily by the department managers. Therefore, in general, it is difficult to mention the utilization of this process in Turkish shipbuilding industry. Either utilized or not, expert believe defining activities is strictly necessary and useful for shipbuilding projects.

“Define activities” process also covers defining the milestones. Some of the major milestones in a shipbuilding project could be given as follows:

- The first steel cutting,
- Keel laying,
- Launching,
- Main engine start up,
- Sea trial and
- Delivery

Most of those milestones are also used as a basis for the installments in the shipbuilding contract.

4.4.8 Sequence activities for shipbuilding

Likewise the “define activities” process, “sequence activities” process is used by some of the Turkish shipyards. Activity sequencing depends mainly on physical constraints, but the organizational process assets and shipyard layout are major considerations that define the discretionary dependencies. For instance, the sequence

of painting/coating work could be performed right after the block production or when the block erections are finalized. This would depend on the finishing sequence of so-called hot work. The availability of a painting workshop, the extent of block outfitting during the block production, availability of information flow from the designer and/or the equipment manufacturers and accuracy of working drawings could be listed as the major items that affect the subject decision.

Either utilized or not, experts believe that defining activities is strictly necessary and useful for shipbuilding projects.

4.4.9 Estimate activity resources for shipbuilding

In Turkish shipbuilding industry, the production work is performed by the sub-contractors in almost all of the shipyards. Utilizing sub-contractors usually provide flexibility to the shipyards for increasing or decreasing the resources during the project. However, the organizational structure of the sub-contractors are so poor that the shipyards need to control the subcontractors closely in order to avoid bankruptcies in the middle of a project. Shipyards also need to check the payment of subcontractor workers salary and insurance fees due to their responsibility according to the Turkish laws. As a result, although the sub-contractors sign legally binding contracts, very few of them are able to complete the work in compliance with the contract.

On the other hand, the resource estimating related with the shipyard staff and facilities are not performed according to almost the entire industry expert. While, all experts consider resource planning is quite necessary for shipbuilding industry.

Some experts state that, it is getting more and more common to use enterprise resource planning (ERP) systems in shipyards, especially in newly established ones. However, experts also mention that package software usually makes the works harder for shipyard staff due to lack of good process definitions and limited personnel involvement in the software implementation period.

4.4.10 Estimate activity durations for shipbuilding

Most of the Turkish shipyards define very few activities and consequently make limited estimations related with the activities (See 4.4.8 and 4.4.9).

Where “estimate activity durations” process is performed, the data from the previous projects are used. For important activities, expert judgment from the site engineers is considered.

4.4.11 Develop schedule for shipbuilding

The inputs of “develop schedule” are mainly provided from the outputs of “define activities”, “sequence activities”, “estimate activity resources” and “estimate activity durations” processes. Considering limited utilization of subject processes, it is difficult to mention a proper process of schedule development in Turkish shipbuilding industry.

Most of the Turkish shipyard suffer from the penalties occurred due to late delivery of the vessel to the owner. Therefore, either utilized or not, the industry experts believe that the schedule development is very critical and necessary for Turkish shipbuilding projects considering the general late delivery problems.

4.4.12 Estimate cost for shipbuilding

The beginning of a project is assumed as the contract signing stage in this thesis. Due to the complex nature of shipbuilding contracts, the major cost estimations are performed before the project commences.

Therefore, according to the general experts’ opinion, this process is not applied during the project. On the other hand, some expert states that the cost estimations and the project budget for each item are considered when contracting for equipment, material and workmanship supply. Sometimes the cost estimations may not be sufficient during contract negotiations and further study might be necessary. For example, the steel construction work is usually sub contracted on steel tonnage basis. However, when the detailed design is completed and depending on the structural complexity of the vessels, subject estimates might need to be modified.

Most of the industry experts state that the shipyards suffer from the cost changing contracts with the sub-contractors. Generally, most of the work is finished over the contract price due to rework, additional work, bankruptcies, etc. Therefore, shipyards need to be very careful in sub-contractor selection and make sure that the sub-contractor understands the scope of work. In this context, the sub-contractor

evaluation shall be carefully made by shipyards considering the cost of quality analyses.

4.4.13 Determine budget for shipbuilding

The beginning of a project is assumed as the contract signing stage in this thesis. Generally, the shipbuilding contracts involve the total lump sum price for the turnkey delivery of a vessel plus a one-year guarantee or more.

For this reason, according to the industry experts, the budget for a shipbuilding project should be very carefully determined by the shipyard. Most experts think that involvement of major shipyard personnel such as department managers is essential during the contract stage of a shipbuilding project.

4.4.14 Plan quality for shipbuilding

The global property of shipbuilding industry sets most of the quality standards for the ships. A commercial vessel sailing between the international ports needs to comply with several rules and regulations. On the other hand, several quality standards are set for shipyards related with the building practices. Therefore, Turkish shipyards already have several quality requirements to be met related with the product and the some of the shipbuilding processes in technical means.

However, according to the experts, it is almost impossible to mention a proper quality planning in Turkish shipyards. There is an absence of quality standards related with how to perform the work and how to comply the requirements of the project. For this reason, several rework occur during the project due to lack of quality in documentation, management, etc. Experts consider “plan quality” is necessary and useful in Turkish shipbuilding industry. However, applicability of this process would depend on the availability and extent of the organizational process assets of the shipyard.

4.4.15 Develop human resource plan for shipbuilding

“Develop human resource plan” covers the roles, responsibilities, required skills and reporting relationship for the project team (PMI, 2008).

The human resource requirement in a shipbuilding project is mainly defined in accordance with the organizational structure of the shipyard. Most projects have

similar requirements considering the similar processes performed within the project. Major Turkish shipyards take the organizational structure seriously and officially publish their organization chart in shipyard's website.

According to most of the industry experts, Turkish shipyards define their human resource needs. However, some experts claim that, even the project team members and responsibilities are defined, subject information is not documented.

It is believed that the shipyards should consider each team member as a manager who is responsible for completing the required work by coordinating the related sub-contractor in accordance with the shipyard's process assets.

4.4.16 Plan communications for shipbuilding

Communications are planned in order to the scope, extent and timing of informing stakeholders (PMI, 2008).

Shipbuilding projects involve a huge number of stakeholders with different information needs. Make to order property of Turkish shipbuilding industry increases the amount of revised information during the project progress. A production drawing for example might need to be revised even ten times due to lack of information, classification society remarks, owner demand, process improvement, etc. Therefore, it is critical for a shipyard to make sure that the correct information is used for production. On the other hand, commercial projects require high privacy on business secrets that prevents a project manager to spread all the information in the same extent to each related stakeholder.

Industry experts think that "plan communications" process is not utilized in Turkish shipyards. However, they found it necessary, practical and useful if applied in a systematic manner.

4.4.17 Plan risk management for shipbuilding

In this thesis, the beginning of a shipbuilding project is considered as the contract signing. Most of the sector experts believe that the major risks should have been identified during the contract negotiations and shall be managed by preparing a proper contract with the owner, classification society, designer, etc. in order to

decrease the impact of a risk by transferring, avoiding and preventing techniques. Industry experts claim that, project risks are not evaluated properly when the project commences. However, almost all of the experts find risk related processes very useful and necessary for shipbuilding while the practicality is limited with the organization's maturity level. To sum up, according to industry experts' opinion, risk related processes are not applied, are not practical because the organizational maturity levels, but are very useful and necessary.

According to the experts' opinion, risks could be considered in following groups:

- Risk that may cause the owner to reject the vessel e.g. deadweight, speed, stability, etc.
- Risks that may cause penalties e.g. late delivery, acceptable capacity shortage or speed reduction, etc.
- Risk that may cause commercial losses e.g. huge rework, etc.

According to some experts, the major risks should have been considered before the contract signing with the owner.

On the other hand, the operational risks are considered as a different topic. Most of the experts believe shipyard should have defined, analyzed and improve processes to avoid accidents and hazards. Some of the experts also believe the HSE (Safety, Health and Environment) issues shall be managed in separate processes in shipbuilding project management.

4.4.18 Identify risks for shipbuilding

Please see 4.4.17 "Plan Risk Management" section of this thesis.

4.4.19 Perform qualitative risk analysis for shipbuilding

Please see 4.4.17 "Plan Risk Management" section of this thesis.

4.4.20 Perform quantitative risk analysis for shipbuilding

Please see 4.4.17 "Plan Risk Management" section of this thesis.

4.4.21 Plan risk response for shipbuilding

Please see 4.4.17 "Plan Risk Management" section of this thesis.

4.4.22 Plan procurements for shipbuilding

A majority of workmanship, equipment and material are outsourced in Turkish shipbuilding projects. Although the sub-contractors are available in the local market to meet workmanship requirements; major material and equipment are provided from the global market, mainly from Europe and Far East. Therefore, planning the procurements is essential.

Although it is not possible to mention a documented procurement plan in Turkish shipbuilding industry, most of the industry experts believe the procurement work is coordinated in departmental basis and informed to related units via work order systems. Some experts also believe that a shipyard should have a common procedure for procurement for all projects.

4.4.23 Direct and manage project execution for shipbuilding

Shipbuilding projects require physical work to be completed. It is unavoidable for a shipyard to direct and manage project execution where several contracts exist with a huge amount of stakeholders. The project team is at least, faced to several stakeholder requirements related with information, material and production space and tools.

Industry experts' opinion is different for the utilization of "direct and manage project execution". Some of them believe it is properly handled and is useful. On the other hand, others claim that the utilized process is nothing more than problem solving and believes a proper management should be proactive manner.

The requirements for "direct and manage project execution" in PMI is more likely to be in line with the second opinion. PMI requires managing not only the physical work, but also controls the project performance at the same time. For this reason, corrective actions, preventive actions and defect repairs are also considered within this process (PMI, 2008).

4.4.24 Perform quality assurance for shipbuilding

"Perform quality assurance" is a process that uses the data created from the "perform quality control" process in order to audit if the quality standards and operational definitions are used appropriately. The auditing work could be performed within the organization regardless the position, authority, etc.

Some of the experts believe that quality assurance is provided by the shipyard management by approval forms, meetings, etc. Subject experts also mention that, shipyards are getting more and more familiar with quality assurance concept due to the popularity of shipyard certification in accordance with ISO 9001 quality management systems.

However, other experts claim that properly documented quality assurance systems in shipbuilding projects do not exist in Turkish shipyards.

Either utilized or not, almost the entire experts share the same opinion related with the practicality and usefulness of "perform quality assurance" process in Turkish shipbuilding projects. Minority of the experts believe that the Turkish shipbuilding industry is not ready for such processes. The utilization of quality assurance systems would cause waste of time with a lot of unused documentation.

4.4.25 Acquire project team for shipbuilding

The functional organizational structure in shipyard usually authorizes the department managers to assign team members for each project. Although it is hard to mention a documentation for team member assignments, resource calendars, etc.; most experts believe that Turkish shipyards are utilizing the "acquire project team" process.

In Turkish shipbuilding industry, usually the site work is sub-contracted. Therefore, shipyards may choose to assign the staff according to their field of profession and manage the sub-contractor expectations effectively. As an alternative, the personnel could be assigned to a specific project or more projects at the same time depending on the workload. Team members in a shipbuilding project could be given as follows, but not limited to:

- Project manager
- Planning engineer
- Design engineer (hull)
- Design engineer (outfitting)
- Steel construction engineer / foreman
- Piping installation engineer / foreman
- Machinery installation engineer
- Electrical installation engineer / foreman

- Heating-ventilation-air conditioning-insulation engineer / foreman

4.4.26 Develop project team for shipbuilding

According to PMI, the project manager is majorly responsible in team development. However, it is not easy to mention a fully authorized project manager in Turkish shipyards. The personnel could be assigned with a title of project responsible, project expeditor or project representative, etc. Whatever the title and authorities, that person needs to develop the project team with his/her own interpersonal skills, so called soft skills.

Most of the industry expert consider the activities (training, recognition, awards, team building, etc.) related with "develop project team" process are rarely applied. However, considering the importance of human factor, almost all of the experts consider the team developing process is necessary and useful in Turkish shipbuilding industry.

4.4.27 Manage project team for shipbuilding

The functional structure of shipyards usually allow only department managers to comment on the performance of the personnel. Therefore, the evaluation of shipyard staff is done from the departmental point of view, but not from the project performance.

There are some experts who believe the process of managing project team is applied, but not effectively. Others claim a proper team management is not applied in Turkish shipyard, but it would be practical and useful if applied.

4.4.28 Distribute information for shipbuilding

Shipbuilding projects involve a very large number of stakeholders and data. Therefore, distribution of information and the way of informing are crucial. For example, several stakeholders (owner, classification society, project team, sub-contractor, etc.) need to be informed about the design drawings. Yet the details of the drawing may be different for each stakeholder. Another example could be given related with the correspondences related with the scope of the project. It is legally necessary to make written and official correspondences with the owner when the

issue in question is related with the building technical specification and/or the legal contract.

It is not possible to mention a systematic information distribution within a plan. Please see 4.4.16 “Plan Communications” for Shipbuilding section of this thesis. Therefore, most of the experts do not believe the process of “distribute information” is applied in Turkish shipbuilding projects. However, some of the experts believe department managers are providing necessary information to related stakeholders.

Either utilized or not, distributing information and how to do it should be quite necessary and useful for shipbuilding.

4.4.29 Manage stakeholder expectations for shipbuilding

The inputs of “manage stakeholder expectations” process include stakeholder register, stakeholder management strategy and project management plan. As stated in the previous sections, subject inputs are not available in Turkish shipbuilding industry. Therefore, most of the experts believe the this process is not properly utilized.

However, in general, the requirements of the owner and the classification society are mandatorily managed over remark lists. The vessel is delivered to the owner and the classification society in a systematic manner. Therefore, for each delivery (drawings or physical work), the representatives of the owner and/or classification society inspect the work and either accept, reject or accept with remarks. The author believes, a shipyard shall at least document the subject remarks as well as the change requests, by use of issue logs or change logs. The common opinion from the experts support this idea.

4.4.30 Conduct procurements for shipbuilding

Generally, the turnkey shipbuilding contracts involve a list of makers for major equipment. Depending on the agreement between the shipyard and the owner, the number of makers mentioned in subject list for each equipment, could be one or more. The shipyard should select a maker whose name is mentioned in the makers list.

The other important point in equipment and material selection is the compliance with the building technical specification. Shipyard should consider not only the

commercial items in a proposal, but also the technical rules, ease of installation, commissioning, availability of local service engineers, guarantee, spare parts supply.

Conducting procurement processes could make it possible to foresee, transfer, avode or prevent from the major project risks. Most of the Turkish shipyards prefer purchasing an overall system, instead of supplying each equipment separately. Purchasing an overall system will reduce the risk of improper selection of related equipment. Main engine and propulsion system procurement is one good example for such selection.

Most of the industry experts believe the conduct procurement process is utilized in Turkish shipbuilding industry and is useful.

4.4.31 Monitor and control project work for shipbuilding

According to the experts, most of the Turkish shipyards organize weekly meetings in order to evaluate the progress and problems of the project. However, the items discussed in subject meetings are related with how to perform the required work, how long will it take, why the work could not be completed in time, etc. Therefore, the major part of scope of those meetings should have been discussed during the planning stages.

Some of the industry experts believe that the subject process is utilized and useful in Turkish shipbuilding industry.

However, “monitor and control project work” involves tracking, reviewing and regulating the progress to meet the performance objectives defined in the project management plan (PMI, 2008). Since most of the Turkish shipyards are not preparing a project management plan and or a detailed project schedule, it is not possible to mention a properly performed monitor and control the project work process.

4.4.32 Perform integrated change control for shipbuilding

Shipbuilding projects are a good example of progressive elaboration. For instance, the design work includes several repetitive actions. Once the preliminary design is available, the amount and capacity of the required equipment will be informed to the purchasing department. When the purchasing is finalized, all related drawings need to be revised and detailed in accordance with the selected equipment. Furthermore,

subject drawings might need to be revised after owner and classification society approval. Moreover, feedback from the site engineers may necessitate further changes. Therefore, changes are unavoidable in shipbuilding; projects because of its nature. Please also see 4.4.29 “Manage Stakeholder Expectations” for Shipbuilding section of this thesis.

According to experts a very few of the Turkish shipyards “perform integrated change control” in a documented structure. In addition, almost all of the experts believe this process is practical and useful.

4.4.33 Verify scope for shipbuilding

Shipbuilding industry might be unique in way of scope verification considering that each process is being controlled and verified by several stakeholders. The main reason is that the final product (ships, marine structures, etc.) is classified and certified by independent organizations. Scope verification starts with the approval of design drawings and follows with continuous verification during the production stages. For example, a coating work could be final checked for compliance with the required painting specification. However, the verification is performed in stage of a painting application including the verification of grit material, paint material, surface preparation, cleaning, each layer of coating, etc.

The scope is verified at least considering the international rules and regulations that the vessel should comply, building technical specification and organizational process assets. The following is a list of major stakeholders that are involved in checking and verifying the scope of a shipbuilding project, but not limited to:

- Project Team
- Designers
- Quality control personnel
- Owner representatives
- Classification society surveyors
- Painting/coating inspectors
- Flag states
- Port authorities

Therefore, scope verification is an unavoidable process in shipbuilding projects. The opinions of experts support this idea.

4.4.34 Control scope for shipbuilding

"Control scope" is the process involves managing changes to the scope baseline. Please see 4.4.32 "Perform Integrated Change Control" for Shipbuilding section of this thesis. Uncontrolled changes are defined as scope creep (PMI, 2008).

Experts' opinions are different related with the utilization of subject process. However, there is common understanding that "control scope" process is practical and useful for shipbuilding projects.

4.4.35 Control schedule for shipbuilding

The inputs of "control schedule" process involves project management plan and project schedule. Although, most of the Turkish shipyards are struggling to meet the delivery date of the projects, it is hard to mention a proper schedule control process. This is due to the lack of a properly prepared project schedule with a baseline. Please see 4.4.11 "Develop Schedule" for Shipbuilding section of this thesis.

According to industry experts, there are few shipyards existing in Turkish market, in which the schedules are properly controlled. However, there is a common agreement on the necessity and usefulness of subject process.

4.4.36 Control costs for shipbuilding

"Control costs" process includes the following actions (PMI, 2008):

- Avoiding unapproved changes
- Ensuring all changes are performed in a timely manner
- Managing changes and informing related stakeholders
- Monitoring work performance and variances from the cost baseline
- Influencing factors that may change the approved cost baseline,
- Actions to bring the expected cost overruns within acceptable limits

In general, the costs and budget are defined in the contract stage of a turnkey shipbuilding project. Usually Turkish shipyards are organizing the payments and related invoices in project basis. Therefore, the total amount spent for each project could be identified at the end of each project. However, according to the industry

experts, during the project execution, most shipyards do not control the costs as activity or work package basis.

Either utilized or not, almost all of the experts believe the cost control processes are highly necessary and useful in the shipbuilding industry. However, the practicality of utilizing this process will depend on the capability of the shipyard to create the data for base lining and projection.

4.4.37 Perform quality control for shipbuilding

The importance of quality for shipbuilding is obvious. Please see 4.4.14 "Plan Quality" for Shipbuilding section of this thesis. Performing quality control is an unavoidable process for shipyards. Inspection is the common technique for quality control in shipbuilding industry.

The industry experts claim that most of the Turkish shipyards do not have their own quality control unit or personnel. Experts added that the shipyards are using the approving authorities for the quality control activity of the project deliverables.

Depending on the shipyard, the quality control processes are utilized or not in Turkish shipyards. However, experts mention that quality control is one of the most important processes in shipbuilding.

4.4.38 Report performance for shipbuilding

The performance reporting process involves the periodic collection and analysis of baseline versus actual data to understand and communicate the project progress and performance as well as to forecast the project results (PMI, 2008).

The application of performance reporting is therefore, very much dependent on the availability of baseline data which is not likely to be existing in Turkish shipyards. Generally, the project performance is only checked once and at the end of the project.

Most of the industry experts believe this process is not utilized in Turkish shipyards, although it is quite necessary and useful.

4.4.39 Monitor and control risks for shipbuilding

In Turkish shipyards, project risks are not systematically evaluated. Please see 4.4.17 "Plan Risk Management" for Shipbuilding section of this thesis.

Therefore, it is not possible to mention a proper application of monitoring and controlling the risks in accordance with PMI guidance.

Some of the experts consider that, during the execution of projects several commercial and technical risks are evaluated and preventive actions are performed. However, none of those studies are properly documented or performed in a systematic manner.

Likewise, the other risk related processes, experts believe subject processes are practical and useful in Turkish shipbuilding industry, although never applied.

4.4.40 Administer procurements for shipbuilding

The "administer procurements" process ensures that the seller's performance meets procurement requirements and that the buyer performs according to the terms of the legal contract (PMI, 2008).

Some of the industry experts believe this process is being utilized in some of the Turkish shipyards. Considering the major part of the scope of a shipbuilding project is outsourced, it is critical to administer the procurements properly. Experts' opinions support this idea, finding this process very practical and useful for Turkish shipyards.

4.4.41 Close project or phase for shipbuilding

The "close project or phase" is the process of providing the final product, project files, closure documents, historical information and lessons learned documentation (PMI; 2008).

According to the industry experts, an official closure of a shipbuilding project is performed between the owner and the shipyard with the involvement of classification society, flag state, banks, etc. In the closure meeting, the parties make sure that all work in the project scope is completed, required certifications are provided and all necessary documentation (certificates, test reports, drawings, approval forms, etc) are delivered. Upon agreement, the final payment is realized.

Experts believe close project process is mandatorily utilized in Turkish shipbuilding projects.

Although there is an official closure in shipbuilding projects with project files. However, generally the lessons learned are not documented to support the future projects.

4.4.42 Close procurements for shipbuilding

"Close procurements" process provides officially closed procurements, procurement files, deliverable acceptance and lessons learned documentation.

Usually the turnkey shipbuilding contracts require the shipyards to provide a guarantee for the vessel for 6-18 months during operation. Therefore, even the procured items are installed onboard and accepted as deliverables, the correspondences may continue in the guarantee period due to possible defects.

In this thesis, the shipbuilding project is considered to end when the vessels is delivered to the owner. Therefore, some of the experts assume this process is not applicable within the given boundaries of shipbuilding projects. Experts inform that many shipyards are struggling with insurance fees of the subcontractor staff even after the guarantee period is expired.

However, some of the experts consider the "close procurements" is utilized so that the procurement documents are handed over to the guarantee related personnel or department. Either properly applied or not, experts in general find the close procurement outputs as stated in PMBOK, quite practical and useful in shipbuilding projects.

4.5 Additional Processes for Shipbuilding

As a general opinion, the management of health, safety and environmental issues could be added as a separate process in shipbuilding projects. In fact, all shipyards are forced to consider those issues due governmental and or international rules. It is getting more and more common for shipyards to be certified in accordance with OHSMS (Occupational Health and Safety Management Systems), such as OHSAS 18001. However, those standards are generally documented, but not applied properly. Shipyards need to integrate the processes mentioned in such standards with each project. Other processes that may need to be considered separately for shipbuilding projects are as follows:

- Sub-contractor management
- Contract management
- Shipyard layout and equipment
- Financing of the project

5. CONCLUSION AND RECOMMENDATIONS

A shipbuilding project creates such a unique product that is capable of sailing in the oceans for transferring goods and people, while providing everything onboard as one may need in land. Due to the uniqueness of the final product, shipyards need to struggle with several challenges, which are not likely to occur in any other industry. Therefore, it is recommended that the management of shipbuilding projects should be performed in a special manner considering the special challenges and requirements of shipbuilding.

In this thesis, the utilization of PMI project management methodology for Turkish shipbuilding industry is evaluated. The general structure of the industry is discussed and opinions of industry experts are investigated related with the utilization, practicality and usefulness of project management processes in PMI PMBOK. Based on a questionnaire and informal interviews, answers to following questions are gathered for each process:

- Is the subject process utilized in Turkish shipbuilding projects?
- If the subject process is utilized, is it useful for Turkish shipbuilding projects?
- If not utilized, is the subject process practical to be applied in Turkish shipbuilding projects?
- If not utilized, is the subject process useful to be applied in Turkish shipbuilding projects?
- What are the general comments and evaluation on managing Turkish shipbuilding project?
- Which processes shall be carried out in Turkish shipbuilding projects in addition to the ones mentioned in PMI PMBOK?

Above questions were discussed with 16 industry experts who are experienced majorly in shipyard management, project management, project planning, design planning and production planning areas in Turkish shipyards. General comments and

findings related to project management processes are summarized in knowledge area basis.

The shipbuilding project is considered as a new building project with a turnkey contract, where the project starts with contract signing between the owner/shipyard and ends with the delivery of the vessel to the owner. All of the evaluations are made from the shipyard's point of view.

The processes related with integration management are rarely utilized in Turkish shipbuilding projects. Considering the complexity of shipbuilding projects, integrating processes would be useful, could be practically applied and adapted in shipyards in short time.

The processes related with scope management are generally utilized in Turkish shipbuilding projects. In fact, the product scope is usually described in detail as a building technical specification and drawings attached to the contract. Scope management is crucial and shall be carried out very systematically in order to avoid any commercial losses that may lead shipyard to bankruptcies.

Processes related to time management are generally utilized in Turkish shipbuilding projects. It is found that most of the new building projects are delivered late to the owners, resulting penalties to the shipyard. Therefore, it is recommended that the Turkish shipyards should improve their time management processes.

Processes related with cost management are partly utilized in Turkish shipyards. In general, the cost vs. budget is only checked when the project is finalized. Generally, the budget of a shipbuilding project is defined before the contract signing. However, subject budget is usually prepared in lump-sum basis for workmanship, equipment, material, overhead, etc. The costs are required to be estimated in activity or work package basis in order to monitor and control during the project execution.

Processes related with quality management are partly utilized in Turkish shipyards. It is understood that quality is only controlled, but neither planned, nor assured. However, several shipyards are certified in accordance with quality management systems. The next step would be integrating the quality management systems with the projects.

The processes related with communication management are not utilized in Turkish shipyards. The subject process might create extra documentation since most of the

communication requirements are defined in related contracts (with the owner, designer, classification society, supplier, etc.). On the other hand, managing communication in a systematic manner will prevent several information based problems. Utilization of this process will require several additional work related with the shipyard's organization structure, job definitions, etc. Therefore, in practice, the proper application of those processes would take long time.

The processes related with human resources management is partly utilized in Turkish shipyards. Although it is not likely to see documented human resource plans in project basis, several shipyards manage general human resource requirements in dedicated department. The project team members are usually assigned by department managers with a very little influence from the project managers. Human resource management is useful and practical in Turkish shipbuilding projects.

The processes related with project risk management are not utilized in Turkish shipbuilding industry. There are several studies related with operational risks with little integration to the project works. The major risks shall be managed before the contract signing with the owner. In general, risk management processes were found definitely necessary for Turkish shipbuilding projects.

The processes related with procurement management are generally utilized in Turkish shipbuilding projects. Since the Turkish shipyards are outsourcing the majority of the goods and workmanship, the procurement processes are performed unavoidably. However, it is understood that contract management is generally poorly performed by Turkish shipyards.

Some additional processes for following knowledge areas were found to be required in Turkish shipbuilding projects; health-safety-environment management, sub-contractor management, contract management, shipyard layout and equipment management, finance management.

To sum up, most of the processes defined in PMI project management standard (PMBOK) would be useful if utilized. However, although each process is practical to apply, it would not be practical to start applying all processes at the same. This is due to the maturity level of the organizations, availability of skilled and educated personnel, cultural reasons and changing market conditions.

Table 5.1 : Summary of Findings.

Knowledge Areas	**Utilization**	**Practicality**	**Usefulness**
Integration Management	Partly utilized	Practical and crucial.	Useful
Scope Management	Generally utilized, but need to be improved.	Practical in turn key contracts	Very Useful
Time Management	Generally utilized, but need to be improved.	Practical and necessary.	Very Useful when properly applied.
Cost Management	Partly utilized	Practical, but not easy to apply	Very Useful when properly applied.
Quality Management	Partly utilized	Practical and crucial.	Useful
Communication Management	Not utilized	Not Practical due to required additional work related	Useful
Human Resources Management	Partly utilized	Practical depending on the organizational structure	Useful
Risk Management	Not utilized	Practical and very necessary	Very Useful
Procurement Management	Generally utilized, but need to be improved.	Practical	Very Useful

Therefore, it is suggested to integrate the already utilized processes in order to increase the project performances. Turkish shipyards need to increase their management skills, either by use of project management systems or other applicable systematic means.

The utilization of project management processes in Turkish shipbuilding industry is summarized in Table 5.1 based on knowledge area grouping.

As a further study, each project management process may be studied in detail with an applicable model for Turkish shipyards. Although, each new shipbuilding is considered as a projects, the standardization of required documentation could make some of the project work repetitive for each project. As a result, the management of those processes could be easier with less resource utilization. Therefore, the further studies may include standardized forms, checklists and flow charts to determine the special focus points in a shipbuilding project.

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