A PROPOSED MODEL FOR TURKISH LAND FORCES COMMAND SOFTWARE INTENSIVE SYSTEMS ACQUISITION PROCESS

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Approval of the Graduate School of Informatics

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ABSTRACT

A PROPOSED MODEL FOR TURKISH LAND FORCES COMMAND SOFTWARE INTENSIVE SYSTEMS ACQUISITION PROCESS

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Turkish Land Forces Command uses information technology opportunities to satisfy its needs arising from the obligation for being a strong army. One of the main difficulties in using information technologies is the acquisition of these systems.

This thesis reviews the fundamentals of software intensive systems acquisition process and then proposes a new model for Turkish Land Forces Command. Software acquisition process models are discussed and compared with each other. The current Turkish Land Forces Command acquisition process is studied to state the management, legal, resource, and industrial problems within the comtemporary models' perspective. The focus of this thesis study is proposing an acquisition model based on four international models, successes of which have been proven.

Keywords: Software Intensive Systems Acquisition Process, Euromethod, ISO/IEC TR 15504, Software Acquisition Capability Maturity Model, IEEE Recommended Practices for Software Acquisition, Requirements Development, Tendering.

ÖZ

KARA KUVVETLERİ KOMUTANLIĞI YAZILIM YOĞUNLUKLU SİSTEM TEDARİK SÜRECİ İÇİN BİR TEKLİF

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Kara Kuvvetleri Komutanlığı güçlü bir ordu olma zorunluluğundan kaynaklanan ihtiyaçlarını karşılamak için bilişim teknolojileri fırsatlarını kullanmaktadır. Bu teknolojilerin kullanımındaki en büyük zorluklardan biri bu sistemlerin tedarik konusudur.

Bu çalışma, yazılım yoğunluklu sistem tedarik sürecinin temellerini inceledikten sonra Kara Kuvvetleri Komutanlığı için yeni bir model önermektedir. Yazılım tedarik süreç modelleri incelenip karşılaştırılmıştır. Kara Kuvvetleri Komutanlığının hali hazırdaki süreci, yönetimsel, kanuni, kaynak ve sektörel problemleri ortaya koymak için, çağdaş modellerin ışığı altında incelenmiştir. Bu tez çalışmasının temel amacı; Kara Kuvvetleri Komutanlığı için, başarıları kanıtlanmış dört uluslararası modele dayalı bir tedarik modeli önermektir.

Anahtar Kelimeler: Yazılım Yoğunluklu Sistem Alım Süreci, Euromethod, ISO/IEC TR 15504, Yazılım Tedarik Yeteneği Olgunluk Modeli, Yazılım Tedariği İçin Tavsiye Uygulamalar, İsterlerin Geliştirilmesi, İhale.

To My Family

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LIST OF ACRONYMS

AIS : Automated Information Systems
BNPD : Branch Needs Proposal Document
CM : Configuration Management
EA : Evolutionary Acquisition
FND : Force Needs Declaration
FNP : Force Needs Plan
FNPD : Force Needs Proposal Document
GPPD : General Planning and Policy Department
IEC : The International Electrotechnical Commission
IEEE : Institute of Electrical and Electronics Engineers
ISD : Information System Department
ISO : The International Organization for Standardization
ISPL : Information Services Procurement Library
IT : Information Technology
KPA : Key Process Area
LSO : Logistics Supply Office
MND : Ministry of National Defense
MNS : Mission Need statement
NPC : National Prime Contractor
NDF : Need Declaration Form
ORD : Operational Requirements Document
PA : Process Attribute
PEC : Proposal Evaluation Commission
PEEC : Project Examination and Evaluation Commission
PM : Program Manager
PMP : Program Management Plan
PPIC : Planning, Programming and Investigation Committee
R&D : Research and Development
RFP : Request for Proposal
SA-CMM : Software Acquisition Capability Maturity Model
SEI : Software Engineering Institute
SLOC : Source Lines of Code
SPICE : Software Process Improvement and Capability dEtermination
SPRITE-S^2 : Support and Guidance to the Procurement of Information and Telecommunication Systems and Services
STL : State Tender Law
STP : Strategic Target Plan
TAF : Turkish Armed Forces
TLFC : Turkish Land Forces Command
TRADOC : Training and Doctrine Command
TYPP : Ten Year Procurement Program

UDI : Undersecretariat of the Defense Industry
US : United States

CHAPTER 1

1 INTRODUCTION

1.1 Statement of the Problem

As the major component of Turkish Armed Forces (TAF), Turkish Land Forces Command (TLFC) is responsible for organizing well-trained, well-equipped, and well-managed combat forces satisfying the requirements of future battlefield. TLFC military training instruction notes four factors that will impact and shape the future wars [KKK, 1999]:

- Leadership of commanders at all levels,
- Training and readiness for battlefield,
- Doctrines,
- Technological advancements.

The fourth factor includes developing and employing advanced systems to meet the needs arising from being a strong army. New systems may be classified as automated information systems (AIS), weapon systems, command, control and communication systems and etc. These and other all new advanced systems have a common critical component; *software*. At the heart of these systems, there is software which operates and manages them.

It is clear that the future will be software's world and the warrior side who is the best on this area, will win the battle. So, the significance of software to the military is inestimable, because military systems are increasingly reliant upon software. What will the software do? The software will,

- increase the capability of TLFC troops,
- help decision making of commanders,
- provide the ability to do more with less.

Software acquisition is the procurement of a software product by using an external source when the acquirer (buyer) does not have adequate resources, skills or experience to develop the product within the desired time period [Marciniak &

Reifer, 1990]. The output of a software acquisition process is a software product which satisfies user needs.

A 1990 study of software acquisition in one large US Federal Government organisation showed that only 1,5 percent of major software projects were used as delivered, 3 percent were used after modification, 19 percent were used but later abandoned within two years, 29 percent of the projects was never delivered to contract and 47,5 percent was delivered but never used [STSC, 1996-1]. In commercial industry 50 percent of software projects overshoot their schedules, 33 percent of projects are canceled and 75 percent of those that are not canceled have some important failures.

The research mentioned above shows us that the actual source of problems in a software acquisition process is the difficulties inherent in software development. Frederic P. Brooks, Jr. addresses these inherent problems of modern software systems in his article named "No Silver Bullet: Essence and accidents of Software Engineering" [Brooks, 1987]:

- *Complexity*: Software entities are complex because there are not repeated elements and no two parts are alike. But in other human construct like computers, buildings or automobiles, repeated elements are abound.
- *Conformity*: Software products are produced to run with other entities, much complexity comes from the need to conform to other interfaces.
- *Changeability*: The software products are constantly subject to pressures for change.
- *Invisibility*: Software is invisible and unvisualizable.

Like any other organization or army throughout the world, TLFC also uses information technology (IT) opportunities. There are two ways to obtain advanced systems; producing in-house or buying from external sources. When producing or buying a software intensive system, the possibility of encountering some problems is very great. Because *software is different*. It is difficult to define the desired system. The requirements identified by users may be vague or the user may not know what he wants. The supplier (vendor) may not understand what user wants.

The focus of this study is proposing an acquisition model based on four models, successes of which have already been proven for software intensive systems

acquisition process in TLFC. The proposed model provides a framework including necessary activities for software intensive systems procurement.

1.2 The Need for A Model

There is a risk of failure in every acquisition project, but especially in software acquisition due to the inherent problems presented in previous section, and also the fact that the acquisition process maturity of buyer is often much lower than the development process of the supplier. The software itself requires developing and employing an acquisition process which considers its particular differences and difficulties.

An acquisition process is composed of people, processes, tools, methods and techniques. Processes, methods, tools and techniques help people to implement a disciplinary approach to acquire more quality software intensive systems. An acquisition model provides the framework that gathers these themes together to achieve the program objectives through optimizing resources and to minimize possible risks in the program.

This study identifies the activities which should be performed to acquire software intensive systems in the TLFC. The model including these activities has been formed based upon four acquisition models and specific needs of TLFC.

1.3 Objectives of the Study

The first and most important objective of this thesis study is to form and define an acquisition model containing necessary operations which should be performed during the TLFC software intensive systems acquisition process.

The second is to investigate available acquisition models to identify the fundamental concepts of software acquisition. The results of this investigation will be used to compare those models with each other and also will be used to define the proposed model for TLFC software acquisition process.

Last and the third objective is to investigate the problems of current TLFC acquisition process prior to proposing a model. The proposed model will be formed with the aim of removing the problems resulting from the lack of a disciplinary methodology.

1.4 Scope of the Study

This thesis consists of six chapters. Following the Introduction in Chapter 1, Chapter 2 briefly reviews four acquisition models to provide a comparison of these models and to introduce basics of software acquisition. It analyzes the structures and processes of four models,

- US Software Engineering Institute's (SEI's) Software Acquisition Capability Maturity Model (SA-CMM),
- Euromethod,
- ISO/IEC TR 15504 (Software Process Improvement and Capability dEtermination), and
- IEEE Recommended Practices for Software Acquisition.

Chapter 3 reviews the current software acquisition process problems in the TLFC. Current problems will be examined under four titles: *problems related with the process, industrial problems, resource problems, and legal problems*. While the current process is analyzed from the viewpoint of adequacy and quality of a software acquisition process, Turkish informatics industry is analyzed to provide a better understanding of current problems. Problems related with funding, staff, equipment, and tools are explored in resource problems, and finally regularity framework of TLFC software acquisition environment is analyzed under the title of legal problems. At the end of the chapter, a specific recent proposal [Çalkayış, 2001] is evaluated based on the concepts of acquisition models reviewed in Chapter 2.

Chapter 4 introduces a new proposal formulated with the aim of responding to the needs as recognized in Chapter 3. The model is described step-by-step. The templates of work products to be produced are available at the end of the thesis.

Chapter 5 includes discussion of application of the proposed model within the context of a specific case study to provide a better interpretation of the proposed model and to assess its benefits and disadvantages. The case study is an actual project undertaken by a deparment of TLFC.

Chapter 6 discusses the results of this study through evaluating the proposed model. The earnings and the defficiencies of this thesis study are reviewed.

CHAPTER 2

2 SOFTWARE ACQUISITION LITERATURE REVIEW

2.1 Introduction

Acquisition is the procurement of a software product by using an external source when the acquirer does not have the adequate resources, skills or experience to develop the product within the desired time period [Marciniak & Reifer, 1990]. Software acquisition process begins with the decision to acquire a software product and ends when the product is no longer available for use [IEEE, 1998]. The output of an acquisition process is a software product that meets the organization's needs.

The process itself has a very important impact on the success of acquiring such systems. A process is a systematic approach to the creation of a product or the accomplishment of some task [Osterweil, 1987]. Individual efforts are temporary but a capable acquisition process can guarantee the success. Therefore, organizations should develop the skills, knowledge and abilities to establish a reliable acquisition process.

Failed projects over the world have showed that organisations need more reliable and improved acquisition processes. This important necessity got software people and pioneer organisations to develop new standards and improvement models. This chapter briefly reviews the following software acquisition improvement models and standards; ISO/IEC TR 15504 (SPICE), Software Acquisition Capability Maturity Model (SA-CMM), Euromethod, and IEEE Recommended Practices for Software Acquisition. At the end of the chapter, a comparison of these models and an overview of "evolutionary acquisition " as an alternative approach will be discussed.

2.2 ISO/IEC TR 15504 (SPICE)

2.2.1 Introduction to ISO/IEC TR 15504

ISO/IEC TR 15504 has been prepared and published by The International Organization for Standardization (ISO) and The International Electrotechnical Commission (IEC) in 1998. The aim was to provide an initial technical report on the

field of software process assessment, which will be the foundation of an International Standard [ISO/IEC, 1998].

ISO/IEC TR 15504 is a framework for process assessment. It includes the requirements of performing an assessment and it can be used as a roadmap to improve software processes. The software process domains to be improved are acquisition, supply, development, operation, maintenance and supporting processes.

ISO/IEC TR 15504 consists of nine parts. Different types of users can use different parts of the report for different purposes. Figure 2.1 shows the relationships among the components of the report.

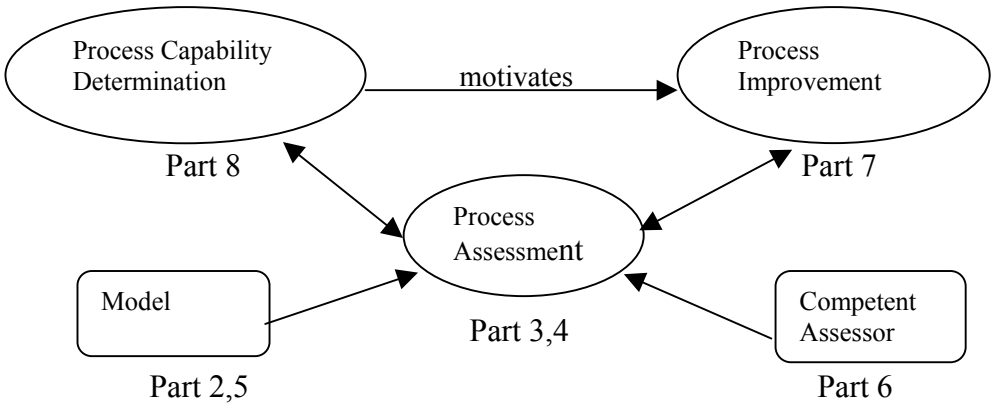


Figure 2.1 Relationships Among The Parts of the Report

- *Part 1*: Concepts and introductory guide (informative). This part is an introduction to ISO/IEC TR 15504. It provides a guidance for selection and use of nine parts of the document.
- *Part 2*: A reference model for processes and process capability (normative). The model(s) of the processes being assessed, which will be used by the assessor, must be compatible with the reference model contained in this part of the report. This part provides an assessment model that can be used as the basis for any assessment model.
- *Part 3*: Performing an assessment (normative). It includes the minimum requirements for performing an assessment.
- *Part 4*: Guide to performing assessments (informative). This part of ISO/IEC TR 15504 provides assessment guidance on interpreting the requirements contained in ISO/IEC TR 15504-3 for performing an assessment. It enables the assessor and other participants in an assessment process to understand process assessment.

- *Part 5*: An assessment model and indicator guidance (informative). In the reference model contained in ISO/IEC TR 15504-2, the processes are described in terms of their purpose statements and process outcomes. This part of ISO/IEC TR 15504 provides an examplar model compatible with the reference model. In addition to purpose statements and process outcomes, it includes the set of indicators of process performance and capability.
- *Part 6*: Guide to competency of assessors (informative). In performing an assessment, the assessment team should include at least one competent assessor.This part of ISO/IEC TR 15504 includes the requirements for being a competent assessor and the mechanisms that can be used to verify the competency of the assessor.
- *Part 7*: Guide for use in process improvement (informative). It includes a guidance on using process assessment for the purposes of process improvement.
- *Part 8*: Guide for use in determining supplier process capability (informative). This part includes a guidance on using process assessment for the purposes of process capability determination.
- *Part 9*: Vocabulary (normative). This part of ISO/IEC TR 15504 defines the terms used in the deocument.

2.2.2 Components of ISO/IEC TR 15504 and A Road Map For Users

A process assessment can be conducted for two main purposes; process improvement and capability determination.The user types of ISO/IEC TR 15504 differentiate based upon the context for the use of process assessment. Assessment sponsor, process improvement sponsor, process capability determination sponsor, assessors, developers of assessment models are possible examples of user types.

ISO/IEC TR 15504-7 and ISO/IEC TR 15504-8 provide guidance on using the process assessment for process improvement and for process capability determination respectively. Other parts of ISO/IEC TR 15504 includes different aspects of process assessment, which enable the users to understand the requirements for performing an assessment.

ISO/IEC TR 15504 has been developed for use of acquirers, suppliers and assessors. Everyone interested in software processes and process assessment can use the document for different purposes. Table 1 indicates possible user types and a

potential road map for them. ISO/IEC TR 15504 gives its full value when users know the purpose for which they use the document suite.

2.2.3 The Assessment Framework

Capers Jones describes the assessment like a medical diagnosis to find all of the strengths and weaknesses associated with software [Jones, 1999].This assessment may include the processes of the whole organization or the processes of a part of the organization. As a result of process assessment, an improvement program can be conducted or process capability of a particular supplier can be determined.

Table 2.1 A Road Map for Users [ISO/IEC, 1998]

Class of Reader	**Interests**	**Suggested parts to be read**
Assessment Sponsor	How? What is required?	1, 2, 3, 4, 6
Process Improvement Sponsor	How an assessment is used for improvement purpose?	7
Process Capability Determination Sponsor	How an assessment is used for capability determination purpose?	8
Assessors	Performing an assessment, Needed skills and competencies	2, 3, 4, 5, 6
Developers of Assessment Models	Developing an assessment model competible with the reference model	2, 3, 4, 5
Developers of Assessment Methods	Developing an assessment method	2, 3, 4
Tool Developers	Developing supporting tools	2, 3, 4, 5

ISO/IEC TR 15504-3 contains a guidance on performing an ISO/IEC TR 15504 conformant assessment. The assessment process includes at minimum the following activities:

- *Planning*: Inputs, a schedule of the activities, resources, responsibilities and etc.
- *Data Collection*: How the data will be collected. Which techniques will be used to collect and analyze of data. (Guidance is contained in Clause 6 of ISO/IEC TR 15504-4)
- *Data Validation*: The data collected shall be validated.

- *Process Rating*: A process profile shall be assigned for the processes assessed.

The starting point of performing an assessment is to identify the purpose for which it is being conducted. This may be;

- to establish a culture of continous process improvement in the organization,
- to optimize the resources of the organization,
- to understand the current state of the processes to initiate a process improvement program (ISO/IEC TR 15504-7),
- to support process capability determination (ISO/IEC TR 15504-8).

In all cases the assessment process begins with the compilation of assessment input. The assessment input defines the purpose of the assessment (why it is being conducted), the scope of the assessment (which processes will be assessed), the constraints, and the responsibilities for carrying out the assessment.

An assessment must be carried out based upon an assessment model. This assessment model has to be compatible with the reference model contained in ISO/IEC TR 15504-2.

2.2.4 The Reference Model (ISO/IEC TR 15504-2)

In performing an assessment, selected processes must be assessed against an assessment model. ISO/IEC TR 15504-2 contains a reference model of processes and process capability that can be a basis for any model to be used for the purposes of process assessment.

The reference model consists of two dimensions. The first dimension is the process dimension which defines the processes to be assessed. The processes are defined in terms of their purpose statements. The purpose statement includes additional information about the outputs of succesful implementation of the process. Satisfying the purpose of a process represents the first step in building process capability. The processes are grouped into three life cycle process groupings which contain five process categories; Customer-Supplier, Engineering, Support, Management and Organization Process categories.

The second dimension is the process capability dimension characterized by nine process attributes. A process attribute is a measurable characteristic of process capability applicable to any process. The process capability is defined in capability

levels. A capability level demonstrates the level of achievement of a process attribute for a given process and means an enhancement in the capability of the process. There are six capability levels in the reference model;

Level 0: The Incomplete Process: The process does not satisfy its purpose or it is not implemented.

Level 1:The Performed Process: The purpose of the process is generally achieved but in an ad hoc manner, not planned and tracked.

Level 2: The Managed Process: The process delivers the work products according to specified procedures and is planned, tracked, verified and adjusted.

Level 3: The Established Process: There is a well-defined standard process and individual implementations of the process use approved, tailored versions of the standard process. The resources are allocated to establish the process definition.

Level 4: The Predictable Process: The defined process is performed consistently within defined limits to achieve its defined process outcomes. Performance is quantitavely managed.

Level 5: The Optimizing Process: Performance of the process is optimized to meet current and future business needs. Process feedback is obtained and changes are made to optimize the processes.

The level of detail of the Reference Model is not sufficient. An assessor needs some additional information to make a real judgement. This necessity is provided by the indicators contained in ISO/IEC TR 15504-5 (Exemplar Model). Assessment indicators are defined to support an assessor's judgement of the performance and capability of the assessed process.

Within the reference model, the capability of a process is evaluated based upon the process attributes (PA). Each attribute measures a particular facet of the process and these attributes are measured based upon a percentage scale;

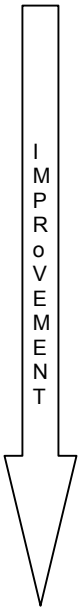
N Not achieved : 0% to 15%

P Partially achieved : 16% to 50%

L Largely achieved : 51% to 85%

F Fully achieved : 86% to 100%

Table 2.2 Capability Level Ratings [ISO/IEC, 1998]



Scale	Process Attributes	Rating
Level 1	Process Performance	Largely or fully
Level 2	Process Performance	Fully
	Performance Management	Largely or fully
	Work Product Management	Largely or fully
Level 3	Process Performance	Fully
	Performance Management	Fully
	Work Product Management	Fully
	Process Definition and Tailoring	Largely or fully
	Process Resource	Largely or fully
Level 4	Process Performance	Fully
	Performance Management	Fully
	Work Product Management	Fully
	Process Definition and Tailoring	Fully
	Process Resource	Fully
	Process Measurement	Largely or fully
	Process Control	Largely or fully
Level 5	Process Performance	Fully
	Performance Management	Fully
	Work Product Management	Fully
	Process Definition and Tailoring	Fully
	Process Resource	Fully
	Process Measurement	Fully
	Process Control	Fully
	Process Change	Largely or fully
	Continous Improvement	Largely or fully

The process attributes are used to determine whether a process has reached a given capability. Process attributes and their brief descriptions are as follows;

- PA 1.1 : Process Performance Attribute: The extent to which the process achieves its purpose and outcomes.
- PA 2.1 : Performance Management Attribute: The extent to which the performance of the process is managed to meet the defined objectives.
- PA 2.2 : Work Product Management Attribute: The extent to which the work products of the process are documented, controlled, verified and adjusted to satisfy the requirements.
- PA 3.1 : Process Definition Attribute: The extent to which a process is defined as the standard process and to which a standard process has the tailoring principals for individual implementations.
- PA 3.2 : Process Resource Attribute: The extent to which the process has the required resources.

- PA 4.1 : Measurement Attribute: The extent to which product and process goals and measures are used to control the achievement of the defined goals.
- PA 4.2 : Process Control Attribute: The extent to which the process performance is managed quantitatively through the suitable analysis and control techniques.
- PA 5.1 : Process Change Attribute: The extent to which changes to the process are controlled and evaluated based upon the defined product and process goals.
- PA 5.2 : Continous Improvement Attribute: The extent to which the efforts are available to perform improvement actions in a continous manner.

2.2.5 The Exampler Model (ISO/IEC TR 15504-5)

The processes contained in the reference model are described in terms of their purpose statements and process outcomes. This information is not sufficient to perform a reliable and repeatable assessment. It must be supported by some additional information to support an assessor's judgement. This additional information is provided by the exemplar model contained in ISO/IEC TR 15504-5.

The exemplar model provides the assessment indicators of process performance and capability. Indicators are used to determine whether a specific process achieves its purpose. Base practices, work products and work product characteristics are the set of indicators of process performance and they demostrate the achievement of the purpose of a specific process. A base practice is a software engineering or management activity that addresses the purpose of a particular process. Associated base practices can be found in Clause 5 of ISO/IEC TR 15504-5. The base practices and work products are indicators of a Level 1 process performance. Work products can be found in ISO/IEC TR 15504-5 Annex A, and their characteristics in ISO/IEC TR 15504-5 Annex C.

The processes defined in the process dimension have a set of associated base practices. Similarly, each process attribute in the capability dimension has a set of associated management practices that are the principal indicators of process capability. Management practices are common activities and they are applicable to any process. There are usually four management practices for each attribute.

Management practices and their descriptions can be found in ISO/IEC TR 15504-5 Annex B.

2.2.6 The Acquisition Process of ISO/IEC TR 15504

The acquisition process of SPICE consists of four steps. They are as follows;

1 Acquisition preparation process: The purpose of the acquisition preparation process is to establish the needs and goals of the acquisition. It involves;

- 1.1 Preparing product need assessment
- 1.2 Defining the requirements
- 1.3 Preparing acquisition strategy
- 1.4 Defining acceptance criteria
- 1.5 Preparing the request for proposal (RFP)

2 Supplier selection process: The purpose is to choose a qualified supplier that will satisfy the contractual requirements. It involves;

- 2.1 Preparing supplier history record
- 2.2 Evaluating the responses and selecting a supplier
- 2.3 Preparing and negotiating the contract

3 Supplier monitoring process: The purpose is to monitor the supplier's activities during the development of the software product or service. It involves;

- 3.1 Provide supplier feedback
- 3.2 Review development with supplier

4 Acceptance process: The purpose is to approve the supplier's deliverable when all acceptance conditions are satisfied. The delivered software product should be evaluated with regard to the agreed requirements.

- 4.1 Evaluating the delivered product
- 4.2 Accepting the product

2.3 Software Acquisition Capability Maturity Model (SA-CMM)

2.3.1 Introduction to SA-CMM

The goal of a standard is to encourage organizations to enhance product quality and to optimize the resources of the organization by improving the processes that achieve the activities.

The Software Engineering Institue (SEI) published the Software Acquisition Capability Maturity Model Version 1.01 in 1996 and Version 1.02 in 1999 [CMU/SEI, 1999]. While the CMM for Software (SW-CMM) describes the software product developer's role, the SA-CMM describes the buyer's (acquirer's) role in the software acquisition process as shown in Figure 2.2.

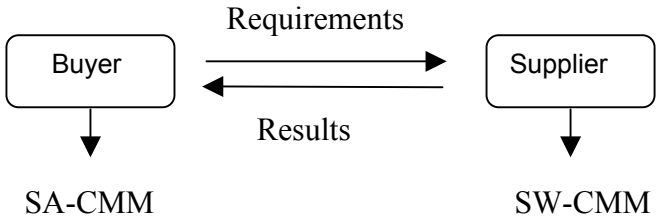


Figure 2.2 The Difference Between SA-CMM and SW-CMM

The SEI is funded by U.S. Department of Defense, which experienced considerable problems when acquiring software products for the Government. As a result of these important experiences the SEI has developed the SA-CMM, which is a framework that describes the key elements of an effective and mature software acquisition process. It provides an evolutionary improvement path from an ad hoc, immature process (initial) to a mature, disciplined process (optimizing). When applied, these key practices improve the ability of organizations to meet organizational acquiring goals in an effective manner.

2.3.2 Structure of The SA-CMM

The SA-CMM defines five maturity levels from Level 1-the initial level to Level 5- the optimizing level as shown in Figure 2.3. A maturity level represents a particular level of process performance and process capability. Each maturity level (except Level 1) has some key process areas (KPA) that indicate where an organization should focus to improve its software acquisition process. Table 2.3 indicates the KPAs at each level. For a process to reach a particular maturity level, it must satisfy all the goals that are identified in the KPAs of that level. A maturity level encompasses the KPAs of lower levels. For example, an organization has a team that is responsible for performing the project's software acquisition management activities in the Project Management key process area at Level 2, the SA-CMM assumes that the same team exists at Level 3.

KPAs also include five common features besides the process goals. Key practices of the KPAs are divided among these five common features; commitment to perform, ability to perform, activities performed, measurement and analysis, and verifying and implementation. The existence of common features indicates three attributes of a KPA; effective, repeatable and lasting. If these three attributes exist than we can say that this KPA is implemented appropriately and effectively, it will be maintained over time and it can be applied successfully to new projects. For an organization or a process to achieve a KPA, it must perform the full set of common features and the detailed activities

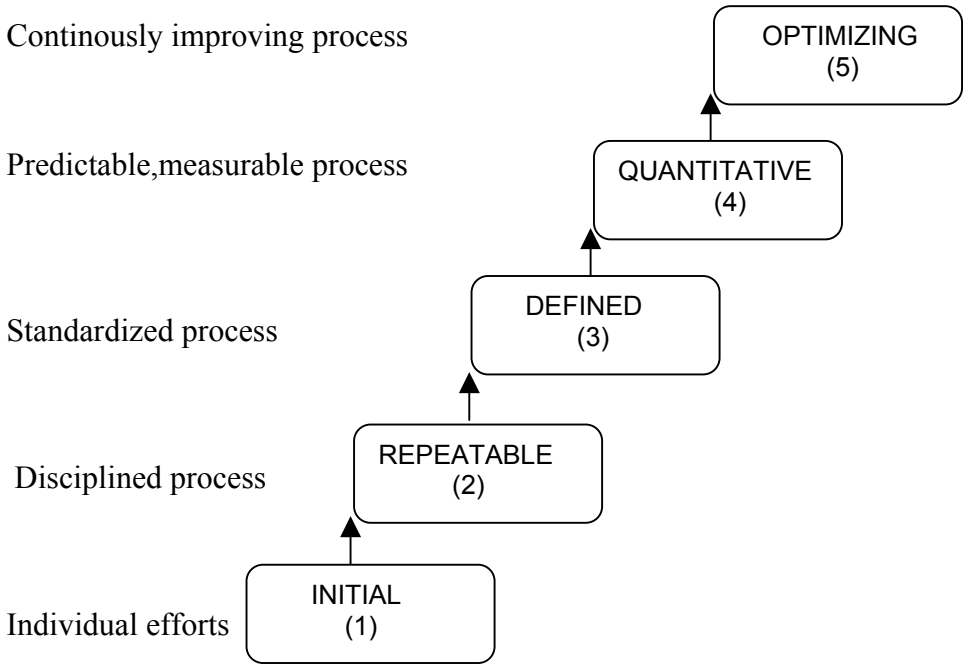


Figure 2.3 SA-CMM Maturity Levels [CMU/SEI, 1999]

The common features and their descriptions are as follows;

- *Commitment to perform* : Commitment to perform describes the actions that the organization must take to establish the process. It involves establishing organizational policies and management sponsorship.
- *Ability to perform* : Ability to perform includes the requirements to perform a software acquisition process competently. It involves resources, organizational structures and training.

- *Activities performed* : Activities performed describes the roles and procedures necessary to implement a KPA. It involves establishing plans and procedures, performing the work, tracking it and taking appropriate management actions.

Table 2.3 Key Process Areas at Each Level [CMU/SEI, 1999]

Level	Key Process Areas
Optimizing 5	Acquisition Innovation Management Continous Process Improvement
Quantitative 4	Quantitative acquisition Management Quantitative Process Management
Defined 3	Training Program Acquisition Risk Management Contract Performance Management Project Performance Management Process Definition and Maintenance
Repeatable 2	Transition to Support Evaluation Contract Tracking and Oversight Project Management Requirements Development and Management Solicitation Software Acquisition Planning
Initial 1	---

- *Measurement and analysis* : Measurement and analysis describes the need to measure the process and analyze the measurements. This need arises from the necessity to determine the status of the activities performed.
- *Verifying implementation* : Verifying implementation describes the actions to control the activities. It involves reviews by management.

2.3.3 Maturity Levels of The SA-CMM

Level 1- The Initial Level : A Level 1 organization performs the software acquisition process in an ad hoc manner. The basic skills needed to perform the acquisition process are not known. The composition of project team depends on availability of the individuals. Individual effort is a characteristic of the projects.

Level 2- The Repeatable Level : A Level 2 organization has basic management controls to establish a process discipline. Software acquisition project management processes are performed and there is a process discipline, resulting in repeating earlier successes on similar projects. The project team is composed of

individuals which have basic acquisition skills, and team members are committed to apply the plans, policies, regulations and standards.

Level 3- The Defined Level : A Level 3 organization has a well-defined, documented, and standardized acquisition process. Individual projects use an approved, tailored version of the organization's standard acquisition process. Personnel training is in place to ensure that all participants and managers have the knowledge and skills required to carry out their tasks. There is a software acquisition process group to conduct the process definition and maintenance efforts.

Level 4- The Quantitative Level : A Level 4 organization measures the process performance and these quantitative measurements are used when making decisions. The processes are controlled in acceptable quantitative boundaries. Variations outside the acceptable limits are not allowed and the data on that variation is uesd to adjust the process.

Level 5- The Optimizing Level : A Level 5 organization is focused on continous process improvement. Innovative ideas and new technologies are piloted and the results are used to improve the process.

2.3.4 An Acquisition Process Based On SA-CMM

The SA-CMM is more suitable for the acquisition activities of government acquirers. It has very detailed acquisition steps and institutionalization efforts and requirements

SA-CMM's KPAs are the attributes that should be involved in an acquisition process, they are not the steps of a process. Nevertheless, a mature software acquisition process based on SA-CMM can be established, but this subject is out of this chapter's scope.

2.4 Euromethod

The European Union procurement directives and council decision on standardisation in the information systems (IS) field [Euromethod, 1996] led to some new needs for public IS procurers. In cooperation with Member States, The European Union has developed the Euromethod to meet these needs and to provide a common terminology and a common basis for customer and supplier of IS . The

Euromethod provides guidance on analyzing, planning and managing customer-supplier relationships at a contractual level in IS-adaptations or IS service provisions.

Any system that achieves providing, usage, and distributing the information in an organization is called Information System.The Euromethod describes an IS-adaptation as a correction, enhancement, improvement, automation, introduction or inclusion activity of a new computer system of an IS to fulfil the needs of an organization.

The Euromethod addresses a second type product; steady-state service provision which supports the day-to-day functioning of the organization. Steady-state processes are usually continuous and they contain activities that are repeated regularly.

In Euromethod the steady-state service (service for short) and adaptation service (adaptation for short) are addressed.

2.4.1 Euromethod Project Objectives

The most important issue in an acquisition process is the mutual understanding of the desired final product. Euromethod assumes that one of the main obstacles to achieving mutual understanding is the variety of methods using different concepts and terminology. The other is the different backgrounds of the customer and supplier groups in terms of culture, training and methodologies. The first objective of Euromethod is to facilitate the mutual understanding between customers and suppliers through considering adaptations and service provisions from an acquisition point of view rather than an engineering point of view.

The second objective is to improve the acquisition of information systems and services by taking full account of the problem situation and associated risks.

The third objective is to provide a framework in the customer-supplier relationship area, in which the harmonization between different development methods can be achieved.

In 1996, The European Union has launched a new program: Support and Guidance to the Procurement of Information and Telecommunication Systems and services (SPRITE-S^2) and Euromethod is being marketed under the name ISPL; Information Services Procurement Library since then [Euromethod, 1996].

2.4.2 The Structure Of Euromethod

Euromethod describes two key roles in an acquisition process:

- *Contract authority* is the person or persons who are responsible for and authorized to make a decision about the issues related with the contract,
- *Service or project authority* is the person or persons who are responsible for and authorized to make a decision about the issues related with the service or projects.

Euromethod assumes that these two roles are presented in both the customer and supplier organizations.

Acquisition starts as a customer process and then includes customer-supplier processes.The participants of an acquisition process can use Euromethod as a guidance for them. The Euromethod document consists of five chapters, annexes and a dictionary.

- *Chapter 1*: Introduction of concepts; this chapter provides the key concepts and roles used in Euromethod and is an entry point for all user types.
- *Chapter 2*:The acquisition process; this chapter includes a detailed guidance on acquisition process. The key processes of acquisition are outlined here with references to more detailed information throughout the remainder of the book.
- *Chapter 3*: Deliverables; this chapter includes the deliverables of Euromethod. It describes the deliverables for the project authorities from both the customers and suppliers.
- *Chapter 4*: Adaptation planning techniques; this chapter is specific to adaptations because it provides a guidance for the planning of adaptations. It should be read by the project authorities.
- *Chapter 5*: Describing and planning services; this chapter is similar to chapter 4 but it focuses on service provision planning.

2.4.3 The Acquisition Process of Euromethod

The acquisition process starts with a customer process “The Acquisition Initiation Process” and ends with the “Contract Completion Report” process. The model cosists of two main parts; acquisition initiation and procurement. Procurement means a simple acquisition or a simple part of a complex acquisition. After

acquisition initiation process, one or more procurement processes begin. Each procurement process consists of a series of customer-supplier processes related to one contract; tendering process, contract monitoring process and contract completion process that can be summarized as shown in Table 2.4. The steps of the process are as follows:

Table 2.4 Acquisition Process of Euromethod

1. Acquisition Initiation	1.1 Acquisition Goal Definition	1.1.1 Define target domain
		1.1.2 Refine the definition of the acquisition goal
		1.1.3 Analyse costs and benefits
		1.1.4 Analyse stakes and stakeholders
	1.2 Acquisition Planning	1.2.1 Determine overall provisions scenarios
		1.2.2 Analyse risks
		1.2.3 Design acquisition strategy
		1.2.4 Plan the main decision points of the acquisition
		1.2.5 Setting-up the customer organization within acquisition
2. Procurement	2.1 Tendering	2.1.1 Preparation of request for proposal
		2.1.2 Response preparation
		2.1.3 Supplier selection
		2.1.4 Contract preparation
	2.2 Contract Monitoring	2.2.1 Validate target domain deliverables
		2.2.2 Validate project and service management deliverables
		2.2.3 Propose alternative decisions
		2.2.4 Report on contract status
		2.2.5 Make and report on decisions
		2.2.6 Perform actions according to decisions
	2.3 Contract Completion	2.3.1 Report on contract status
		2.3.2 Make contract completion decisions
		2.3.3 Report on contract completion (contract completio report)

1. Initiating the Acquisition Process

1.1. Acquisition goal definition: To have a sufficiently clear understanding of the requirements to the systems and services that are the goal of the acquisition.

1.1.1. Define target domain: Defining the borders of the area impacted by the adaptation or defining of processes which should be contracted.

1.1.2. Refine the definition of the acquisition goal: The definition of the acquisition goal must identify the necessary deliverables and services and define their requirements. It must achieve sufficient precision in requirements.

1.1.3. Analyse costs and benefits: As far as possible,the benefits should be evaluated in financal terms. All benefits should be identified including those that cannot be quantified. All costs related to the acquisition must be considered. Examples of costs are: hardware purchase, software development, acquisition management, project and service management, quality assurance, test data preparation, training, system and service installations.

1.1.4. Analyse stakes and stakeholders: Identify and advertise benefits for all stakeholders who may either make the acquisition a succes or a failure. A SWOT (Strengths,Weaknesses,Opportunuties,Threats) analysis may be done here.

OUTPUT PRODUCT: ACQUISITION GOAL

1.2.Acquisition planning: Define an acquisition strategy adapted to the situation, plan the main decision points of the acquisition, and establish the acquisition organization.

Inputs: Acquisition goal definition.

1.2.1.Determine overall adaptations and service provisions scenarios: Make scenarios according to priorities and dependencies between deliveries.

1.2.2.Analyse risks: The situation must be analysed to identify the risks involved in the acquisition. Situational factors are the properties of the situation which generate risks and which sholud be taken into account in the design of the acquisition strategy. The Euromethod situational factors analysis can be used to predict the risks within a situation and to determine the most appropriate adaptation strategy for their avoidance or containment.

1.2.3. Design acquisition strategy: The design of a risk management strategy should be treated as the key to the design of the acquisition strategy.

1.2.4. Plan the main decision points of the acquisition: The customer contract authority should plan and organise the main decision points of the acquisition based on the acquisition goal, the plans for deliveries, and selected risk management options. The acquisition plan must contain the planned procurements and other customer activities.

1.2.5. Setting-up the customer organisation within the acquisition: Establishing the organisation which will carry out the acquisition process.

OUTPUT PRODUCT: ACQUISITION PLAN INCLUDING THE ACQUSITION STRATEGY.

2. Procurement process: A procurement is the process of obtaining adaptations and service provisions regulated by one contract. The requirements to a procurement are outlined during acquisition initation and documented in an acquisition plan. The acquisition plan must be kept up-to-date under version management control.

2.1.Tendering: This process aims to select a supplier and to agree with the chosen supplier on a contract.

2.1.1. Preparation of request for proposal: The goal is to produce a request for proposal that documents the customer's requirements in line with the acquisition goal and plan and that is a sufficient basis for interested suppliers to make proposals.

OUTPUT PRODUCT: REQUEST FOR PROPOSAL

2.1.2. Response preparation: An activity related with the supplier.

OUTPUT PRODUCT: RESPONSE

2.1.3. Supplier selection: The aim is to select the best, most cost effective proposal from the responses received.

OUTPUT PRODUCTS: SUPPLIER EVALUATION REPORT AND NOTICES TO SUPPLIERS

2.1.4. Contract preparation: The aim is to agree on a contract consistent with the current requirements which is likely to secure the best value for money from the allocated budget.

OUTPUT PRODUCT: CONTRACT

2.2. Contract monitoring: Monitoring the supplier process to ensure that the deliverables and services conform with the specified requirements.

2.2.1. Validate target domain deliverables: Target domain deliverables are systems or documents related to the target domain of an acquisition. There are two types of target domain deliverables: operational item or descriptive item.

2.2.2. Validate project and service management deliverables: These deliverables are used to plan and control projects and services provisions.

2.2.3. Propose (alternative) decisions (decision point proposal): The supplier should make some proposals for decisions.

2.2.4. Report on contract status (contract status report): The supplier should make a contract status report when required in the decision point description, or the situation demands decisions regarding the contract.

2.2.5. Make and report on decisions (decision point report): The organization and procedures described in the decision point description should be applied.

2.2.6. Perform actions according to decisions

OUTPUT PRODUCT: DECISION POINT REPORT

2.3. Contract completion: The aim is to ensure that all outstanding technical and commercial issues regarding this IS-procurement contract have been satisfactorly concluded.

2.3.1. Report on contract status (contract status report): Based on project and service management reports, the supplier should make a final contract status report to support the contract completion decisions.

2.3.2. Make contract completion decisions: The completion decisions based on the contract status report should be taken. The customer should close the contractual relationship with the supplier.

2.3.3. Report on contract completion (contract completion report): The purpose of the report is to record all the decisions during contract completion and to which degree the contract has successfully achieved its business objectives, including the planned benefits; and to identify lessons to be learnt with regard to future IS procurements.

OUTPUT PRODUCT: CONTRACT COMPLETION REPORT

2.5 IEEE Recommended Practice for Software Acquisition, IEEE Std.1062

The IEEE Recommended Practice for Software Acquisition was initially published in 1993 and the last version was published in 1998 as a document of 43

pages [IEEE, 1998]. Like other standards and models, it also provides useful practices on software acquisition. The objectives were to promote consistency within acquiring and supplier organizations, to emphasize quality considerations during acquisition planning, and to provide guidance on evaluating supplier.

2.5.1 Software Acquisition Process of IEEE Std.1062

The practice describes the software acquisition life cycle as a period of time that begins with the decision to acquire a software product and ends when the product is no longer available for use. The whole life cycle is divided into five phases as shown in Table 2.5;

1. Planning Phase: The phase begins with developing the idea for acquiring and ends with releasing the RFP.
2. Contracting Phase: The phase begins when the RFP is released and ends with signing the contract.
3. Product Implementation Phase: The phase begins when the contract is signed and ends when the software product is received.
4. Product acceptance Phase: The phase begins with receiving the software product and ends with acceptance of the product.
5. Follow-on Phase: The phase begins acceptance of the product and ends when the product is no longer available for use.

The acquisition process includes nine sub-processes, in other words acquisition life cycle is composed of nine steps. The steps and the tasks to be achieved are as follows;

1 Planning organizational strategy: Three activities should be performed here;

1.1 Initiate a planning process: Develop a scope for the planning process, form a planning group and review the organization's objectives, and finally identify the software product quality characteristics.

1.2 Setting organizational strategy: Organizational acquisiton strategy should be developed based upon the quality characteristics that the software product should have. Identify the capabilities which the supplier should have for this project and select potential suppliers who could have these capabilities.

1.3 Establishing general practices: General practices should be established to achieve consistency in negotiating and contracting with suppliers for software products.

OUTPUTS FROM THE STEP:

- Quality characteristics of software
- Organizational strategy for acquiring software
- General practices

2 Implementing organization's process: This process typically includes establishing the software acquisition process and tailoring it for specific projects.

Table 2.5 The Acquisition Life Cycle of IEEE Std 1062,1998 [IEEE, 1998]

1. Planning	1.1 Planning organizational strategy
	1.2 Implementing organization's process
	1.3 Determining the software requirements
2. Contracting	2.1 Identifying potential suppliers
	2.2 Preparing contract requirements
	2.3 Evaluating proposals and selecting the supplier
3. Product Implementation	Managing supplier performance
4. Product Acceptance	Accepting the software
5. Follow-on	Using the software

2.1 Establishing the software acquisition process: A documented software acquisition process should be established and it must fit the organization's needs.

2.2 Including contracting practices: When establishing an acquisition process (in step 2.1) contracting methods, deliverables, support, training, acceptance requirements, and selection criterias should be identified.

2.3 Obtain services from other organizations: If acquiring organization does not have knowledge, skills and abilities to perform the tasks above, it can obtain these from an external organization.

2.4 Assigning responsibility for success of software acquisition process: Success of process will mainly depend on effective coordination, hence one person should be appointed with overall responsibility for the project.

2.5 Tailoring the process: A reference list of information currently available for additional guidance on implementing a process should be maintained. A person who will assure the tailored process should be appointed .

OUTPUTS FROM THE STEP:

- A defined software acquisition process for organization
- Supplier qualification and selection process

3 Determining the software requirements: The software product should be well-defined and RFP must be prepared.

3.1 Defining the software being acquired: When defining the software being acquired, help can be obtained from the supplier(s) to make realistic assessments of the size, scope and cost of the effort required to produce the software.

3.2 Establishing proposal evaluation standards: An evaluation criteria should be developed to use in selecting a qualified supplier.

3.3 Establishing acquirer and supplier obligations: The objective is to identify clearly the obligations of both the acquirer and the supplier.

3.4 Developing plans to evaluate and accept software and services: Quality and maintenance plans should be developed.

3.5 Develop contingency plans: Contingency plans should be developed to use in the event the suppliers fails to satisfy contract requirements.

OUTPUTS FROM THE STEP:

- A well-defined software product
- Quality and maintenance plans
- Proposal evaluation standards
- Contingency plan
- Request for proposal

4 Identifying potential suppliers: The aim is to gather information about the product and suppliers.

4.1 Gather information on available software products: The software requirements defined in step 3 should be used when gathering information on available products.

4.2 Evaluate software during a demonstration: Acquirer may want supplier to demonstrate the product.

4.3 Survey users of the supplier's software: To ensure that the candidate supplier's product quality, acquirer may use the number of satisfied companies currently using the software.

4.4 Review performance data from previous contracts: If software has been previously acquired from any of the potential candidates, it would be helpful to review performance data on each supplier from previous contracts.

4.5 Survey several suppliers' offerings: Suppliers should be evaluated on the basis of their answers to the following elements: financal soundness, experience and capabilities, development and control processes, technical assisstance, quality practices, maintenance services, product usage, warranty, and costs.

OUPUTS FROM THE STEP:

- Information on available software
- Candidate list and user survey

5 Preparing contract requirements

5.1 Determine the quality of the work: Identify the measures of reliability and quality of the product, specify performance and functional requirements and etc.

5.2 Determine how payment is to be made: The contract should tie supplier payments to deliverables.

5.3 Determine nonperformance remedies: The contract should provide the acquirer the right to terminate the contract if the supplier cannot perform according to the contract's terms.

5.4 Prepare contract provisions: Contract provisions should be developed to the acquirer's needs.

5.5 Review contract provisions with legal counsel: Modified provisions should be reviewed by organization's legal counsel to ensure the consistency with law and regulations.

OUTPUTS FROM THE STEP:

- Acceptance criteria
- Supplier performance criteria

- Evaluation and test criteria
- Payment schedule
- Contract and legal counsel review

6 Evaluating proposals and selecting supplier: The selection process should include, as a minimum, the following activities; evaluating supplier proposals, visiting supplier facilities, selecting a qualified supplier and finally negotiating the contract.

6.1 Evaluate supplier proposals: Use the evaluation criteria. Consider the supplier's management qualifications, technical approach, quality assurance program and proposed cost estimate. Suppliers that are not completely responsive to the requirements in the RFP should be eliminated from further consideration.

6.2 Visit supplier facilities: The aim is to investigate and evaluate financal position, tachnical capability, experience and quality practices.

6.3 Select a qualified supplier: Select a qualified supplier from the best two or three candidates and begin negotiations.

6.4 Negotiate the contract: Negotiate the contract with the supplier to identify any problems and misunderstandings.

OUTPUTS FROM THE STEP:

- Evaluation of proposals
- Evaluation of suppliers
- Qualified suppliers list
- Selected supplier
- Negotiated contract

7 Managing supplier performance:

7.1 Manage the contract during execution: Supplier should meet contract requirements. An individual should be appointed to be responsible for contract tracking.

7.2 Monitor supplier's progress: The objective is to monitor the supplier's progress to ensure that all milestones are met.

OUTPUTS FROM THE STEP:

- Work segments approved

- Completed milestones
- Software deliverables
- Reliability and quality measurements
- Feedback to supplier

8 Accepting the software:

8.1 Evaluate and test the software: Acceptance criteria must be kept meaningful and current. If the software is to be used in another system, system-level test should be performed.

8.2 Maintain control over the test: The acquirer should have a role in the testing process.

8.3 Establish an acceptance process:The aim is to ensure that all acceptance criteria have been satisfied.

OUTPUTS FROM THE STEP:

- Acceptance process
- Acceptable software
- Usable documentation

9 Using the software: Use the product and identify both good and bad aspects of the acquisiton. Analyze the software acquisition contract.

9.1 Evaluating contracting practices: Identify strengths and weaknesses of the process.

9.2 Evaluate user satisfaction: Record the amount of software maintenance work that is needed soon after the software is put into use.

9.3 Evaluate supplier performance: Retain performance data on the individual supplier for future reference.

2.6 Comparison

While SA-CMM, SPICE and IEEE address the acquisition of software portion of a system, Euromethod addresses procurement of a whole Information System. In fact the others also require that software acquisition should be performed in conjunction with the whole system acquisition. But because of the risky aspect of software portion of the system, they explicitly address software acquisition instead of IS-procurement.

All models that have been mentioned above are generic models. They encompass general steps and procedures of a software acquisition process. Organizations which decide to improve their acquisition processes should develop their own processes through tailoring the models according to their business needs and the environment in which they perform their activities.

After examining the models, it can be clearly seen that SA-CMM does not give a step-by-step process. It only provides the key process areas which should be considered in an acquisition process. For example, if an organization decides to improve its requirements development and management sub-process in its current acquisition process, SA-CMM can be used as an excellent guidance. On the other hand, other models provide a step-by-step process which can be established at the beginning of an acquisition process.

The comparison of models will be attempted in two parts. The structure, scope and guidance of the models will be considered in first part and the acquisition processes of models will be compared in second part.The structure means the structure of model's document, the scope represents the software processes that are considered in the model, and finally the guidance shows the area on which the model provides a guidance.

2.6.1 Comparison of Structures

It can be seen from Table 2.6 on the next page that SA-CMM, IEEE and SPICE give only what-to-do when performing processes. But Euromethod provides a guidance on how to perform the acquisition process. While SPICE includes all software life cycle processes (organizational customer-supplier, engineering, management and supportive processes), other models encompass only acquisition process.

The areas on which the models provide guidance are different. For example, SPICE includes overall information on the concepts of software process assessment and its use in performing process improvement and in process capability determination.

2.6.2 Comparison of Acquisition Processes

Although the models have some differences, they all have similar steps and phases. After examining the models, it can be clearly seen that a software acquisition process consists of four phases from the point of view of acquirers and as a result of acquirer-supplier relationship it consists of three phases from the point of view of suppliers. These phases are shown in Figure 2.4 and it can be seen that the process begins as an acquirer process and continues as an acquirer-supplier common process. Management of this process primarily requires applying project management discipline and specifying the customer requirements.

Table 2.6 Comparison of Models

Characteristic of Model	Structure	Scope	Guidance
SA-CMM	A document consists of an introduction and explanation of five maturity levels.	Software Acquisition Processes. All types of acquisitions (embedded, stand-alone, COTS, NDI)	What to do when performing software acquisition process (key process areas)
SPICE	A document consists of nine parts (informative and normative parts)	Software Life Cycle Processes. All types of acquisitions.	What to do when performing processes, assessments, and developments of models and methods.
IEEE Std.1062	A document of vi+43 pages including three annexes	Software acquisition processes. More suitable for MOTS and fully developed software	Performing software acquisition process (step-by-step)
EUROMETHOD	A reference manual (around 220 pages), a dictionary, and an annex with examples and templates.	IS-procurement processes including the tasks of suppliers. Any IS development, upgrade, modification or customization.	Not only what to do, but also how-to-do.

According to all examined models and as Figure 2.4 shows, software acquisition process can be divided into four phases: planning, tendering, contract monitoring (supplier monitoring) and acceptance. Table 2.7 shows these phases and the sub-processes of models.

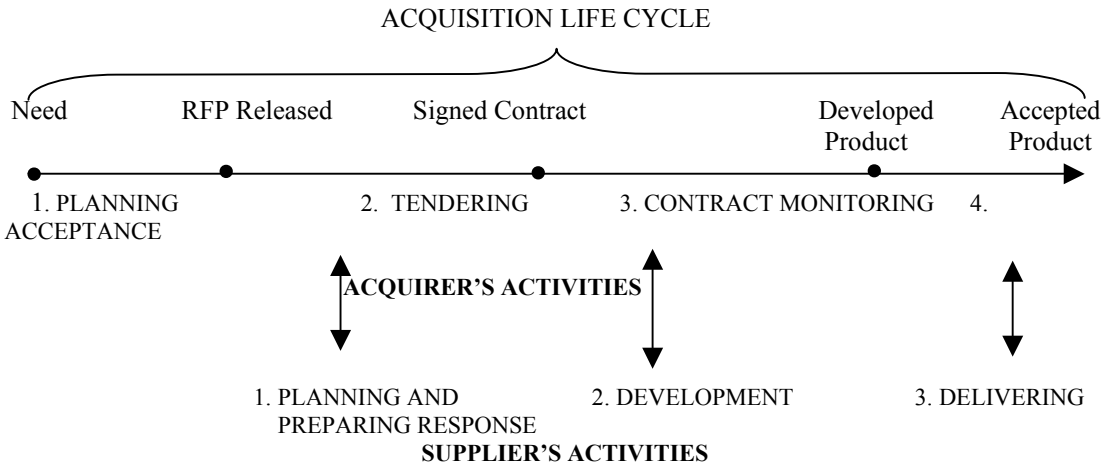


Figure 2.4 Software Acquisition Process Phases and Mutual Relationship

Planning phase is the first and most important phase of the acquisition process. This phase has a great impact on the success of the process. Acquisition planning should include all elements of the acquisition project.The main activities of this process are acquisition goal definition, acquisition strategy developing, feasibility analysis, staffing a project office, developing contractual requirements, preparing cost and schedule estimates, and identifying the risks. Table 2.8 on the next page shows planning process activities of models.

Table 2.7 Acquisition Processes of Models

	EUROMETHOD	IEEE Std.1062	SPICE	SA-CMM
Planning	Acquisition goal Definition Acquisition planning	Planning	Acquisition preparation	Software acquisition planning Requirements development and management
Tendering	Tendering	Contracting	Supplier selection	Solicitation
Contract Monitoring	Contract monitoring	Product Implementation	Supplier monitoring	Contract tracking and Oversight
Acceptance	Contract completion	Product acceptance Follow-on	Customer acceptance	Evaluation Transition to support

Euromethod has an acquisition goal definition step before planning process. It describes acquisition goal as a consistent set of system and service requirements that satisfy the selected business needs of the target domain (part of an organisation which is affected by an adaptation or a service). Examples of acquisition goals are: an improved business process, a new organisational structure, a new computerized application, an improved computer system operation service. Euromethod's planning

phase (after developing the acquisition goal) begins with determining overall acquisition scenarios and ends with setting up the acquisition project office. Defining target domain is the first step of Euromethod's process and it does not exist in other models. This step emphasizes that the target domain should be well identified, it can make the acquisition a success or a failure.

The acquisition planning process of SA-CMM is very detailed and it includes the whole life cycle of the project. Software acquisition planning documents including the acquisition strategy are prepared during system acquisition planning and maintained throughout the acquisition. IEEE Std.1062 addresses three steps in planning process: reviewing acquirer's objectives and developing an acquisition strategy, establishing a software acquisition process and determining the software requirements. In IEEE's planning phase the qualities of software product should be identified. Because IEEE emphasizes that acquisition strategy should be designed based on quality characteristics of product. In addition, while IEEE requires assigning one person for overall responsibility for the success of the process, other models do not have such an obligation.

In planning phase, designing acquisition strategy is one of the most crucial steps. All models have an acquisition strategy development step in planning phase. Euromethod describes acquisition strategy as determination of the number and the kinds of adaptations, service provisions, and contracts that are needed to reach the acquisition goal. Here, determination number of contracts means deciding on decomposition of acquisition into one or more than one procurements (each contract represents only one procurement). In a short statement, defining acquisition strategy means identifying the way of acquiring the desired product. As it can be seen from Table 2.8, all models require developing the acquisition strategy.

Table 2.9 shows that Euromethod has a risk management driving factor in designing strategy, while IEEE requires considering quality characteristics of the desired product. SA-CMM and SPICE stresses identifying the acquisition approach, contract and tendering types. SA-CMM's strategy definition emphasizes that the the contract type should be chosen based on the percieved risk of successfully delivering the required items while satisfying the cost and schedule requirements of the contract.

Table 2.8 Comparison of Planning Process

EUROMETHOD	IEEE Std.1062	SPICE	SA-CMM
Define target domain	Initiate a planning process	Preparing product need	Establishing a software acquisition group
Refine acquisition goal	Setting organizational strategy	assessment	Reviewing the system acquisition planning
Analyse costs and benefits	Establishing general practices	Defining the requirements	Developing software acquisition strategy
Analyse stakes and stakeholders	Establishing the software acquisition process	Preparing acquisition strategy	Preparing life cycle cost and schedule
Determine overall provisions	Obtain services from other organizations	Defining acceptance criteria	estimates
Scenarios	Assigning responsibility for success		Developing software acquisition planning
Analyse risks	of software acquisition process		
Design acquisition strategy	Tailoring the process		
Plan the main decision points of	Defining the software being acquired		
The acquisition	Establishing proposal evaluation standards		
Setting up the acquisition	Establishing acquirer and supplier obligations		
Organization	Developing plans to evaluate and accept		
	software and services		
	Develop contingency plans		

Table 2.9 Comparison of Acquisition Strategy

EUR OMETHOD	IEEE Std.1062	SPICE	SA-CMM
Risk management	Quality characteristics	The need to be acquired	Objectives of the acquisition
Framework	Required supplier	Approach for acquisition	Constraints
Standards	Capabilities	(off-the-shelf, develop...)	Alternatives?
Types of suppliers	Responsibilities with either	Evaluation criteria	Acquisition methods
Types of tendering	The supplier or the acquirer	Acceptance strategy	Contract types and terms
Single or multi phase?	The extent of supplier's	Constraints	End user considerations
Contract flexibility	organizational involvement		Risk identification
	Contractual requirements		

The second phase of acquisition process (refer to Table 2.7) is tendering phase. The aim of this phase is to select a qualified supplier for the considered needs of a particular acquisition and to agree with the chosen supplier on a contract defining the requirements and responsibilities of both parties. The main activities of this process are: planning solicitation activities, gather information on potential suppliers, preparing contract requirements, evaluating supplier proposals, selecting a supplier, and signing the contract. Table 2.10 shows tendering processes comparison of models. This table shows that IEEE has an emphasis on surveying suppliers. It requires visiting supplier facilities before selecting the supplier.

As a difference from other models, Euromethod presents a delivery plan approach for preparing the contract, which defines the contract monitoring process and the contract completion process. Euromethod's delivery plan is structured by decision points that are the milestones where the customer, possibly together with the supplier, is making decisions on supplier's delivered products. Euromethod and SPICE use "request for proposal" term, SA-CMM uses "solicitation package" and IEEE uses "contract" term. In fact they all stand for same thing with a nuance. "Request for proposal" is a baseline for contract and it is used to invite suppliers to give their proposals. After selecting a supplier and signing activity, "request for proposal" becomes a contract. Table 2.11 indicates the content of request for proposals of models, except IEEE, because it does not provide a template for it.

In SA-CMM's preparing solicitation package, life cycle cost and schedule estimates are reviewed by an independence unit. This provides organization making more realistic estimations.

Table 2.10 Comparison of Tendering Processes

EUROMETHOD	IEEE Std.1062	SPICE	SA-CMM
Preparation of request for proposal	Gather information on available software products	Define acquisition requirements	Preparing solicitation package
Define the target domain of the	Evaluate software during a demonstration	Preparing request for proposal	Developing software requirements
IS-procurement	Survey users of the supplier's software	Preparing supplier history record	Preparing for the evaluation
Determine the objectives of the	Review performance data from previous contracts	Evaluating the responses and selecting a supplier	of responses
contract and the requirements	Survey several suppliers' offerings	Preparing and negotiating the contract	Conducting the evaluation
Determine the organisational	Determine the quality of the work		Conducting supporting negotiations
Constraints and procedures	Determine how payment is to be made		Contract award
Determine delivery plan	Determine nonperformance remedies		
Define the supplier evaluation	Prepare contract provisions		
Approach	Review contract provisions with legal counsel		
Determine instructions for bidding	Evaluate supplier proposals		
Suppliers	Visit supplier facilities		
Supplier selection	Select a qualified supplier		
Contract preparation	Negotiate the contract		

Table 2.11 Request for Proposal Comparison

EUROMETHOD	SPICE	SA-CMM
Depiction of the target domain	Reference to the requirements	Objectives of the solicitation
Business objectives, needs	Specifications	Software requirements
Acquisition goals	System architecture	Proposal evaluation criteria
Instructions to bidders	Configuration requirements	Statement of work
Acceptance criteria	Requirements for service, consultants	Contract documentation
Payment conditions, warranties	Quality criteria	Contract form, contract type
Financal constraints, budgets	Project schedule requirements	Incentives
Requirements on supplier	Expected delivery/service dates	List of deliverable supplies and services
organizational characteristics	Cost/price expectations	Contract acceptance procedure
Supplier evaluation approach	Regulatory standards/requirements	Instructions to bidders
Reqoired delivery plan	Requirements for format of responses	Documentation requirements for the
Systems descriptions		offerors to submit with their responses
Required project and service plans		Proposal evaluation plan

In tendering phase, one of the most important things is that the solicitation activities are compliant with relevant laws, regulations and policies. IEEE offers a "Survey Several Supplier's Offerings" step as a difference from other models. This step requires choosing the best two or three candidates and each candidate should conduct a demonstration and provide formal proposals with detailed cost estimates as input to the final selection. In addition IEEE emphasizes visiting supplier facilities before signing the contract.

The third phase of acquisition process is contract-monitoring process. This phases's activities are the ones through which the acquirer tracks and monitors the supplier's development activities. SA-CMM uses " contract tracking and oversight", SPICE uses " supplier monitoring process ", Euromethod uses "contract monitoring" and finally IEEE uses "product implementation" for this phase. In this phase of the process, the acquirer provides supplier feedback to control the progress. There is a communication mechanism which enables the acquirer to have a sufficient insight into the development activities of supplier. Table 2.12 shows contract monitoring activities of models.

One of the baselines of contract monitoring phase is the contract. All models require planning supplier deliverables and acceptance procedures of these deliverables in contract. Euromethod deliverable concepts provide the means to characterise the deliverables that are exchanged between customers and suppliers during IS-procurements. It describes three types of deliverables: target domain deliverables, contract domain deliverables and management deliverables. Target domain deliverables are the deliverables related to the target domain of an acquisition, which are delivered from the supplier to the customer or vice-versa. Contract domain deliverables are the deliverables exchanged between customer and supplier related to the contract domain. And finally management deliverables (plans and reports) are the deliverables that describes the management domain with respect to service provisions and adaptations.

The fourth and the last phase of acquisition process is acceptance process. The purpose of this process is to approve the supplier's deliverables when all acceptance conditions are satisfied. The main activities of this process are evaluation, testing, verification and validation. SA-CMM has two key process areas for this

Table 2.12 Contract Monitoring Process Comparison

EUROMETHOD	IEEE Std.1062	SPICE	SA-CMM
Validate target domain deliverables Validate project and service management deliverables Propose alternative decisions Report on contract status Make and report on decisions Perform actions according to decisions	Manage the contract during Execution Monitor supplier's progress	Provide supplier feedback Review development with supplier Monitor the acquisition Monitor supplier	Contract tracking and oversight Review required supplier software planning document Compare actual cost and schedule Review supplier's work products Appropriate corrective action system Involving all affected groups

phase; evaluation and transition to support. The purpose of transition to support is to provide for the transition of the software products being acquired to the eventual software support organization [CMU/SEI, 1999].

Euromethod uses “contract completion” term for this phase. It represents the end of all adaptations and services provided within a single contract. All contract related issues (e.g. warranty, payment, etc.) should be resolved before closing the contract.

2.7 An Alternative Approach: Evolutionary Acquisition Method

The inherent complexity of software itself and the difficulty in defining the desired system leads us to employ a different strategy for acquisition of software intensive systems, because traditional acquisition strategies are often unable to deal with the problems in acquiring these complex systems. As an iterative strategy, *evolutionary acquisition* (EA) is an alternative approach which should be considered in acquiring large software systems [TÜBİTAK, 1998], [Henderson & Gabb, 1997].

The iterative aspect of EA helps us developing and acquiring an operational core component with a limited capability. This core component of the system is used and evaluated by the users of the system, and the required enhancements, additional capabilities and other improvements are made based upon the feedback provided by these users. This iterative process continues until the first product evolves into the desired final system.

EA approach can be used in acquisition of software intensive defense systems, computer based systems (rapidly changing technology), and systems which are new to TLFC.

The EA approach can be helpful in;

- developing a well defined and comprehensible core component,
- providing an early operational component,
- shortening the development time period,
- understanding and mitigating of expected risks,
- providing ability of interoperability,
- incorporating new technologies.

Competitive tendering can be used only for the first phase (for the core/initial system) and the same contractor can develop the succesive phases. The desired

capability should be well understood by the supplier before all phases. PMs should ensure that only the desired capability is defined before development phase, and also ensure that new emerging technologies be explored and the supplier try to adapt new technologies.

Two factors must be considered in an EA stratgey. The first is end user involvement to evaluation of each release. End users must be a part of the process in order to evaluate evolving products.

The second factor in a successful EA is to establish an open and flexible system architecture that will support possible changes.

A technical report published in 1997 [Henderson & Gabb, 1997] concludes that the number, content and size of acquisition process phases should be decided on the basis of risk, and the capability which is required by the users of the system. The authors note that capabilities which are well known can be included in the early phases. Capabilities which are less well defined should be specified in the later phases.

The same report states that selecting the supplier for an EA project will be difficult because of the flexible nature of the EA model and the typically complex and unprecedented systems involved. The authors propose that the supplier must not only be able to show the ability and commitment to develop a cost effective solution, but must also exhibit the willingness and ability to work closely and cooperatively with the acquirer and users and should be selected based on the past performance.

After this survey of fundamental approaches to acquisition of software intensive systems, in the next chapter, we shall consider the specific needs and problems of TLFC within the same framework.

CHAPTER 3

3 TURKISH LAND FORCES COMMAND SOFTWARE INTENSIVE SYSTEMS ACQUISITION PROCESS REQUIREMENTS

3.1 Introduction

Like other organizations throughout the world, TLFC also uses IT opportunities to satisfy its needs arising from being a strong army. As a component of the TAF, TLFC is responsible for organizing well-trained, well-equipped, and well-managed combat forces satisfying the requirements of the future battlefield.

In fact, there are no great differences between developing, producing and usage of a new system in a civilian organization and in TLFC. But defense systems are more expensive, require more security and safety, and also they are used for a considerably long time period. The sole customer of defense systems is the state which requires to be independent from foreign defense market as a result of its national security concern. In [TUBİTAK, 1998] the characteristics of defense systems are explained as follows:

- Large and complex systems
- Extensive use of advanced informatics technologies
- High cost
- Long usage time period
- High quality
- Operability in adverse environmental conditions

Hence defense systems acquisition requires more detailed concept developing and project management activities. As an example, in USA's new SC-21 class of battleships, total number of software instructions or source lines of code (SLOC) to realize the proposed capabilities is estimated at greater than 8,4 million. A development cost for software of this size and complexity is estimated in the range of $100.000.000 to $1.000.000.000 [Boehm & Scacchi, 1998].

Turkish Armed Forces' weapon, equipment, material and all kinds of logistics supply needs are met by Ministry of National Defense (MND) according to the types and amount identified by Force Commands and approved by General Staff. This

mission begins with sending Need Declaration Form (NDF) to MND, continues through planning, procuring, distributing, and ends with payment activity. Information systems acquisition has been considered on the same basis as other hardware and manifactured systems. Besides MND, there are two other participant bodies in an acquisition process: project office and need owner. After preparing Mission Need Statement (MNS) and Operational Requirements Document (ORD) by need owner, remaining documents are prepared by project office assigned by the Project Order.

In TLFC, current projects can be considered as major AISs. These systems are used to automate and standardize organisational and operational activities. They are aimed to be helpful in improving quality, reducing cycle time and decreasing costs. AISs are being acquired through national contractors. Other major weaponry systems are being acquired via Undersecretariat of the Defense Industry (UDI) from abroad.

3.2 Terms and Definitions

The following terms are used in the TLFC acquisition process. Before examining the current process it is helpful to have information about these terms. They are mainly based on [KKK, 2000] and [MSB, 2001-2].

CONCEPT (KONSEPT): Describing future battlefield to identify fundamental criteria that will be used to determine required capabilities. In other words, concept is the total of target capabilities.

MASTER PLAN - MP (MASTER PLAN): A living (dynamic) document which is prepared to guide future decision making, and which describes all aspects of the operational need. It forms a baseline for future decisions and project activities in terms of relationships and coordination requirements within the units. MP is mostly developed to restructure a current organizational unit, to develop a complex system, or to develop and acquire software intensive systems. The purpose is the same as the purpose of preparing the PNS. If MP exists, there is no need to prepare the PNS.

MAIN SYSTEM (ANA SİSTEM): The weapon, equipment or materials which require a considerable long development time period and which can be acquired for a comparatively high cost. AISs can also be considered as main systems.

MISSION NEED STATEMENT – MNS (GÖREV İHTİYAÇ DOKÜMANI): When nonmaterial solutions do not provide adequate fulfillment of mission deficiencies, upgrade, modification and new acquisition programs are established. The MNS is a brief statement identifying and documenting mission deficiencies requiring material and/or software solutions.

OPERATIONAL REQUIREMENTS DOCUMENT - ORD (HAREKAT İHTİYAÇ DOKÜMANI): As capabilities become better defined, specific requirements for the new or modified system are stated in the ORD. It also includes a summary of MNS.

PLANING, PROGRAMING, BUDGETING and IMPLEMENTATION SYSTEM - PPBIS (PLANLANMA, PROGRAMLAMA, BÜTÇELEME VE UYGULAMA SİSTEMİ): A management system that transforms military strategy and target capabilities to personnel, equipment, organization and training.

PRODUCT NEED STATEMENT – PNS (PROJE TANIMLAMA DOKÜMANI): This document is the basis of technical contract. It includes the scope of the desired system, the definition of capability that will be satisfied by the system and the operating medium of the system.This document is prepared before research and development activities. It is an input to MP and is prepared by need owner, the department or the branch school who request the system/product.

PROJECT ORDER - PO (PROJE EMRİ): In order for an identified need to become an acquisition project, General Planning and Policy Department prepares a Project Order to assign project management authority and to announce project schedule and resources. Modification of a current system, acquiring or development of a new system cannot be conducted without Project Order.

STRATEGIC TARGET PLAN -STP (STRATEJİK HEDEF PLANI): This plan identifies target capabilities which will be reached by TAF after ten years. It is a long term plan and it includes the projects that will be performed within the future.

TEN YEAR PROCUREMENT PROGRAM - TYPP (ON YILLIK TEDARİK PROGRAMI-OYTEP): Allocation plan of resources which will be used to perform the projects to reach the military strategic targets. TYPP is a subset of STP. The projects of TYPP are selected from STP according to their priorities and the status of monetary resources.

3.3 Current Project Types and Supply Methods

As mentioned in the introduction section, TLFC acquires software intensive systems which can be considered as major automated information systems. Although smart weapons and other advanced technologies are used in the army, these high-technology products are being acquired from abroad, there is no production or development from scratch as it occurs in USA. But this does not mean that Turkish Army will not develop information age weaponry systems in the future. Whatever the source of requirement, it is certain that the demand for new software will arise. If the process by which software products are acquired is imperfect, the outcome will be imperfect too.

TLFC meets its battlefield, operational and administrative needs through applying different solutions. If there is a gap between the target capabilities and current ones, after analyzing the problems and solutions, most appropriate solution is selected and applied. This may be material or nonmaterial solutions, changes in force structure, system modifications or upgrades, science and technology applications and new acquisition programs [KKK, 1997].

When the solution requires an acquisition program, this acquisition can be performed in different ways, through different supply methods. A supply method identifies the way in which TLFC procures its needs. The type of supply method affects project management applications. Project managers are able to decide to omit some of the steps of the general process which is explained in section 3.4. TLFC supply methods are as follows:

1. *Commercial-off-the-Shelf – COTS*: If there is an obligation for procuring a weapon/system in a short time and it is too expensive to develop the weapon/system then the need is satisfied by acquiring a COTS product. This can be done in two ways:

1.1. *Domestic Procurement*: It is essential to develop and produce the critical defense requirements of the TAF and those that must be national at domestic industrial facilities having appropriate national classified facility security documents based on research and development. In the areas where this principle cannot be applied, the defense industry is divided into sub-sectors and the national main contractor application is used at the selected sub-sectors.

1.2. *Foreign Procurement*: Priority is given first to the domestic defense industry for the equipment and systems that are decided to be procured. For those to be procured from abroad, priority is given to proposals which provide an opportunity for direct and/or indirect offset applications that will provide contributions to the domestic industry. The offset principles are determined by the MND [MSB, 2001-1].

2. *Joint Production in Turkey*: A project which

- requires technology transfer,
- requires great investments,
- is helpful in establishing fundamental technologies,
- satisfies continuous needs, is procured through this method.

3. *Domestic Research & Development*: R&D includes studies which explore needed information on a particular subject. TLFC should have required capabilities to perform the missions in military concepts. These new capabilities can be gained through introducing new systems and technologies. The main source of research and development studies is the military concepts. In this method TLFC leads the research activities and finally develops the desired system.

The preliminary study concerning which of the main system projects needed should be included in the STP and by which procedures they would be procured is made by the Planning, Programming and Investigation Committee (PPIC). The procurement method is determined according to the results of the research and evaluations to be made by MND. In recent years, production through consortiums and domestic R&D methods have gained a special importance [MSB, 2001-1].

3.4 Current Acquisition Process Overview

TLFC published an instruction [KKK, 2000] in 2000 to throw light on the acquisition process of major systems. This instruction includes the activities to be performed by TLFC personnel who are responsible for carrying out the acquisition process. It contains decision points and milestones from identifying the need to disposal of a product/system from usage. The overview presented below is mainly based on this instruction.

TLFC has two cycles when acquiring and developing major systems. The first one is related to identifying the need and defining a solution to this need in Planning,

Programming, Budgeting, Implementation System [KKK, 2000-1]. This cycle is based on allocation of resources and budgeting. It is refreshed every two years. The second one is the project management cycle. This cycle is mostly based on software engineering and project management activities. There is a project office for implementing the project and they perform system and software engineering activities to capture the system and software requirements, to define the desired system and to select most qualified supplier. This section will mostly explore the second life cycle in detail.

TLFC acquisition process is composed of seven sub-phases in two main phases as shown in Figure 3.1. "Production and Use" phase contains "Production and Deployment", "Operations and Support", and "Disposal from Inventory".

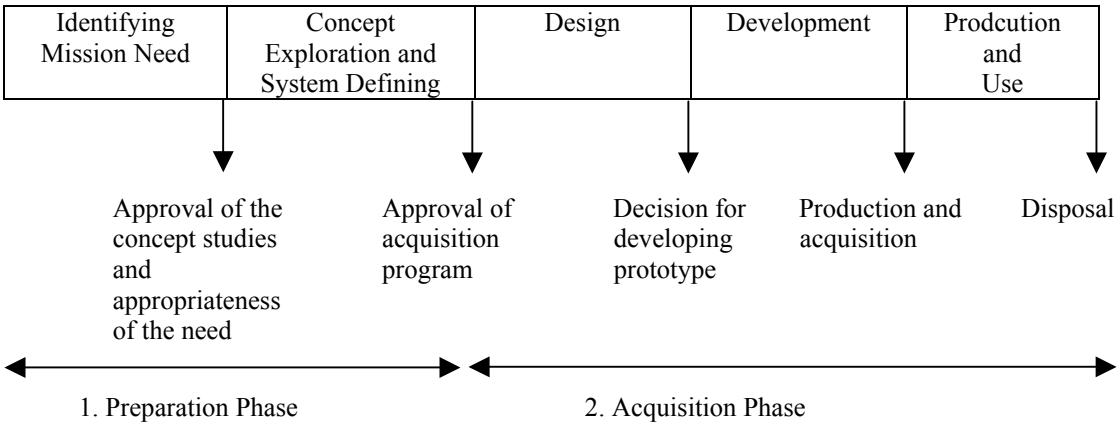


Figure 3.1 Acquisition Process of TLFC [KKK, 2000]

3.4.1 Identifying Mission Need Phase

A mission need is a requirement on the field of doctrine, training, leader training, force structure and equipment to win the combat [KKK, 2000-2]. Mission need arises from one or more of the following reasons:

1. Mission area assessments in the light of concepts
2. Threat changes
3. Changes in military strategies and in duties
4. The desire for utilizing technological changes
5. The increase or decrease in modification resources

The Branch Schools prepare the Branch Needs Proposal Document (BNPD) as a result of concept studies and mission area analysis. While in most of the cases it is the branch schools who prepare the BNPD, in some rare cases TLFC departments may also start the process by declaring their mission need [KKK, 1997]. If operational need requires procuring a material or a system, then need owner should prepare MNS to identify and document mission deficiencies requiring material and/or software solutions. Training and Doctrine Command (TRADOC) merges all BNPDs coming from branch schools and form Force Needs Proposal Document (FNPD). Sub working group of PPIC reviews FNPD and prepare Force Needs Plan (FNP). After forming the FNP, the needs requiring material and/or software solutions are re-reviewed according to priorities and target capabilities and FNP becomes Force Needs Declaration (FND). When a project is declared in FND, the need owner begins to prepare the ORD to state specific requirements levied on the new or modified system and to better define the target capability. After receiving and reviewing all FNDs from Force Commands, General Staff approves the projects and announces Forces Needs Assessments to start the procurement activities. After the approval of General Staff, General Planning and Policy Department announces a project order which includes the structure of the project office. This order is the beginning point for forming the project office and for starting the procurement activities. During the first phase, the need for the acquisition program is studied and documented [KKK, 2000-1].

STP consists of approved Force Proposals and is prepared setting forth the targets of the TAF aimed to be reached on the subjects of the force structure of the TAF in the medium and long-term, the main systems required for this structure, preparedness for war and maintaining operations and construction.

After the preparation of the STP, the TYPP is prepared based on this plan. This program is a document including the allocation of resources for the capabilities desired to be attained during the succeeding ten years [KKK, 2000-1], with the objective of reaching the force structure and strength specified in the STP.

Inputs to the phase: Concepts,
Results of Mission Area Analysis,
Threats,

Branch Assessments

Exercises

Modification Proposals

Outputs from the phase: Mission Need Statement

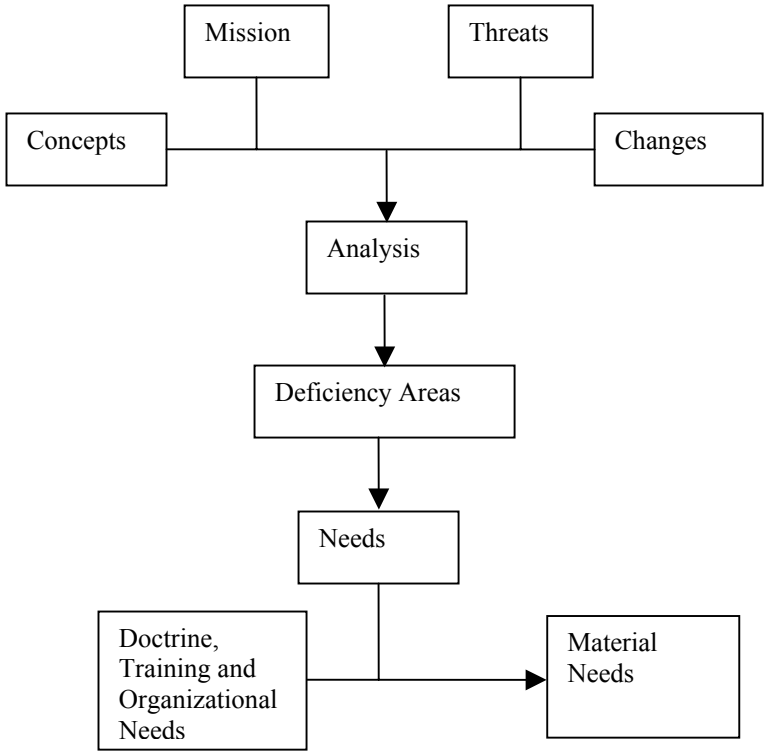


Figure 3.2 Identifying Operational Needs [KKK, 2000]

3.4.2 Concept Exploration and System Defining Phase

The purpose of this phase is to identify the best solution which satisfies the need. This phase involves a series of studies to identify the best possible solutions to the mission need in terms of cost, risk, schedule, and meeting deficiencies. In order to assess the alternatives and to find the best solutions, need owner office begins to prepare the draft ORD which transforms the target capability identified in MNS into the technical detailes. The project office prepares the PNS. If the system is very complex and requires more detailed studies, project office may prepare a MP to gain an insight into the large system. But these two documents include approximately the same things, so, if MP is prepared, there is no need to prepare the PNS.

Solution alternatives may be explored through short term contracts focused on defining and evaluating the feasibility of alternative options. The ORD is solution-oriented and defines the feasibility studies conducted during this phase. After assessing the alternatives, the project office chooses the best option and updates the ORD. Following a successful feasibility analysis and selecting the best option, PNS or MP is documented. Concept exploration and system defining phase ends with approval of PNS (or MP).

Inputs to the phase: Approved MNS,
Project Order,

Outputs from the phase: Master Plan
Project Plan
Technical Contract (if MP is prepared by universities or other technical institutions)
Product Need Statement
Operational Requirements Document

3.4.3 Design Phase

The purpose of this phase is to develop the concept identified in the second phase, to define the desired system in details and to identify the cost and measures to reduce the risks.

Operational assessments of critical components are performed. Early user involvement, prototyping, and testing is considered as a risk and cost reduction measure. Cost drivers and alternatives are identified and analyzed. As a function of risk, the costs of alternative design approach(es) are evaluated against increases in performance capabilities. Project plan and project management organization are reviewed. At the end of this phase, a "System Design and Development Goal Document" is prepared.

Inputs to phase : Product Need Statement
Master Plan
Operational Requirements Document
Feasibility Analysis

Outputs from the phase: System Design and Development Goal Document
Updated Operational Requirements Document

Updated Product Need Statement

3.4.4 Engineering and Development Phase

The purpose of this phase is to transform different design alternatives to an operational and reliable system, and to confirm that the system is adequate to fulfill the deficiencies. This phase is the development phase for main information systems.

Prototypes are tested under conditions reflecting the real life. System-specific performance capabilities are developed in coordination with user approval. Assessments of performance, schedule, and cost are made throughout this phase. Tests and evaluations are performed. A production baseline (the cost, schedule and performance of the desired system is evaluated and a baseline is decided to compare the results of the next phase) is established that reflects cost, schedule, and performance assessment requirements for the next phase. At the end of this phase, a "System Production Goals Document" is prepared.

Inputs to the phase : System Design and Development Goal Document
Operational Requirements Document
Product Need Statement

Outputs from the phase : Test Reports
System Production Goals Document
Technical Data Packets
Technical Documents
Request for Proposal
Technical Contract

3.4.5 Production and Deployment

System performance and quality are monitored during this phase by follow-on operational tests. Cost, schedule, and performance are periodically reviewed and compared to the production baseline. User feedback and the results of field experience, to include operational readiness rates, are continuously monitored. Support plans are implemented to ensure sufficient support resources are acquired and deployed with the system.

Inputs to the phase : Technical Contract

Request for Proposal
Technical Documents
System Production Goals Document

Outputs from the phase : Signed Contract
Test and Acceptance Activities

3.4.6 Operations and Support

This phase begins after initial systems/products have been deployed. This phase is marked by either the declaration of an operational capability or the transition of management responsibility from the developer to the maintainer. It continues until the system is retired from the inventory or a decision is made to commit to a major upgrade or modification. The modification needs may be arising from one or more of the following reasons; interoperability needs, satisfying a deficiency, logistics support, reduction of operational costs, and safety needs.

Inputs to the phase : Material/Weapon/System
New Requirements
Operational Test Results

Outputs from the phase : Modification Needs
Test Reports

3.4.7 Disposal from Inventory

Disposal criteria are identified before operational use of a weapon/system. A weapon/system can be removed from usage only when operational and support costs are not cost effective, and when it does not satisfy operational requirements. The disposal decision is made based on the assessment of economical, physical, and technological life cycle of a weapon/system.

3.5 Problems with Current Process

It was mentioned in Chapter 1 that software as the highest risk system component, has some inherent problems. These problems have been studied by experts over the years. They all have reached the same conclusion. Our inability to build reliable, economical software is not due to technical shortcomings — but is a product of poor management practice [STSC, 1996-3]. This result is also very

common in software intensive systems acquisition field. Management deficiencies can be prevented only by well established processes and milestones, decision points, reviews, audits in these processes.

Although it is not specific to software, TLFC also has an acquisition process. This process forms a framework for procurements but it suffers from some problems and shortages. This section will briefly describe the problems before proposing an acquisition model for TLFC.

US DOD's Software Technology Support Center's "Guidelines for Successful Software Acquisition" [STSC, 1996-3] explains that software-intensive systems acquisitions fail due to:

1. The inherent complexity of the software entity,
2. Poor estimation of size, time, and cost,
3. Unstable requirements,
4. Poor decision making by acquisition managers,
5. A belief that something other than improved management skills will cure our ills,
6. Failure to establish and preserve technical in-depth participation and awareness of the state of the program.

Naturally TLFC also has the problems mentioned above. But it is thought that it will be suitable to explain some other problems specific to TLFC and to Turkey. These problems may be explored under four titles: problems related with the process, industrial problems, resource problems, and legal problems.

3.5.1 Problems Related With Process

TLFC has a general acquisition process to procure its needs. The first phase of this process includes identifying mission needs. This phase is the crucial phase of the whole process. Because the foundations of the desired system is being formed at this phase. If the input to a system is wrong, it is clear that the output will be wrong too. In current process, *identifying mission need phase includes identifying system requirements instead of exploring and defining mission needs on which the desired system will be based.*

Although the acquisition process requires planning and performing activities for a long time period (from identifying mission needs to disposal from inventory),

current acquisition activities are finished after delivering and installing the system. This lack of follow-on phase causes being unaware of the situation of acquired systems and the feedback which should be provided by end users.

The current process does not treat acquisition of software intensive sytems on an exceptional basis. In [Ziylan, 1998], the author notes that the traditional acquisition methods have been changed and software intensive systems cannot be acquired through these classic methods. Because it is difficult to state system requirements, they always change. Due to fast technological developments the author proposes "evolutionary acquisition" approach for acquiring software intensive systems. In addition, when these advanced systems are acquired, *it is important to shorten the development time period and to get end user involved into the design and development phase of the life cycle.*

The phases of the current process are not very clear. The exit and entry criteria for phases and the decision making authorities, the structure of these authorities are not obviously defined. A standard organizational process should have clear phases, well-defined milestones and technical committees which are required to decide at each milestone.

The next phase is not evaluated at the end of previous step. Cost, performance and schedule evaluations are not made by decision authorities at each milestone. Because defense systems should be able to be used in war conditions (heat, cold, pressure, vibration, shaking and etc.), the quality of system design, verification, validation and test processes is crucial for operability of desired system.

Problems related with informatics industry will be explored in the next section. The researches which will be mentioned in the next section show that the main problem of Turkish informatics sector is the *lack of a disciplinary approach* in the development of information systems. The same problem can be considered as a deficiency of TLFC current acquisition process. *There is no systematic approach to system analysis, cost and schedule estimation, requirements specification, and system design.*

The current acquisition activities are not based on well-defined policies and strategies, project offices do not use methodologies and international standards. An expert notes that the public organizations buy information systems as they buy any

other material [TBD, 1991]. In a similar study [Çetin, 1998], which was made to propose an acquisition process based on Euromethod for Turkey, the author states that there is a need for a disciplinary approach in the acquisition of information systems to encourage acquirers to control cost and time scales, to manage risks and help to improve mutual understanding between the customers and suppliers.

The current acquisition system is more suitable for acquiring COTS products[TUBİTAK, 1998]. *It does not reflect the important aspects of acquiring major systems based on R&D* and the projects which take a long time period.

A process should force producing work products and specific outputs of steps and also should define their characteristics. The content, quality, verification and validation of these products are crucial for acquiring products that satisfy user needs. But these *evaluations are done only at the end of the current process, not after performing each phase*. And this lack of control causes poor quality of acquired systems. Many studies about software quality show that the quality of software , especially reliable products can only be developed through controlling the development process, not through controlling the product only at the end of the development phase [Bilgen, 1992].

The processes can be improved by adopting new procedures and innovations as a result of feedback from previous projects. A detailed study was made by Turkish Informatics Association in 1999 on "Information Systems Projects Management" [TBD, 1999]. There, the authors explain product definition, strategic planning and gathering information about past projects as the activities to be performed in system defining phase of the acquisition life cycle, because previous experiences (even they have failed) can be useful for better estimations. This *feedback system is not used in the current TLFC acquisition process*. *End user involvement can not be provided for the current projects*. This causes useless systems and products. The project office needs this user involvement particularly at three phases of the acquisition life cycle: requirements definition, product acceptance and evaluation of the system after it has been delivered [Bilgen, 1992].

Acquisition risk management is a key process area for Level 3 (Defined Level) of SA-CMM [CMU/SEI, 1999]. The purpose of acquisition risk management key process area is to identify risks as early as possible, develop and implement a

risk management process as an integral part of the acquisition organization's standard software acquisition process. An important point is that risk management begins with the process of defining the system need and terminates when the software acquisition is completed. *The current process does not have any risk management process and approac*h. This is done at some recent projects but it is not a part of the process. Risk management issue is achieved only by efforts of individuals who are aware of the importance of the subject.

Another important problem of current process is the number of authorities involved in the acquisition process. There are several departments (TLFC, Requesting Departments, Information System Department, Logistics Command, MND, UDI) involved in the acquisition process. If it is not possible to give the acquiring authority to a sole department, there must be a mechanism to provide coordination among these units. Current process does not have obligations for such a mechanism.

3.5.2 Problems Related With Informatics Industry

In recent years, as a result of advanced computer technologies, the power of military forces has been dependent on software and network technologies. Thus, the power of a state's defense industry heavily relies on the situation of its informatics technologies sector.

Search for a national policy in science and technology and first attempts for policy formulations started in Turkey in early 1960s. The first institution (Scientific and Technical Research Council of Turkey, TÜBİTAK) that has an active role in coordination, organizing and promoting research in the basic and applied sciences was founded in 1963 [TÜBİTAK, 1997]. At the beginning of 1980's, Turkish Science Policy: 1983-2003 was prepared with the contribution of 300 scientists and experts [TÜBİTAK, 1999]. However these policies could not be realized.

The second and most important attempt was made in 1997. The initiative for Turkish National Information Infrastructure (TUENA) Masterplan started in January 1996 with an order from the Prime Minister's office [TUENA, 1999]. The order delegated coordination duty to prepare the Masterplan to the Transportation Ministry to develop an information sector policy for improving information technologies and for enabling Turkey's transition to an information society.

Despite the attempts mentioned above, the current situation of information sector in Turkey is not as advanced as in many developed countries. A study which was made in 1992 [DPT, 1992] shows that the level of development in the software and information technologies sector is directly related to the extensivity of computer use throughout the country. According to another study which was made in 2000 [BİLTEN, 2001] *the rate of computer use in Turkey was only %12,3. This figure was %6,5 in 1997* [TUENA, 1999]. These figures are below the average rates of the European Union. The low rates of computer usage give some tips about Turkish information technology sector.

It was mentioned that TUENA Project was an important attempt to establish national policies on Information Society. In the scope of this research, there is a detailed study about Turkey's National Information Infrastructure [TUENA, 1999]. The capability of Turkish software sub-sector is explained in detail. Some important results from the research are as follows:

- *Software houses are small enterprises in terms of capital, turnover and staff*. 72% of the software houses have capitals of less than TL 1 billion (approximately US$5,000 at the current rate).
- *The average number of staff per software house is 2*.
- *The fact that software houses have not yet started to use methodology and software development instruments extensively, that documentation is not properly systemized, that appropriate methods are not used in the process of software testing can all be cited as important reasons for the failure of software houses to acquire an institutional character so far*. This situation adversely affects the efficiency of software houses and the quality of the software they produce. Concerning the place of quality in the software development process, the following features were noted:
- *Sufficient importance is not attached to quality in the software development process.* It was observed that there were few software houses using methodology in the software development process. It seems that sufficient human resources were not allocated for software quality control and that quality standards were not observed as common practice.

- *It seems that documentation prepared by software houses on the software developed do not usually serve the quality aspect*. It was observed that the documentation prepared were often aimed directly at the customer or the user and that documentation intended for the software development process itself takes low priority.
- Of the annual expenses of software houses, personnel expenses reach up to 48% of the total. Although this was only expected, *considering the financial deficiencies of software houses, it was inevitable that they would save on personnel expenses for cost reduction for undertaking larger scale projects.*

This immaturity of domestic software sector affects acquisition methods, acquisition strategies, contract types, competition conditions and also the awareness of quality. If a state's informatics sector is fully developed, acquirers can establish their acquisition strategies based on competitive acquisition. With this strategy suppliers can compete for the job based on an open solicitation containing definitive requirements. *In a poor developed sector, acquirers will be dependent on sole source or foreign suppliers.*

A more recent study [KALDER, 2002] which has been conducted to support the software organizations that decide to improve their process capabilities and enhance product quality, corroborates these findings to a great extent, and shows that significant progress in Turkish software industry is yet to be achieved.

UDI, as an important part of the TAF acquisition process, has recently developed a Software Capability Evaluation Model based on SEI's capability maturity model for software [UDI, 2002]. The purpose is to evaluate the development processes of domestic software companies and to classify them in order to identify the companies which can offer proposals to MND bids. The UDI Model classifies the companies under three groups:

- Group A: Group A companies can offer proposals to projects with high and medium risks.
- Group B: Group B companies can offer proposals to projects with medium and low risks.
- Group C: Group C companies can offer proposals to projects with low risks.

In the scope of UDI evaluation studies, eight companies have been evaluated and five of these companies have been rated as group A. The aim is to determine the capability level of software organizations and to force domestic companies improving their development processes.

In conclusion, the software sector in Turkey is still in its foundation stage. Although it suffers from several problems and shortages, it is continuously growing and if the government and TAF support this sector, it should be possible to be able to acquire advanced information systems from domestic market.

3.5.3 Resource Problems

In Chapter 2, it has been stated that SA-CMM includes five common features (commitment to perform, ability to perform, activities performed, measurement and analysis, and verifying implementation). The "ability to perform" common feature includes the responsible group, providing experienced software acquisition management personnel and adequate resources for software acquisition activities. The resources include funding, staff, equipment, and tools. Whereas funding is not a constraint for TLFC and they have adequate equipments to perform the activities, *staffing and using sophisticated tools should be considered as problematic areas*.

The sole customer of defense systems is the state. These systems are produced through using advanced technologies. Although large equipments and materials are not used in software development they require high levels of qualified manpower on the contractor side [TBD, 1991], and the acquisition of these systems also requires technical skills of different disciplines on the acquirer side. These skills should be on identifying mission need, planning, programming, budgeting, project and contract management, logistics support planning and etc. It requires also organizing different resources like personnel, equipment, time, schedule and tools.

The situation of the software market in Turkey was mentioned in previous section. The situation of technical skills in this market is not very different. According to a study which was conducted by Turkish Informatics Foundation (Türkiye Bilişim Vakfı-TBV) in 2000 [TBV, 2000], *Turkey has a serious shortage of manpower in informatics domain*. The need for technical skills on the Internet and network domain is 5500 persons in year 2000, and this figure will be 20500 in 2003. But these are only two sub-domains of informatics industry. This shortage is very

clear in another report [TBV, 1999] which was about the computer engineering departments of universities. It shows that the number of students in computer departments was only 1753 in 1999.

Another detailed study [TUBİTAK, 1998] which was made in 1998 by a group of experts from MND declares that *the first and most important problem of defense acquisition is the shortage of technical skills on some disciplines like project and contract management, system analysis, requirements analysis and especially in acquisition program specialist*. The authors note that the persons who work for MND acquisition units should be trained and they should work on these jobs for a long time period. The authors give examples from other advanced countries like "Defense Acquisition University" in USA and "Armament Administrative Institute" in France.

3.5.4 Legal Problems

As mentioned in previous sections, TLFC acquires goods and services by way of MND. The main law related with these procurements was the State Tender Law (STL), Law 2886 which was enacted in 1983. The first and sole amendment of this law was made in 1984. Although there are many technological developments, there were no changes to this law until very recently. It did not handle defense procurements on an exceptional basis. There were not a defined policy on defense procurements. So, this law was inadaquate to satisfy the new needs of governmantal organisations and also TLFC.

In January 2002, Turkish Grand National Assembly enacted a new law (Law 4734) to replace the Law 2886. This amendment was mainly performed to comply with the international arrangements like those of World Trade Organization and European Union. With this new law, the procurements related with defense, security and intelligence were kept out of the scope of the STL [TBMM, 2002]. MND Technical Services Department has been assigned to prepare a draft defense procurement law for those critical system procurements.

Article 3 of STL [TBMM, 2002] defines the exceptions of this law. The 3-b clause of this law identify MND procurements that are excepted from its scope:

1. The procurement of vehicles like aeroplain, helicopter, ship, weapon, submarine, tank, and missile
2. The procurement of weapons, weapon systems and equipment

3. The bids including the procurement of software (embedded software), modernization projects, and ammunition, research and development projects of 1 and 2
4. The procurement of service, material, equipment, and system in the scope of state security intelligence

are out of the scope of the state tender law. The procurements of major automated information systems (software intensive systems in other words) are not out of the scope of STL. Only the embedded software of vehicles, aeroplains and weapons are out of the scope. But, MND Technical Services Department has declared an opposite opinion [MSB, 2002] which emphasizes that the acquisition of software intensive systems should be out of the scope of the STL. Because these systems can not be well defined and they are very large and complex.

In fact there are two problems here. The first is the national security problem. Because the new law allows foreign companies giving proposals to MND bids. This can be considered as a threat to TAF security requirements. This problem can be prevented through a contract provision requiring offerors having appropriate national classified facility security documents.

The more important problem is that the new law does not allow applying national prime contractor strategy for acquisition of software intensive systems. This strategy can only be applied to acquisitions which are out of the scope of the STL. POs can not contact the suppliers to evaluate the final systems or to exchange information about the systems to be acquired.

After examining the current problems, it will be useful to give some recommendations concerning regulation on software intensive systems acquisition:

1. The regulatory framework should treat information system procurements on an exceptional basis.

2. The definition of “information systems” should prevent conflict between the departments and also between TLFC and MND.

3. The challenge of change and high risks inherent in these systems should be considered. A general framework can be provided to establish fundamental essentials, and other details can be included in related instructions.

4. It should provide mutual understanding between customers and suppliers through specifying the terms of information systems technology.

5. It should allow selecting supplier based on optimum techniques and methods. Prices of proposals should not be the only criteria for selection.

6. There must be provisions which require applying project management practices during IS procurements.

7. The regulatory framework should clearly identify the responsibilities of personnel who participate in IS acquisitions and also it must have an obligation on the members of acquisition teams and program managers. These personnel should not be assigned to another duty before five or more years or before some important milestones of acquisition program.

8. There must be provisions which identify the personnel skills that must exist in a project office, Project Examination and Evaluation Commissions, and in Proposal Evaluation Commision.

9. The time period between the need identifying and product deployment should not be too long (possible changes should be considered).

10. Technical contract should only include the definition of desired system, it should not contain issues related with solution domain.

11. It must be ensured that the products are developed in secure conditions.

12. The regulatory framework should not enforce a particular acquisition method. It must only give general conditions.

13. The regulatory framework should allow "National Prime Contractor" aplication like in other advanced countries [TUBİTAK, 1998]. National prime contractor should make agreements on producing sub-systems of large systems.

14. The regulatory framework should clearly identify the content of technical contract.

3.6 A Particular Proposal for TLFC Acquisition Process

A similar study [Çalkayış, 2001] was made in 2001 to propose a model for TLFC IS outsourcing process. After examining the current process and its problematic areas, the author proposes a model based on some beneficial and applicable parts of two standard approaches, Euromethod and World Bank approaches.

In [Çalkayış, 2001], it is noted that incorrect staffing and nonexistence of international standards are among the most important problems. He gives a proper organization structure to overcome the first problem, and proposes using IEEE standards.

The author proposes that when structuring the project office, the members of the project team come from IS Department and they carry out the project under control of the deparment of requesting office.

Such a structure may cause some problems: First, IS Department does not have adequate skilled personnel. Second, every office carries out its own projects, and these projects are related with each other, so there may be interoperability and installation problems. Third, there may be duplications among projects. To overcome these three problems it is useful to carry out all IS projects of TLFC under the control of IS Department. Requesting offices may involve the projects as end user and to some extent as the customer of the desired system. But, this solution requires restructuring of IS Department.

The Çalkayış model begins with defining the goal and the expected value of the desired system, and ends with managing the contract. It includes fourteen steps to be performed in the process. It does not include milestones, and decision points. The success of a methodology can be measured based upon the work products and the characteristics of these products. But the Çalkayış model does not emphasize work products that must be produced at the end of the steps. The model contains only the tasks and does not provide a detailed guidance about the contents of work products like acquisition project management plan, request for proposal, requirements specification and contract. It would be very useful to provide templates of these important outputs.

CHAPTER 4

4 A PROPOSED MODEL FOR TURKISH LAND FORCES COMMAND SOFTWARE INTENSIVE SYSTEMS ACQUISITION PROCESS

4.1 Introduction

It has been mentioned in previous chapters that the output of an acquisition process is a software product of high quality which satisfies user needs, and which can be acquired in a timely manner, and at a fair and reasonable price. In order for an acquisition process to provide a high quality product, it should be established in a manner that all possible defects and risks should be detected in the earliest phases of the process and it should allow project team separating large and complex final systems into smaller parts. Such an output can only be achieved through following a disciplinary approach or a methodology, and using successful past experiences. Successful acquisition programs are dependent upon competent people, well-defined processes, validated requirements, performance measurement, and clearly defined responsibilities.

In section 3.1, security, safety, use of advanced informatics technologies and complexity were discussed as main characteristics of defense products. The immaturity of Turkish informatics industry which is not able to produce such technology intensive systems leads TLFC towards establishing an acquisition policy which should prompt the capability of Turkey's information industry. This can be achieved by supporting national contractors through acquiring defense systems needs from domestic market.

These supportive attempts in the field of defense products should be carried out under the coordination of the MND to give the necessary direction to the research and development activities of domestic market with the purpose of preparing Turkey's defense industry for the future.

This chapter will introduce a proposal, formulated with the aim of responding to the needs as recognized in the previous chapters for TLFC software intensive systems acquisition process.

The proposed model is not a process improvement project. Such a project requires planning, data collection, data validation, and process rating activities performed by competent assessors.

The model provides necessary activities in a software acquisition process and it will be described step-by-step. The templates for the work products to be produced at the end of each step, will be presented in Appendices B-H.

4.2 Principles of the Proposed Model

In the first chapter, four models have been introduced to identify the key concepts and fundamentals of software acquisition process. The proposed model has been formed based on some extensions to and adaptations of applicable parts from these four contemporary models and specific needs of TLFC. These specific needs have been identified through interviews with stakeholders and analyzing past and current information system acquisition projects documents.

The proposed model which is organized as a hierarchical structure of phases, steps and activities can be mostly used to acquire major information systems. It provides a general framework for the usage of the personnel who is responsible for carrying out the acquiring activities. The decision points are depicted as milestones of the model. The middle products and the outputs of each phase and step are available at the appendixes part of the thesis. The templates can be used as a compass for producing the work products of each particular project.

The general concepts and phases of the process should be tailored based on the complexity, security needs, criticality, possible risks, urgency of the user needs, and other specific needs of each particular project. Every acquisition program is different. Any particular project need not follow the entire proposed model.

The best approach for using the proposed model is to get the end users involved into the activities to provide better understood requirements earlier in the process.

Although the proposed model has been mainly based on the concepts and framework of the SA-CMM, all SA-CMM requirements could not be applied. The problems and the immaturity of the current process mentioned in previous chapter prevent to apply its all requirements. Only one of the second level key process areas has not been included in the proposed model; “transition to support”. This key

process area requires a software support organization. It is clear that this can only be achieved through a more mature organization and process capability.

Two of third level key process areas (there are five key process areas at third level) have been involved in the proposed model; “process definition and maintenance” and “acquisition risk management”. Due to the same reasons mentioned in the above paragraph, these two key process areas could not also be applied with their all parts.

4.3 Defense Acquisition Policy

Defense acquisition policy should be developed and documented to guide procurement activities from acquisition initiation to post-production support through considering following conditions:

- In order to support and improve domestic information industry, “National Prime Contractor (NPC)” application on major areas should be supported and implemented. Examples for these sub sectors of defense industry may be; Aerospace, Command, Control and Communications, Computing and Software, Electronics, Modeling and Simulations, Sensors etc.
- MND acquisition organization can have the ability to agree with a sole qualified supplier responsible for designing, developing, maintaining the defense systems through implementing NPC application.
- The acquisition activities on the technological fields presented above should be carried out by specialists who have acquired experience in that area. The continuity for acquisition duities and training of this personnel should absolutely be provided.
- NPCs may be selected among current contractors based upon their technological infrastructures, defense industry experience, software development capabilities, new technologies transferring and assimilating capabilities.
- NPCs should be responsible for technology transferring, developing major systems and system integration. They should be able to sign contracts with sub-contractors to develop components or some units of the whole desired system.

- Acquisition of major defense systems should be made based on R&D. To achieve R&D activities, MND should be in close contact with universities, institutions and other possible suppliers.
- The problem of multiple authorities involved in acquisition process can be solved through restructuring of MND and UDI. As in other many advanced countries, the whole defense procurement activities should be carried out by a sole department. The personnel of Forces Commands should be end users, they should not be responsible for acquiring activities.

4.4 National Strategy for Defense Acquisitions

In order for MND to satisfy the acquisition policy presented above, it should classify the defense systems as [TÜBİTAK, 1998]:

- *National*, systems which requires absolutely acquiring from domestic market through contracting with a NPC on that area. These systems are mostly operated and controlled by software and have critical security requirements.
- *Critical,* systems which require producing at and acquiring from domestic market in the long term. They have a relatively long development time period and domestic market does not have adequate technological infrastructure for producing them.
- *Others,* systems which may be acquired from various sources.

Each project team should develop and maintain their own acquisition strategy through considering specific needs according to the groups presented above. This strategy will be used to guide program execution from identifying need through operational support. In developing the acquisition strategy, the project team should consider all acquisition policy and instructions as well as the following:

- Interoperability Requirements: Interoperability is the ability of systems to exchange data and information between each others which enables them to operate effectively together. TLFC will not use the systems as separate parts. All systems should incorporate with some others. Those other systems should be identified and required issues must be solved before development phase.

- R&D activities should be completed in a rational time period. The initial prototypes of the desired system must be evaluated by end users as rapidly as possible before production.
- The acquisition strategy should consider all possible risks and encompass all necessary actions.
- Evolutionary acquisition approach should absolutely be considered in acquiring software intensive systems to be able to capture more reliable and validated requirements.
- Competitive suppliers should be provided for innovation and product quality.

4.5 Using Evolutionary Acquisition Approach

When the problems related with current process were mentioned in section 3.5.1, it has been noted that shortening of the development and acquisition time period of software intensive defense systems is very important due to rapid technological advances and continuously changing user requirements. In addition to this important aspect of defense systems, it was mentioned that they are too large and complex systems.

That early user involvement should be provided to define clearly all system and user requirements is crucial for development of such systems, because the requirements beyond the core capability can generally be identified.

The problems presented in previous chapters have led to the Evolutionary Acquisition approach for acquisition of complex systems [TÜBİTAK, 1998], [Ziylan, 1998].

The proposed model which will be presented in next sections can be used in EA approach and also in other types of acquisitions. But when it is used with EA method, only the initial system must be well defined, not the whole system, as well as the planning of next improvements, additional capabilities and other enhancements. The initial system can be handled as a core system that is composed of fundamental system architecture and other required components which have basic functionalities and common services for the system.

4.6 Acquisition Organization

TAF's weapon, equipment, material and all kinds of logistics supply needs are met by MND according to the types and amount identified by Force Commands and approved by General Staff as discussed in section 3.1. The parties in the current process are need owners (the department which identifies the mission deficiency), deparments of Forces Commands, MND and UDI. This multiplicity of authorities makes the process more difficult and causes lack of coordination.

Although the proposed model can be used by any person who participates in an acquisition process of a software intensive system, it can be used better by skilled personnel of project offices or project teams. Thus, the first requirement of this model and all other four contemporary models explored in second chapter is to form an acquisition organization and to staff required skills.

In the current process, the personnel of Forces Commands are acting as project managers, contract managers, system analysts or software engineers. In fact this personnel should also be considered as final users. All acquisition and project management activities should be carried out by MND to acquire the systems requested by Forces Commands.

To achieve the task mentioned above, MND should be restructured and the existence of UDI should be reviewed. Because all needs of TAF must be procured via a sole department similarly to the practice in many other developed countries. MND should establish an acquisition organization based on departments which are specialized on major defense industry fields like aerospace, command, control and communications, computing and software, electronics, modeling and simulations, sensors and etc. The acquisition and project management activities should be carried out by those departments. The personnel is trained on their expertises and they have the opportunities of having procurement duties for a long time period.

4.7 Structure of Project Office (PO)

The first and most important prerequisite for acquiring software intensive systems is to establish a project office (or team) which includes all required skills and knowledge.

In the first chapter, when examining the "IEEE Recommended Practice for Software Acquisition", it has been noted that even if specific responsibilities are assigned to various people, one person should be appointed with overall responsibility for the success of the process. The term "Program Manager (PM)" will be used in this thesis to indicate this assignee. It is important that the PM is aware of user needs and constraints, general policy, strategy and process of TLFC, and have adequate management skills and experience. SA-CMM defines this experience as *having participated in software acquisition management planning on at least one project, having a minimum five years acquisition experience, having knowledge of the software's application domain, and having knowledge of current software engineering processes and technology.*

The PM shall have the following responsibilities:

- Establishing an appropriate project team,
- Establishing technical, performance, and quality requirements,
- Managing supplier performance under the contract,
- Assessing supplier performance during the period of the contract,
- Evaluating and accepting the product for TLFC.

The project team which will be formed by the PM shall include all required skills. The knowledge and other required skills for each particular project differentiates based on the technical aspects and software domain of the desired system. [SEI, 1999] defines *software acquisition knowledge units* as:

- *Procurement Management:* The unit which is concerned with knowledge about the process for competitive procurement of software systems and which includes knowledge about preparation and distribution of a solicitation package, proposal evaluation and source selection, and contract negotiations and finalization.
- *Acquisition Planning:* The unit which is concerned with knowledge about developing a life-cycle plan for acquisition and use of a software system and which includes knowledge about project organization and communication, project budget and schedule, acquisition and development standards, subcontractor management, and software development planning.

- *Performance Management:* The unit which is concerned with knowledge about assessing the developer's performance in developing the system being acquired and which includes knowledge about management reviews, quality assurance, test and evaluation, and metrics and performance indicators.

The PM may form his project office based upon the knowledge units presented above. It should be noted that expecting successful acquisitions without talented and trained personnel is unrealistic [Çetin, 1998].

4.8 The Proposed Model

Having noted in the previous two chapters that TLFC has some problems related with its software intensive systems acquisition process, there is a need to examine the process at a more detailed level to investigate and establish the phases, activities, relationships in an acquisition process in the scope of proposing a new model to provide some guidance for those participating in acquisition activities.

In the framework of general policy, strategy, regulatory framework and acquisition organization mentioned above, the proposed model can be used to prepare required documents and to perform necessary acquisition activities for a software intensive defense system after it has been decided that the system will be acquired.

The process has been formed based on the models explored in second chapter and through considering specific needs of TLFC. If the process is followed in a disciplined manner, a more capable and quality system will result.

The process consists of four main phases as shown in Table 4.1. The contents of phases in general are explained below:

1. *Acquisition Initiation*: The first and most important phase of the acquisition life cycle is the "Acquisition Initiation" the purpose of which is to develop management approach, identify acquisition strategy, and plan acquisition life cycle.
2. *Implement System Engineering Activities*: The purpose of this phase is to define the desired system which includes hardware and software, as well as other system life cycle elements. System engineering activities are

performed to translate user needs and requirements into the system which will be acquired.

3. *Solicitation & Contracting*: The third phase is the "Solicitation and Contracting" phase the purpose of which is to prepare and issue solicitation and award contract. Preparing a solicitation package that identifies the needs of a particular acquisition and selecting a contractor who is best capable of satisfying the requirements of the contract are main activities of this phase.
4. *Supplier Monitoring & Product Acceptance*: The fourth and last phase of the process is "Supplier Monitoring & Product Acceptance" phase the purpose of which is to manage the acquisition after the contract is awarded to ensure products are designed and delivered in compliance with user's expectations.

4.8.1 Acquisition Initiation

Acquisition initiation process is the first process executed to plan and allocate the required resources. It involves planning acquisition process in such a way that it encompasses all elements of the project. The desired system is defined at this phase. The initial activities until forming the project office are performed by the assigned PM for the project.

Table 4.1 The Outputs of Four Main Phases of Proposed Model

Acquisition Initiation	Project's Defined Acquisition Process Acquisition Strategy Program Management Plan
Implement System Eng. Activities	Requirements Specifications Risk Management Plan Configuration Management Plan Quality Management Plan Evaluation Plan
Solicitation & Contracting	Contents of Solicitation Package Request for Proposal Proposal Evaluation Plan Signed Contract
Supplier Monitoring & Product Acceptance	Accepted Product

4.8.1.1 Establish Program Management Structure

The aim is to establish the required management structure and to form a PO to provide necessary coordination among the stakeholders and to perform the acquisition activities. The possible stakeholders are user representatives, need owner department, Logistics Supply Office (LSO) representative and personnel from Information System Department (ISD). The personnel coming from other administrative departments like LSO, and ISD, participate to PO only for coordination. They do not have any responsibility for implementing the project. But this model requires participating of those personnel with their defined responsibilities.

Figure 4.1 Acquisition Initiation Process

The process shall begin with the identification of required skills and ends with establishing the PO. The ORD, and PNS/MP have adequate information about which technical skills shall be included in the PO. The PM should identify these skills and propose his team formation to related department.

The SA-CMM assumes that an acquisition organization exists and is responsible for more than one project. The project team is the entity that has the responsibility for executing the specific acquisition. In the SA-CMM, the terms "group", "team", "office" indicate situations where the specific implementation may vary from a single individual assigned part-time, to several part-time individuals assigned from other departments, to several individuals dedicated full-time [CMU/SEI, 1999].

Euromethod identifies four key roles in an acquisition process, two of which are at acquirer's side. A contract authority is the person or persons with the power to resolve or conclude an open issue with regard to a specific contract. And a service or

project authority is the person or persons with the power to resolve or conclude an open issue with regard to a specific service or project [Euromethod, 1996]. These two roles exist in both the customer and supplier organizations.

Whatever the complexity of the project or the number of the project team members, these two key roles identified by Euromethod should be included in the PO.

In section 4.7, three knowledge units of software acquisition have been provided. In the scope of these knowledge units, the composition of the PO depends upon the specific acquisition needs, level of project complexity, and possible risks involved in achieving the acquisition goals. A typical PO should have members at least like the following:

- Project Manager
- Engineers
- Contract Specialist

However, in acquisition of complex software systems, the PM shall consider some other functional areas when forming the PO:

- System Analyst
- Data Manager
- Cost Analyst
- Test Engineer
- System Engineer
- Legal Counsel
- Quality Assurance Member

4.8.1.2 Tailor Organizational Standard Process and Define the Project's Individual Process

"Process Definition and Maintenance" is a third level key process area of SA-CMM, other three models do not have such sub-process. IEEE has a step which requires establishing a software acquisition process that fits the organization's needs after "Planning Organizational Strategy" step. As an acquisition strategy has already been developed in earlier project documents like MNS, ORD, or MP, the proposed model requires defining the process at this point, not after planning organizational strategy.

In the SA-CMM, an acquisition process group exists and responsible for the definition, maintenance, and improvement of the organization's standard software acquisition process, and other process assets, including guidelines for all projects to tailor the standard software acquisition process to their specific situations. The proposed model emphasizes only definition of a specific acquisition process by PM to establish the framework for the project activities. As the current process maturity is low, and the acquisition staff is inadequate, a process definiton group can not be established at this level.

The PM should develop a management strategy for the acquisition program to ensure a logical progression through a series of phases and activities. This will provide adequate information to proceed to the next phase of the program. To achieve this, the PM should construct the acquisition process in logical phases separated by major decision points called milestones.

The number of phases and decision points of the general process shall be tailored to meet the specific needs of individual project, based on objective assessments of desired system's type, complexity, expected risks, and the urgency of the user needs. The tailored process should be defined, documented and issued to all PO members.

The process definition should prescribe how people, activities, tools and tasks are interacted to acquire the desired system. This definition is used as a template for the planning and implementing of the acquisition process. The steps for defining the process are as follows:

- Analyze and review TLFC standard acquisition process
- Analyze and review your project's particular needs and requirements
- Tailor the standard process based on your specific needs
- Document the tailored process

The documentation and definition of a process can be made in different ways and through using different notations. The detail of information which will be used to define the process is largely determined by the definition notation. The flowchart of proposed model as an example is available at Appendix A. And a template for *process definition* can be found at Appendix B.

4.8.1.3 Develop Acquisition Strategy

The *acquisition strategy* is a description of how the desired system will be acquired. The ORD describes what is to be bought, the acquisition strategy describes how it will be bought.

Euromethod has a risk management driving factor in designing the acquisition strategy, while IEEE Std. 1062 considers the quality factors of the product, and also it requires developing acquisition strategy just after defining the requirements. SA-CMM and SPICE stresses identifying the acquisition approach, contract and tendering types in developing the strategy. These are all should be considered in this proposed model. But, the quality factors may not be identified at this stage. In addition to these points, the PO should also consider the security issues of defense systems.

In developing the acquisition strategy, the PM and the PO should well understand the program objectives and requirements. The priorities, constraints and specific needs of the project should be considered. For example, if the PNS shows that the final system will operate with seven other systems, three of which are also being developed, the acquisition strategy will differ from that for a system which must only operate with two other well-established systems.

The PM needs to know the scope, deliverables, critical events, and exit criteria for each phase to help manage the process and to relate the acquisition strategy to process phases and milestones. The strategy should include deliverables for each acquisition phase, and should identify the critical events of the program.

The first issue in developing the acquisition strategy is to identify whether the project is freed from the scope of state tender law. As discussed in section 3.5.4, procurement of software embedded in weapons, vehicules, aeroplanes or missiles is out of the scope of this law. Other automated information system procurements should be made in accordance with the requirements of state tender law.

The *acquisition strategy* shall also include whether the acquisition approach that will be used to achieve the program objectives will be an evolutionary or a single step approach. If the desired system can be well defined, the user knows what he needs, the required technology is available then the single step approach can be used. Otherwise an evalutionary approach may be appropriate as discussed in section 4.5.

The *acquisition strategy* should identify the risks associated with the acquisition and the risk management approach which is planned based those risks.

At the end of this step a defined acquisition strategy for the project should be documented and it should be updated whenever the strategy changes or as the program elements become better defined. A template for *documented acquisition strategy* can be found at Appendix C.

4.8.1.4 Plan Acquisition Life Cycle

Euromethod has an acquisition goal definition step before planning process. Examples of acquisition goals are: an improved business process, a new organizational structure, or a new computerized application. The goals of TLFC acquisition projects are identified in ORD and PNS documents. Therefore, this step is mainly derived from SA-CMM's second level key process area "Software Acquisition Planning". It is very detailed and includes the whole elements of the project.

The aim is to plan the whole life cycle so that all elements of the project are included. Acquisition planning begins when the requirements start to be prepared. In planing the acquisition process, affordability of plans should be considered.

The *acquisition program management plan (PMP)* shall describe the specific purpose, goals, and scope of the acquisition activities. The requirements and planned employment of the products to be acquired and the type of the contract should be described. Acquisition strategy shall be included in PMP.

To facilitate attainment of the acquisition objectives, the written acquisition plan must address all the technical, business, management, and other significant considerations that will control the acquisition.

The PMP should be documented prior to solicitation activities and maintained current. The PMP documentation may be in a single document or in separate documents depending on the specific needs of the project.

Acquisition planning process should start just after the PO has been formed. After tailoring life cycle process in section 4.8.1.2, the project environment shall be established. A Work Breakdown Structure (WBS) which is a product-oriented family tree composed of hardware, software, services, and data can be built to specify

objectives of the program. The WBS defines the program in terms of hierarchically related product-oriented elements.

After building a WBS, the PM can make initial size, cost, and effort estimates through using the WBS as a framework.

The last step in program planning is to build an initial project schedule.

At the end of this step, the PM should assemble the program plan and develop the PMP through using the template available at Appendix D.

4.8.2 Implement System Engineering Activities

System engineering activities involve defining the desired system which includes hardware and software, as well as other system life cycle elements. The systems engineering process is a structured, disciplined, and documented technical effort through which requested products are defined, developed, and integrated.

System engineering approach shall be implemented to translate user needs and requirements into a system which will be acquired. The system definition should reflect the requirements for all system elements: hardware, software, facilities, people, and data.

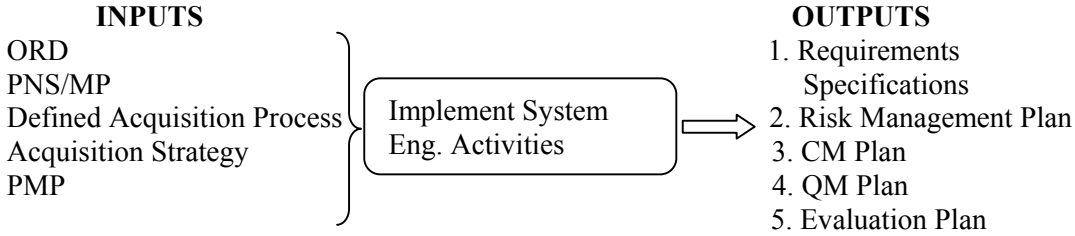


Figure 4.2 System Engineering Activities Phase

4.8.2.1 Develop & Manage Requirements

The purpose of this phase is to establish an unambiguous definition of *contractual requirements* that are understood by the PO and end users, and that will also be understood by contractors. Requirements management ensures that user requirements are unambiguous, traceable, verifiable, documented, and controlled, and performs its activities in accordance with its requirements development and management plan. A template for this plan can be found at Appendix E.

The *develop and manage requirements phase* translates desired system requirements into specific, detailed functional and data requirements which are called

contractual requirements. At the end of this phase, a complete detailed description of the system and software functions is available to guide the subsequent phases.

In developing system and software requirements, emphasis should be on what the user needs, not on how to design the system. The requirements should be defined from the top down into independent subcomponents.

Major activities of this phase are as follows:

- Identify the scope of the desired system objectives and expected major functions from ORD and MP/PNS.
- Define the current system along with its inputs and outputs. Break down system and major functions to processes, and processes to the single-function level. Write function definitions to describe the actions or activities taking place within the processes.
- Develop a logical data model showing how the data within the system are related in order to minimize duplication of data, provide flexibility, and allow the data to be mapped to the TLFC standards.
- Determine data conversion and report requirements.
- Develop a system security plan that describes the controls needed to provide the required security.
- Organize walkthroughs or peer reviews to provide feedback.

Contractual requirements can also be defined as technical and non-technical requirements. Technical requirements are system requirements (functional requirements,performance requirements, security requirements, quality requirements, design constraints, architectural constraints, external interface requirements and standards) and non-technical requirements are contractual agreements, conditions and any other important issue (e.g. products to be delivered, data rights, intellectual property rights, delivery dates, and milestones with exit criteria) affecting the acquisition.

Requirements development always require direct participation from the end user to ensure that system-level requirements are well understood. This does not mean that the PO should announce an order to the related TLFC units to acquire feedback or useful thoughts as performed in current process. This user participation is crucial for acquiring a system which satisfies operational needs and it should be

provided as direct participation of related personnel to PO at least in requirements development phase.

4.8.2.2 Develop Risk Management Plan

A risk management plan which has an outline at Appendix F should be developed and must be integrated and continuously applied throughout the whole program to manage and control the risks identified in acquisition strategy.

The PM has the responsibility, as an on-going task, to identify and manage his project's risks. PM's prime emphasis should be on problem prevention, not on correction.

It is too difficult to employ an independent risk management team due to inadequacy of the personnel. This important activity should be executed by selected PO members under the control of PM.

The risk management process shall address risk planning, the identification and analysis of potential sources of risks including cost, performance, and schedule risks based on the technology being used. After identifying, and analyzing the risks, they must be tracked and controlled in accordance with risk management plan.

Continuous process, *teamwork*, and *an open communication environment* are the most important aspects of managing a project's risks.

The PM shall form a risk factors table (following top-10 list can be used to identify potential risk areas). After developing risk statements based upon this table, the PO should evaluate and rank the risk statements. The third activity is to develop plans to handle risks. In executing the risk plans, required actions and measures are performed to track and control, and to reduce and mitigate the risk impacts.

The following list provides a *Top-10* list of major software development areas where risk must be addressed [Boehm, 1991]. Even though these risks have not been specifically identified for acquisition projects, they provide guidelines for software system risks. Hence this list can be used to identify the possible risks in acquisition-intensive projects as well.

- Personnel shortfalls
- Unrealistic schedules and budgets
- Developing the wrong software functions
- Developing the wrong user interface,

- Gold-plating,
- Continuing stream of requirement changes,
- Shortfalls in externally furnished components,
- Shortfalls in externally performed tasks,
- Real-time performance shortfalls, and
- Straining computer science capabilities.

4.8.2.3 Develop Configuration Management (CM) Plan

Although CM process is not an acquisition specific process, it has been handled here to show its importance, and also to aid PM managing the project. As a managerial process, CM is the ongoing process of identifying and managing changes to deliverables and other work products as they evolve through acquisition project. Although the basic elements of CM are the same, the implementation of CM activities varies depending upon the type of the system to be acquired and the experiences of the PM and PO.

A comprehensive CM system has four functions [Marciniak & Reifer, 1990]:

- *Configuration Identification*. Configuration items to be placed under configuration control are identified.
- *Configuration Control*. Once the program is identified, changes to it can be controlled.
- *Configuration Status Accounting*. The record keeping part of CM where the status of all changes in the system are reported.
- *Configuration Audit*. Audits are held periodically to determine whether the process is working.

In fact, CM should start with producing first work products related with the process. To control the CM process, the PM should develop a *configuration plan* which can be subsection of PMP or a standalone document depending upon the project's type, size, and complexity.

4.8.2.4 Implement Quality Management

Quality is the composite of material attributes including performance features and characteristics of a product or service to satisfy user needs. The quality of

products, or services is determined by the extent they meet requirements and satisfy the customer at an affordable cost.

The *quality management approach* should not only include assessment of deliverables and products, but also include an assessment of contractor's quality management process, experience, facilities, development process and test activities. It should focused on preventing, controlling and detecting defects.

4.8.2.5 Prepare Cost & Schedule Estimates

Although the final prices and costs of the projects are identified by MND Prices and Cost Analysis Section, the PO should prepare a cost analysis report. Because there is not any law necessity which requires identifying the cost by the MND unit. In some cases, this unit does not identify the cost. They only verify the cost identified by the POs.

This cost analysis report should be prepared based on the past experiences and available information on similar projects. This report will be used as data for comparison made by MND Prices and Cost Analysis Section in identifying the cost and price.

The estimating activity should be based upon program objectives, operational requirements, contract specifications, risk assessments, and work breakdown structure (WBS). The WBS permits managers to decompose the system into activities, tasks, and work packages, as stated in previous sections.

There are two main metrics which should be estimated in an acquisition process; project's cost and schedule (development+installation). But, before estimating the cost and schedule of the acquisition, size of the project should be estimated. Because, the project size is the most important driver of cost and schedule as well as the other factors like:

- *Human resources;* the number and qualifications of the people required,
- *Hardware resources;* manufacturable parts of the desired system,
- *Software Resources;* the cost of software tools used in acquisition process.

To measure the size of software portion of systems to be acquired, there are two basic methods. The first method was number of *source lines-of-code* which is programming language dependent and is made on an analogy between the projects. However, it is difficult to relate software functional requirements to SLOC. An

alternative method to SLOC is *function points* analysis which is programming language independent and is made on system and software specifications.

A technical report published by SEI [Park, 1995] notes that there must be six requisites for reliable estimating processes in an organization:

- A corporate memory; this is the historical database of the organization which contains a useful set of completed projects. The information on completed projects includes the life cycle model used, changes in size resulting from changes in requirements, the original cost and schedule estimate, re-estimates, reasons for re-estimates, actual cost and schedules, actual size of delivered products, staffing profile of project office and contractor organization, nonlabor costs, management costs and etc.
- Structured processes for estimating product size.
- Mechanisms for extrapolating from demonstrated accomplishments on past projects.
- Audit trails; values for the cost model parameters used to produce each estimate are recorded and explained. The organization's process documentation identifies who is responsible for preparing the audit trail for estimates.
- Integrity in dealing with dictated costs and schedules.
- Data collection and feedback processes that foster capturing and correctly interpreting data from work performed.

TLFC Information System Department should take measures to establish these requisites to make more reliable and correct cost and schedule estimates.

4.8.2.6 Consider Contract Type

SA-CMM considers contract types in the first stage of the process. The most appropriate contract type should be identified in acquisition planning step as a part of acquisition strategy. IEEE Std. 1062 emphasizes selection of contracting methods when establishing the acquisition process. Euromethod defines the procurement as the process of preparing a contract and obtaining the systems and services that are defined within this contract. An important result of Euromethod's "Acquisition Initiation" process is the decomposition of the overall acquisition into a set of procurements, each one being concerned with a sub-set of the systems and services.

Two basic types of contract can bu used to to provide needed flexibility in acquiring the large variety and volume of supplies and services required by TLFC. These are fixed-price and cost reimbursement. The characteristics and conditions of these contract types can be found in related army instructions.

When the requirements are well-defined and the risk of development is low, a *fixed-price type contract* is probably the right choice. When the requirements are poorly defined and development risk is high, a more flexible *cost-reimbursable contract* may be more appropriate.

The following factors may be used in selecting the contract types:

(a) *Price competition.* Effective price competition results in realistic pricing,

(b) *Type and complexity of the project.* Complex projects, where performance uncertainties or the likelihood of changes makes it difficult to estimate performance costs in advance.

(c) *Urgency of the needed system.* If urgency is a primary factor, the PO may offer incentives to ensure timely contract performance.

(d) *Contractor's technical capability and financial responsibility.*

*(*e*) Availability of qualified competition*

*(*f*) The risk associated with development*

4.8.2.7 Update & Review the Program Management Plan

This point is a very important point of the process. It can be considered as a milestone of the process. A commitee should review the PMP, defined system level requirements, cost and schedule and other performed activities up to this point.

The reviews and audits of TLFC acquisition projects are made by *Project Examination and Evaluation Commission (PEEC).* But the PEEC only reviews the system specifications of the projects. They do not review other documents and activities. This commision is led by TLFC Chief of Staff and includes members from LSO, ISD, and other related departments. The PM presents his project specifications and defenses them.

This proposal requires applying PEEC reviews also prior to solicitation activities. A PEEC approval of process progress is a necessity at this point. This will provide more control and useful feedback to PO. The PO will feel that they are on the right way to a successful acquisition.

4.8.3 Solicitation and Contracting

The infrastructure of the project has been formed, resources have been allocated, and definition of the desired system has been made. A solicitation package that identifies the needs of the acquisition will be prepared and a contractor which is best capable of satisfying the requirements of the contract will be selected at this phase.

Solicitation and contracting phase begins with preparing for the evaluation of responses and ends with signing the contract.

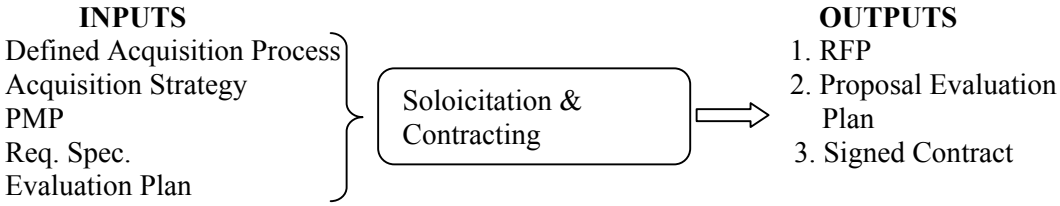


Figure 4.3 Solicitation and Contracting Phase

4.8.3.1 Identify the Contents of the Solicitation Package

The first step of this phase is to determine the contents of the solicitation package to be prepared. The related MND instructions shall be examined, and as an example, the previous solicitation packages should be reviewed.

SA-CMM provides the contents of the solicitation package such as:

- The software requirements.
- The proposal evaluation criteria.
- The statement of work including software-related tasks.
- The contract documentation and information recording requirements.
- The contract form, contract type, and a list of deliverable supplies and services.
- Information on contract acceptance procedures, specific acceptance criteria, and payment.
- Guidance on how the offerors are to respond.
- Documentation requirements for the offerors to submit with their response.

4.8.3.2 Develop Proposal Evaluation Plan

The *proposal evaluation plan* will guide the activities to be performed after receiving the proposals. The PM should define the factors based upon which the evaluation will be made.

In acquiring software intensive systems, the lowest bid should not be the sole factor to select the best proposal. Costs should be compared to other supplier's prices and schedules. Caution should be exercised when the supplier's proposed costs are much higher or lower than the average of all costs received [IEEE, 1998].

The PM should develop management and technical evaluation factors which are based on assessment of bids' prices and qualification of suppliers. The most important factor in evaluating a proposal is that whether the supplier understands the defined requirements and desired system. Suppliers that are not completely responsive to the requirements should be eliminated from further considerations [IEEE, 1998].

The second is the capability of the supplier, because developing software intensive systems is an extremely intellectual work. Information on potential suppliers should be provided prior to proposal evaluation phase. Past performances of offerors should be considered in selecting the best proposal. Because past performance is an indicator of offeror's ability to perform the contract.

The third factor is the development process of the supplier. The process is critical to program success. RFPs should include requirements for suppliers to define their development process.

The fourth factor is the employment of key personnel in the development process. The supplier should guarantee the employment of key personnel who has software engineering experience and domain experience.

In addition to those general factors above, the PM shall develop the specific evaluation factors of his particular acquisition project and should produce a *proposal evaluation plan* at the end of this step. A template for proposal evaluation plan can be found at Appendix G.

4.8.3.3 Prepare Request for Proposal (RFP)

The most important part of solicitation package is RFP. Its contents include the procurement package and all those administrative and legal provisions required to comply with the law. A RFP template which satisfies SA-CMM's requirements is available at Appendix H.

The RFP must contain clear and sufficient technical guidance so the contractor has an understanding of the desired system. It is also important that the development requirements are included and that those requirements are clearly scoped. Inconsistencies, insufficient detail, and inappropriate software requirements will result in an inadequate response from suppliers.

The following steps can be used to prepare a qualified RFP. The list of [Euromethod, 1996] has been modified herein:

- Define the objectives of the acquisition,
- Determine the system and software requirements,
- Determine the organizational constraints and procedures,
- Determine the required delivery plan,
- Determine the constraints likely to affect the project plans,
- Determine the financial constraints and budget,
- Define the legal clauses of the contract,
- Determine the supplier evaluation approach,
- Determine the instructions for bidding suppliers,
  - Requirements for defining software development process
  - Requirements for relevant domain experience
  - Requirements for appropriate documentation
  - Requirements for quality management program
  - Requirements for supportability planning
  - Requirements for Risk Management Plan

4.8.3.4 Identify Potential Suppliers

Although the current TLFC process does not have such a step, there is not any prohibitive rule for conducting this step. This step will provide more information about the offerors.

This step is executed to prepare for evaluating suppliers. In evaluating suppliers' proposals, past performance, technical and management capability are the three main criteria related with supplier organizations.

The PM should identify the following issues and establish the mechanisms which will be used to gather and evaluate the collected information:

- Potential suppliers,
- The type of information to be collected and recorded about these suppliers,
- How this information will be used in proposal evaluation process,
- Information about available similar software products.

4.8.3.5 Issue the RFP

The prepared RFP should be send to MND acquisition department. This department has the responsibility for announcement of RFPs. The PO should follow the bidding activities and provide required participations to Proposal Evaluation Commission (PEC).

The PEC is the sole authority for evaluating and selecting qualified suppliers. But the PO members participate to these commisions. The evaluating and selection activities are made in accordance with the plans and procedures prepared by PO.

4.8.3.6 Evaluate the Proposals

The objective is to ensure that a skilled and qualified supplier is selected. Proposals are evaluated in accordance with documented solicitation plans. The evaluation criteria have been determined in previous phases.

The selection committee use proposal evaluation results to support their decision to select a contractor. Competitive proposals shall be evaluated solely on the factors specified in the solicitation.

IEEE Std. 1062 emphasizes visiting supplier facilities to investigate and evaluate financial position, technical capability, experience, and quality practices in the scope of evaluating the proposals. This should be done in 4.8.3.4 step of the proposed model.

4.8.3.7 Negotiate the Contract

Negotiations are held between the offerors and evaluation commitee to alter technical, cost, legal and other contract terms and conditions, with the intent of allowing the offeror to revise its proposal.

4.8.3.8 Sign the Contract

The requirements prepared in previous phases shall be incorporated into the contract. Preparing contract should be a focus for PO, because it is the basis of all the supplier monitoring efforts.

The responsibility of implementing the project passes again to PO at this point.

4.8.4 Supplier Monitoring and Product Acceptance

SA-CMM uses "Contract Tracking and Oversight", IEEE Std. 1062 uses "Managing for Supplier Performance", SPICE uses "Supplier Monitoring Process", and finally Euromethod uses "Contract Monitoring" for this process. They all require monitoring supplier performance after signing the contract.

The purpose of *supplier monitoring & product acceptance* phase is to monitor the product development to ensure that the supplier activities are being performed in accordance with the specified requirements. This process results in accepting quality products that conform with contractual requirements.

The process begins with signing the contract and ends with transition of delivered product to user department or organization.

The major activities to be performed are managing the contract, managing and assessing the acquisition progress, and finally performing quality and acceptance testing.

4.8.4.1 Manage the Contract

An individual (contract manager, or Euromethod's "contract authority") should be appointed to manage the contract and to deal with the supplier on all aspects of the contract. An open communication line should be maintained with the supplier. Periodic reviews and interchanges shall be conducted with the supplier to

ensure that the supplier is implementing activities according to the approved plans. These reviews may include end users and other affected groups as needed.

4.8.4.2 Monitor and Assess Supplier Progress

The objective is to monitor the supplier's progress to ensure that all milestones and deliverables are met and to approve work. This steps shall provide regular and continuous feedback to the supplier on its performance. Supplier performance should be quantified in terms of all contractual requirements and other project constraints like the following:

- Complying with schedule
- Defining test and acceptance criteria
- Defining processes and standards to be followed
- Defining documentation standards
- Number of resolved problems
- Providing deliverables items

4.8.4.3 Evaluate Actual Cost/Schedule

The actual cost and schedule of the contractor's development effort shall be compared to planned schedules and budgets and the results of this comparison should be recorded for use in future projects. Some examples of measurements may include effort expended, funds expended, progress, number of problems and completion of milestones.

4.8.4.4 Test and Evaluate Products

The objective is to ensure that all deliverables and products satisfy contract requirements prior to acceptance and delivering to user deparment or organization.

Evaluations and tests should be conducted to detect the differences between existing and required conditions, and to evaluate the features of products such as performance, reliability, availability, ease of modification, and functionality.

This phase of the process shall be conducted by a *test & evaluation team*. This should be established prior to the phase and may be trained to be able to perform required activities. This team may include end users and all other affected groups.

The results of test and evaluations should be documented and reported in order to use in case of a disagreement.

4.8.4.5 Accept the Product

Before accepting the products, the PO should ensure that all acceptance criteria have been satisfied. Different acceptance strategies can be developed based upon specific needs of projects.

The implementers of this phase should prepare the acceptance documents. This phase should include testing on TLFC facilities or user units. Contractor should install the system. The system must be tested and evaluated based upon the criteria identified in previous phases.

In Table 4.2, a summary of the proposed model is presented with a comparison to the main reference models used for each process step and an indication of the differences, where applicable.

Table 4.2 Comparison of the Proposed Process

The Proposed Process	Reference Process
1. Establish Program Management Structure: Establishing management structure and forming the PO.	1.All models assume that a project team exists and a project manager is assigned. SA-CMM assumes an acquisition organization performes all acquisition activities, and the project team is responsible only for a particular project. This acquisition organization involves MND, TLFC Departments, and the owner of the need.
2. Tailor Organizational Standard Process and Define the Project's Individual Process: TLFC's general process is tailored based on the specific needs of the project like type, complexity, expected risks and etc.	2. This step is mainly based on "Process Definition and Maintenance" key process area which is one of the SA-CMM's defined level key process areas. But there is not a group responsible for process definition and maintenance due to the shortage of qualified personnel.
3. Develop Acquisition Strategy: The ORD describes what is to be bought, the acquisition strategy defines how it will be bought.	3. SPICE and SA-CMM require developing the acquisition strategy in the scope of the planning process. SPICE defines acquisition strategy as the decision on how the product will be acquired. But the proposed model and SA-CMM emphasize all elements related

	with the acquisition; evolutionary or single step, national prime contractor or tendering, fixed-price or cost reimbursement contract type and other considerations should be identified prior to solicitation phase.
4. Plan Acquisition Life Cycle: Planning the whole life cycle of the project so that all elements of the project are included.	4. This process is derived from SA-CMM's planning key process area. But the template (Appendix D) has been developed based on the IEEE Std. 1062.
5. Develop and Manage Requirements: As defense systems are so complex systems, this process is one of the most important processes. The desired system is defined and contractual requirements are identified here.	5. IEEE Std. 1062 has "determining software requirements" step in its planning process. The proposed model considers the complexity and criticality of defense systems and it provides an independent step for requirements development. And also, it includes management of requirements as SA-CMM requires.
6. Develop Risk Management Plan: Developing a plan to identify, manage and control project's risks.	6. This step is similar to SA-CMM's acquisition risk management key process area. The template (Appendix F) includes requirements of this key process area.
7. Develop Configuration Management Plan: Identifying and managing changes to deliverables and other work products as they evolve through acquisition project.	7. As a managerial process (CM is not an acquisition specific process), CM has been noted here to show its importance.
8. Implement Quality Management: Managing assessment of deliverables and products, as well as assessment of contractor's quality management process, experience, facilities, development process and test activities.	8. All models require establishing a quality management approach.
9. Prepare Cost and Schedule Estimates: Estimation of project's cost and schedule.	9. SA-CMM requires life cycle cost and schedule estimates are independently reviewed. The final prices and costs of the TLFC projects are identified by the related MND departmnet.
10. Consider Contract Type: Analyzing project's characteristics and identifying most appropriate contract type.	10. All models emphasize that fixed-price contracts are not appropriate for software intensive systems acquisition. But specific conditions of Turkish informatics industry and economical situation prevent the PO to select a cost reimbursement contract type.
11. Update and Review Program Management Plan: This is an important	12. "Verifying Implementation" is one of the five common features of the SA-

milestone. The PEEC review the PMP.	CMM. It typically encompasses reviews by management. In TLFC acquisition projects, it is done by PEEC.
12. Identify the Contents of the Solicitation Package: The contents of solicitation package is identified based on related MND instructions and available templates.	12. The models other than SA-CMM, require preparing a RFP. But SA-CMM requires preparing a solicitation package prior to tendering process.
13. Develop Proposal Evaluation Plan: Planning the activities to be performed after receiving the proposals.	
14. Prepare Request for Proposal: Preparing a RFP which includes the procurement package, and all those administrative and legal provisions.	14. Euromethod defines the contents of the RFP. The RFP template (Appendix H) has been made based upon the Euromethod contents. But Euromethod specific terms like target domain, situational factors have not been used.
15. Identify Potential Suppliers: Gathering and recording information about offerors.	16. This step is mainly based on the IEEE Std. 1062. But IEEE Std. 1062 requires evaluating software product during a demonsration. As defense systems are so complex, this can not be done at this point. The proposed model includes only gathering information on potential suppliers to make a more objective assessment.
16. Issue the RFP: The RFP is sent to MND acquisition department.	16. A specific process to the proposed model.
17. Evaluate Proposals: Selection of the qualified supplier.	17. All models require evaluating proposals based upon the factors identified in earlier phases.
18. Negotiate the Contract: Negotiations are held with the intent of allowing the offeror to revise its proposal.	18. The difficulty of identifying a fixed price for software intensive systems is clear, so the negotiations can be very helpful in reducing the costs.
19. Sign the Contract	
20. Manage the Contract: An appointed contract manager manages the contract to deal with the supplier on all aspects of the contract.	20. All models require managing contract based upon the prepared contractual requirements in earlier phases.
21. Monitor and Assess Supplier Progress: Monitoring supplier's progress to ensure that all milestones and deliverables are met.	21. IEEE Std. 1062 has two main steps for this stage of the whole process; manage the contract during execution and monitor the supplier progress. SA-CMM also requires evaluating and recording supplier progress. The proposed model encompasses these two

	steps.
22. Evaluate Actual Cost/Schedule: Actual cost and schedule of the contractor's development effort shall be compared to planned schedules and budgets.	22. All models emphasize the importance of such records. They will be used to prepare cost and schedule estimates of future projects.
23. Test and Evaluate Products: Testing all deliverables and products to ensure that they satisfy all contractual requirements.	
24. Accept the Product	

CHAPTER 5

5 CASE STUDY

5.1 General

The proposed model has been defined with its phases and work products in the previous chapter. Application of that model will be discussed in this chapter, within the context of a specific case study to provide a better interpretation of the proposed model, and to assess its benefits and disadvantages.

The acquisition process of an actual project will be reviewed in the framework of the proposed model of this thesis. The project which will be considered as the case study shall be called project A, for reasons of security. The project A has been undertaken by Department X of TLFC.

The purpose of this case study is to demonstrate the application of the proposed model on a real project and also to show its merits. A critical evaluation of the acquisition process of the project A is not within the scope of this work.

Specific references are available for each fact stated about project A, however these will not be exposed, for reasons of secrecy. The author can be contacted for further requests.

5.2 Statement of the Problem

TLFC wants to develop and employ an automated information system acquisition program of which is called project A. The system to be acquired will automate operational area activities by digitally modelling the battlefield. It will produce tactical snapshots which will be shared among tactical and command control units with the aid of application software units. Department X is responsible for carrying out the project.

5.3 Expected Functionality

The system which will be acquired in the scope of the project A will achieve the following functions:

- Establishing a network with the aim of collecting, recording, evaluating, and distributing needed information.
- Digitally modeling the battlefield with the information provided by other related units.
- Achieving data flow from the troops on the front line to the Armed Forces Command and Control Center.
- Collecting and evaluating information in real time.
- The system will be developed based on an open system architecture.
- Other governmental departments which are authorizeed will be able to exchange information through system.
- The system will interact with several other systems, some of which are also currently being developed.

5.4 An Overview of Project A's Life Cycle

The project A is an acquisition project of the system to be developed as the solution to the problem stated in section 5.2. Evolutionary acquisition approach will be used due to the system complexity and the difficulty in defining the final system.

The acquisition program of this system consists of seven phases:

1. Project Defining Phase (Concept Studies)
2. Master Planning and Technical Architecture Design Phase
3. Model System Acquisition Phase
4. Model System Pilot Testing
5. System Re-evaluation and Designing
6. Model System Demonstration
7. Production and Employment of System for Other TLFC Units

An operational part of the system will be developed and tested in real conditions in fourth phase. System production and employment in other TLFC units will be possible after defining additional enhancements and functionalities.

The system will consist of five major components. These sub-systems will interact with each other and will be able to communicate via a closed network.

Each system component consists of work stations, distance work stations, computer hardware and software, communication hardware and software, and finally a vehicle for protecting the system on the field.

5.5 Assumptions

Before applying the proposed model, certain assumptions should be made regarding overall project's life cycle.

The major assumption is that the required activities have been performed before initiating the acquisition program. TLFC has decided to acquire such a system after evaluating its missions and requirements of future battlefield. The project A is now at *engineering and development phase* (refer to section 3.4.4) which is the fourth stage of the general acquisition process of TLFC. At this phase; the desired system should be defined and solicitation package must be prepared before selecting a qualified supplier to develop the system. Here is the point where the proposed model must be integrated into the TLFC acquisition process. In other words, the proposed model should be used after system acquisition program has been initiated.

5.6 Case Study Approach

The project A will be explained through stating its phases and steps in two major aspects; process related points and managerial issues. It has been noted in earlier chapters that an acquisition process includes acquisition oriented technical processes and project management processes. Preparing solicitation package or developing system requirements are technical processes, whereas project management, quality management or establishing a PO are managerial processes.

The steps of project A will be clarified with their work products and activities. Then, the proposed model will be applied to this already undertaken project. At the end of this evaluation, the advantages and disadvantages of proposed model will be clear to the reader.

5.7 Analyzing Project A's Life Cycle

This section will review the implemented project life cycle and its performed activities. The phases will be discussed with their inputs, durations, activities and outputs. The information below is mainly based on the interviews with project A stakeholders and analysis of project documents.

5.7.1 Pre-Acquisition Initiating Phase

This phase includes activities before initiating project A acquisition program. As discussed in 3.4, TLFC acquisition preparation phase consists of two sub-phases; identifying mission need phase and concept exploration and system defining phase. As the current program management does not plan the acquisition program based on a process concept, the following names are different names of phases (original names of project A phases) which have been formed in a product oriented fashion.

5.7.1.1 Project Defining Phase

Inputs: Defficiency Areas, Future Battlefield Conditions, Automation Needs, Requests of Department X.

Duration: This phase has started with need identification and ended with letting a contract for preparing master plan of project A. From Day1 (D1) to D420. Total duration of this phase is 14 months.

Activities: Concept studies have been performed to identify defficiency areas. Requests of department X have been reviewed and evaluated. After analyzing automation needs and future battlefield environment, a system has been defined as a solution to the requests of department X.

D1: Project Order has been announced.

D276: PNShas been approved by TLFC.

D294: Project A working group (not project office) has been formed in department X. This group consists of two administrative persons from department X.

D339: NDFand PNS has been sent to MND to let a contract for MP preparing.

D420: A contract has been awarded to prepare the MP of project A.

Outputs: PNS, Signed Contract for MP Preparing, Project A Working Group

5.7.1.2 MP Preparing and Technical Architecture Designing Phase

Inputs: PNS, Signed Contract for MP Preparing, Project A Working Group, Requirements for Interoperability with Other Systems

Duration: This phase has been started with MP preparing contract awarding and ended with signing a protocol with a university for preparing technical contract of project A. Total duration of this phase is 25 months.

Activities: The contractor which has been selected in previous phase for MP preparing has prepared the MP. A PO has been formed to perform project A activities instead of working group. The PNS has been updated. A second tender has been performed and a university team has been selected as consultants in preparing the technical specifications.

D540: A PO has been established in department X instead of project A working group.

D665: A project manager and a system engineer has been appointed to PO, but system engineer has not participated in the team.

D675: PNS has been updated and send to General Planning and Policy Deparment (GPPD).

D685: Project A Mission Need Statement and Operational Requirements Document has been prepared and sent to GPPD.

D730: A battlefield defining project officer has been appointed to PO but has not joined.

D870: The changes to PNS have been sent to contractor so that the contractor consider them while preparing the MP.

D1002: Project A's MP has been accepted by TLFC.

D1007: Three universities and a government research agent has been invited to offer their responses to the tender about preparing project A technical contract.

D1057: Other related TLFC departments have been invited to appoint personnel to PO with the aim of providing coordination.

D1094: A university has been identified for preparing technical contract.

D1182: A protocol has been signed with selected university.

Outputs: PO Structure, Updated PNS, MNS, ORD, MP, A signed protocol for preparing technical contract.

5.7.2 Acquisition Phase

This phase includes identifying technical specifications, preparing technical contract, preparation for solicitation, tendering, selecting a qualified supplier, system development, system testing, and employment.

5.7.2.1 System Defining Phase

Inputs: MP and ORD

Duration: This phase will be started with signing the protocol for preparing technical contract and will end with accepting the contract. Total duration of this phase is 5 months.

Activities: The objective of this phase is to define the model system with its technical specifications based on the architecture included in MP. Activities of this phase have been carried out by a group of experts from selected university.

D1186: Project orientation studies have been conducted by experts.

D1196: Project's source documents have been examined by experts group.

D1207: The group has identified TLFC solicitation package requirements.

D1237: Work flow diagrams have been prepared.

D1272: System requirements have been developed.

D1289: Technical requirements have been prepared and detailed.

D1310: The cost of system has been estimated.

D1325: Technical contract has been accepted by TLFC.

Outputs: System Specifications, Technical Contract

5.7.2.2 Tendering Phase

This phase includes solicitation of responses to bid, evaluating suppliers' responses, selecting a qualified supplier and signing a contract for system development and employment.

At the time this thesis was written, the PO was preparing for the PEEC evaluation. As mentioned above, product oriented plans of PO do not include any planning in advance. The PO does not have any plan on how the solicitation will be performed, what criteria will be used to evaluate evolving products or supplier responses. Hence, the remaining phases can not be evaluated in the scope of this study.

5.8 Application of Proposed Model in the Framework of Project Management Practices

The most important issue that the proposed model provides is *to plan a process oriented acquisition program,* rather than a product oriented one. As

analyzed in section 5.7, project A is based on a product oriented program. The proposed model requires tailoring and defining an acquisition process based on specific needs of the project A as discussed in chapter 4. If the proposed model were applied to project A, a defined process (with its phases, steps, activities, roles and responsibilities, milestones, and program reviews) would be developed for project A at the beginning point of the project.

The prerequisite for applying the proposed model is to appoint a project manager and to form a project office which includes required skills. It can be understood from section 5.7 that a working group was established at D294, and a formal PO was formed at D540.

The proposed model requires forming a PO just after project order announcement. This would be helpful in planning in advance the entire life cycle of project A. Process oriented planning would provide a picture of the whole project A, and project's risks would be clearly identified.

As the *process concept* was not applied to project A, *operational requirements document* and *mission need statement* have not been prepared before project order announcement. Prior to project order, ORD and MNS should be developed. If the proposed model were applied to project A, it would require review ORD and PNS/MP as inputs to the acquisition initiation phase. And possible risks which would arise in system defining phase could be prevented.

5.9 According to the Proposed Model's Process Application

This section includes application of the proposed model to project A. Current process of project A will also be provided to give an ability for comparison.

The phases of proposed model will be applied while it is assumed that the project order of the project A has been announced.

5.9.1 Establish Program Management Structure

Current Application	Proposed Model
No project office was built. Department X has treated project A as any other administrative activity. A working group was built at D294, and a formal PO was formed at D540.	A PM would be appointed just after the project order announcement. The PM would form a PO based on the technical skills after analyzing project source documents such as ORD, PNS/MP. See 4.8.1.1.

Outputs	Outputs
Department X has treated project A as other daily activities.	An appointed PM. A PO established with its roles and responsibilities. Project management structure including other related TLFC departments.

5.9.2 Tailor Organizational Standard Process and Define the Project's Individual Process

Current Application	Proposed Model
Organizational general process has been applied to project A. Project A's specific needs are not considered. There is no documented process for project A.	The PO would begin tailoring their particular acquisition process. Projet A's documented acquisition process would be defined with its phases, steps, activities, roles and responsibilities, milestones, and program reviews. See 4.8.1.2 and Appendix B.
Outputs	**Outputs**
There is no such activity.	Project A's acquisition process is defined and documented.

5.9.3 Develop Acquisition Strategy

Current Application	Proposed Model
PO has not developed an acquisition strategy at this point. They considered the strategy identified in source documents like PNS in previous phases.	The PO would review the acquisition strategy identified before. If it would require modifications, PO would update and document the acquisition strategy. As the system is very large, evolutionary acquisition strategy would be applied. See sections 2.7, 4.8.1.3 and Appendix C.
Outputs	**Outputs**
An acquisition strategy defined in a few statements in ORD or PNS/MP.	A documented acquisition strategy describing how the desired system will be acquired.

5.9.4 Plan Acquisition Life Cycle

Current Application	Proposed Model
A general (abstract) plan including evolving product status (product oriented planning).	An acquisition program management plan containing all acquisition life cycle (system definition, solicitation, tendering, supplier evaluation, supplier monitoring, product testing and accepting) would be developed. See 4.8.1.4 and Appendix D.

Outputs	Outputs
An abstract project plan. The university team has developed their own plan including technical contract preparing phase.	A documented acquisition program management plan.

5.9.5 Develop & Manage Requirements

Current Application	Proposed Model
Project A has a specific aspect for requirements definition. Its specifications have been developed by university team.	System and user requirements would be developed by PO with the contributions of end users. See 4.8.2.1 and Appendix E.
Outputs	**Outputs**
Technical and non-technical requirements for project A.	Technical and non-technical requirements are developed and will be managed through project's life cycle.

5.9.6 Develop Risk Management Plan

Current Application	Proposed Model
A risk management plan has been developed in the scope of project A with the help of university. This plan was developed in the phase of technical contract preparation.	Initial risks identified in developing acquisition strategy phase would be reviewed, and required modifications would be done. A formal risk management plan would be developed and documented. See 4.8.2.2 and Appendix F.
Outputs	**Outputs**
A documented risk management plan. It includes only identification and analysis of risks.	A documented risk management plan including risk management implementation roles and responsibilities for handling, tracking, and controlling risks.

5.9.7 Develop Configuration Management Plan

Current Application	Proposed Model
There is no such activity.	A configuration management plan would be developed to manage changes to deliverables and other work products. See 4.8.2.3.
Outputs	**Outputs**
-	Documented configuration management plan.

5.9.8 Implement Quality Management

Current Application	Proposed Model
A quality management plan was not developed. Project A technical contract includes only requirements for suppliers to develop their own quality management plan for their system production process.	A quality assurance team would be established to assess deliverables and products, and also to assess contractor's quality management process, experience, facilities, development process and test activities. See 4.8.2.4.
Outputs	**Outputs**
Quality requirements for suppliers' system development process.	Documented quality management plan for acquisition process and also for supplier's quality management process.

5.9.9 Prepare Cost & Schedule Estimates

Current Application	Proposed Model
Cost and schedule estimations were done based on contractual requirements.	Estimations would be done based upon program objectives, operational requirements, contract specifications, risk assessments, and work breakdown structure.
Outputs	**Outputs**
Cost and schedule report.	Cost and schedule report.

5.9.10 Consider Contract Type

Current Application	Proposed Model
The PO has not yet decided on the contract type. The PO wants to apply sole source acquisition, and bargaining method will be probably used.	The PO would analyze all possible contract types. After identifying advantages and disadvantages of alternatives, they would select an appropriate contract type. See 4.8.2.6.
Outputs	**Outputs**
A contract type is selected.	Most appropriate contract type is selected.

5.9.11 Update & Review Program Management Plan

Current Application	Proposed Model
The current process does not have such milestone. The PEEC reviews only technical contract just before tendering phase.	The proposed model requires reviewing all documents produced up to now. Especially program management plan would be reviewed and updated. This point is one of the most important milestones of the proposed model. Because remaining phases will be implemented based on the documents

	prepared up to this point. See 4.8.2.7.
Outputs	**Outputs**
-	Approval/disapproval to proceed to the solicitation and contracting phase.

5.9.12 Identify the Contents of the Solicitation Package

Current Application	Proposed Model
Only an RFP is used rather than an extensive solicitation package.	The PO would analyze related instructions and previous solicitation package to identify their specific package contents. See 4.8.3.1.
Outputs	**Outputs**
A technical contract template.	Contents of solicitation package.

5.9.13 Develop Proposal Evaluation Plan

Current Application	Proposed Model
An evaluation plan is not developed. Only evaluation criteria is defined.	The PO would develop an evaluation plan which guides the activities to be performed after receiving the proposals. See 4.8.3.2 and Appendix G.
Outputs	**Outputs**
A few not well-defined evaluation criteria.	An evaluation plan including evaluation schedule, pre-conditions for proposal accepting, evaluation committee's structure and evaluation criteria.

5.9.14 Prepare Request for Proposal

Current Application	Proposed Model
MND is responsible for preparing and announcing RFP. But product related documents (contractual requirements, evaluation criteria, specific needs for evaluation schedule and etc.) of RFP are prepared by project implementers of TLFC.	The PO would prepare a draft RFP. MND would use it to invite the offerors. See 4.8.3.3 and Appendix H.
Outputs	**Outputs**
Some parts of RFP	A RFP

5.9.15 Identify Potential Suppliers

Current Application	Proposed Model
Current process does not have a formal process for identifying potential suppliers. The information about suppliers are not documented, project	After sending RFP to MND, the PO begins to collect information about potential suppliers to be able to objectively evaluate the proposals. See

implementers have this information in their mind.	4.8.3.4.
Outputs	**Outputs**
-	Information (technical and domain experience, past projects, financial adequacy) on suppliers.

5.9.16 Issue RFP

Current Application	Proposed Model
RFP will be sent to MND	RFP is sent to MND
Outputs	**Outputs**
A document confirming RFP delivering.	A document confirming RFP delivering.

5.9.17 Evaluate Proposals

Current Application	Proposed Model
Proposals will be evaluated based on the criteria identified by PO.	Proposals are evaluated based on the plan developed by PO. See 4.8.3.6.
Outputs	**Outputs**
A selected qualified contractor.	A selected qualified contractor.

5.9.18 Negotiate the Contract

Current Application	Proposed Model
Evaluation committee will negotiate the contract with the offeror to allow the offeror to revise its proposal.	Evaluation committee negotiates the contract with the offeror to allow the offeror to revise its proposal.
Outputs	**Outputs**
Negotiated and modified contract.	Negotiated and modified contract.

5.9.19 Sign the Contract

Current Application	Proposed Model
The contract will be signed by MND and selected supplier.	The contract is signed by MND and selected supplier.
Outputs	**Outputs**
Signed contract.	Signed contract.

5.9.20 Manage the Contract

Current Application	Proposed Model
The contract will be managed by PO based upon the criteria and constraints identified.	A contract manager manages the contract, evolving products and deliveries according to criteria identified in evaluation plan.
Outputs	**Outputs**

Contract status reports.	Contract status reports.

5.9.21 Monitor and Assess Supplier Progress

Current Application	Proposed Model
The PO will control and evaluate supplier progress according to the constraints identified in contract.	Contract manager evaluates supplier performance according to the constraints identified in contract. See 4.8.4.2..
Outputs	**Outputs**
Reports on supplier progress.	Reports on supplier progress.

5.9.22 Evaluate Actual Cost and Schedule

Current Application	Proposed Model
Actual cost and schedule will be reviewed and recorded.	Actual cost and schedule is reviewed and recorded to use in future projects. See 4.8.4.3.
Outputs	**Outputs**
-	Actual cost and schedule of project.

5.9.23 Test and Evaluate Products

Current Application	Proposed Model
Test activities will be made based upon the plan developed by the supplier..	Evolving products would be tested according to the criteria and constraints identified in evaluation plan. See 4.8.4.4.
Outputs	**Outputs**
Test reports.	Test reports of final and evolving products.

5.9.24 Accept the Product

Current Application	Proposed Model
The final system will be accepted/rejected after testing.	The final system is accepted after testing.
Outputs	**Outputs**
Acceptance Report.	Acceptance Report.

5.10 Assessment of Case Study

The proposed model has been applied to a real acquisition project undertaken by department X of TLFC in this case study. The explanation of case study has been kept as concise as possible. No technical specifications were made in order not to direct the reader for a particular specification. Because this case study aims at emphasizing necessary operations and the importance of applying a disciplinary approach in acquiring software intensive systems.

As understood from the current process of project A, some phases and steps are omitted due to the lack of applying a process driven management approach. Also due to the organization structure, some phases are performed by external entities. This outsourcing of some phases (eg. preparing MP and developing specifications of project A) has incurred a specific extra cost to TLFC. The proposed model application would reduce this cost. Because a PO which is formed based on the required skills noted in this model, would be able to perform these outsourced phases.

Master plan of project A was delivered at D1002 and a protocol about preparing technical specifications has been signed with a university experts team at D1182. This six months have been devoted to select and sign technical specifications preparation protocol. The proposed model application would save this duration of six months.

Turkish regulatory framework is not an obstacle to apply the proposed model. This model does not require employing different strategies. The major necessity of the model is that it requires following a defined process and applying a disciplinary approach in acquiring software systems. It includes necessary activities which should be performed. These operations are very important, because software is different.

The main difficulty in applying the proposed model is to have adequate skilled personnel to form a project office. In fact TLFC has these skills, but due to the wrong organization structure, this personnel is working in different departments and in different positions. The second difficulty of the proposed model is that it requires senior management commitment for treating software acquisitions on an exceptional basis. TLFC acquisition system should be reviewed and restructured to meet new needs. In this scope, new state tender law has changed, and these amandments have been discussed in Chapter 3.

The proposed model emphasizes analyzing and applying most appropriate contract type to the software acquisitions. There is no one right contract type. But this is an other difficulty of the proposed model. Turkey has recently experienced a serious economical crisis. This gets people more sensitive when spending government resources. Project implementers prefer fixed price contract types. Other alternatives should be considered. If the desired system can be defined with its all

requirements, then the fixed price contract type is probably the right choice, but it has been noted that it is very difficult to define the final system at the outset. The author holds the opinion that if the PM has strong reasons to apply more flexible contract types, they can select and apply them.

As understood from the system specifications, the desired system is a very complex and large system. There are interoperability requirements of lots of components, and the system will be employed in a great part of TLFC units. National prime contractor strategy has been decided for project A. The PO and TLFC will have a qualified partner to develop and improve the system. The NPC will be responsible for the whole system, it will be able to make agreements on sub-systems development. But TLFC will have only one contractor to negotiate with.

If this proposed model were applied in TLFC, a qualified project office would be formed, project management practices would be applied and a process oriented acquisition program would be employed to acquire more quality products in a rational schedule and with reasonable resources.

CHAPTER 6

6 CONCLUSION

6.1 Summary

After analyzing problems of current process under process, legal framework, informatics industry, and resources titles, a software acquisition model for TLFC based on four investigated models has been proposed in the scope of this thesis study. Four acquisition models are compared with each other to give a better understanding of software acquisition concepts.

The proposed model has been formed based upon three factors:

- *Specific needs of TLFC*. These needs have been observed by the author himself and also have been derived from the interviews with stakeholders and project documents reviews.
- *Basic concepts of software acquisition*. These fundamentals of software acquisition have been derived from analyzing contemporary models in Chapter 2.
- *Results of analyzing current problems*. The proposed model forms a framework for preventing and destroying identified problems in Chapter 3.

Finally a case study has been performed to provide a better understanding of proposed model. Project A which is a really undertaken project by Department X of TLFC, has been selected as the case study.

6.2 Evaluation of Proposed Model

As discussed in Chapter 3, the current TLFC acquisition process does not treat acquisition of software intensive systems on an exceptional basis. Many studies have concluded that "*software is different"*. If software is different, then the acquisition of it must also be different. The *proposed model* has been formed based upon this conclusion.

The first and most important superiority of the proposed model is that it is a software oriented model and it requires applying a disciplinary approach to software

intensive systems acquisition. It has been formed to provide a model including fundamental concepts and necessary operations which may be used to establish a process to deal with the problems of the current approach.

In developing and defining the proposed model, four contemporary acquisition models (SA-CMM, SPICE, Euromethod and IEEE Rec. Practice) have been analyzed. The second superiority of the proposed model is that it has been formed based upon these models, successes of which have been proven and which have been prepared based upon the experiences on the acquisition field of software intensive systems.

SA-CMM has mainly formed the basis of the proposed model. It is designed for use by any government or industry organization, especially for use by US Department of Defense. This feature of the SA-CMM is the first reason to be selected, as the proposed model is also for use by TLFC which is a government organization.

On the other hand, all key process areas and common features could not be used. The problems and the immaturity of the current process can be considered as the reasons for this lack.

One of the common features of SA-CMM is *commitment to perform*. It describes the actions that the organization must take to establish the process and to ensure that it can endure. It typically involves establishing organizational policies about sub-processes and management sponsorship. One of the proposed model's principles is that it requires management commitment, but it is obvious that the current process can not achieve this requirement. The proposed model considers this aspect of the current process, and it requires only establishing and defining the acquisition process of the particular project.

The importance of having a defined acquisition process has been noted in the previous chapters. The third superiority of the proposed model is that it requires applying a process driven (not product driven) management approach to acquisition of software intensive systems. Through this approach, the PMs may plan the whole acquisition life cycle (with its all elements; requirements development and management, solicitation, risk management, contracting, supplier monitoring,

evaluation, accepting and support) at the beginning of the process. And they will have the opportunity to monitor and evaluate their program/plan progression.

One of the most important problems of complex systems acquisition is the failure of defining the desired systems. The current TLFC approach also suffers from this problem. This proposal requires early user involvement in requirements development process. "Identifying all affected groups and establishing a management approach to get these all groups involved in the process as needed" was noted as a PM responsibility.

The "*evolutionary acquisition*" approach has been proposed as an other solution to difficulties in defining final systems. Detailed information on this approach was discussed in Chapter 3.

The immaturity of the domestic informatics industry and the absence of mature companies has been stated as a specific problem to Turkey. To deal with this important problem "*national prime contractor*" application has been proposed. This approach will foster the growth of more mature and powerful companies which can produce quality software products.

Other process related superiorities of the proposed model are as follows:

- It emphasizes employing software acquisition professionals and other technical skills.
- In estimating project's cost and schedule, it requires using estimating techniques, successes of which are proven.
- It provides templates and outlines for work products of the process. The current process does not have such templates.
- It requires applying system engineering approach to acquisition of software intensive systems acquisition.
- In current approach, implementation of projects is thought as any other activity of TLFC department. But the proposed model requires assigning an individual as the PM.
- A project office (or team) which is formed based upon the required technical and managerial skills is the requisite of the proposed model.
- The proposed model requires tailoring of the standard process based on the specific needs of the particular project and defining this tailored process

with its milestones, entry and exit criteria of phases, roles and responsibilities of PO members.

- The current approach does not require defining, establishing and implementation of a risk management process. As a solution to this problem, a risk management plan developing step has been included in the proposed model.
- A comprehensive and realistic project plan is not developed to monitor and manage the project. The current planning process does not include planning the entire life cycle of the acquisition process. The proposed model requires planning the process life cycle with its all elements.
- Forming a software intensive systems acquisition process repository has been proposed to support process improvement activities.

In addition to these superiorities of the proposed model, it also has some defficiencies and difficulties. It has lots of work products to be produced. This requires more time and more resources. The focus of PO may be on the quality of these work products, but this is true in early time of the proposed model application. As the model has been applied to the projects, the PO would have the required experiences to do the quality work.

In addition to the paperwork, a second difficulty is that the proposed model requires experienced project managers and technical skills on software domain. Even if TLFC had adequate staff for software intensive systems acquisition, poor organization would reduce their effectivity. If related units of TLFC can be restructured, this technical staff can be used in an optimized manner.

The objectives of this thesis study have been identified in the first chapter. One of them was to investigate the available software acquisition models and to compare them with each other.

After exploring software acquisition process models, it can be clearly stated that *software* should be treated on an exceptional basis. All models that are analyzed in Chapter 2 have lots of similarities about acquisition process. They all emphasize that the most important issue in a software acquisition process is to employ *a disciplinary approach and* to establish *a well-defined process* while allocating required resources such as staff, funding, tools, and techniques.

The author notes that SA-CMM and SPICE provide a framework for software acquisition. These two models can not be used as a guidance on how to do when acquiring a software product. On the other hand IEEE Std. 1062 and Euromethod describe the activities in an acquisition process through providing a guidance on how to proceed.

An acquisition process consists of several other sub-processes like requirements development process, solicitation process, and proposal evaluation process. If an organization wants to assess a particular sub-process of its whole acquisition process, SA-CMM provides an excellent source for such an assessment. It includes key process areas which are formed based on these sub-processes.

Another observation of the author is that all models should have explanatory sections about how to apply the model for a particular acquisition program. Because it is too difficult to understand the models and to apply their concepts to real projects.

Second objective was to analyze the problems of current TLFC acquisition process to identify its deficiency areas. Although current process have different problems causes of which are also different, a model can be used to remove the problems related with lack of a methodology or a disciplinary approach. The proposed model, as a disciplinary framework, may be a remedy for current software project applications.

6.3 Future Work

A software acquisition information repository can be very helpful in forming a culture and also in using successful acquisition practices. This repository should be available to all TAF units and also to informatics industry. All affected groups should be able to share the information included in the repository. This information may be articles about software acquisition, past projects' documents (these should be available only to authorized personnel), work product templates, guidelines for software acquisition and etc. Such a database will help TLFC in forming an organizational experience independent from individuals and decreased the required time effort for similar projects [Çalkayış, 2001].

The proposed model does not include using any software acquisition tool. Software acquisition tools can be explored and used to automate the acquisition

process. This can help the acquisition team in producing more quality work products and raising their productivity as well as enhancing consistency.

A formal process assessment can be performed to identify the deficiencies of the proposed model. This assessment may be done in the framework of SA-CMM or ISO/IEC TR 15504. These two models have adequate information about process assessment. This will be useful in improving the proposed model. Because this model is not a process improvement project definition. Such a project requires more resources and capable assessors.

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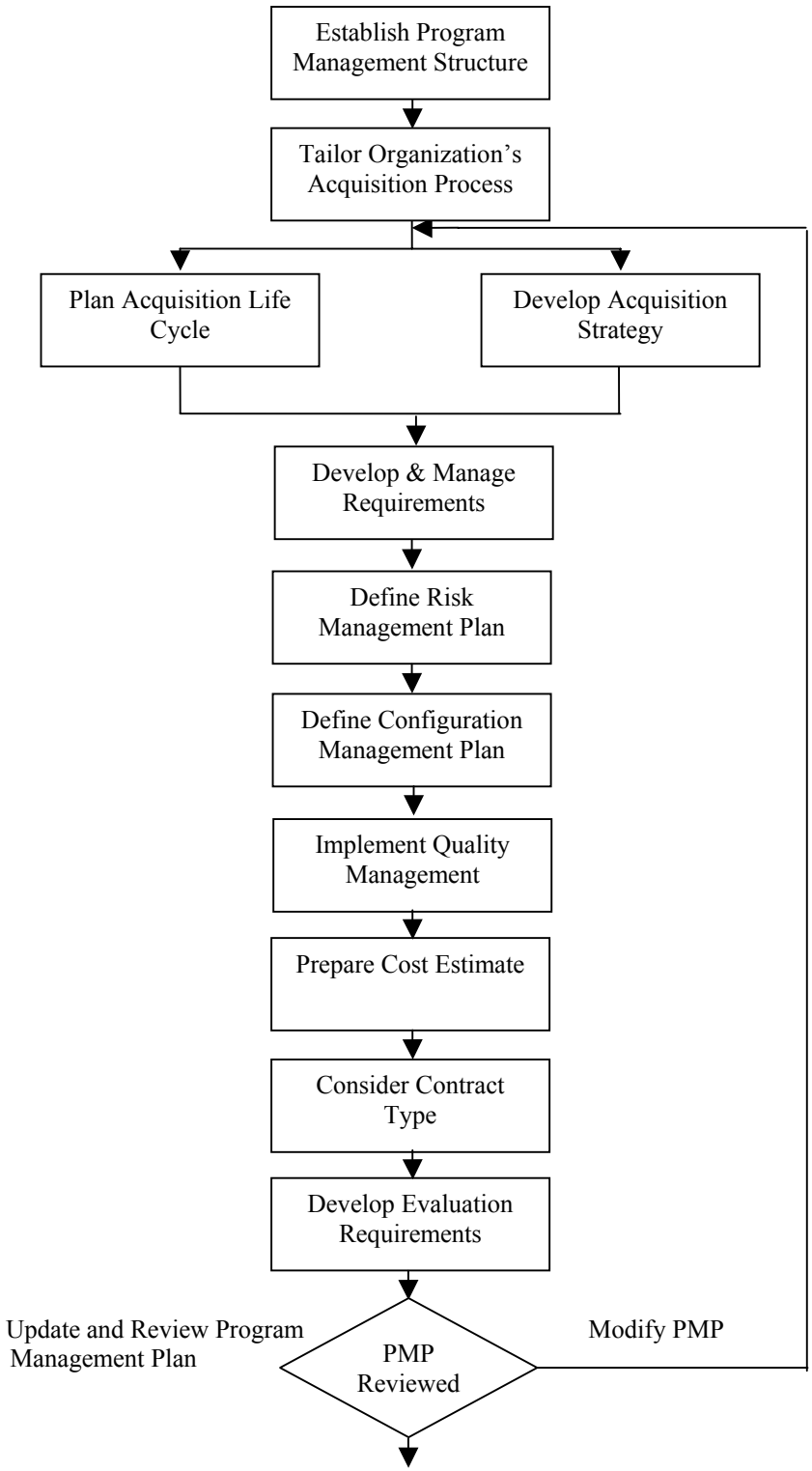
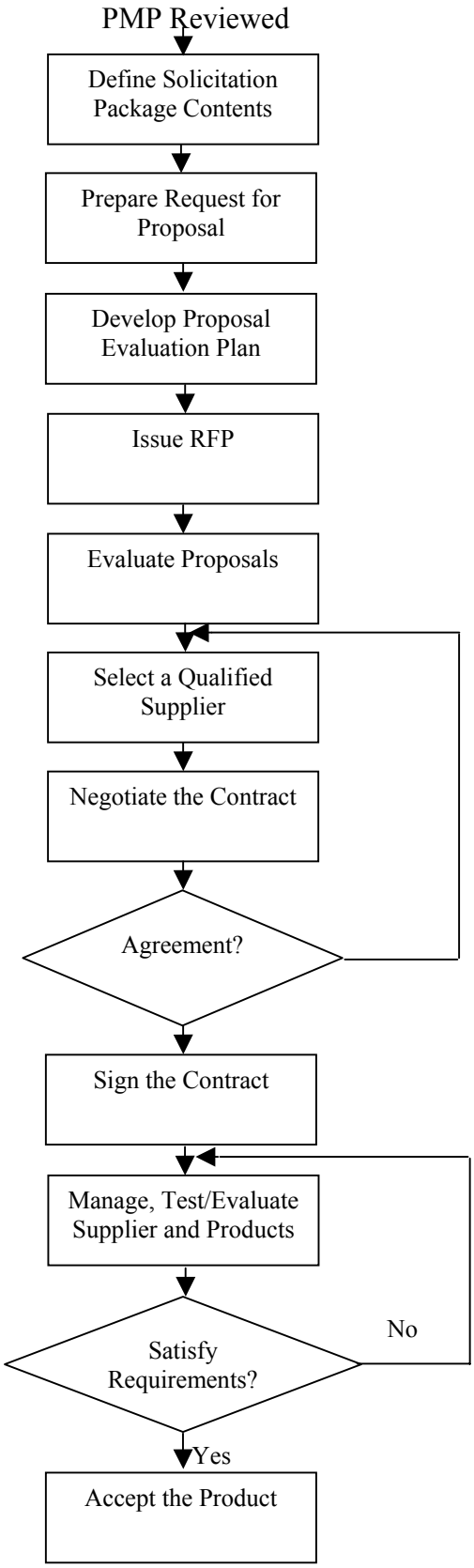
APPENDICES

Appendix A A Defined Process




PMP Reviewed
Define Solicitation Package Contents
Prepare Request for Proposal
Develop Proposal Evaluation Plan
Issue RFP
Evaluate Proposals
Select a Qualified Supplier
Negotiate the Contract
Agreement?
Sign the Contract
Manage, Test/Evaluate Supplier and Products
Satisfy Requirements?
No
Yes
Accept the Product

Appendix B Process Definition Outline

1. Introduction: State briefly the purpose, scope, goals and objectives of this document.

2. Process Overview: Explain the scope and the objectives of acquisition process in general. Define the terminology and project specific terms.

3. Process Structure: Describe major sub-processes and their relationships with each other. Explain the required criteria to pass to the next phase.

4. Process Definiton:

   4.1 Inputs to Process: Define available work products and other specific needs required to start the process.

   4.2 Activities: Describe major activities of the process and the relationships with each other.

   4.3 Outputs from Process: Identify the outputs and work products which should be achieved at the end of the process.

   4.4 Roles and Responsibilities: Describe what kind of skills the process requires. Identify the responsibilities of these required entities.

   4.5 Milestones and Decision Points: Define milestones and major decision points of the process. Identify the authorized personnel/committee which will decide on and approve the program progression at each milestone.

   4.6 Data to be Collected: Identify the data which will be used to track the process progression and which should be collected and recorded. Examples of this data may be; estimated and actual project size, effort and cost, schedules, staffing data, and etc.

   4.7 Standards: Identify the international and organizational standards which the process should comply with.

   4.8 Other Required Information: Discuss similar projet's process data collected in the past and provide other information about the project.

5. Modeling of Defined Process: If the PM believes that there is a need to have a better process visibility the defined process can be modeled through using a notation.

6. References

Appendix C Template for Documented Acquisition Strategy

1. Objective: State the aim of this document. Describe briefly the objective of the acquisition and the requirement to be satisfied.

2. Current Status of the Program: Summarize the activities which have already been done up to this documentation. Define the documents which have already been prepared (ORD, MNS, MP and etc.)

3. Market Research: Describe the status of related industry and discuss the information on potential suppliers.

4. Acquisition Approach: Describe the acquisition approach to be used to achieve the program objectives and the reason for choosing this approach (off-the-shelf, develop through contract, enhance existing software product and etc.). Will the acquisition approach be an evolutionary or a single step approach?

5. Contracting Approach: Define the contracts which should be made during the acquisition life cycle (contract for preparing MP, contract for developing any component of desired system and etc.). State the type of these contracts and define special contract terms and conditions.

6. Process Definition: Define your acquisition process with its phases. Describe the entry and exit criteria for each phase. Assign the responsibilities for the activities of the acquisition phases. State the decision points and define the personnel /committee to approve and make these decision points.

7. Program Risks: Identify possible risk areas. Describe the risk management approach to eliminate the risks.

8. Managerial Issues: Describe project management approach and the responsibilities of project office members. Define the project resources and other constraints.

9. Other Considerations

10. References

Appendix D Template for Acquisition Program Management Plan

1. Introduction: Introduce the plan with a brief statement of acquisition need which should be accomplished. Describe specific purpose, goals and scope of the acquisition project. State the date and status of this plan.

1.1 Reference Materials: Define the materials which have been used to prepare this plan.

1.2 Definitions and Acronyms: Define terms and identify acronyms required to understand the plan. Describe all abbreviations and notations used in the plan.

1.3 Assumptions, Dependencies, and Constraints: State any assumptions, constraints and dependencies. Define all requirements for compatibility with existing systems or the systems which are being developed.

2. Project Office:

2.1 Organizational Structure: Define the PO structure and interrelationships.

2.2 Staffing Risks: Because of personnel shortage is a great risk for TLFC information projects, identify PO's ciritical technical skills required to achieve the objectives. Define staffing risks related with these identified critical skills and state your risk management approach to eliminate the staffing risks.

2.3 Responsibilities: Identify an overview of the PO elements and responsibilities for acquisition steps.

2.4 Tools, Techniques, and Methods: Describe tools, techniques, methods, special documents to be used in the acquisition process. If a new technique, method or tool will be used, plan personnel training.

3. Cost, Schedule, and Performance Overview: Define the cost concepts and methods to be used in the process and any established cost goals. Identify a master schedule for acquisition milestones. State the expected performance from the desired system.

4. Important Considerations: Identify important issue/s related with acquisition project. Define major critical events and decisions.

4.1 Acquisition Approach: Describe the acquisition approach to achieve the program objectives.

4.2 Competition: Describe whether the solicitation will be open to competition or not. If not, discuss why open competition cannot be used.

4.3 Supplier Selection Procedures: Summarize the supplier selection procedures for the acquisition. Identify the schedule for issuing RFP, and evaluation of proposals.

4.4 Contracting Approach: Discuss contract type selection and any other special contracting conditions.

5. Acquisition Process: Define the acquisition phases and steps of the process. Identify the entry criteria and exit criteria for each phase. Describe the details of what a step is expected to do and what is to be performed to control the results of the step.

5.1 Acquisition Initiation

5.2 Implement System Engineering Activities

5.3 Solicitation & Contracting

5.4 Supplier Monitoring & Product Acceptance

6. Acquisition Management Requirements

6.1 Control Procedures: Describe how prodcuts and outputs should be configured, protected, and stored.

6.2 Standards: Identify any standards (organizational and international) which the process or work products should comply with.

6.3 Documentation Requirements: Describe the procedures to be followed in recording and presenting the outputs of each acquisition step.

6.4 Risk Management: Identify project's risky areas. Describe what efforts are planned to reduce risks and consequences of failure to achieve goals.

7. Other Considerations

Appendix E Requirements Development and Management Plan Outline

1. Introduction: State the objectives of the PO's requirements development and management activities.

2. References: Describe referenced documents.

3. Stakeholders: Identify all stakeholders from other TLFC departments and troops associated with requirements development and management activities. Plan PO responsibilities for requirements development and management activities.

4. Procedures: Define all procedures related with analyzing, defining, specifying, verification, and approving activities. Define the procedure in case of any changing requirement.

5. Criteria: Define attributes that describe a 'satisfactory' requirement for the acquisition project.

6. Requirements Development and Management Process: Define the activities to be perfomed to achieve the process goals.

   6.1 System Requirements Development Process

   6.2 Software Requirements Development Process

Appendix F Risk Management Plan Outline

1. Introduction: Describe the purpose and scope of the plan. Define any assumptions, constraints, and policies for implementing the process.

    1.1 Purpose

    1.2 Definitions and Acronyms: Define any terms and identify acronyms required to understand the plan.

    1.3 References

2. Acquisition Program Overview: Describe briefly the acquisition program including the acquisition strategy and approach.

    2.1 Statement of Need: Define the acquisition program by a brief statement of need.

    2.2 Acquisition Background: Summarize the acquisition including the technical and contractual history.

    2.3 Acquisition Process Overview: Describe generally the projet's acquisition process with an emphasis on milestones and decision points.

3. Risk Management Strategy: Describe acquisition program's risk management strategy. Provide an overview of risk management process and activities, and define how the risk management effort is integrated with other project management activities. Define risk management options (avoidance, control, transfer). Provide guidance on the circumstances in which these options will be employed.

4. Risk Management Process: Describe the process in detail. Define all activities, steps, and procedures required to be performed for a systematic risk management.

    4.1 Identify Risks: Define all information about possible risks related with acquisition program.

    4.2 Analyze Risks: Analyze collected risk data to decide on what measures risk management will take to prevent the risks become problem. Identify priorities to project risks.

    4.3 Plan Risk Handling Actions: Describe the activities to be performed to control the risks.

    4.4 Track and Control Risks:

Appendix G Template for Proposal Evaluation Plan

1. Program Overview: Introduce the plan by a brief statement of program objectives and goals. State the purpose of this plan.

2. Supplier Evaluation Committee: Define evaluation committee in terms of the technical skills and MND representatives. Provide an organization chart of the committee and responsibilities.

3. Acquisition & Contract Considerations: Describe briefly the acquisition strategy. Define contracting approach. If any, state special contract requirements.

4. Supplier Information Section: Define required data and information on past performance and on industrial status of the suppliers. And also plan how this data will be collected.

4.1 Domain Experience (similar projects)

4.2 Software Engineering Experience

4.3 Past Performance with TLFC

4.4 Employment of Experienced Skills

5. Evaluation Procedures: Identify which evaluation procedures will be used.

5.1 Evaluation Methodology: Define your evaluation methodology.

5.2 Evaluation Factors: Describe evaluation factors (if needed, define also subfactors) and their relative importance. The factors should reflect the program characteristics.

5.3 Risk Analysis: Define how the risks associated with each proposal will be anlyzed.

5.3 Schedule: Define evaluation process schedule. Provide the order of activities (RFP release, propsals received, initial evaluations completed and etc.) to be performed.

6. Other Important Considerations

7. References

Appendix H RFP Outline

1. General Information:

    1.1 Program Definition: Briefly describe the project and the purpose of the project.

    1.2 Scope: Define the scope of the project.

    1.3 RFP Structure and Explanation: Describe the RFP structure and provide explanatory statements about the RFP.

    1.4 Definitions: Define the specific terms used in this RFP.

2. Instructions to Bidders:

    2.1 General Instructions

    2.2 Submitting the Proposal: Define number of copies required and provide proposal due date and delivery address.

    2.3 Format of Proposal:

3. Supplier Organizational Requirements

    3.1 Domain Experience

    3.2 Staff Qualifications

    3.3 Certification Requirements

4. Proposal Evaluation and Selection Process:

    4.1 Initial Evaluation

    4.2 Evaluation Criteria with Weights

    4.3 Evaluation Schedule

5. Scope of Work: This section may be entitled either "Statement of Work" or "Technical Specifications" as determined suitable by the PM. The selection of the title is dependent on the nature of the requirement.

    5.1 Project Description

    5.2 Functional Requirements

    5.3 Technical Requirements

        5.3.1 System Architecture

        5.3.2 Performance Requirements

    5.4 Expected Deliverables

5.5 Documentation Requirements: Describe what type and/or size of the documentation the supplier will have to provide.

6. Contractual Requirements

7. References