

CHANGE PROCESS OF INTEGRATING CAPABILITY MATURITY MODEL
INTEGRATION (CMMI®) INTO A TECHNOLOGY COMPANY:
A CASE STUDY

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CASE STUDY**

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ABSTRACT

CHANGE PROCESS OF INTEGRATING CAPABILITY MATURITY MODEL INTEGRATION (CMMI®) INTO A TECHNOLOGY COMPANY: A CASE STUDY

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The purpose of this study is to investigate the phases of change process of integrating a quality development model into an information technology company in Turkey. While the transformation phases were being examined by a qualitative study, the factors that affect the change process also were investigated.

This study explores the process of traveling through the way to CMMI (Capability Maturity Model Integration) level 3 certification by a company that gives information technologies service to banking sector. Since circulation of staff prevents us from obtaining what an exact number of workers, the company has about 450 employees. At the beginning, the company had no quality standards and most of the work processes were not

documented, even documented processes were not consistent. After the commencement of the quality development project, work flows of processes were defined and documented. The company changed its organization according to the new process improvement model, called CMMI.

In this case study, interviews performed with ten experts from inside of the company and three experts from outside of the company, observation diaries and assets of the company were data sources. Participant observation, questionnaire and document analysis were used as data gathering methods. Collected data were interpreted by descriptive analysis. As a result of the research, while resistance to change came out naturally, it is determined that transformation has four stages such as: “*motivation and adoption*”, “*adaptation*”, “*acceptance and implementation*” and finally “*use and improvement*”.

Key Words: Human Performance Technology (HPT), Diffusion of Innovation, Change Management, CMMI, Adult Education.

ÖZ

BÜTÜNLEŞİK YETENEK OLGUNLUK MODELİ’NİN (CMMI®) BİR TEKNOLOJİ ŞİRKETİNE ENTEGRASYONUNUN DEĞİŞİM SÜRECİ: BİR DURUM ÇALIŞMASI

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Bu çalışmanın amacı, Türkiye’de bilişim teknolojileri alanında faaliyet gösteren bir şirkette, kalite iyileştirme modeli entegrasyonun yarattığı değişim sürecini incelemektir. Dönüşüm safhaları nitel çalışma ile incelenirken, değişim sürecine etki eden faktörler de araştırılmıştır.

Bu tez, bankacılık sektörüne bilişim teknolojileri hizmeti veren bir şirketin, CMMI (Capability Maturity Model Integration) seviye 3 sertifika hedefine ulaşmak için izlediği yolda geçirmiş olduğu değişim sürecini araştırmaktadır. Personel değişiklikleri sebebiyle kesin bir sayı verilemez ise de, şirket yaklaşık 450 çalışandan oluşmaktadır. Şirket başlangıçta ulusal ya da uluslararası herhangi bir kalite standardını belirleyen sertifikaya sahip değildir, süreçlerin çoğu yazılı olmayıp, yazılı olanlar da tutarlı

uygulanmamaktaydı. Kalite gelişim projesi başlatıldıktan sonra, süreçlerin iş akışları tanımlanmış ve dokümente edilmiştir. Şirket yapılanmasını yeni süreç iyileştirme modeli olan CMMI'a, uygun bir şekilde değiştirmiştir.

Nitel yaklaşımla, durum çalışması (örnek olay) türünde yapılan araştırmada, onu şirket içinden, üçü şirket dışından olmak üzere uzmanlarla yapılan görüşmeler, gözlem notları ve şirketin sahip olduğu her türlü materyal veri kaynağı olmuştur. Veri toplamak amacıyla ise katılımcı gözlem, mülakat ve doküman incelenmesi yöntemleri kullanılmıştır. Toplanan veriler betimsel analiz tekniği ile değerlendirilmiştir. Çalışma sonucunda, değişime direnç gösterme doğal bir sonuç olarak ortaya çıkarken, dönüşüm sürecinin, *“güdülenme ve benimseme”*, *“alışma”*, *“kabullenme ve uygulama”* en son olarak da *“kullanma ve iyileştirme”* olmak üzere dört ana aşamadan meydana geldiği belirlenmiştir.

Anahtar Sözcükler: İnsan Performans Teknolojileri, Yeniliğin Yayılımı, Değişim Yönetimi, CMMI, Yetişkin Eğitimi

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CHAPTER 1

INTRODUCTION

Today's knowledge workers operate in an environment of rapid change that originates from many sources. Several disciplines have approached this issue from their unique perspectives. How individuals and organizations respond to change affects is a subject that has been thought about intensively (Mallack, 1999). For organizations confronted with rapid change, handling and management of this change has become a major institutional goal (Huckabay, 1983). Process improvement studies are themselves instruments of change that can affect an entire institution. Several models have therefore been proposed to help organizations develop their processes, one of which is Capability Maturity Model Integration (CMMI).

In 2008 Carnegie Mellon University, Software Engineering Institute, reported that "Capability Maturity Model Integration (CMMI) is a process improvement approach that provides organizations with the essential elements of effective processes." (p.1). As developers of the concept, they aimed to guide process improvement across a project, a division, or an entire organization. CMMI helps integrate traditionally separate organizational functions, set process improvement goals and priorities, provide guidance for quality

processes, and provide a point of reference for appraising current processes (CMSEI, 2008).

This case study examined the phases of change process observed during the application of the Capability Maturity Model Integration (CMMI) by a technology company and the factors that affected this process.

1.1. Background and Statement of the Problem

In our information era, most companies have needed to adapt to a significant rise in global competition and markets. Productivity became a key concern along with ways to improve the processes involved. This challenge was especially apparent in the software development industry, where even leading high-tech companies experienced difficulty in staying within project limits such as time, budget and specifications (Frederick, 1987). In response, researchers at Carnegie Mellon University's Software Engineering Institute first proposed the Capability Maturity Model as a way to assess and describe the quality of an organization's software development. First released around 1990, CMM was eventually extended to other process areas. In 2001, many disparate elements were brought together into a single initiative known as CMMI, or the Capability Maturity Model Integration.

CMMI amalgamates a carefully chosen set of practices sourced from a variety of disciplines such as systems analysis and design, software engineering and management. With CMMI, it is claimed that an organization can simultaneously apply a range of enhancements that would previously only have been undertaken consecutively or as free-standing initiatives. It is thought that this multidisciplinary approach encourages improvement throughout the

enterprise and helps organizations consider the full product development life cycle (Kay, 2005). Customers of information technology (IT) companies too realized the relevance of CMMI and began to request CMMI certification from their vendors, obliging many IT contractors to implement CMMI within their firms.

Integrating CMMI often requires modification of an organization's structure, the management of which is not straightforward. Consequently, there has been an explosion of commercial consulting companies that offer to assist organizations in the implementation of CMMI. The reality is that CMMI remains a novel concept even amongst many consulting companies who have been shown to be prone to problems with the diffusion of innovation (Rogers, 1995) throughout an organization. The adoption of CMMI varies internationally, as seen in Table 1, with fewer than 10 Turkish companies having completed a CMMI appraisal according to the ("Process Maturity Profile", 2008).

Generally, very little information exists concerning the integration of CMMI into organizations. While this may be for competitive reasons, lack of comparative data also limits the effectiveness of those who package, educate / train and offer consultancy services geared to assist organizations to make the transition to a new technology intensive model.

Table 1
Number of Appraisals and Maturity Levels Reported to the SEI by Country

Country	Number of Appraisals	Maturity Level 1 Reported	Maturity Level 2 Reported	Maturity Level 3 Reported	Maturity Level 4 Reported	Maturity Level 5 Reported
Argentina	47		31	10	2	3
Australia	29	1	8	4	2	4
Austria	10 or fewer					
Bahrain	10 or fewer					
Brazil	79		37	31	1	8
Canada	43		10	18	5	3
Chile	20		13	5		1
China	465	1	103	293	18	34
Colombia	18		6	9	1	2
Denmark	10 or fewer					
Egypt	27		12	11	2	2
Finland	10 or fewer					
France	112	4	67	34	1	2
Germany	51	7	27	7	1	1
Hong Kong	14		1	9		4
India	323	1	11	127	22	151
Israel	16		3	9		2
Italy	17		9	8		
Japan	220	16	64	88	13	15
Korea Rep.	107	1	31	48	11	7
Malaysia	42		15	24		3
Mauritius	10 or fewer					

Table 1 continued,

Mexico	39	1	18	13	3	4
Morocco	10 or fewer					
Pakistan	14	1	8	3		1
Philippines	20		2	10		7
Poland	10 or fewer					
Portugal	10 or fewer					
Romania	10 or fewer					
Singapore	16		3	8	1	4
South Africa	10 or fewer					
Spain	75	1	49	21	1	3
Sweden	10 or fewer					
Switzerland	10 or fewer					
Taiwan	88		60	25		2
Turkey	10 or fewer					
U.K.	71	3	36	24	1	2
U.S.	1034	25	365	347	21	114

Source: Process Maturity Profile (2008; p.17)

1.2. Purpose of the Study

This research has three main purposes:

- a. to explore the stages in the change process required for the implementation of CMMI

- b. to identify the factors that affect the change process initiated by the implementation of CMMI
- c. to investigate how performance of a company differs during the implementation of CMMI

It should be noted that the case study company's CMMI integration process was still in progress when this dissertation was being written.

1.3. Research Questions

The main research question was:

“What is the nature of change process in a software development company which implements CMMI procedures?”

Since it was an extensive question, it was divided into the following sub-questions:

- a. What factors are responsible for initiating the change?
- b. What is performed to integrate CMMI model into the company?
- c. How does the workflow of the company change during CMMI implementation?
- d. What are the stages of change?
- e. What are the factors that influence change positively and negatively?
- f. How do the quality improvement studies affect the performance of the company?

1.4. Significance of the Study

The research was conducted within an information technology and software development company; which will be called as “Company A” throughout the dissertation, and which is preparing to be appraised for CMMI Level 3. Completing and delivering software product on time is a significant challenge for software development companies and this problem is also a major complaint of customers. Moreover, complete failure of projects are frequently seen (Dorsey, 2006). Many large customers such as the military and government departments want to minimize risk and have begun to request CMMI certification from their contractors. As seen in Table 1, CMMI is a relatively new concept internationally, and firms tend to seek assistance to comply with this requirement.

Implementing CMMI directly challenges the culture of a company and its traditional production methodologies. Most enterprises accept change programs in response to pressures from competition and customers, or to take advantage of an opportunity presented by advances in technology. An uncoordinated, unplanned approach will not be adequate in a complex environment. Disciplined attention to some important aspects of managing change is essential for success (Small & Downey, 2001). In order to devise a suitable strategy, all agents of change should be defined. In this context, it is important to identify the factors (agents) that affect the change process while the stages of change required for CMMI implementation are determined.

As mentioned above and seen in Table 1, CMMI is a recent concept and the findings of this study would help organizations that try to obtain certification both internationally and in Turkey. The research shows the positive and negative faces of the change and

assists organizations to draw a roadmap to a successful transformation. This is the practical side of the research. Additionally, the literature indicates a scarcity of research studies on stages of implementation, institutionalization and, furthermore, the complete change process (Hsu, 2004). This study therefore contributes to the literature on the change process, particularly in terms of Organizational Science and Human Performance Technology (HPT), which is considered within the body of knowledge of the field Instructional Technology.

As stated before, the main purpose is to improve productivity. In organizations which produce services such as software development houses and education institutions, human activities and human performance are much more important than a factory where production is largely performed by machinery. Human Performance Technology (HPT) is a discipline that has arisen to improve the productivity of people. Pershing (2006) defines HPT as a systematic approach to improve individual and organizational performance. Understanding the change process triggered by integration of CMMI is necessary to correctly supply interventions that enhance the performance of workers in a technology company, typically a principal interest of researchers and practitioners in the field of Instructional Technology.

Rosenberg (2006) states that most learning takes place on the job. Staff mostly learns from their peers and work environment, also an area of interest to practitioners of *adult education* and *organizational learning*. Participants of the research are adults hence the principles of adult learning have impact on the research. Working, learning, and innovating are closely related forms of human activity and occupational learning is a subject of organizational learning. This

research both consults and seeks to contribute to the fields of adult education and organizational learning.

We note that as technology continues to expand its influence on our lives, the ability to design and build products and services will require ever more complex computerized systems. Similarly, more computerized education and training will require new instructional design and models. In this respect, this study will help to address issues that are encountered when new instructional models are designed and implemented.

1.5. Definition of Terms

Adult Education: a set of core adult learning principles that apply to all adult learning situations (Knowles et al., 1998; p. 2).

Capability Maturity Model Integration (CMMI®): a process improvement approach that provides organizations with the essential elements of effective processes (CMSEI, 2008).

Change Management: a structured approach to transitioning individuals, teams, and organizations from a current state to a desired future state (“Change Management (People)”, 2008).

COBIT: The Control Objectives for Information and related Technology (COBIT) Maturity Model appraises management processes according to internal controls (Hardy, 2002)

Diffusion of Innovation: the spread of a new idea from its source of invention or creation to its ultimate users or adopters (Rogers, 1995)

Human Performance Technology (HPT): a systematic approach to improving individual and organizational performance (Pershing, 2006)

ISO: the International Organization for Standardization (*Organisation Internationale de Normalisation*), widely known as ISO is an international-standard-setting body composed of representatives from various national standards organizations ("International Organization for Standardization", 2009).

SCAMPI: the standard benchmarking tool for CMMI process area capability and maturity level profiles (SSC, 2006).

CHAPTER 2

REVIEW OF THE LITERATURE

This part is a review of the literature about process improvement models, change management, human performance technology (HPT) and adult education. Since the topic of this dissertation is to explore the change process concerning the implementation of quality improvement, this chapter begins with the explanation of process development approaches such as CMMI and COBIT. The company that is the subject of the case study operates in the finance and banking sector and supervised by the Banking Regulation and Supervision Agency (BRSA). Institutions regulated by BRSA are encouraged to attain COBIT certification and the company is audited accordingly. This chapter therefore includes definition of the COBIT standard and what it entails.

The second section of the review examines the concept of “change process”, including consideration of the roles of leadership and communication throughout the process. The third section focuses on human performance technology as the prime concern of the researcher is to reveal facts that enhance human performance in a challenging new technology environment. The final section concerns adult learning as this study is conducted with adults and relates to their changes in behavior in the workplace.

2.1. Process Improvement Models

Since the focus of this dissertation is to explore the change process required for the implementation of quality improvement in a technology company, this section expands on the concept of CMMI, and provides details about COBIT and ISO. The company in our case began its steps towards a quality culture with the application of ISO standards. However, these put emphasis on company procedures rather than concentrating on meaningful improvements. The company then underwent an audit by COBIT as the Banking Regulation and Supervision Agency uses COBIT controls for information systems auditing of financial organizations in Turkey. COBIT is an IT governance tool used to appraise the management processes according to internal controls. However, to use the COBIT Maturity Model as an effective management tool, organizations should develop an efficient methodology to measure the maturity level of their IT processes. On the other hand, CMMI provides a complete framework that would enable organizations to more consistently create quality software products. CMMI is similar to ISO 9001, an international standard that specifies an effective quality system for software development and maintenance. The main difference between them is that ISO 9001 specifies a minimal acceptable quality level for software processes, while CMMI establishes a framework for measuring continuous process improvement and it is more clear in defining the means to that end.

The three models are described in detail below.

2.1.1. CMMI and Its Development

The Capability Maturity Model (CMM) was conceived by Carnegie Mellon's Software Engineering Institute (SEI) in the late 1980s. CMM arose in response to the explosion of software development that accompanied the introduction of microprocessors and new information technologies. Customers and producers alike sought a yardstick against which to measure the uneven performance of the many players in the industry and the quality of their output. The goal of CMM was therefore to provide a framework that would enable organizations to more consistently create quality software products. During this period software development was often likened to crisis management, and some might argue that this is still the case in many organizations. It was widely held that projects would only have a chance of succeeding if teams were populated with 'heroic' workers who were exceptionally talented and dedicated. The SEI approach was to advance a model that set out the Key Process areas that must be successfully undertaken by a software developer in order to accomplish manageable projects and to demonstrate success from one project to another. To begin with, Key Process areas was mapped across five maturity levels. It was thought that an organization must fundamentally acquire each key process level prior to ascending to a higher level (Davis, Glover, Manzo & Oppertthausen, 2005).

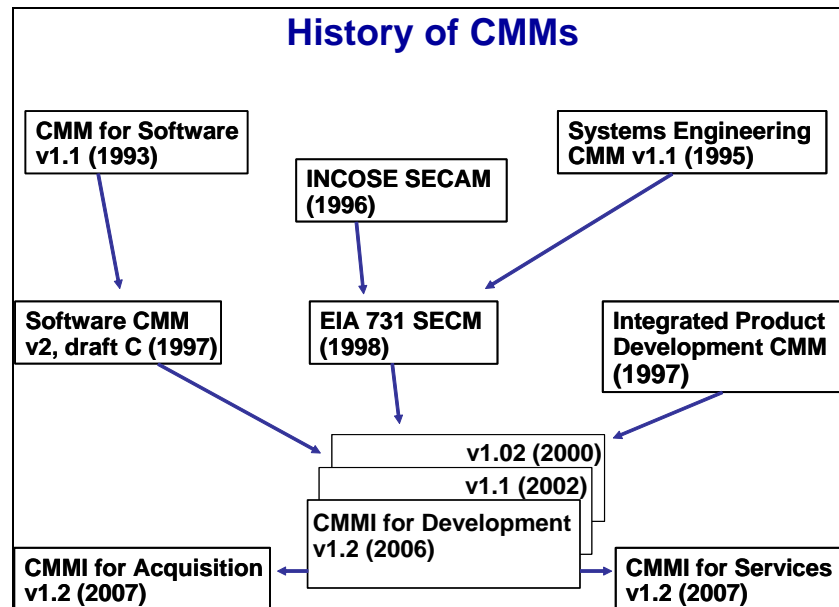


Figure 1. History of CMMs (CMU/SEI, 2006; p.6)

The CMMI model, which emerged from the CMM approach to quality assurance, can be typified as one of two basic types: staged or continuous. Staged CMMI, with five levels of maturity (see the Figure 1), is the best known model. It enables direct comparison between organizations and enables the organization to demonstrate a proven sequence of improvements. On the other hand, the continuous representation of CMMI path allows organizations to highlight specific improvements that encapsulate its business objectives and minimize risk. This option can make it easier for decision makers to compare processes across projects and for developers to transition from other quality standards. In fact, both CMMI representations are capable of equivalent results. Table 2 (CMU/SEI, 2006; p.11) compares the relative advantages of continuous and staged representations.

Table 2*Comparative advantages of CMMI representations*

Continuous Representation	Staged Representation
Grants explicit freedom to select the order of improvement that best meets the organization's business objectives and mitigates the organization's areas of risk	Enables organizations to have a predefined and proven improvement path
Enables increased visibility of the capability achieved in each individual process area	Focuses on a set of processes that provide an organization with a specific capability that is characterized by each maturity level
Allows improvements of different processes to be performed at different rates	Summarizes process improvement results in a simple form - a single maturity level number
Reflects a newer approach that does not yet have the data to demonstrate its ties to return on investment	Builds on a relatively long history of use that includes case studies and data that demonstrate return on investment

Source: CMU/SEI (2006; p.11)

Each of the five levels of CMMI maturity addresses five inter-related and measurable assets: goals, commitment, ability, measurement and verification. As it is seen in Table 3 (CMU/SEI, 2006), CMMI for Development, Version 1.2 includes 22 process areas which describe the aspects of product development relevant to organizational processes. CMMI offers a precise method to appraise how well an organization meets the goals of each level. The Standard CMMI Appraisal Method for Process Improvement (SCAMPI) provides detailed ratings of strengths and weaknesses relative to the CMMI models (Kay, 2005).

Table 3
Key Process Areas of CMMI-DEV, V1.2

Name	Area	Maturity Level
Requirements Management	Engineering	2
Project Monitoring and Control	Project Management	2
Project Planning	Project Management	2
Supplier Agreement Management	Project Management	2
Configuration Management	Support	2
Measurement and Analysis	Support	2
Process and Product Quality Assurance	Support	2
Product Integration	Engineering	3
Requirements Development	Engineering	3
Technical Solution	Engineering	3
Validation	Engineering	3
Verification	Engineering	3
Organizational Process Definition	Process Management	3
Organizational Process Focus	Process Management	3
Organizational Training	Process Management	3
Integrated Project Management	Project Management	3
Risk Management	Project Management	3
Decision Analysis and Resolution	Support	3
Organizational Process Performance	Process Management	4
Quantitative Project Management	Project Management	4

Table 3 continued

Organizational Innovation and Deployment	Process Management	5
Causal Analysis and Resolution	Support	5

Adapted from CMU/SEI (2006)

SCAMPI is a CMMI related method of appraisal that set out to help organizations to improve their processes, set priorities and focus on improvements relevant to their business objectives. Being a diagnostic tool, it is meant to support, enable, and encourage an organization's commitment to process improvement. Essentially it enables an organization to review its process area capability, or organizational maturity, by aligning the relative strengths and weaknesses of its current processes to CMMI. In this way an organization can prioritize its improvement plans, focusing on those that are most advantageous, while simultaneously obtaining current ratings for process capability and maturity level. The SCAMPI method is also the standard benchmarking tool for CMMI process area capability and maturity level profiles (SSC, 2006). Many third-party organizations therefore offer SCAMPI appraisal services.

CMMI is notionally similar to ISO 9001, an international standard that requires applicants to provide evidence of an effective quality system for software development and maintenance. However, while ISO 9001 sets a basic standard of quality for software processes, CMMI offers a specific framework for continuous improvement of such processes and is more explicit in defining and

measuring this progression. CMMI has two representations as staged and continuous, which are shown in the Figure 2 and the Figure 3 respectively.

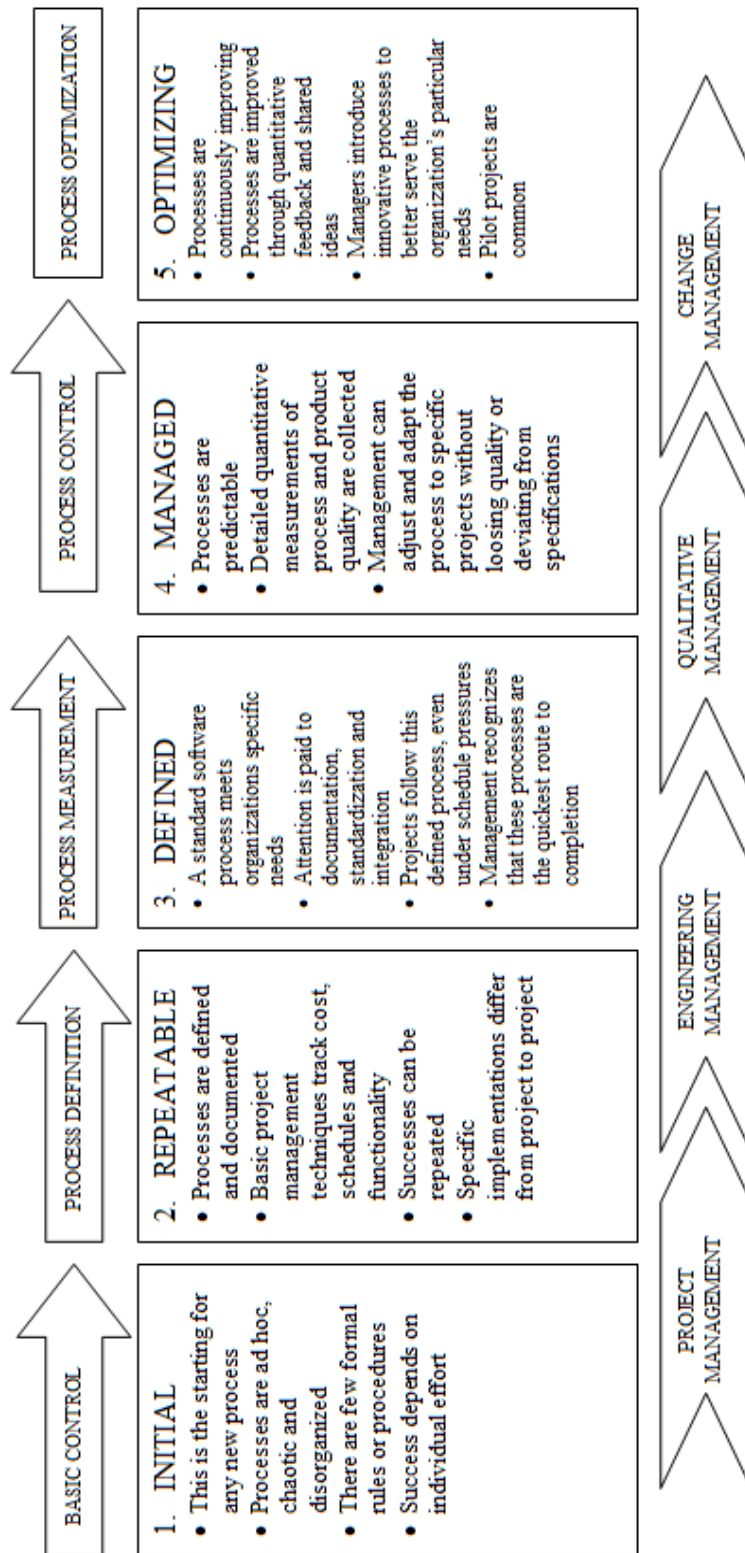


Figure 2. Staged CMMI (Kay, 2005; p.2)

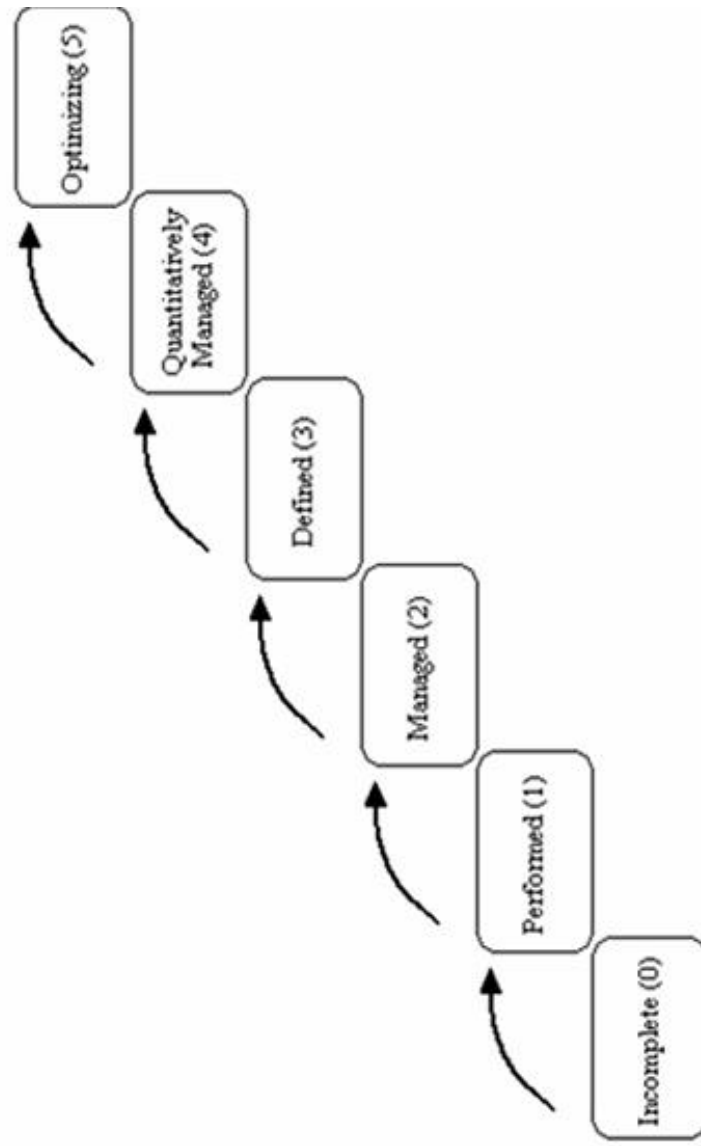


Figure 3. Continuous CMMI (Grottko, 1999)

Table 4 (CMU/SEI, 2006; p.46) summarizes and compares both representations.

Table 4
Comparison of Continuous and Staged Representations

Continuous Representation	Staged Representation
The organization selects process areas and capability levels based on its process improvement objectives.	The organization selects process areas based on the maturity levels.
Improvement is measured using capability levels. Capability levels <ul style="list-style-type: none"> • Measure maturity of a particular process across an organization. • Range from 0 through 5. 	Improvement is measured using maturity levels. Maturity levels <ul style="list-style-type: none"> • Measure maturity of a set of processes across an organization. • Range from 1 through 5.
Capability level profiles are used to target and track process improvement performance.	Maturity levels are used to target and track process improvement performance.
Equivalent staging allows an organization using the continuous approach to process improvement to derive a maturity level as part of an appraisal.	There is no need for an equivalence mechanism back to the continuous approach.

Source: CMU/SEI (2006; p.46)

2.1.2. COBIT

The Control Objectives for Information and related Technology (COBIT) Maturity Model appraises management processes according to internal controls. As such it is an IT governance tool. An organization can use the COBIT maturity model to evaluate itself in levels from nonexistent (0) to optimized (5). This range of maturity levels provides an opportunity for auditors to inform managers of their IT governance responsibilities, a first step in empowering them to exercise effective responsibility over the use of IT just like any other part of the business (Hardy, 2002).

The COBIT standard was published by the Information Systems Audit and Control Association (ISACA) in 1996 and has been revised three times. It was devised to help organizations to direct and manage the operation of their IT systems and consists of 34 high-level control objectives and 318 detailed control objectives. The standard is coherent and readily accessible, with COBIT documentation available online including the executive summary, framework, control objectives, audit guidelines, management guidelines and an implementation guide. A further development in the form of a special version of COBIT called "QuickStart" for small and medium-sized businesses, is due for release by the ISACA. This will contain a subset of the COBIT standard and focus on elements that are viewed as most critical for organizations that lack the resources to pursue the full standard (Spafford, 2003).

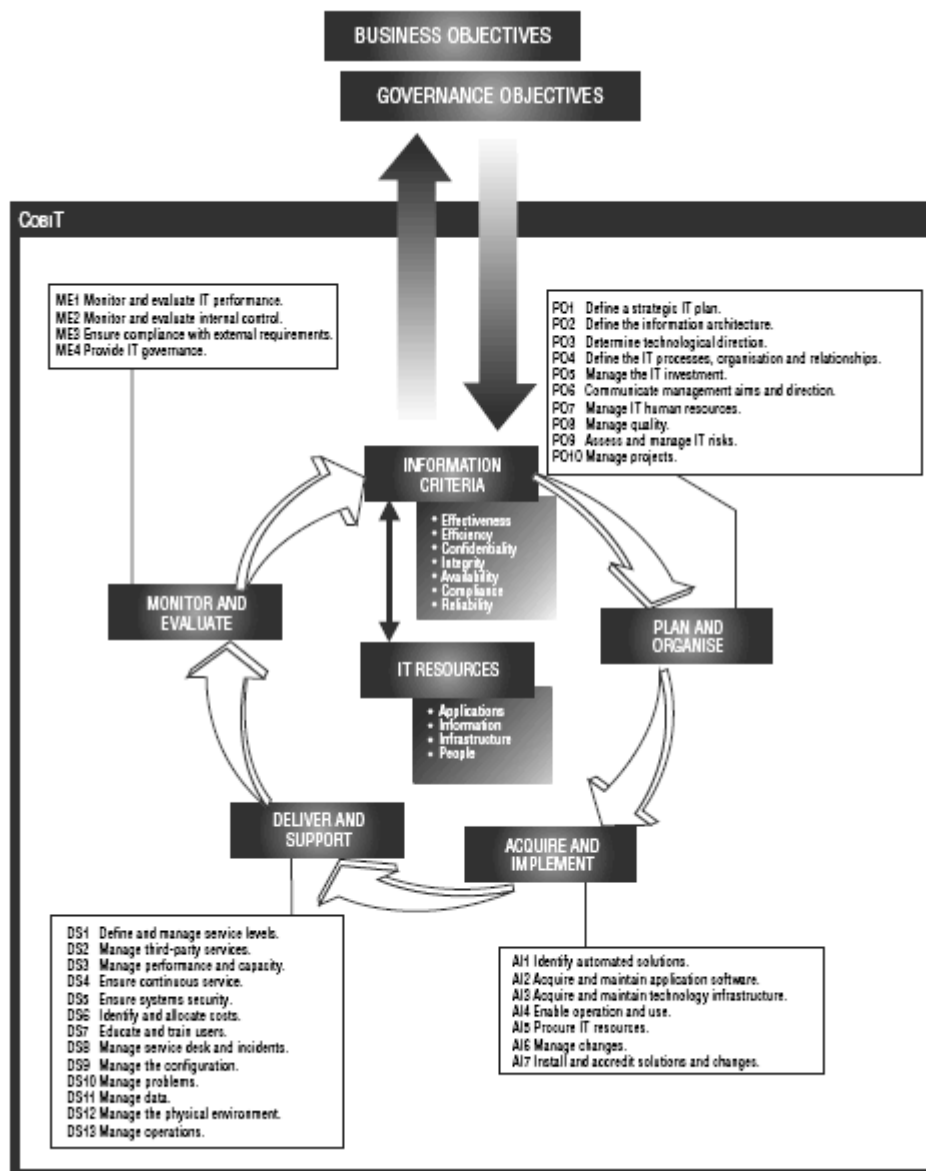


Figure 4. Over all COBIT framework (Executive Summary and Framework, 2008; p.26)

The Management Guidelines for COBIT allow for a variety of approaches to evaluating the maturity level of the IT processes. It should be noted however, that as an effective management tool, the COBIT Maturity Model requires companies to develop an efficient

methodology to measure the maturity level of their IT processes (Pederiva, 2003).

Maturity levels of COBIT can be seen in Figure 4 (Executive Summary and Framework, 2008; p.26) and attributes are shown in the Table 5 (Executive Summary and Framework, 2008; p.21).

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Table 5,
Maturity Attribute Table

Awareness and Communication	Policies, Plans and Procedures	Tools and Automation	Skills and Expertise	Responsibility and Accountability	Goal Setting and Measurement
1 Recognition of the need for the process is emerging. There is sporadic communication of the issues.	There are ad hoc approaches to processes and practices. The process and policies are undefined.	Some tools may exist; usage is based on standard desktop tools. There is no planned approach to the tool usage.	Skills required for the process are not identified. A training plan does not exist and no formal training occurs.	There is no definition of accountability and ownership of issues based on their own initiative on a reactive basis.	Goals are not clear and no measurement takes place.
2 There is awareness of the need to act. Management communicates the overall issues.	Similar and common processes emerge, but are largely intuitive because of individual expertise. Some aspects of the process are repeatable because of individual expertise, and some documentation and informal understanding of policy and procedures may exist.	Common approaches to use of tools exist but are based on solutions developed by key individuals. Vendor tools may have been acquired, but are probably not applied correctly, and may even be shelfware.	Minimum skill requirements are identified for critical areas. Training is provided in response to needs, rather than on the basis of an agreed plan, and informal training on the job occurs.	An individual assumes his/her responsibility and is usually held accountable, even if this is not formally agreed. There is confusion about responsibility when problems occur, and a culture of blame tends to exist.	Some goal setting occurs; some financial measures are established but are known only by senior management. There is inconsistent monitoring in isolated areas.
3 There is understanding of the need to act. Management is more formal and structured in its communication.	Usage of good practices emerges. The process, policies and procedures are defined and documented for all key activities.	A plan has been defined for use and standardisation of tools to automate the process. Tools are being used for their basic purposes, but may not all be in accordance with the agreed plan, and may not be integrated with one another.	Skill requirements are defined and documented for all areas. A formal training plan has been developed, but formal training is still based on individual initiatives.	Process responsibility and accountability are defined and process owners have been identified. The process owner is unlikely to have the full authority to exercise the responsibilities.	Some effectiveness goals and measures are set, but are not communicated, and there is a clear link to business goals. Measurement processes emerge, but are not consistently applied. IT balanced scorecard ideas are being adopted, as is occasional intuitive application of root cause analysis.

Table 5 continued

<p>4 There is understanding of the full requirements. Mature communication techniques are applied and standard communication tools are in use.</p>	<p>The process is sound and complete: internal best practices are applied. All aspects of the process are documented and repeatable. Policies have been approved and signed off on by management. Standards for developing and maintaining the processes and procedures are adopted and followed. External best practices and standards are applied. Process documentation is evolved to automated workflows. Processes, policies and procedures are standardised and integrated to enable end-to-end management and improvement.</p>	<p>Tools are implemented according to a standardised plan, and some have been integrated with other related tools. Tools are being used in main areas to automate management of the process and monitor critical activities and controls. Standardised tool sets are used across the enterprise. Tools are fully integrated with other related tools to enable end-to-end support of the processes. Tools are being used to support improvement of the process and automatically detect control exceptions.</p>	<p>Skill requirements are routinely updated for all areas, proficiency is ensured for all critical areas, and certification is encouraged. Mature training techniques are applied according to the training plan, and knowledge sharing is encouraged. All internal domain experts are involved, and the effectiveness of the training plan is assessed. The organisation formally encourages continuous improvement of skills, based on clearly defined personal and organisational goals. Training and education support external best practices and use of leading-edge concepts and techniques. Knowledge sharing is an enterprise culture, and knowledge-based systems are being deployed. External experts and industry leaders are used for guidance.</p>	<p>Process responsibility and accountability are accepted and working in a way that enables a process owner to fully discharge his/her responsibilities. A reward culture is in place that motivates positive action. Process owners are empowered to make decisions and take action. The acceptance of responsibility has been cascaded down throughout the organisation in a consistent fashion.</p>	<p>Efficiency and effectiveness are measured and communicated and linked to business goals and the IT strategic plan. The IT balanced scorecard is implemented in some areas with exceptions noted by management and root cause analysis is being standardised. Continuous improvement is emerging. There is an integrated performance measurement system linking IT performance to business goals by global application of the IT balanced scorecard. Exceptions are globally and consistently noted by management and root cause analysis is applied. Continuous improvement is a way of life.</p>
<p>5 There is advanced, forward-looking understanding of requirements. Proactive communication of issues based on trends exists, mature communication techniques are applied, and integrated communication tools are in use.</p>					

2.1.3. ISO

The **International Organization for Standardization** (*Organisation Internationale de Normalisation*), or ISO, convenes members from various national standards organizations. Essentially an international-standard-setting union that disseminates industrial and commercial standards, the organization was founded in 1947 and is headquartered in Geneva. As "International Organization for Standardization" would have different acronyms in different languages ("IOS" in English, "OIN" in French for *Organisation internationale de normalisation*), its founders opted for "ISO", derived from the Greek *isos*, meaning "equal". Although the ISO is not a lawmaking body, its standards so determined mostly enter into law, either through consensus or national standards (International Organization for Standardization, 2009).

ISO networks the national standards institutes of 159 countries and is de facto the world's largest developer and publisher of International Standards. One member per country coordinates the network as a non-governmental organization which aims to represent the interests of both the public and private sectors. Recognizing that many of its member institutes are part of the governmental structure of their countries, the ISO also serves to generate solutions that meet both the requirements of business and other needs of society (About ISO, 2009).

As with other approaches to quality management, ISO standardization has criticized by some researchers and quality practitioners who hold that ISO certification is biased towards industrial and technical applications and do not meet the needs of the broadening services sector. Others hold that the ISO uniquely encourages all kinds of organizations to be well organized, consistent, and effective. Singles et al. (2001) suggest

that ISO certification offers both internal benefits which are related to the internal functioning of an organization (such as its processes and structure), and external benefits which are related to an organization's environment (such as customers and competitors of the organization). Singles et al. argues that an organization with ISO certification may expect the following internal benefits: increased productivity, improved efficiency, reduced costs and waste, improved management control, more clearly defined organizational task structure and responsibilities, improved coordination structure, support in decision making, and increased motivation in personnel. Furthermore, they believe that an ISO certified organization will enjoy the following external benefits: competitive advantage, increased sales and market share, access to new markets, better maintained customer relations, increased customer satisfaction, increased organization reliability, and improved reputation which can result in better possibilities for establishing partnerships, comakerhips, and mergers.

Other researchers warn of disadvantages that could result from ISO certification including higher costs for achieving ISO certification, increase in the record keeping workload, lack of attention for development of personnel, and discouraging creative and critical thinking in organization (Biazzo and Bernardi 2003; Dick,2000; Martinez-Lorente and Martinez-Costa, 2004; Staines; 2000; Seddon, 1997).

Wiele and Williams (2000) argued that there was a wide gap between the requirements of the ISO 9000 series and the actual level of TQM maturity. They found that most certified organizations were principally motivated to attain ISO 9000 requirements as an end in itself and were content to do so by simply describing their key processes. Moreover, they imply that the ISO 9000 series can be completed without clearly setting out how each process relates to an organization's overall strategy and goals. A weakness that could be further compounded by the failure of the series to

adequately specify how processes are varied and controlled. They did find, however, that the ISO 9000 series may assist managers to utilize the language of total quality management (TQM).

Other researchers have observed that the ISO standards' emphasis on procedures sells organizations short in that they fail to evidence meaningful improvements resulting from those procedures. They therefore regard ISO certification as no more than a minimum requirement. Others have reported that the ISO standards alone cannot help an organization to improve its quality of services sufficiently unless it is followed by greater quality improvement efforts, such as TQM, strategic planning and performance management. Gotzamani and Tsiotras (2001) set out to establish the value of ISO 9000 standards to certified companies in Greece and found that certification boosts quality culture and quality commitment and offers a number of operational and other benefits to the certified organizations. They too support the view that ISO certification can offer a good first step towards TQM.

Biazzo and Bernardi (2003) suggest the ISO 9000 standards could be considered a possible foundation for TQM. "Pursuing a strategy of continuous improvement and competitive quality" makes sense after a minimum level of maturity in controlling processes has been achieved.

2.2. Change Process

"Change is a simple process. At least, it's simple to describe. It occurs whenever we replace the old with the new. Change is about traveling from the old to the new, leaving yesterday behind in exchange for a new tomorrow." (De Jager, 2001 cited in Egan & Fjermestad, 2005, p.2). It sounds simple doesn't it? De Jager (cited in Egan & Fjermestad, 2005, p.2) continues, "But implementing change is incredibly difficult. Most people are reluctant to leave the familiar behind. We are all suspicious about the

unfamiliar; we are naturally concerned about how we get from the old to the new, especially if it involves learning something new and risking failure.”

Despite the efforts of a large body of the literature, only a few works provide a coherent framework for describing key components of the change process. Notable amongst these are studies conducted by researchers in the field of rural sociology (Rogers, 1995). Rogers’ book, *Diffusion of Innovations* (4th ed.), offers a useful overview of factors influencing the adoption and diffusion of innovation and several important ideas that were themselves innovative.

Firstly, Rogers proposed that the adoption of an innovation is a process rather than a single act. Prior to finally deciding to continue with the utilization of an innovation, a potential adopter would consciously progress through five consecutive stages of decision-making. Initially, in the knowledge phase, the potential adopter gains a basic understanding of the innovation and how it is applied. In the second phase, a potential adopter feels enabled to express their persuasion or attitude, typically a positive or negative stance towards the innovation. In the third, or decision phase, they take decisive action to accept or reject the innovation. Thereafter, the potential adopter engages in an implementation phase where they try out the innovation. In the fifth and final confirmation phase the adopter reviews their application of the innovation and make decisions about future use according to the perceived advantages.

The second important notion to emerge from Rogers work is the concept of adopter categories that serves to illustrate how a specific population responds to innovation. Innovators, early adopters, and the early majority, will readily do so before others, such as the late majority and laggards, who resist.

The third idea concerns the perceptions that people tend to attribute to innovations. Often these opinions center on whether an innovation will enhance conditions in the workplace. Other factors to perception are how compatible an innovation is with their values and belief systems, the complexity involved in applying an innovation, the degree to which an innovation can be trialed, and what observable benefits it can bring.

The fourth idea is the S-shape adoption curve, by which researchers can illustrate the rate of adoption, typically a process that is initiated by a period of gradual adoption followed by a shorter period of rapid adoption prior to a gradual leveling off.

Clearly, the diffusion of innovation theory assists our understanding of the change process and also enables us to better grasp why organizations need change. Factors that influence this include:

- challenges of growth, especially global markets
- changes in strategy
- technological changes
- competitive pressures
- customer pressure, particularly shifting markets
- to learn new organization behavior and skills
- Government legislation/initiatives.

CIPD (2007) indicates that organizations undergo major change approximately once every three years, with smaller changes occurring almost continually. They also report that there are no signs that this pace of change will slow. For these reasons, it is increasingly important that careful

consideration is given to the way change is introduced and managed by organizations. In this context managers play a key role in helping to ensure that the organizational objectives of change are met. Principally they must strive to secure the ongoing the commitment of their teams, both during and after implementation.

2.2.1. Change Models

Just as change is not a uniform phenomenon, it is necessary for organizations to shape their model of change to suit their particular needs and concerns. When change efforts fail, it is common to blame organizational resistance but this is an inadequate explanation. Failure can arise for systemic reasons and inadequate leadership, vision, communication, planning, resources, compulsion, or inconsistent messages. At this point it is useful to consider the various ways in which change is introduced. Typically, change models can be divided into three categories: top-down; transformational leadership; and strategic approaches (Treasury Board of Canada Secretariat, 2003).

2.2.1.1. *Top-down models*

These models place emphasis on hierarchical leadership. Senior staff are empowered to command rapid change by announcing a vision, and directing employees to implement it. Those at the top determine goals, explain desired outcomes, give feedback, reward desired performance and take action when goals are not met. While they may be concerned about their staff and want to see them succeed, they focus on performance driving cultural change, not the reverse (Treasury Board of Canada Secretariat, 2003). With the traditional driver of change coming from above, many organizations are finding that “top down” change is less effective than “whole systems change” (Biothinking, 1999).

2.2.1.2. Transformational leadership

Henry Mintzberg, Professor at the McGill University, in his popular book *Managing Politically*, examined three federal departments in the United States. His proposal is that change arises within the group. "You can't drive change down an organization," he says. "You facilitate the situation so that change can come up. Create a climate where people can individually and collectively think for themselves, take initiatives, and build interesting things. Change grows from the grass roots, where people know what needs to be done." (CAYA, 2004; p.66).

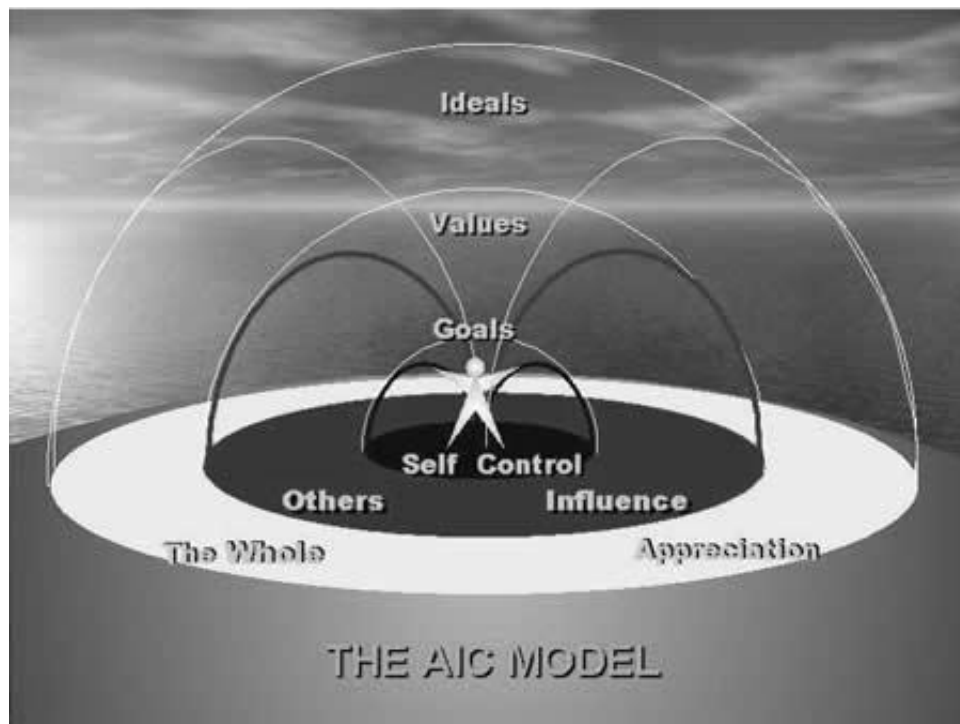


Figure 5, Transformational Leadership (The Transformational Leadership Process, 2008; p.1)

The transformational leadership process centers on motivating workers to achieve more by influencing their values and priorities. In this model the leaders in an organization are seen to personally encourage

followers through definition of an organizational mission, optimism, enthusiasm and emotional appeal. Leaders also set a personal and ethical example, offer coaching and make sacrifices for the group when necessary. Unlike traditional leaders they invite people to see problems from new perspectives and to find new solutions. By so doing they make it possible for workers to express negative emotions and business concerns. Followers then tie more to the mission, try to find ways to improve their performance and thus develop the organizational culture (Biothinking, 1999).

2.2.1.3. Strategic approaches

In the business world, when large organizations want to bring about major change of their culture and their direction, they often consult John P. Kotter, who is the content expert for the Harvard Business School's Change Management course and is a frequent speaker at top management meetings throughout the world as probably the best-known person in the field (Ratcliff, 2006).

Kotter (1996) lays out an eight-step strategy:

1. Establish a sense of urgency.
2. Create the guiding coalition.
3. Develop a vision and strategy.
4. Communicate the change vision.
5. Empower employees for broad-based action.
6. Generate short-term wins.
7. Consolidate gains and produce more change.
8. Anchor new approaches in the culture.

In this model the vision emerges following an urgent realization for change and the formation of a coalition to help motivate the process. Kotter (1996) warns that failure to undertake the first stages will lead to failure. Interestingly, he considers institutional or cultural change the final step in the process.

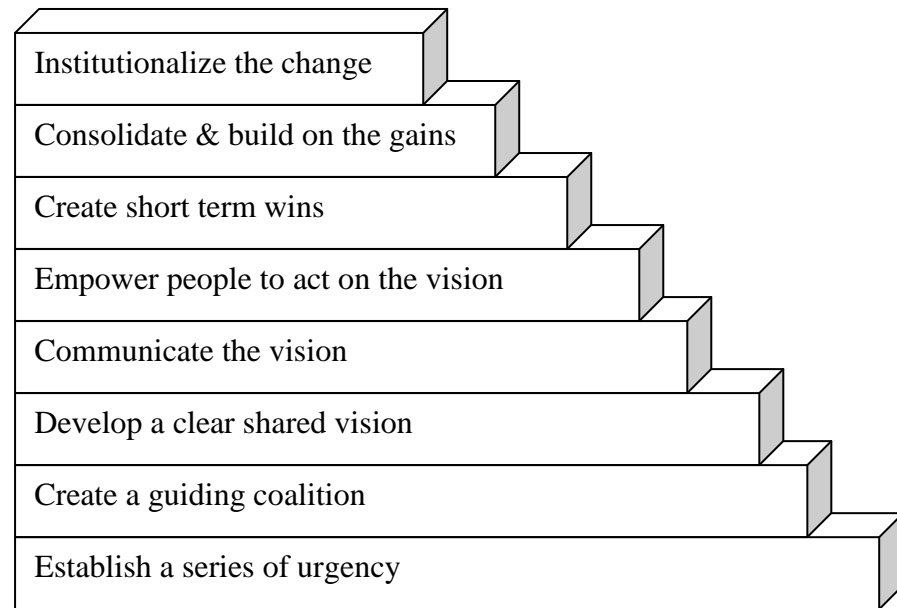


Figure 6, Kotter's eight-step strategy (RapidBI, 2008; p.1)

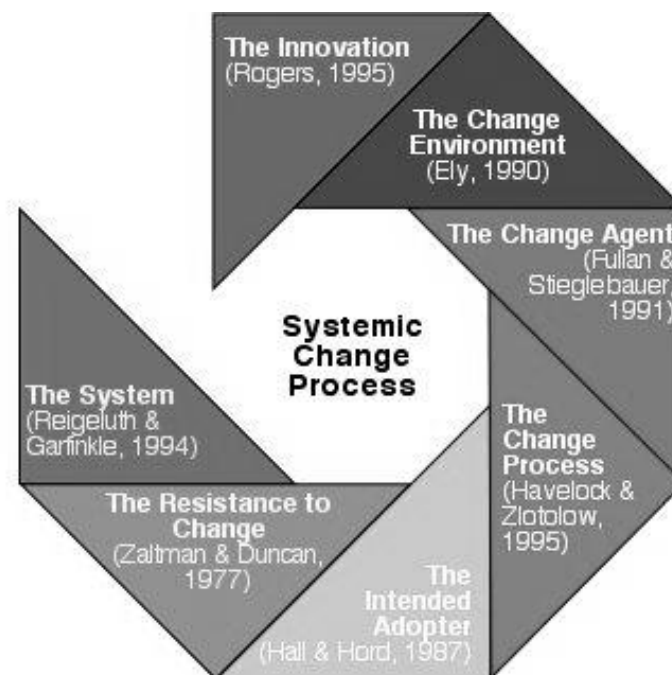
2.2.2. Systemic Change

Systemic change proposes an opportunity to perform change while moving beyond thinking about individuals and individual organizations, single problems and single solutions. It requires thinking about systems such as policy systems, education systems, social service systems, information systems, technology systems (Toolkit, 2003).

Lane (1996) says "While this term has been used in many contexts, the underlying idea of systemic change is that it occurs on a global level and takes into account the interconnectedness and the inter-relatedness of

all parts of a system.” Here systemic change is not linear, and therefore cannot be achieved in a stepped or, systematic way; rather it seeks to observe the bigger picture in an effort to ensure the function of the entire system. Systemic change tries to find ways to break free from current constraints. Its advocates seek to design, develop, and implement new processes, instead of looking for ways to adapt what is current. This model seeks to encompass the interests of all of the stakeholders in the system meaning that any change should therefore not occur in isolation of its members (Lane, 1996).

The management of systemic change is therefore practiced as a cyclical process that considers the impact of change on all parts of the whole and their relationships to one another.



Ellsworth's Systemic Change Process Based on Sequence of Questions Asked in a Change Effort and Corresponding to the Change Communication Model

Adapted from: Ellsworth, J.B. (2000). Surviving Change: A Survey of Educational Change Models. Syracuse, NY: ERIC Clearinghouse on Information and Technology [ED No. 443417].

Figure 7. Systemic Change Process

Essentially, systemic change involves engaging with stakeholders throughout the system to (Toolkit, 2003):

- Visualize a desired system and what it will accomplish.
- Establish the current situation.
- Compare the vision with the relative strengths and weaknesses of the current system.
- Identify areas for improvement and prioritize them.
- Draw up a plan to action the priorities and determine how success will be measured.
- Assess progress consistently and revise actions as necessary.
- Review the overall situation, using inputs to check fit with vision and keep pace with momentum for the next cycle of renewal.

2.2.3. New Paradigm of Change

Today's decision makers must handle constant and rapid change. Managers are often face choices that did not exist when their plan for direction originated. Thus successful management embodies the correct observation of changes in the environment and organization, evaluation of such change and what to do about it. "Managing change does not mean controlling it, rather understanding it, adapting to it where necessary and guiding it when possible" (McNamara, 2006).

Marilyn Ferguson (1993) summarizes shift of paradigm in the Table 6.

Table 6
Comparison of old and new paradigm

Old Paradigm	New Paradigm
promote consumption at all costs	appropriate consumption
people to fit jobs	jobs to fit people
imposed goals, top-down decision making	autonomy encouraged, worker participation
fragmentation in work and roles	cross-fertilization by specialists seeing wide relevance
identification with job	identity transcends job description
clock model of company	recognition of uncertainty
aggression, competition	cooperation
work and play separate	blurring of work and play
manipulation and dominance	cooperation with nature
struggle for stability	sense of change, of becoming
quantitative	qualitative as well as quantitative
strictly economic motives	spiritual values transcend material gain
polarized	transcends polarities
short-sighted	ecologically sensitive
rational	rational and intuitive
emphasis on short-term solutions	recognition that long-range efficiency must take in to account harmonious work environment
centralized operations	decentralized operations when possible
runaway, unbridled technology	appropriate technology
allopathic treatment of symptoms	attempt to understand the whole, locate deep underlying causes of disharmony

Adapted from Marilyn Ferguson (1993)

Additional concepts from Fullan (1993) can be seen below. “Each lesson is a paradox and different from the norm of thinking about change. They are a set and benefit one another; no one lesson by itself would be useful” (Fullan, 1993, p.19). Fullan summarizes the approach as follows (p. 41):

1. “You can't mandate what matters [the more complex the change the less you can force it]
2. Change is a journey not a blueprint [Change is non-linear, loaded with uncertainty and excitement and sometimes perverse]
3. Problems are our friends [Problems are inevitable and you can't learn without them]
4. Vision and strategic planning come later [Premature visions and planning blind]
5. Individualism and collectivism must have equal power [There are no one-sided solutions to isolation and groupthink]
6. Neither centralization nor decentralization works [Both top-down and bottom-up strategies are necessary]
7. Connection with the wider environment is critical for success [The best organizations learn externally as well as internally]
8. Every person is a change agent [Change is too important to leave to the experts, personal mind set and mastery is the key to the ultimate protection]”

2.2.4. Resistance To Change

Resistance to change is natural, even if the change is a positive one (Conner, 1992, cited in Kalman, 2001). Acceptance of change depends on personal perceptions of a range of potential benefits including simplicity, compatibility, modifiability, relative advantage and low social impact (Rogers, 1995). Egan and Fjermestad (2005, p.3) explain reasons for resistance to change as:

- “People resist, because they lack the skills to use and gain benefits from the new technologies.
- There is resistance because employees in the traditional companies and industries do not understand the ‘big picture’ and how the application of the new technologies changes how business is done and processes executed.
- Finally, resistance, especially in middle and upper management, comes from the fact that new technologies and their translation into new business models redefine the organizational structures and the power bases.”

Keen’s (cited in Egan and Fjermestad, 2005) 1981 paper on long-term change in organizations emphasized the need for facilitation, especially when contemplating strategic change. Keen’s view was that organizations are pluralistic and require an incremental approach, essentially utilizing political mechanisms to build coalitions for change. Keen’s observations on pluralism have impacted Information Systems Behavioral Theory, Management Science, and Operations Research.

2.2.5. Leadership

Failure to incentivise the activation of change can rapidly translate to resistance to the process as a whole. Among the conditions found in the

literature, leadership is the most commonly identified factor involved in empowering change (Senge, 1990). Leadership is defined as the capacity or ability to lead, guide, command, take charge, or influence individuals or an organization (Hsu, 2004).

Hsu (2004) divides leadership into four categories:

- a. "Transformational Leadership: Perceives the change as a new opportunity, shares values and beliefs on a deeper level with followers. Leaders are independent persons and self-critical persons.
- b. Participative Leadership: Attempts to consult the followers regarding the vision and does not always see the change as a turning point.
- c. Transactional Leadership: Focuses on rigid plans, bargains with followers and avoids sharing values and beliefs.
- d. Autocratic Leadership: Serves the function of a monitor who doesn't trust followers and creates bureaucratic structures".

Kalman (2001; p.67) summarizes the personality characteristics of leadership in Table 7.

Table 7
Personality characteristics of leadership

Characteristic	Dimensions of the Characteristic
Extraversion (urgency)	Dominance, assertive, energy, talkative, active, sociability
Emotional stability	Self-confidence, independence, anxiousness, anger, worry, insecurity
Agreeableness (likeability)	Flexibility, trusting, good-natured, cooperative, forgiving, tolerant, supportive, friendly
Conscientiousness	Dependability, responsible, organized, planful, persevering, hardworking, achievement-orientation, initiative, personal integrity
Openness to experience	Imaginative, curiosity, artistic sensitivity, broad-minded

Source: Kalman (2001; p.67)

2.2.6. Communication

Organizational change creates states of uncertainty and potentially ambiguity and confusion. Unmanaged this leads to anxiety and a tendency to resist change. It is therefore important to efficiently monitor the influence of organizational doubt and to counter resistance effectively. A well-planned communications strategy helps to ameliorate acceptance of organizational change. People refuse to accept change due to lack of information and too much uncertainty (Kalman, 2001).

Unsurprisingly, leadership has a key role in the communication process. In this role, it has five tasks (Ristino, 2005):

- a. Communicate the need for change;
- b. Make the case for change;

- c. Create the vision for change;
- d. Establish a system-wide process for communicating change;
- e. Actively participate in communicating the change strategy among all key constituencies.

When communicating change, leaders bring key messages and engender interactions throughout the organization. By using a combined strategic communication process, the leadership can help to ensure that it will be reliable with what it says about the change strategy (Ristino, 2005).

2.3. Human Performance Technology (HPT)

Human Performance Technology (HPT) follows a systematic approach to improving individual and organizational performance (Pershing, 2006). Also known as Human Performance Improvement (HPI) this approach "uses a wide range of interventions that are drawn from many other disciplines including total quality management, process improvement, behavioral psychology, instructional systems design, organizational development, and human resources management" (What is Human Performance Technology, 2007).

Many theorists have described this as discipline for improving organizational performance, however, while not being able to agree a common definition they do agree on several critical attributes as listed below (Population Leadership Program, 2007).

a. Systematic: HPT is methodical throughout its preparation and application. HP technologists look for performance problems and identify them using established techniques. Following examination they select suitable interventions, before applying them in an organized way.

b. Systemic: HPT categorizes gaps in human performance as those parts of systems that overlap or work with others. As performance is arises from a number of different variables, without an evaluation of all the facets of the system, HPT is unable to bring solutions.

c. Grounded: HPT has a scientific basis, grounded in proven theories derived from experimental facts. Wherever possible, HPT technologists look to apply appropriate scientific to enhance human performance. If, HPT is unable to proceed in this way it can still add value by compiling and documenting evidence on current practice in an organization.

d. Open to all means, methods, and media: HPT is not restricted in the resources or technologies it can apply. This frees the technologist to focus on means that are likely to prove the most useful, competent and economical.

e. Focused on achievements of human performance and the value of a system: HPT seeks basic results and its goal is both to raise the performance of the performer and the organization in which he or she performs.

2.3.1. Model of HPT

A model of HPT developed in 2004 is shown in Figure 9. It consists of five processes (Rothwell, 1999):

Performance Analysis: Identifies the organization's performance requirements and compares them to its objectives and capabilities. In 1986, Joe Harless described this as "front-end analysis" whereafter Rossett (1988) proposed that performance analysis aims to measure the gap between desired and actual performance.

Cause Analysis: Determines the basic reasons why performance gaps have occurred, if they do presently and are likely to occur in future. The process essentially aims to discover the source of the problem.

Intervention Selection: Selects the action appropriate to decreasing the gap between desired and actual performance. Such actions may include: training, careers advice, vocational training, enabling individual feedback, developing incentives and rewards, team building activities, amending the organizational culture, coaching, recruiting new blood, planning for succession, enhancements to the workplace, upgrading IT resources, and proposing design criteria for facilities.

Change Management: Oversees the implementation of interventions with a view to achieving their full realization and longevity in such a way that minimizes disruption and discomfort to employees.

HUMAN PERFORMANCE TECHNOLOGY (HPT) MODEL

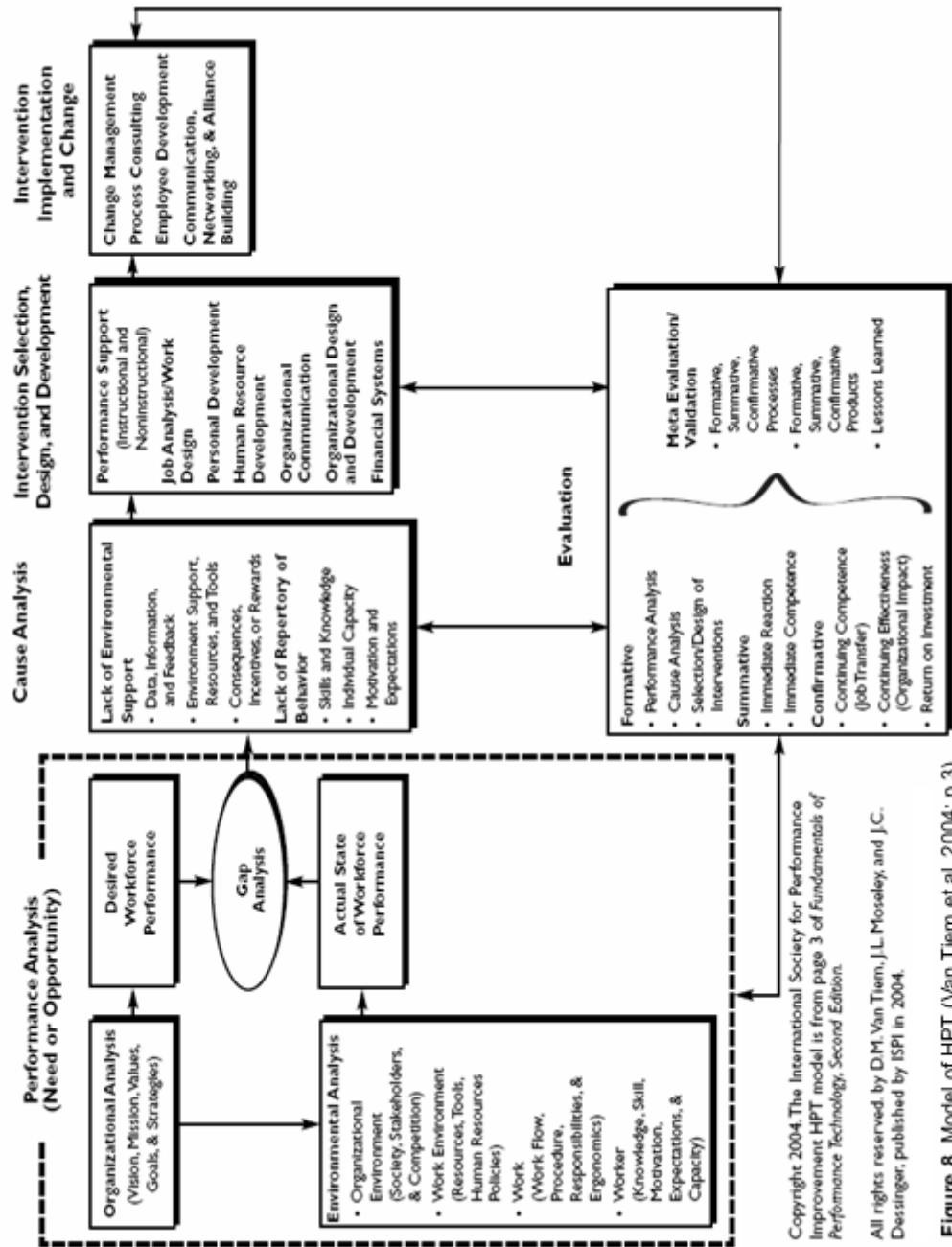


Figure 8. Model of HPT (Van Tien et al, 2004; p.3)

2.3.2. Evolution of Human Performance Technology

The development of HPT has been incremental, grounded as it is in real situations and organizations, and instructional technologists' views as to which organizational instruction and training systems were applicable. Their decisions also considered other factors such as the readiness of the organization. Rosenberg notes that HPT is a discipline assembly of various components as explained below (Rosenberg, et al. 1999).

A **system**: in the HPT context comprises a set of related components that can be identified as contributing towards a defined purpose. Here, systems theory is employed to align the HPT framework to a particular system and situation.

The source of the HPT framework is known as **learning psychology** which arose in the 1950's from experiments on innovative methods to enhance the learning process. Fresh perspectives on how human beings learn, were achieved by researchers such as Skinner, who suggested that learning can be enhanced by incremental instruction supported by intensive feedback. By 1962 the basis of what is now referred to today as "instructional technology" was proposed and led to the field of **Instructional Systems Design (ISD)**. Table 8 shows the relevance of the process steps of Instructional Technology to the modern application of Human Performance Technology. The steps are identical, yet the focus of each has evolved to accommodate new findings and circumstances.

Table 8

Differences between Instructional Technology and Human Performance Technology

Process Step	Instructional Technology	Performance Technology
Requirements Evaluation / Analysis	-- Focuses on <ul style="list-style-type: none"> • skills/knowledge gaps • individuals or groups • within organizations or society 	-- Focuses on <ul style="list-style-type: none"> • a full-range of human performance gaps • individuals, groups, or organization • within organizations setting
	-- Determines if problems or opportunities exist	-- Determines if problems or opportunities exist
	-- Analyzes those aspects of the performance gaps related to skills / knowledge	-- Analyzes all aspects and interrelationships of performance gaps
	-- Determines most appropriate instructional tactics, methodologies, technique, and media	-- Determines most appropriate strategies.
Design	-- Based upon <ul style="list-style-type: none"> • characteristics and constraints of the content, context of performance and the target population(s) 	--Focuses on the integration of all strategies into a holistic approach.
		-- Includes design of the tactics within each selected strategy.
Development	-- Develops instructional content congruent with selected tactics and characteristics of content, context, of performance and target population(s).	-- Integrates, sequences and synchronizes the implementation of the selected strategies and tactics.
Implementation	-- Implements the job aid(s), structured practices and/or training.	-- Integrates, sequences and synchronizes the implementation of the selected strategies and tactics.

Table 8 continued

	-- Evaluates	-- Evaluates
Evaluation	<ul style="list-style-type: none"> • the effectiveness, validity, and reliability of the training and/or, • impact on on-the-job performance 	<ul style="list-style-type: none"> • the effectiveness, validity, and reliability of strategies and combinations of strategies and/or, • impact on organizational effectiveness.

Adapted from Hutchison (2007)

Clearly the theory, practice and concept of HPT is rooted in ISD. For example, the importance of task analysis was noted when practitioners reported that locating or identifying tasks was crucial to the design of appropriate instruction. Researchers also agreed that the result of such instruction must be measurable, observable and identifiable. ISD was however primarily concerned with problems related to inefficiency and ineffectiveness. These included consideration of new methods of teaching and learning to extend and speed up the transfer of knowledge in organizations. New tools such as audio-visual based instruction were proposed and subsequently found to approximate the value of instructor based teaching. Such innovations were aided by the development of a framework researchers could use to derive workable scientific models. Known as ADDIE: **analysis, design, development, implementation**, this framework has proved very successful, with most of the current working

models aligned to ADDIE's scientific approach. Essentially HPT constitutes and depends on the development of such models. In this way, as the community asked questions about the phases of analysis and evaluation, more scientific methods acquired.

Subsequently more effective methods to evaluate and analyze organizations, gave birth to **Analytical Systems**. Realizing that the analysis stage for an instructional problem was applied following the design of a process, Harless suggested the notion of front-end analysis using the concept of analytical systems. In contrary to traditional methods, this analysis is used in early stages of an instructional design to consider specific performance problems that can be insulated from a formerly obtained solution. A methodology for evaluating the consequences of HPT regardless of changes in behavior was then advanced by Gilbert. This assigns values to performance by measuring its achievements. Also known as the behavior-engineering model, it defines six properties of behavior, namely data, instruments, incentives, knowledge, capacity, and motives. As features of behavior they can be adjusted to improve performance. Another technique to analyze organizational structure, proposed by Rummler and Brache, is based on the observation that individual performance is related to the performance of the organization and that both can influence each other. A dynamic and complex structure of external forces affects the performance of organizations, individuals and all variety of their

subsystems. The contributions of Harless, Gilbert, and Rummier have come to constitute the basis of performance analysis and HPT.

Cognitive Engineering is another example of how combining multiple disciplines can enable us to deal with new problems and the field shares many similarities with HPT. Cognitive science utilizes the knowledge and methods of cognitive psychology and affiliated disciplines to set out the basis for rule-based design of person-machine systems. The aim is to facilitate adaption to new situations, targets, systems, and technology. Cognitive engineers conceptually merge a technology with learning patterns to maximize human-machine interfaces. This approach measures the achievements of the human machine system and has advanced an important way for organizations to conceive of output.

Human performance technology continues to be greatly influenced by **Information Technology** and its successors. This is only natural given that organizational structures and information architectures are the main design aspects for HPT. It also defines specific tasks and interventions for enhancing performance and can foster a cycle for redesigning tasks as necessary. The practice of HPT has also been seriously affected by the emergence of the Internet, globalization and new demands on the management of information and knowledge in modern organizations.

Machines, materials and integrated systems are also linked to our measurable skills through **Ergonomics and Human Factors**, which

informs the relation between user requirements and the design of systems. Consequently, HP technologists consider not only the roles of human beings but also on their interactions with their tools.

The measurement of human accomplishments and capabilities is called the **Psychometrics** which is also associated with testing general ability and learning. Today, dependable tests exist for the forecasting of achievement and behavior. Psychometric techniques have therefore become an important tool of HPT in predicting performance, with personnel selection and staffing the main application areas.

Feedback Systems are particularly valuable to human performance technology and have been proven to facilitate efficient and capable strategies for improving performance. Feedback concerning the significance of a person's behavior has long been known as necessary for learning and for developing viable incentives in performance-oriented organizations.

Thus far a number of contributors to the practice of HPT have been referred to in this study. Table 9 provides a summary of these.

Table 9
Some of the contributors of HPT

HPT Professional	Contributions
Allison Rossett	Defined goal of performance analysis to measure the gap b/w the desired and actual performance (1988).
Geary Rummler	Helped pioneer field in 1960s. Article: <i>Systems View of Human Performance</i> , (1988) with Brache.
Erica Keeps	Co-Editor of <i>Handbook for Human Performance Technology</i> , 1992.
Harold Stolovitch	Co-Editor of <i>Handbook for Human Performance Technology</i> , 1992.
Rothwell	Developed a well-known HPT Model.
Marc Rosenberg	Suggested 4 categories of interventions (1990): human resource development, human resource mgt., organizational development, and environmental engineering. PT Model.
Peter Pipe	Mager and Pipe (1970) on performance problems.
Sivasailam Thiagarajan	Article "Performance Technology and Instructional Development" (1990). PT is empirical (data-based) Believed ID is a subset of PT. PT is a systematic process that involved analysis, design, evaluation and evaluation and implementation.
Tom Gilbert	Behavioral Engineering Model (1978). Performance Engineering Mode. Helped pioneer field in 1960s. 3x3 matrix of the Nine Performance Variables.
Joe Harless	Helped pioneer field in 1960s. Coined "front-end analysis" in 1986. Defined HPT as the process of analysis, design, development, testing, implementation and evaluation of relevant and cost-effective interventions.
Robert Mager	Discussed use of systems as framework for HPT (1988). Helped pioneer field in 1960s. Published text " <i>Preparing Instructional Objectives</i> " (1962).

Table 9 continued

Kurt Lewin	Social psychology/OD. Force Field Analysis: examine the positive and negative forces being exerted by the environment. Behavior is determined by the interaction of person with environment. Participative management. All problems have social consequences.
Wedman and Graham	Development of Performance Pyramid (1991, 1997).
Peter Drucker	Management
Dean Spitzer	Suggested 11 intervention design principles (1992).

2.4. Adult Education

As the study participants were adults, it is useful to consider how HPT is influenced by the field of adult education that evolved from behaviorist psychology and educational psychology. Merriam looked at the concept widely and concluded that learning was not only the sequence of obtaining and storing knowledge, it “also makes sense of our lives, transforming not just what we learn but the way we learn it” (p. 96). Merriam proposed that adult learning occurs as andragogy and self-directed learning.

Andragogy

Lindeman and Houle were principal researchers in the field of adult education until 1980. Their work helped to distinguish the ways in which adults and children learn (Knowles & Associates, 1984; Merriam & Caffarella, 1999). During this period “theory building came at a time when proponents of adult education were moving to distinguish the field of adult

education from other educational fields” (Knowles, 1980; Merriam, 2001, p. 4). Knowles (1990) sought to organize the body of knowledge about adult learners into “a systematic framework of assumptions, principles, and strategies. This was what andragogy sets out to do” (p. 7).

Knowles (1984) compared the andragogical and pedagogical models. Pedagogy, considered the art and science of teaching children, is derived from assumptions about educating and learning that can be traced back to 10th century European practices. Initially this model assumed that the child was passive and subject to the teachers’ direction. All class activities were therefore to be supervised by the teacher who was seen to be responsible for how a student envisaged knowledge.

Early pedagogical approaches held that students were akin to empty vessels or *tabula rasa*, a derivative of Latin meaning blank slate. The teacher would attempt to fill the students’ blank slate with facts that were considered useful. Pedagogy has since evolved to utilize active inquiry techniques, abolishing the traditional passive approaches to child learning. Theorists such as Montessori, Dewey and Neill hypothesized that it was natural for children and adults to be self-directed, however, various societal pressures prevent us from nurturing the self-directed character of the child.

Montessori observed that learners were predominantly self-motivated and generally learned by themselves, leading her to suggest that the teacher is of less importance than the quality of the learner's overall

environment. Montessori found adults were constrained by their own prejudices and mostly failed to recognize the self-directing capacity of children (Merriam, 2001).

Dewey suggested that the educator should not impose a direction on the student, rather they should act as a guide and an assistant. This challenged the controlling habits of traditional education that prevents or discourages adults from seeing the child as an individual. Neill was also a strong advocate of the self-directing capacity of the child. In his experimental Summer Hill School in the 1920s, Neill went so far as allowing children to choose whether to attend school (Neill, 2002).

Despite the widely published contributions of theorists, such as Montessori, Dewey and Neill, most schools from the elementary level to higher education remained firmly in the embrace of the pedagogical model. Implicitly, adults were being taught with a model created for children (Knowles, 1990). Therefore, in contrast to pedagogy, andragogy was first expressed as the art and science of helping adults learn (Knowles & Associates, 1984) and later “a set of core adult learning principles that apply to all adult learning situations” (Knowles et al. (1998, p. 2).

Assumptions of Andragogy

Knowles identifies several attributes of adults that distinguish them from younger learners (Knowles et al., 1998):

1. The learners' self-concept reflects maturity in adults who are conscious of being responsible for their own lives and decisions.

2. The role of the learners' experience reflects that adults enter an educational activity with wider experience than youths.

3. Readiness to learn reflects that adults readily focus on learning things that enable them to cope effectively with the real situations they face.

4. Orientation to learning reflects that, in contrast to their experience of subject-centered orientation to learning as children, adults are life-centered (or task-centered or problem-centered).

5. Motivation reflects that adults respond variously to external motivators such as better jobs, promotions, higher salaries, etc. However, most tend to internal motivators and desires such as job satisfaction and career progression.

6. The need to know reflects the adult demand to know the reason for learning something before starting to learn it. (Knowles, 1990, pp. 57-63) Knowles et al. (1998) also identified that: "Andragogy works best in practice when it was adapted to fit the uniqueness of the learners and the learning situation. We see this not as a weakness of the principles, but as a strength. That is, their strength was that these core principles apply to all adult learning situations, provided they were considered in concert with other factors that were present in that situation." (p. 3)

Andragogy is empowered by the notion that the adult learner is self-directed and understands how he or she best learns. Adult learners are therefore held to be capable of conducting an initial self-assessment of their learning requirement. As this principle is a major factor in adult learning, the next section explores this assumption in depth.

Self-directed Learning

Knowles (1975) defined self-directed learning as:

“A process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes.” (p. 18)

This learning process assumed that adult learners were self motivated and able to establish their learning needs, express learning goals, locate resources for learning, choose and activate learning strategies, and evaluate learning outcomes.

While Knowles implied that while in some circumstances adult learners depend on one another to direct their learning, they become more self-directed as they mature. Therefore, every action of teaching should encourage and aid the adult learner towards self-directed learning (p. 11). Adults should be enabled to transfer dependency to themselves and to

direct their learning process. This adaptation is necessary for an adult to benefit fully from the learning experience. Cranton (2006) stated, “The learner was freed from constraints of unquestioned or inflexible way of knowing” (p.117). Merriam (2001) stated, “Andragogy and self-directed learning continue to be important to our present-day understanding of adult learning, they were the pillars of the adult learning theory” (p. 27).

The principle of self-direction is particularly important in distance learning environments where adult learners are remote from their tutors. In this context learners must sustain their independence and self-direction throughout, thereby enabling lifelong learning.

Experiential Learning

Self-directed learning was founded on a second assumption of adult learning which values life experiences, with a view to recognizing previous accomplishments and raising the learner’s confidence to learn. Merriam (2001) described adult learning as an “accumulated reservoir of life experiences” (p. 29). Adults accumulate experiences and learn to apply their knowledge base to new situations.

Stephen Brookfield (1983) described experiential learning as what transpires when we are given an opportunity to acquire and apply knowledge, abilities and emotions in an immediate and relevant setting. Experiential learning involves a “direct encounter with the phenomena being studied rather than merely thinking about the encounter, or only

considering the possibility of doing something about it” (Borzak 1981:9 quoted in Brookfield, 1983). In comparison to younger learners, adults bring a larger volume and different quality of experience to the distance learning environment. This benefits adult learners who can draw on their own background throughout the process of acquiring new knowledge.

Adult learners are more able to apply prior knowledge to their learning experiences. This they can contribute to the quality of the learning environment and assist other learners and themselves toward achievement of their educational goals. Educator should facilitate such contributions by seeking connections between prior experiences and the overall learning environment. Technology based instruction also utilizes learners prior knowledge and life experiences to stimulate the learning process. It is recognized that adult learners bring more to the classroom than younger learners with more limited experiences; and that the distance learning environment is particularly diverse due to the larger number of adult learners that populate such programs. Adults are also known to seek out learning environments that include opportunities for them to demonstrate their knowledge and experience.

Reflective Learning

In addition to experiential learning, Mezirow (1997) also noted that being able to comprehend the meaning of one’s experience is a defining condition of being human. The way we denote things has important

implications for learning. A simple explanation by an authority figure may not fit with perceptions derived from real life experiences. This can demotivate the learner. Instead we can foster the acquisition of meaning by encouraging individual responses, judgments and interpretations of general purposes and beliefs.

“Reflective learning involves the assessment or reassessment of assumptions... and becomes transformative whenever assumptions or premises were found to be distorting, inauthentic or otherwise invalid” (Knowles, 1990, p. 27). Knowles goes further to propose that facilitating such understanding is indeed the fundamental goal of adult education (p. 5). His view is that learners who analyze traditions and prejudices tend to want to revisit their own experiences. In the process they further their understanding of complex issues and challenges.

Transformational Learning

Rogers (1969) noted the importance of the desire to learn something and the acceptance of the process of transformation that takes place while learning about it.

Mezirow (1997) holds that when people are motivated to reflect on their own belief systems and assumptions, they can utilize this awareness to begin assembling new ways of describing their worlds. Transformational education drew on the "realm of interior experience, one constituent being the rational expressed through insights, judgments, and decision; the other

being the extensional expressed through symbols, images, and feelings" (p. 275).

The theory of transformative learning has grown "into a comprehensive and complex description of how learners construe, validate, and reformulate the meaning of their experience" (Cranton, 1996, p. 22). It was also significant to distance education in that it involves change that does not occur exclusively in the classroom. In the process adult learners were seen to modify their outlook on education and learning, work, the family and the world that they lived in. Based on a clear understanding of experiential and transformative learning, a third assumption of adult learning was examined in the following section.

Readiness to Learn

The third assumption of andragogy centers on the learner's readiness to learn. It was noted that adult learners are generally more eager and ready to learn. They are also more able to manage issues that might challenge the learning process for a less motivated learner.

It is seen that most adult learners respond positively to linking their learning to the achievement of future goals. Distance learning and technologically based modalities helped motivate learners wishing to enhance their education while simultaneously advancing their occupations.

Gibbons and Wentworth (2001) stated that:

“Online learners should be recognized for who they were and where they stand in achieving their educational goals. Their readiness to learn and orientation to learning were inexorably tied together, as both of these assumptions center on learners' life tasks and problems.” (p. 32)

This helps to understand why adults might not be successful if they were coerced into continuing education programs; rather, adults also require self-motivation to achieve self-improvement. This innate drive, combined with the other abilities of adult learners, provides for a more meaningful and rewarding experience.

Approach and Orientation to Learning

A fourth assumption of andragogy was rooted in how learners are oriented to the learning experience. Given their more developed perspectives on life and educational, adult learners need to visualize how a course of education will apply to their lifestyle. Interlocutors such as advisors, facilitators, or tutors need to accurately orient adult learners, explaining the positive aspects of a learning experience and addressing likely challenges. Adult learners also need to assess how their previous learning experiences at school or on-the-job training experiences have prepared them for learning as an adult. Maturity alone cannot nullify or substitute for bad habits associated with earlier learning experiences.

However, via effective orientation, a learners' learning suit can also be assessed, giving them an accurate analysis of their ability or potential.

Motivation to Learn

A fifth assumption of andragogy focuses on the learner's motivation to learn, which is also seen as vital to the success of self-directed learning. With maturity this motivation is a partly internalized and partly incentivized. A motivated learner must first be able to know his or her educational needs. They can then proceed to devise a personalized set of goals for their learning and to determine what learning resources are relevant and available. This strategic preparation is seen as essential and must be adequately undertaken before any attempt to achieve an educational outcome is initiated.

Motivation for the adult learner was generally related to his or her desire to satisfy professional needs. However, there is evidence that some learners are simply motivated to learn something or interesting to them. Mackeracher (2004) noted that while three quarters of adult learners enrolled in distance learning programs for work-related reasons, others chose their courses for personal or social reasons (p. 39). As adults tend to know their goals, they tend to look for learning experiences that offer the type of learning environment they seek. Adult learners also like to establish the viability or achievability of their goals before going on to determine which learning experience best suits them. The opportunity to establish

personal goals engenders self-reflection. This in turn can serve to further catalyze self-motivation. Additionally, the achievement of goals naturally heightens motivation and self-esteem. Along with motivation, we see that the exploration of student development theories furthered the understanding of andragogy.

Staged Development Models

Models by Dreyfus and Guskey describe professional development as stages. Dreyfus's is used fairly widely to assess and support progress in the development of skills or competencies. It is also used to help define an acceptable level for the assessment of competence or capability.

Table 10
Dreyfus' model

Level	Stage	Characteristics
1	Novice	Rigid adherence to taught rules or plans Little situational perception No discretionary judgment
2	Beginner	Guidelines for action based on attributes or aspects Situational perception still limited All attributes and aspects are treated separately and given equal importance
3	Competent	Coping with crowdedness Now sees actions at least partially in terms of longer-term goals Conscious, deliberate planning Standardized and reutilized procedures

Table 10 continued

4	Proficient	Sees situations holistically rather than minimum terms of aspects Sees what is most important in a situation Perceives deviations from the normal pattern Decision-making less labored Uses maxims for guidance, whose meanings vary according to the situation
5	Expert	No longer relies on rules, guidelines or maxims Intuitive grasp of situations based on deep tacit understanding Analytic approaches used only in novel situations or when problems occur Vision of what is possible

Adapted from Dreyfus (1986)

It should be noted that the “expert” level does not imply an end to personal development. Certainly, expert level practitioners still need to evaluate their practice and keep up-to-date.

The second theorist, Thomas R. Guskey (2003) also uses stage theory to explain how professional development induces change. Table 11 describes Guskey’s model of five sequential levels to be addressed when evaluating professional development.

Table 11
Guskey's Model

Level	Stage	Characteristics
1	Participants' Reactions	Content questions Process questions Context questions
2	Participants' Learning	Various types of goals to be measured: cognitive, affective, psychomotor
3	Organization Support and Change	Organizational variables related to support for change: Organization policies, resources, collegial support, the principal's support, administrators' leadership, provision of time, and recognition of success.
4	Participants' Use of New Knowledge and Skills	Gathering data to answer related questions may involve direct observation; interviews with the participant, his/her supervisor, his/her students; focus groups; reflective journals; and, participants' portfolios
5	Student Learning Outcomes	Standardized performance assessments, teacher-developed classroom assessments students' portfolios, questionnaires, and school records are vehicles for data collection

Adapted from Guskey (2003)

Both Dreyfus (1986) and Guskey (2003) attempt to systematically chart professional growth. Dreyfus worked on categorizing levels of knowledge, a method dependent on the quality of assessment throughout. It also recognizes the value of diversity and therefore the need for differentiating professional development instruction. Guskey (2003) then looked at how differentiated professional development practices can stimulate change. He showed how knowledge can be advanced via goal setting and giving learners access to necessary resources and support. The stage models are complementary, once levels of professional

understanding are determined (novice, beginner, etc.), support is provided according to the needs of individuals.

Critics of Andragogy

Although andragogy started with a different assumption and was promoted as a theory that can explain the adult learning process, it was not without criticism. Davenport and Davenport (1985) discussed whether andragogy was a theory, a learning theory, or a teaching theory. Another concern was to what degree principles of practice could be grounded in andragogy if it was not a robust theory and whether its focus on the learner and learner autonomy adequately considered the sociohistorical context of the learner (Merriam, 2001).

Pratt (1993) suggested that andragogy amounted to little more than a philosophical attitude, “a statement about the relationship an individual has with the larger society rather than a theory of adult learning” (p. 22). Knowles and associates (1984) stated that the andragogical model “was a system of elements that can be adopted or adapted in whole or in part. It was not an ideology that must be applied totally and without modification. An essential feature of andragogy was flexibility” (p. 418). Later, Knowles (1989) claimed that andragogy satisfied universal definitions of a theory; however, he viewed the andragogical model as a “model of assumptions about learning or as a basis for an emergent theory” (p. 112). In later writings, Knowles (1990) recalled the model was “not as an ideology; it was

a system of alternative sets of assumptions” (p. 64). Throughout his observations, Knowles (1990) noted that there remain key between the pedagogical and andragogical models and that the pedagogical model was fundamentally ideological and therefore excluded andragogical assumptions.

This situation created a dilemma for practitioners, who needed to determine which model or assumptions best suited specific learners, their goals, and situations. Moreover which one was most suitable to initiate the process (Knowles, 1990). It seems that both models were considered suitable for adults and children but were dependent on the specific situations and types of learner encountered. Knowles et al. (1998) further acknowledged that andragogy is most practical when it is adapted to fit the uniqueness of the learners and the learning situation. This he saw not as a weakness of the principles, but as a strength. That is, the core principles are applicable to all adult learning situations, provided they were considered in concert with other factors present. (p. 3)

Additionally, given the quality of experiences and knowledge that adult learners bring into their learning environment, andragogy may have been particularly successful with adults (Knowles, 1980). The pedagogical model dictated that the instructor was accountable for, “...what will be learned, how it will be learned, when it will be learned, and if it has been learned. It was teacher-directed education” (Knowles, 1990, p. 54). Students were

required to submit during learning while in the andragogical model, they were expected to direct their own learning with the instructor serving as facilitator during the learning process “creating the conditions within which learning can take place” (Darkenwald & Merriam, 1982, p. 49).

An additional assumption of andragogy was that the instructor cannot be force the learning process but rather “one person can only help another person learn” (Knowles, 1980, p. 48). Knowles saw the teacher/facilitator as aiding adults to take charge of their learning and that the andragogical model, in practice, “treats the learning-teaching transaction as the mutual responsibility of learners and teacher” (p. 48).

Houle (1996) stated that, “andragogy remains the most learner-centered of all patterns of adult educational programming” (p. 30). Darkenwald and Merriam (1982) stated that teachers who appreciate individual growth and development could conduct their practice by “emphasizing process over content, the adult as the center of the experience, teacher as facilitator, and group interaction as the primary vehicle for learning” (p. 49).

Merriam and Caffarella (1999) noted the criticism of andragogy in the literature (p. 88). They stated, “there has been minimal empirical work undertaken to test the validity of the andragogical model’s sets of assumptions or whether the model has use in predicting adults’ learning behaviors” (p. 89). Knowles (1989), in his autobiography, held that most

critiques served to facilitate and stimulate further thinking and modification of the andragogical theory. Despite the criticisms, andragogy continued to be regarded as the best-known model of adult learning (Merriam & Caffarella, 2001). Those who worked with adult learners also continued to find its practical application useful in understanding adult learners (p. 89). Despite its basic assumptions, the positive aspects of adult learning were unambiguous.

2.5. Summary of the Chapter

This review begins with a brief explanation of three process improvement models respectively: CMMI, COBIT and ISO. The definition and emergence of CMMI is given in detail and the facts that motivated its development are explained. During integration of the process improvement model into an organization, the problem of change management arises and the essentials of the change process are examined. Factors of leadership and communication are also seen to impact the change process and they are explained in this section.

As the underlying purpose of our endeavors is to improve human performance and productivity, the discipline of human performance technology is also described in this chapter, with a view to highlighting key aspects of this systematic approach to improving individual and organizational performance. The last section is about adult learning, as change requires new things to be learnt and the focus of the research concerns adults.

CHAPTER 3

METHODOLOGY

This chapter explains the methodology of the study. This case study aims to examine the change process of integrating CMMI into a technology company by using a qualitative approach. This part of the dissertation includes the purpose of the study, design of the study, participants, data collection and analysis, reliability and validity, and limitations of the study.

3.1. Purpose of the Study

As the subjects of inquiry in this research are human beings, the researcher took care to avoid any physical or emotional harm to the participants. Permission was first obtained from the management of the company in which the fieldwork of the study took place. The participants gave their written consent and information was given about the purpose and undertaking. Participants were informed that participation was voluntary and that they could withdraw from the study any time they wanted and their identities would be protected. The transcripts of interviews were shown to interviewees for their approval.

As it is uttered in chapter 1, there were three main reasons for this research:

- a. to define stages of change process caused by CMMI implementation

- b. to find out the factors that affect change process
- c. to investigate how performance of the Company that the research was executed differs

The CMMI integration process was still in progress when this dissertation was being written. Limitations on time required the researcher to submit this dissertation prior to the company achieving certification of CMMI Level 3.

The main research question was:

“What is the nature of change process in a software development company which implements CMMI procedures?”

It was complex and divided into sub-questions which directed the research:

- a. What factors are responsible for initiating the change?
- b. What is performed to integrate CMMI model into the company?
- c. How does the workflow of the company change during CMMI implementation?
- d. What are the stages of change?
- e. What are the factors that influence change positively and negatively?
- f. How does quality improvement study change the performance of the company?

3.2. Design of the Study

The research was undertaken using a qualitative approach. Qualitative research is defined as research dedicated to building up an understanding of human systems (Savenye & Robinson, 2003). It tries to understand human behavior and the reasons that direct them. Qualitative researchers work on different faces of behavior; thus, they need smaller but focused samples instead of large random samples and classify data as patterns to form a basis for arranging and reporting results (Denzin and Lincoln, 2005). In terms of the purpose of the study (see section 3.1) qualitative research was seen as the most appropriate vehicle.

Creswell (1998) gives five types of qualitative study: biography, phenomenology, grounded theory, ethnography, and case study, each of which has its own specific design characteristic and terminology. Qualitative research has several specifications. It is executed in a natural environment and includes in-depth descriptions of human behaviors and opinions. The underlying logic is that people construct their own reality, and an understanding of it. The research questions frequently progress as the study does, since the researcher wants to learn “what is going on” and may not want to prejudice the study by looking at the investigation too closely. Interacting strongly with the subjects of the study turns the researcher into a part of the study. In qualitative research, it is not assumed that the findings of one study may be generalized easily since there is a worry about the singularity of a specific setting and members (Savenye & Robinson, 2003).

This dissertation presents a case study. Yin (2003; p.1) stated, “case studies are the preferred strategy when “how” or “why” questions are posed, when the investigator has little control over events and when the focus is on a contemporary phenomenon within some real-life context”. A case study is an empirical exploration where:

- a contemporary phenomenon is investigated within some real-life context
- the boundaries between phenomenon and context are not clearly evident

The case study method is used when a researcher wants to encompass contextual conditions appropriate to the phenomenon of the study. A case study is mainly related with interaction of factors and events and the strongest method that permits a researcher to focus on a specific instance or situation and to define several interactive processes at work (Bell, 1999).

A case study does not use samples and pursue a strict procedure to peruse limited number of variables; its methods involve a detailed, long-lasting inspection of a single instance or event. They supply a structured way of collecting data, analyzing information, and presenting the results. In the end, the researcher could acquire understanding of how the instance occurred and what can be important to examine more widely in next research (Flyvbjerg, 2006).

The researcher selects the area for study and decides which material to put in the closing report. Since it is not easy to cross check information, there is always the risk of misrepresentation. Critics of the case study approach hold that it is prone to distortion of information, and generalization. The generalization problem frequently appears in the literature and it is said that the results are not widely applicable in real life (Tellis, 1997). On the other hand, Denscombe, Bassey and Yin found that where the research results are relatable and publication of the findings extends the knowledge, then the research should be seen as valid (Bell, 1999). In addition to this, Flyvbjerg (2006, p.229) says that “generalizability of case studies can be increased by the strategic selection of cases” and

gives strategies for the selection of samples and cases as shown in Table 12 (Flyvbjerg, 2006; p.230).

Table 12
Strategies for the selection of samples and cases

Type of Selection	Purpose
A. Random selection	To avoid systematic biases in the sample. The sample's size is decisive for generalization.
1. Random sample	To achieve a representative sample that allows for generalization for the entire population.
2. Stratified sample	To generalize for specially selected subgroups within the population.
B. Information oriented selection	To maximize the utility of information from small samples and single cases. Cases are selected on the basis of expectations about their information content.
1. Extreme/deviant cases	To obtain information on unusual cases, which can be especially problematic or especially good in a more closely defined sense.
2. Maximum variation cases	To obtain information about the significance of various circumstances for case process and outcome (e.g., three to four cases that are very different on one dimension: size, form of organization, location, budget).
3. Critical cases	To achieve information that permits logical deductions of the type, "If this is (not) valid for this case, then it applies to all (no) cases."
4. Paradigmatic cases	To develop a metaphor or establish a school for the domain that the case concerns.

Source: Flyvbjerg (2006; p.230)

After determining the sample and the case, sources of data are chosen. Yin (2003) identified six sources of data, these are:

- documentation,
- archival records,

- interviews,
- direct observation,
- participant observation,
- physical artifacts.

No one source has an advantage over the others; rather they may be complementary and can be used together. Table 13 illustrates the various advantages and disadvantages of data gathering methods.

Table 13
Types of Evidence

Source of Evidence	Strengths	Weaknesses
Documentation	<ul style="list-style-type: none"> • stable - repeated review • unobtrusive - exist prior to case study • exact - names etc. • broad coverage - extended time span 	<ul style="list-style-type: none"> • retrievability - difficult • biased selectivity • reporting bias - reflects author bias • access - may be blocked
Archival Records	<ul style="list-style-type: none"> • Same as above • precise and quantitative 	<ul style="list-style-type: none"> • Same as above • privacy might inhibit access • bias due to poor questions
Interviews	<ul style="list-style-type: none"> • targeted - focuses on case study topic • insightful - provides perceived causal inferences 	<ul style="list-style-type: none"> • response bias • incomplete recollection • reflexivity - interviewee expresses what interviewer wants to hear

Table 13 continued

		<ul style="list-style-type: none"> • time - consuming
Direct Observation	<ul style="list-style-type: none"> • reality - covers events in real time • contextual - covers event context 	<ul style="list-style-type: none"> • selectivity - might miss facts • reflexivity - observer's presence might cause change • cost - observers need time
Participant Observation	<ul style="list-style-type: none"> • Same as above • insightful into interpersonal behavior 	<ul style="list-style-type: none"> • Same as above • bias due to investigator's actions
Physical Artifacts	<ul style="list-style-type: none"> • insightful into cultural features • insightful into technical operations 	<ul style="list-style-type: none"> • selectivity • availability

Source: Yin (2003; p. 80)

Gathered data are analyzed in three steps, data reduction, coding data and data management (Savenye & Robinson, 2003). Miles and Huberman (1994) constructed a model that consists of data reduction, data display, and conclusion drawing or verification phases to implement the data analysis process. In this study, the data collected were analyzed using the *descriptive analysis* method. Yıldırım and Şimşek (2003) define descriptive analysis as interpretation of data according to determined themes. They divide the method into four steps starting with creating a frame and arranging data according to the frame (data reduction), definition of findings (data display) and interpretation of findings (conclusion drawing).

In this study, the change process arising from the introduction of CMMI into a technology company is investigated. The change phenomenon

was examined and facts that affected the change process were researched. Data were collected using the following methods:

- a. Participant Observation: The researcher was already a member of the quality development project at the company and kept event logs and monthly diaries.
- b. Interviews: Experts, managers and service administrators were questioned
- c. Documentation & Archival Records: Meeting records taken during quality development project sessions, records of the company in circulation

The research was designed in the following steps on the basis of research questions.

1. What factors are responsible for initiating the change?

Data Sources: Observations, managers

Instruments: Observation guide, interview guide

2. What is done to integrate the CMMI model into the company?

Data Sources: Observations, managers

Instruments: Observation guide, interview guide

3. How does the workflow of the company change during CMMI implementation?

Data Sources: Observations, archival records

Instruments: Observation guide, document analysis worksheet

4. What are the stages of change?

Data Sources: Observations, archival records

Instruments: Observation guide, document analysis worksheet

5. What are the factors that influence change positively and negatively?

Data Sources: Observations, managers, archival records

Instruments: Observation guide, interview guide, document analysis worksheet

6. How do the quality improvement studies affect the performance of the company?

Data Sources: Observations, archival records

Instruments: Observation guide, document analysis worksheet

A tabulated form of the research design can be seen in Table 14.

Table 14,
Research Design

Research Question	Data Sources	Instruments	Type of Data Collection	Data Analysis
1	Observations Managers	Observation Guide Interview	Monthly Diary	Descriptive Analysis
2	Observations Managers	Observation Guide Interview	Semi-structured Monthly Diary	Descriptive Analysis
3	Observations Archival Records	Observation Guide Document Analysis Worksheet	Semi-structured Monthly Diary	Descriptive Analysis
4	Observations Archival Records	Observation Guide Document Analysis Worksheet	Document Analysis Monthly Diary	Descriptive Analysis
5	Observations Managers	Observation Guide Interview	Document Analysis Monthly Diary	Descriptive Analysis
6	Archival Records Observations Archival Records	Document Analysis Worksheet Observation Guide Document Analysis Worksheet	Semi-structured Document Analysis Monthly Diary	Descriptive Analysis
			Document Analysis	Descriptive Analysis

3.3. Role of the Researcher

In participant observation studies, researchers actually take part in the situation, activities or setting that they are observing. This case study involved participant-observation in the role of facilitator. The researcher was a member of quality improvement project team and he was enabled to do observations and keep field notes while engaging quality studies. For the first two years of the study, the identity of the researcher was not known by the individuals observed except for the head of Application Development Directorate and the manager of Institutional Performance Improvement. This prevented the group observed from using mask and behaved naturally

Observer effect and observer bias can affect execution of the study and consequently outcomes of the study (Fraenkel & Wallen, 2003). As explained in the previous paragraph, observer affect was dismissed by not revealing the author of the dissertation as a researcher. However the problem of observer bias is something with which all researchers must deal. Since no one can be totally objective, the researcher triangulated his findings with the results of interviews and artifact analysis. He spent three years in the study realizing that most situations are very complex and did the best to collect data from the field. The researcher did not have any expectations from the subjects; he just observed them and what happened as well.

3.4. Participants

The company where the research was conducted provides services and solutions in application programming, networking, system integration and implementation, project management and consultancy, enterprise specific application software development, and user support systems. It has approximately 450 employees, which vary in number due to rapid occupational shift. This large-scaled enterprise (Büyüklüklerine göre işletmeler, 2009) has three main departments, Application Development

Directorate, Infrastructure & Operation Directorate and Service Planning Directorate (see Figure 15). This dissertation focuses on the Application Development Directorate where production is undertaken.

In December 2008, the number of the employees was 445. A few statistics about the workers can be seen from the charts below.

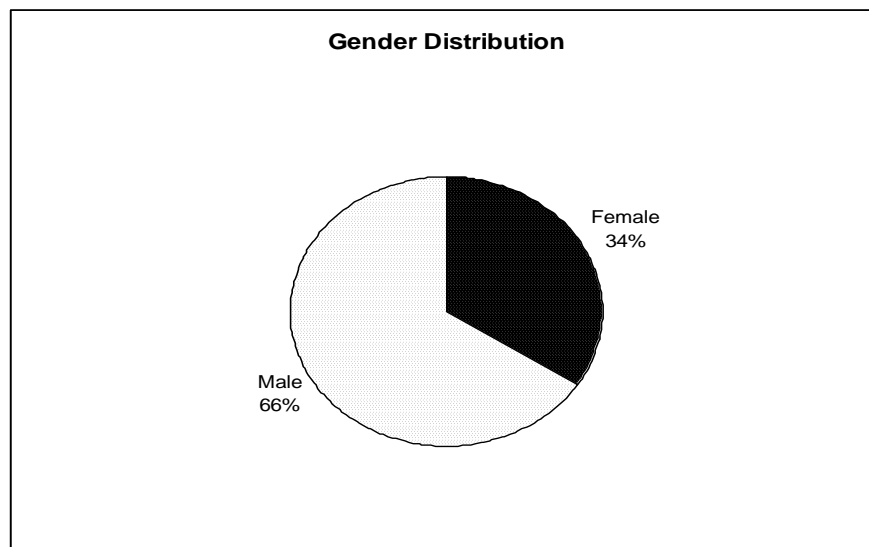


Figure 9. Gender distribution of the employees at the Company A

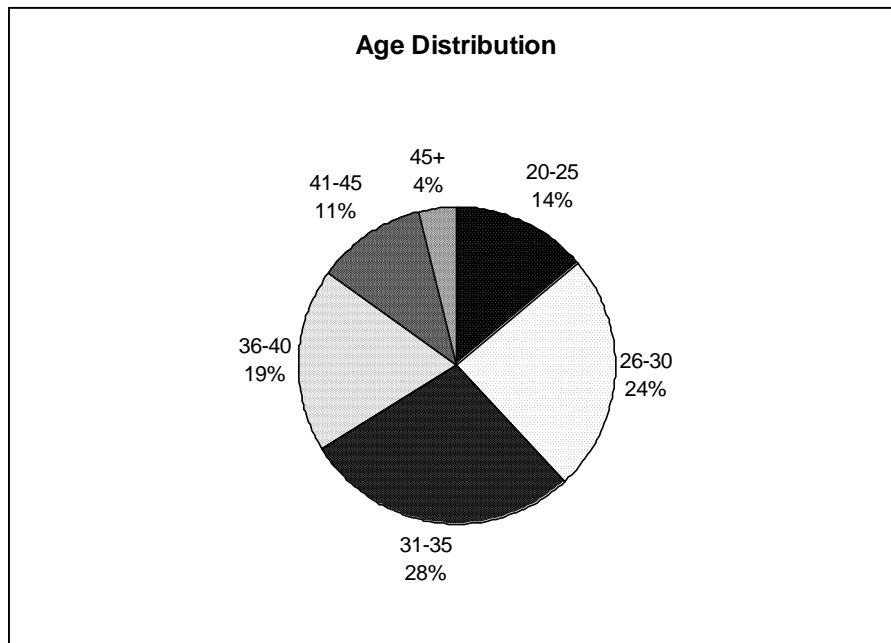


Figure 10. Age distribution of the employees at the Company A

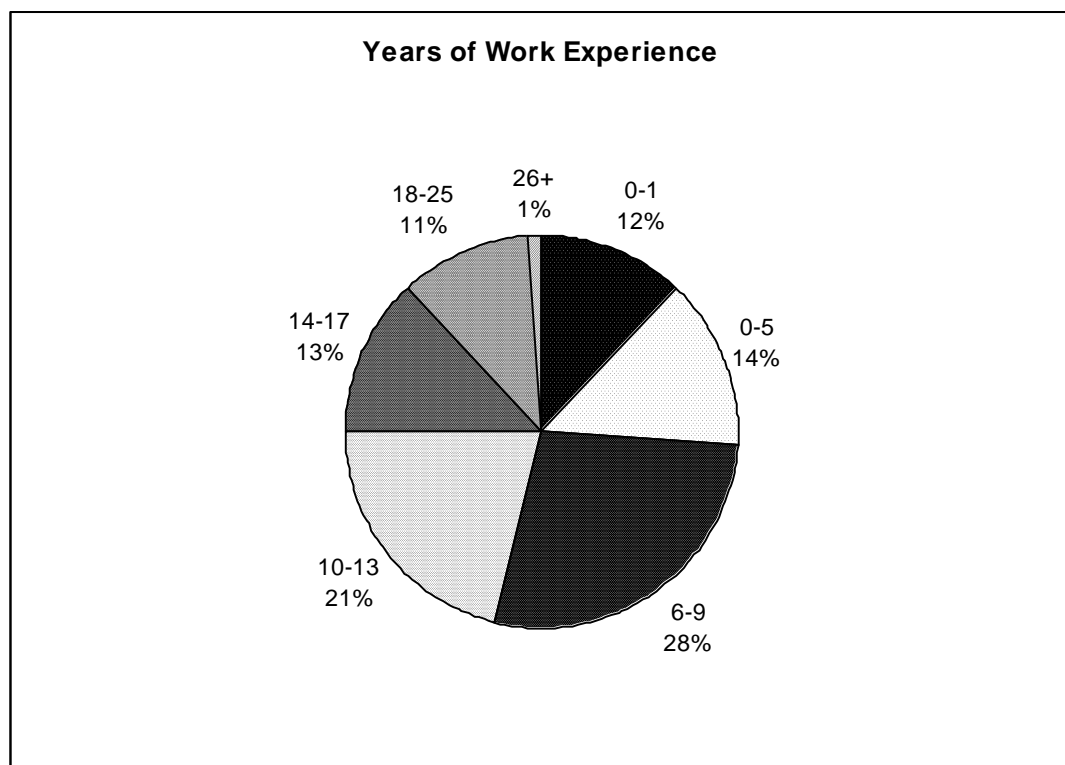


Figure 11. Work experience of employees at the Company A

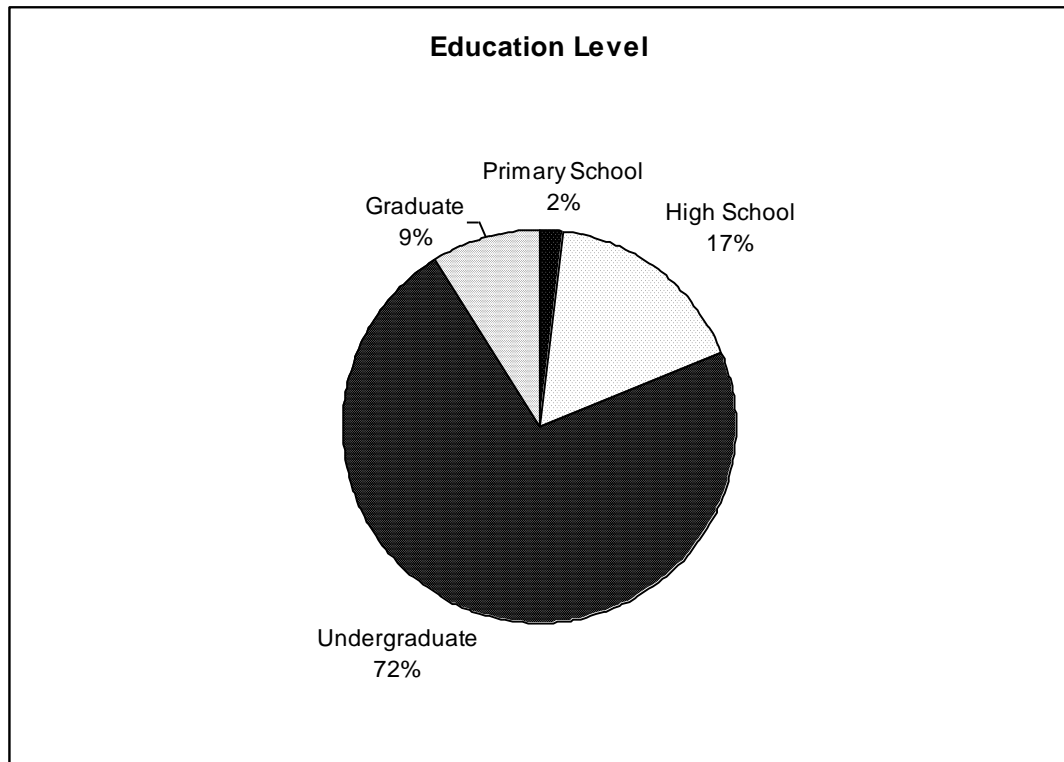


Figure 12. Education level of employees at the Company A

As it is seen in Figure 13, more than two-thirds of the employees (72%) held undergraduate degrees and all participants for the research were selected from this segment.

In this research, two types of interviews were executed. The first was undertaken with 11 service administrators and focuses on the ISO audits (see Appendix D, E, F, G) and were evaluated as document analyses.

The second interview type was a traditional interview with two first level administrators (service administrator) and eight managers (see Appendix B). The whole interview procedure was confidential and interviewees were given an anonymous nickname. Interviews were recorded and decoded into text. Detailed information about participants of in the second interview session is shown in Table 15 and 16.

Table 15.
Education background of the interviewees

	B.Sc. / B.B.A.	M.Sc. / M.B.A.	Ph.D.
Computer Engineering	2	1	
Electrical and Electronics Engineering	2	1	1
Mathematics	3		
Statistics	1		
Economics	1		
Management	1	1	

As for the triangulation of the study, the second type of interview was used to gather data from the experts who work in the sector. While two experts, who are top managers, were interviewed face to face, one consultant sent responses by e-mail.

Table 16
Years of experience in administration

0 – 5	5 - 10	10 - 15	15 - 20	> 20
2	5	2	1	0

3.5. Data Collection

In this case study, qualitative instruments were used not only for gathering data but also for methodological triangulation. Triangulation means that data are collected from more than one data source so as to

complement each other (Bogdan & Biklen, 1998). For example, interviews supported by observations were triangulated by archival records.

A questionnaire was used to measure variables by asking people questions and then to describe what is happening in the research data (Krathwohl, 1993). It is recommended the questionnaire should be tackled when collection of data comes from a large population (Popham, 1993). Therefore, a questionnaire was not necessary to collect data from a limited number of managers. On the other hand, interviews let the researcher collect detailed data from the participants. They also present a convenient situation to release extra information from the participants. Moreover, these multiple data collection techniques are used for triangulation of the data, which increases reliability and validity of the study. For this reason interviews were selected as a data-gathering instrument.

3.5.1. Instruments

Observation Guide: Research in social sciences looks into attitudes, beliefs, values, and emotions of the informer and these complicated concepts cannot be easily translated verbally. All of them can be examined indirectly through body language, facial expression, gestures and social interactions. To grasp information, observation is used. Participant observation, in which the researcher (observer) becomes “part” of the environment, or the cultural context, is a qualitative method frequently used in social science research (Savenye & Robinson, 2003). The researcher was already a member of the quality development project at the company and conditions were sufficient for participant observation. What the researcher observed during the study was recorded in a diary. Diaries are kept on a periodic time-span and this can be generally a day, a week or a month, seldom in longer duration (Bell, 1999). In this study, as the change process was not very quick, a monthly entry was made in the

diary. This is why we called it “monthly diary” and a sample of which can be seen in Appendix A.

Interview Guide: Briggs (1986) considers interviews as one of the most common research methods in social sciences because it is an effective method for collecting information from experiences, attitudes, opinions, complaints, senses and believes. The purpose of the interview method is to discover what is in or on someone else’s mind (Patton, 1990). Since adaptability of the interview is a major advantage, an interviewer can pursue ideas, look into responses and examine motivations and feelings, which the questionnaire can never do (Bell, 1999). The other advantages are listed by Yıldırım & Şimşek (2003) as:

- a. flexibility,
- b. higher response rate,
- c. chance to observe nonverbal behaviors,
- d. control over the environment,
- e. sequence of questions to be asked,
- f. opportunity to observe sudden reactions,
- g. confirmation of data source,
- h. completeness of the data,
- i. in-depth information.

Interviews were used to record, analyze and interpret the participants’ opinions and perspectives on the change process in Company A. Semi-structured interviews were conducted with maximum flexibility. This let the researcher leave enough room for what was not anticipated within

the scope of the study, through open-ended questions the researcher could provide the respondents with a chance to express their deepest thoughts, beliefs, concerns and feelings (Creswell, 1994).

In this study, two types of interviews were used. One of them was for managers while the other was for service administrators. The interview guide for managers can be seen in Appendix B, which was also used for experts outside Company A. The ISO internal audit questionnaires for the service administrators were also regarded as interviews and they can be seen in Appendices D, E, F, and G.

Documentation & Archival Records: Review of documentation and archival records enabled the researcher to examine in-depth printed materials about the research. Although the research mostly determines what documents and archives are to be reviewed, Bogdan & Biklen (1992) give examples of review materials in the educational context as textbooks, circulars, student's records and handbooks, guidelines, and official documents. Forster (1995) lists institutional documents such as mission statements, press releases, office memos, and strategic documents, while Bailey (1982) talks about personal documents, periodicals, magazines, printed press, and books. Yin (2003) also counts formal studies and media clippings, among others.

Yıldırım and Şimşek (2003) show the advantages of documentation review as reaching unreachable subjects, preventing negative reactions, allowing for longitudinal analysis, allowing for a large sampling, providing uniqueness, respectively lower costs, and quality. In this long-term study of a company, the researcher tried to make use of all documents of relevance. As an instrument, document analysis worksheets were used in Appendix C. Official meeting records were reviewed as archival records and can be seen in Appendix H.

3.5.2. Process

The research started in March 2006, and was still in process at the time this thesis was written. As this was a long-lasting study and changes were occurring very slowly, observations made during the study were noted into diaries once a month. Additionally, the group for the quality development study gathered at least once a month and records of their meetings were kept. Since the researcher was a part of the research environment and took part in the activities for quality development, participant observation was the main method used during the process of data collection.

Open-ended interviews were another major method for gathering data. Managers from eight departments and two service administrators were interviewed according to the interview guide that can be seen in Appendix B. The interviews were semi-structured in nature. Bogdan and Biklen (1998) stated that with semi-structured interviews the researchers are sure that they are getting data that can be compared across subjects. Another kind of interview was applied to 11 service administrators and the forms that were used can be seen in Appendices D, E, F and G. Actually, this interview was an internal audit practice but questions were designed like an open-ended interview. The results of this interview were written into documents of the company prior to the researcher evaluating them as document artifacts.

1. Participant observation: Throughout the study, the researcher observed the planning and implementation of process improvement works and recorded any relevant events in the “Event Logs” table (Table 17). The event was randomly given a title. The date and the description of the event were recorded. Every entry was analyzed according to each of the research questions. The number corresponding to each relevant question was

recorded. All these records were transferred to the “Monthly Diary Sheet” (see Appendix A) regularly every month.

Table 17
Event logs table

Field	Description
Event Title	A short name for the event
Date	The date of the event
Description	A detailed description of what happened
Relevant Research Questions	The research questions related to event

Monthly Diary Sheet collects the event logs and considers them as activities. Tangible and intangible changes caused by these activities were recorded. Reactions of the staff to these changes were interpreted and observation details were kept in these diary sheets. *Section 3.4.1* gives an explanation why the “participant observation” technique is used as observation.

2. Interviews for this study were undertaken as follows:
 - a. *Those undertaken with eight managers and two service administrators:* The instrument in Appendix B was used. All of the respondents were over 35 years old and under 50 years old. All participants held at least an undergraduate degree and Table 18 shows detailed education information. The majority of the participants had experience in management of between 5 to 10 years as can be seen in Table 19. The results were evaluated by descriptive analysis.

Table 18*Education background of the interviewees*

	B.Sc. / B.B.A.	M.Sc. / M.B.A.	Ph.D.
Computer Engineering	2	1	
Electrical and Electronics Engineering	2	1	1
Mathematics	3		
Statistics	1		
Economics	1		
Management	1	1	

Table 19*Years of experience in management of the participants*

0 - 5	5' - 10'	10' - 15'	15' - 20'	> 20
2	5	2	1	

The interview began with reading of an information part of the form explaining the purpose of the study, confidentiality of the study and a request for recording the interview. Transcripts of all interviews were provided to the participants.

The same instrument used for interviewing three experts from the sector. The outcomes of these interviews were used for the triangulation of the study and not included in data shown in Tables 18 and 19.

- b. *Those undertaken with eleven service administrators:* Questionnaires in Appendices D, E, F and G were used as instruments. Demographic data was not gathered because this was an internal audit for ISO 9001:2000. The results were evaluated as documentation review.

3. Review of documentation and archival records: The researcher made use of a collection of records and documents belonging to company A. Printed or electronic official correspondence of the company between other companies and its employers, meeting records, instructions, standards etc. were examined and recorded if they were considered relevant to the study. These archival records provided important evidence of relevance to most of the research questions. For example research question 3 was answered easily by comparing a previous organization chart with the current version (see Section 4.4).

It was not easy to extract valuable knowledge from the huge mass of information. Document analysis worksheet (Appendix C) was used as an instrument for categorizing and recording artifacts. Another useful document was the official meeting report (Appendix H), as it was a record of what happened within the meeting rooms in detail. Quality process improvement meetings were routinely recorded because it is a common obligation of quality standards that reports of meetings are kept. At the beginning of the meetings, a member was assigned as a secretary and he/she was responsible for recording what was transpired in the meeting room.

3.6. Data Analysis

Merriam (1998) defines data analysis as the process of making sense from the data. Bogdan & Biklen (1998) says that before starting the data analysis the focus of the study should be stated, otherwise the data

collection has no direction and the data collected may not be sufficient to accomplish analysis later. After deciding the focus of the study, the tasks in data analysis are to organize the data; generate categories, themes and patterns; code the data; test the emergent understandings; search for alternative explanations; and write the report (Marshall & Rossman, 1999). There are two types of analysis; descriptive analysis (simply describing and interpreting the data collected) and content analysis (identify underlying ideas, issues, concepts, themes and patterns in the data). In this study, descriptive analysis was used. Yıldırım and Şimşek (2003) indicate steps of descriptive analysis as:

- a. *Create a framework for descriptive analysis:* A framework is drawn from research questions, observations or interviews. Themes are presented by the framework and organization of data is determined according to these themes.
- b. *Process data according to thematic framework:* Data are selected, identified and organized in context of thematic framework.
- c. *Describe findings:* Findings are described and supported by direct quotations.
- d. *Interpret findings:* Described findings are explained and concluded.

Although some criticize descriptive analysis as being shallow, it was a convenient methodology for this study since this research aims to present findings in an organized and interpreted manner.

The purpose of the research (see section 3.1) drew the framework of the study that has three main categories, namely stages of change, factors that affect change, and performance of the Company. Afterwards,

the themes were identified based on the labels, and collected under major categories. The major topics and themes helped to identify the concepts and main ideas.

After creating the framework, the researcher reduced data by coding and inserting it according to pre-defined themes. During this phase, data in themes was organized as labeled concepts into data display matrixes and structured summaries. Pre-defined themes were converted into defined themes based on the research questions. Observation notes, documents and interviews were classified according to the defined themes.

Observations were kept in the event logs and these event logs gathered in Monthly Diary Sheets (see Appendix A). As seen in Table 20 below, “Relevant Research Questions” field simplified analyzing of observations. Monthly Diary Sheets summarized activities and events for a period of 30 days. Comments and notes on these sheets helped the researcher to interpret data.

Table 20
Example of an event log table

Field	Description
Event Title	Preparing performance report of period 2008 - 1
Date	May 18 th , 2009
Description	Metrics of goals from every service of Application Development Department was gathered, calculations done and performance improvement report prepared.
Relevant Research Questions	RQ6. How does quality improvement study change performance of the company?

Analysis of artifacts and documents were also similar to observation sheets. With the aid of a “Document Analysis Worksheet” (see

Appendix C), fields of “Document Information” and “Notes” enabled articles to be grouped under related themes and research questions.

The analysis of the interviews was not as straightforward as observation activities and document analysis. The interview analysis included the following steps: Firstly, the researcher transcribed the interview notes word by word from the recording device used during the interviews by using Microsoft Word. Then, the researcher set the right margin as 8 centimeters in order to leave sufficient space for writing notes and printed the interview notes. Next, the printed data were read twice in order to get the whole picture of the opinions of interviewees. Afterwards, meaningful data units were identified and appropriate labels about the data units were written in the right margin by the researcher. The labeling was carried out in Turkish as shown in Figure 13. Data were indexed by interviewee aliases in order to locate related data easier when writing up the results chapter. For example M4 represents manager 4. Lastly, the researcher refined and reorganized the categories and also looked for relationship and meaning among and within categories.

4. İş akış değişimi	
4.1. Kalite Yönetim Sistemi kurulmadan önceki ile sistemin uygulamaya alınmasından sonraki iş akış modellerinin kıyaslanması	
4.1.1 Fark yok	M6, M7
4.1.2 Süreç girdi ve çıktıları belirlendi	M3, M4, M8
4.1.3 Görev ve sorumluluklar belirlendi	M1, M4, M8, FL1, FL2
4.1.4 Dokümantasyon yapılmaya başlandı	M2, M3, M4, M8, FL2
I	

Figure 13. An example of analysis of interview

Findings were identified and conclusions were drawn from analyzed data. This final phase included comparison-contrast, clustering, using metaphors, triangulation, and looking for negative cases. The data analysis was continuous and iterative during the study as suggested by Srivastava and Hopwood (2009).

3.7. Reliability and Validity Issues

Whatever procedure for collecting data is selected, it should always be checked whether it is reliable and valid. Ensuring validity and reliability for qualitative and quantitative research differs as “the quantitative study must convince the reader that procedures have been followed faithfully while the qualitative study provides the reader with a depiction in enough detail to show that the author’s conclusion makes sense” (Merriam, 1998; p.199).

Bogdan & Biklen (1998, p.36) found that “in qualitative studies, researchers are concerned with the accuracy and comprehensiveness of their data. Qualitative researchers tend to view reliability as a fit between what they record as data and what actually occurs in the setting under study”. They also stated that two researchers studying the same subject may deliver different findings but both studies may be reliable. If the results are contradictory, the reliability could be interrogated. The role of the researcher in the qualitative pursuit is to describe accurately what is out there and not necessarily to replicate the same observations and results of another researcher. However dependability and consistency of the results are important and to ensure them, the researcher followed the standards below.

- *Stating clearly the assumptions and theory behind the study, the basis of selecting informants, a description of participants;* the properties of the qualitative studies explained in detail in the design of the study

(section 3.2), the idea and theory behind the selection of informants is explained in the participants section (section 3.4), along with information about the informants.

- *Constructing a triangulation of data by using multiple sources of data or multiple methods*; the observations, document analysis, and interview data were collected from Company A. Results gained from interviews made by managers and service administrators were checked against the observations and company documents.
- *Auditing the trail whereby the data collection, categories selection, and decision-making processes are described in detail*; throughout the study detailed information is given about data collection, selection of categories and the decision-making process.
- *Review of instruments by experts*: one expert and two peers revised the interview guide and other instruments.

Validity is a more complex concept. It tells us whether an item measures or describes what it is expected to measure or describe. If an item is unreliable, then it must also be deficient in validity, but a reliable item is not automatically valid (Bell, 1999). Validity can be considered as internal or external (generalization).

Internal validity concerns how well research findings match reality. In this study the data gathered from the participants were recorded. To ensure internal validity the following strategies were followed;

- *Triangulation*: comparison of the interviews with the documentation assets, observations and interviews with experts from the sector.
- *Check on accuracy of recorded data*: the transcripts of the interviews were sent to interviewees by e-mail.

- *Conformation of descriptions and interpretations through peer review:* At each step of the data analysis process, suggestions and comments on findings from colleagues and advisors were taken into consideration
- *Biases of the researcher:* The researcher's assumptions, limitations, delimitations, and theoretical orientation at the outset of the study were clarified.

Generalization or external validity is the extent to which findings from one study may be applied to other situations. As it is difficult to generalize findings, several criticisms exist in relation to generalization of case-study approach (Bell, 1999). On the other hand, Bassey (1981, cited in Bell 1999) prefers to say "reliability" rather than "generalizability" and describes the reliability of a study as the reported details are sufficient and appropriate for a researcher working in a similar situation to be able to relate their decision making to that described in the case study. Merriam (1998) also pointed out that generalization in case (qualitative) study has a different meaning. It is explained as reflection for the underlying assumptions of the inquiry and used to gain an in-depth understanding of the situation and the meaning for those involved. The researcher tried to provide satisfactory descriptions in order that everyone can set up relations between studies.

3.8. Limitations And Delimitations

Validity of this study is limited to reliability of the instruments used and the honesty of the subjects' responses to the instruments. As observation and interviews are the main data collecting methods of this research, contextual limitations were a major limitation. Observation and interviews were triangulated by document analysis and experiences of other companies that use CMMI. Observation is influenced by observer

affect and observer bias while the only drawback of using interviewing is reliance on self-reports.

On the other hand, results are specific to Company A and focus on the change process within this company. In addition, it may not be possible to make generalization from the results of the study to a large population. These are delimitations of the study.

3.9. Description of the Case

Since the demographics of the company were presented in section 3.4 in detail, this section includes some major information. Rather, this section introduces the company's business and organization body. Figure 15 shows its organizational structure and responsibilities. A description of the company's departments and their undertakings is given below.

In December 2008, the number of the employees was 445. The number of female was 152 (34%) and male was 293 (66%). Age distribution intervals were presented at Table 21.

Table 21
Age distribution of Company A.

Age Interval	Number of the Employees	Percentage
20 -25	62	14
26-30	107	24
31-35	125	28
36-40	84	19
41-45	49	11
+45	18	4

3.9.1. Application Development Directorate

a. Application Development Management

Here, detailed analyses are prepared to satisfy the demands of the customer and functional design is created and improved. This department tests the software once the programming process is completed according to the test scenario and integrates it with other modules for research, development, amendment and application of the work in processes which includes the management, control and decision activities of the customer.

The department generates application development and care facilities, which are included in the framework convention or protocol drawn up with the customer, within the defined process of the quality management system. Customer requirements are defined correctly and designed functionally and physically to meet the specified requirements. It implements the appropriate software for the design and coding standard. It verifies that the software is appropriate for the requirements and determines that it covers the customer expectations entirely (test process). This department is responsible for maintenance of the software, which is developed by the company and used by the customer, so as to satisfy project-based applications. Application development facilities are carried out according to the related production and project plans. Essentially, this department of Company A is at the heart of production.

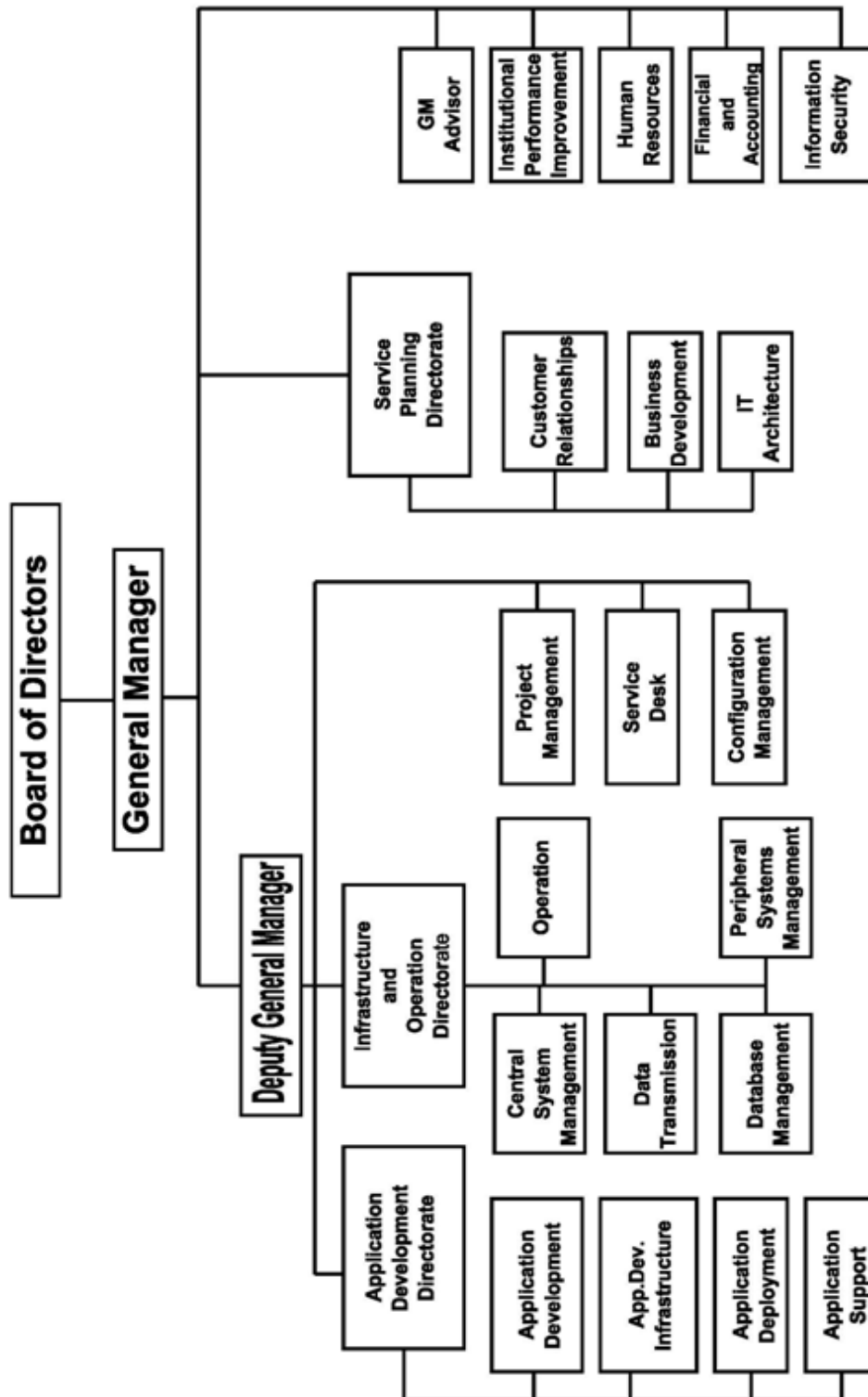


Figure 14. Organizational chart of Company A.

b. Application Development Infrastructure Management

This department follows and examines the technologies related with the software infrastructure, which is used in the application development facilities. It follows that applicable technologies are approved by the related authorities and used, produces and documents the standards for the software development and database and ensures that they are used by the software developers in the Application Development Department. Its approval is required for any new infrastructure components such as new architecture or software that needs to be created or improved. This department ensures the continuous working of the application development environment. Problems (performance, failure, integration problems etc.) that occur in the environment are determined and solved. It carries out performance analysis in coordination with the Infrastructure Operation and Application Development Departments.

c. Application Deployment Management

This department decides whether pilot studies are necessary during the planning stage. It also considers all the applications during the design stage in order to establish any problems that may arise from software produced or used within or outside the company. Effect analyses are executed. Interaction test criteria are defined. It starts the planning of the deployment phase considering the technical infrastructure requirement procurement, prepares the functional design documents before the deployment, controls the functional verification test scenario which includes the results of the applied case, functional validation approval (customer acceptance), performance test results, in the case of a failure to demand that it will be accomplished.

Reference system tests are completed according to the effect analysis prepared for all applications that requested deployment. Pilot –

general deployment is performed for applications that passed interaction tests, made on the reference system according to the conditions defined on the deployment plan after a successful deployment. Generated problems are determined with their cost to the field and solved in the shortest period by field monitoring after deployment.

d. Application Support Management

Assistance service for the customers is supplied. Problems are classified, their order of importance is determined and they are solved in the most efficient way. Usage and operation of the programs submitted to the customer is coordinated with the related department of the customer and user training is executed, user manuals are updated. Support service is given for the parametric and accountancy problems that may occur in the computer process about banking.

Programs which are executed by the Application Development Management are followed up. User manuals, analysis and scope documents about newly executed applications are examined and the correct information is presented to the customer. Customer requests and problems are reported during branch office visits and the reported items are shared with related departments. Proposals are prepared to improve customer satisfaction.

3.9.2. Infrastructure And Operation Directorate

a. Central System Management

Necessary infrastructure facilities and requirements are planned in detail to provide the service that is required by the customer without interruption, with high performance and in accordance with the safety criteria. This department participates in the studies for the procurement of the necessities. Set ups and configurations are accomplished. Tests are

performed before the software is used in the production environment and when it is required to be performed. Applicability of the new technologies to increase the quality of the service is investigated. Documentation of the structure is prepared, facilitative methods are developed for the operational studies. Efficiency is considered as the basis for the management of the system sources.

b. Data Transmission Management

Necessary wide area and local area communication infrastructure is established for the purpose of the audio, data and display transmission of the company and the customer. Infrastructure is operated, managed in place or remotely in response to calls for assistance. Necessary support is provided for the integration studies of new and existing systems. Consultancy support services are provided for the necessities. Support services are provided for the preparation of purchasing and maintenance tenders, specifications and evaluation of potential tenders. Field tests are performed. Setup and maintenance facilities about data transmission that is specified in framework conventions or protocols are maintained according to the processes defined in the quality management system. This department is mainly involved in defining the requirements of the customer correctly. Creating functional and physical design that meets with the specified requirements and procuring the appropriate infrastructure for the design. It contributes to the tender evaluation process. Test studies are supported. System reports are prepared.

c. Database Management

This department is responsible for the continuity and efficiency of the database and data management services required for the computer systems. Necessary database design, monitoring and management activities for increasing the quality of the service are performed. This

department provides for the planning, testing, creating and monitoring and servicing of the database. System interruptions are urgently resolved and a standby database is kept ready at the emergency center. Necessary calibration and upgrade studies are performed for further enhancing system performance.

Operations are managed, monitored and amended according to the criteria of the work continuity and performance for the smooth and continuous operation of the database.

Performance analysis is carried out in the real, test and development environment. Necessary database updates and structural revisions are implemented. The problems that occurred are determined and solved. Data transmission is performed according to requirements of various environments and banking data is archived. Infrastructure planning and development works are carried out. This department works in coordination with the Operation and Application Development department units. New technologies and tools concerning the database management systems are researched. Necessary information and documentation are prepared which are important for unit reporting and documentation.

d. Operation Management

This department gives a wide range of operational support to the applications. Infrastructure that has to serve 24 hours, environment units and systems are monitored. It is responsible for back up and archiving.

e. Peripheral Systems Management

Desktop applications which the users need and are appropriate for the company standards are set up and managed. Servers on which the applications work are set up. This department gives support to the maintenance, management and operation of the applications which will

work on the servers. It also gives support to the maintenance, management and operation of the systems which provides secure transmission on the intranet and internet for the users. Necessary technical support is given to the projects about secure transmission and solutions for this are determined and implemented here.

User process within the operational works, backup and restore check, domain and windows servers check and reporting, messaging service check and reporting, internet security system check, updating and reporting, intranet security system (anti-virus, patch update) check, updating and reporting, system management works are carried out. Messaging system management within the domain management, internet security systems management, intranet security system management works are also performed. Technical support, server set up and technical support, PC setup and technical support works within the portal application management; user application support, server application support, system design, procedure development, procurement and specification arrangement and evaluation works within the branch office establishment are also the responsibility of this department.

3.9.3. Service Planning Directorate

a. Customer Relations Management

Request Management Major Process is performed for all customer requests for new projects or revision of existing or actual programs. Offer, feasibility report and contract documentation is prepared. Necessary coordination and briefing is carried out to submit the items appropriately and committed to the customer in the contract. This department also evaluates customer satisfaction. Requests received from one of the customers are detailed together with the customer; necessary information is conveyed to the related unit of the company, a request is concluded or

directed to the related unit. Customers are visited to state and report if there is any problem. Proposals are developed to increase customer satisfaction. New and project revision requests are recorded and followed up. Project plans and conformity to contract are followed and audited. This department works as negotiator between the customer and the company to solve any problems arising from requests, which are not carried out according to the contract conditions.

b. Business Development Management

Consultancy studies for the orientation, planning and management of the information technology investments of the customers, which are served as out source scope are carried out by this department. Marketing objectives and strategies are developed according to the objectives of the company and application is managed. Consequently project offers are prepared and evaluated; market researching and feasibility studies are carried out. Procurement documentation is prepared. This department is also responsible for the presentation of the company and business development.

c. Information Technology Architecture Management

Model of the information technology architecture which is flexible enough to meet the requirements of the customer's strategic job requirements is developed and directive solutions are found to assure that it is applied entirely throughout the company.

Information technology architecture's development strategy is planned in consideration that it will be cost-effective and meet the requirement of the customer's commercial requirements and be appropriate to the standards. When necessary new technologic products are tested and evaluated. Specifications are prepared which contains the technical details of product or service and should be used for the procurement of the

company's product or service requirements or the customer. Research and development activities are carried out to meet requirements, which are previously defined, according to the company's quality policy and standards. Consequently this department takes necessary institutional measures.

3.9.4. Departments Connected Directly To General Manager

a. General Manager Advisor

He/She compiles the necessary information, proposes, prepares projects or contributes to the preparation of the projects, makes investigations and researches, prepares reports about the subjects that the General Manager assigns to them. Every type of document or information that the General Manager delivers is evaluated, transferred, managed and responded to. Where necessary, the advisor is assigned to take part in the commission, committee and work groups within the company. As and when necessary the advisor conducts or co-ordinates studies on subjects assigned by the General Manager. Presentations, reports and official external letters are prepared on various subjects. Necessary information and documents are prepared for the official audits and third party firms. Necessary cooperative studies are carried out.

b. Institutional Performance Improvement Management

All types of institutional activities, which improve institutional performance are encouraged and the department is empowered to lead such activities when required. This department set up the Quality Management System, which will improve the institutional performance and develops it according to related universal standards. Internal audits are carried out by this department. This department takes necessary action to

acquire and preserve the related quality certification. Company objectives are determined and necessary measurement systems are prepared. Performance of the quality management system is measured and necessary adjustment precautions are taken. Consequently continuous improvement of the quality management system is provided.

c. Human Resources Management

Human resources plan and objectives are determined and applied according to the institutional objectives and policy. Company objectives and performance are supported by effective human resource management that is appropriate to the conditions of the sector and country. This department selects and positions the personnel. It is responsible for the education, improvement, evaluation of the performance, career planning and salary management of the personnel. Personnel motivation plans are developed and carried out. Human resources and personnel documentation and records are prepared and archived according to standards and regulations. Personnel records are prepared and archived within the personnel affairs. This department is responsible of the payment of salaries. Annual vacation and medical reports are recorded. Declarations for Social Security Institution and other legal documentations are prepared and submitted on time.

d. Financial And Accounting Management

Information about the administrative and financial process of the company are recorded correctly, also related units are informed about them. This department keeps the records of the company and archives them, evaluates the taxes and prepares the declarations. Financial charts are prepared. Procedures related with the government agencies, relations with banks and cash management are carried out. Salary, tax, Social Security Institution payments and cash receipts are carried out. This

department has the responsibility of meeting the general requirements of the company and responsible for the secretariat services. Travel and vehicle usage procedures are put into action.

e. Information Security Management

Information security management systems and risk management systems are in the scope of the institutional services included in the framework conventions or protocols and developed according to the processes defined in the quality management system. Necessary risk management and information security planning, coordination, application, transmission, reporting and management works are carried out. Problems and security violations are investigated.

3.9.5. Departments Connected Directly To Deputy General Manager

a. Project Management

This department executes the one-time works which are defined properly and over the specific threshold value of the importance, period and cost criteria of the produced project to meet the requirements and requests of the customer; in the stated time period by usage of the company resources and external resources, if needed, within the stated budget. For this reason customer, customer relations management, other related departments and third party departments, if there is any, are coordinated.

b. Service Desk

Customers relate their problems to the company by the way of web and telephone they can relate, problems, requests for correction, requirements and complaints about the system and software that the company produced or purchased or that are produced under control of the

company. This department acts to solve these complaints and meets the requirements in the shortest period. Calls are categorized, solutions are presented if they are included in the service database and if they are not recorded they are recorded and directed to the related department to be solved. Correction requests and requirements that are received are evaluated and categorized and directed to the related departments. Call ups are followed and related departments are informed about the call ups that are to be solved. Reports are prepared about the process follow up and recruitment to take attention to the problems and prevent the repetition or to reduce the problems.

c. Configuration Management

Necessary information is defined to manage the IT services according to the defined IT service management standards. Database is defined and maintained that includes all of the information that is required to manage the items' situation, life cycle and relations and is composed of the controlled items to manage and supervise IT services. All of the changes in the configuration of the services and products and also the systems that they work on that are produced in the company are done after they are recorded and approved. Configuration of IT entities in the departments of Infrastructure and Operation Directorate are recorded. Complete and correct information of the items that are defined as configuration members and belonging to their documentation is presented to support all the activities of Service Management. IT infrastructure and resources are optimized.

3.10. Summary of the Chapter

This chapter explains the methodology of the study. The aim of this case study is to examine the change process of integrating CMMI into a

technology company using a qualitative approach. This part of the dissertation begins with the purpose of the study section, which includes the research question and the sub-questions. The following section describes the design of the study and it was implemented in detail. While the participants section gives the demographics of Company A and involves gender distribution, age distribution, years of work experience and education level of employees, the description of the case section gives organizational structure of the company and business façade.

Data collection instruments comprise the observation guide, interview and document analysis worksheet. As the researcher was a part of the research environment and participated in the activities for quality development at the company where the research was conducted, participant observation was the main method used for data collection. Collected data was analyzed by descriptive analysis. Given that the case study is a special type of research, the reliability, validity, and limitations of the study are discussed in detail in their related sections. The last section is description of the case.

CHAPTER 4

RESULTS

This chapter explains the findings and results of observations, interviews and document analysis throughout the study. This part of the dissertation includes the change process of integrating new quality development models, observations and interview results and other findings from artifacts of the company. Short of all, this chapter presents the findings that this study seeks:

1. What factors are responsible for initiating the change?
2. What is performed to integrate CMMI model into the company?
3. How does the workflow of the company change during CMMI implementation?
4. What are the stages of change?
5. What are the factors that influence change positively and negatively?
6. How does quality improvement study change performance of the company?

The questions above are subparts of the major question:

“What is the nature of change process in a software development company which implements CMMI procedures?”

Table 22 summarizes the findings on the basis of the research questions. Further details are in the chapter.

Table 22
The research questions and the findings

Research Question	Instruments	Major Findings	Related Section
1. What factors are responsible for initiating the change?	<ul style="list-style-type: none"> • Observation guide • Interview 	<ul style="list-style-type: none"> • Ensuring quality • Improving productivity • Improving competitive power 	4.1
2. What is performed to integrate CMIM model into the company?	<ul style="list-style-type: none"> • Observation guide • Interview 	<ul style="list-style-type: none"> • Reconstruction of organization • Defining of processes • Documentation of processes 	4.2
3. How does the workflow of the company change during CMIM implementation?	<ul style="list-style-type: none"> • Observation guide • Document Analysis Worksheet 	<ul style="list-style-type: none"> • From undefined processes to defined processes • From work based flow to process based flow • From heroes to shared knowledge personnel 	4.3

Table 5 continued

4. What are the stages of change?	<ul style="list-style-type: none"> • Observation guide • Document Analysis Worksheet 	<ul style="list-style-type: none"> • 4 steps • Motivation and Adoption, Adaptation, Acceptance and Implementation, Use and Improvement 	4.4
	<ul style="list-style-type: none"> • Observation guide • Interview • Document Analysis Worksheet 	<ul style="list-style-type: none"> • <i>Negatives</i>: Change on running organization, diversity of educational background of the personnel, being young company, resistance to change, low motivation to the project • <i>Positives</i>: Leadership, support of upper management, high level communication, high education level of the personnel, tools 	
5. What are the factors that influence change positively and negatively?	<ul style="list-style-type: none"> • Observation guide • Document Analysis Worksheet 	<ul style="list-style-type: none"> • Positive impact 	4.5
6. How does quality improvement study change performance of the company?	<ul style="list-style-type: none"> • Observation guide • Document Analysis Worksheet 	<ul style="list-style-type: none"> • Positive impact 	4.6

4.1. Initiatives of Change

Research Question 1:

“What factors are responsible for initiating the change?”

The major purpose of a private enterprise is to make profit and increase its profit. There is always an effort to keep or increase market share and companies are very aggressive in this competition to enlarge their market share. Productivity is one of the uppermost concerns for a company. Many companies seek ways of improving their productivity and in these ways pass through continuously improved processes. Especially, in the software development industry, customers know that IT companies are challenged to stay within project limits such as time, budget and specifications (Frederick, 1987). To ensure delivery of software products, customers ask for quality assurance certifications such as CMMI and to hold such a certification enhances their opportunity to secure future projects.

It was observed that the senior management of Company A (8 managers, 1 director and the general manager) was aware of the value of holding quality improvement certifications, moreover during the interviews this statement was put into words by managers. A manager (M1) stated that:

“It would be difficult to survive even for the best organizations if a quality improvement project does not exist.”

“En iyi yapıların bile, kalite yönetim sistemi ile desteklenmez ise ayakta kalması güçleşmektedir.”

Another manager (M6) said that:

“Quality project is important, because we believe that it would contribute to improvement of the company.”

“Kalite projesi önemli çünkü şirketimizin gelişimine katkıda bulunacağına inanıyoruz.”

Interview analysis showed that almost every respondent believes in the benefits of a quality management system. The common view was that we have to produce better and serve better to compete in the sector. To do so, a quality management system is a necessity and the Institutional Performance Improvement Project has been started accordingly.

All of the three experts from the sector who was interviewed had similar opinions and emphasized internationalization of CMMI. An expert (E2) stated of CMMI:

“It is a model respected internationally and there is no serious competitor of it in the software development world.”

“Uluslararası kabul görmüş saygın bir model ve yazılım geliştirme dünyasında önemli bir rakibi yok.”

Another expert (E3) saw also CMMI as instrumental:

“To improve our competitive power by increasing product quality.”

“Ürün kalitesini yükselterek, uluslararası piyasada rekabet gücümüzü arttırmak.”

On the other hand, line level personnel were skeptical about the benefits of certification and some of them were seen saying:

“While certificates are hung on a wall, business flow works out formerly.”

”Sertifikalar sadece duvarda asılı kalır, işler eskisi gibi yürür.”

Findings showed that worries about productivity and market share were major trigger factors to initiate the change. At the beginning of the change period, line level personnel had suspicions about quality improvement studies whereas senior management had conscious in quality concept.

4.2. Integration process of Quality Improvement Model

Research Question 2:

“What is performed to integrate CMMI model into the company?”

Observation notes (monthly diary sheets) indicated that the institutional performance improvement project was launched in March 2006 at Company A. The company aimed to acquire certification of ISO 9001:2000 (Quality Management System Standard) and CMMI (Capability Maturity Model Integration) Level 3. A quality improvement project initiated for this purpose. A few months later, in a report of an official meeting report, the name of the project was changed to “Institutional Performance Improvement Project” (IPIP). The project covered the detection, control and documentation of work flow processes. The ultimate goal of integrating IPIP was to improve work processes and to increase productivity.

First of all, a study group, team of quality studies, was formed to implement institutional performance improvement within the company. Members of the group were responsible for carrying out the institutional performance improvement project at their departments. The researcher

also joined in the group, then participant observation notes kept on log events and monthly diary sheets became one of the major data-gathering instruments of the research. The group was trained about the basics of quality improvement concepts by the Institutional Performance Improvement Department (former Quality Control Department) of Company A.

Document analysis and observation notes showed that the organization of the company changed so that workflow was able to adapt to the quality improvement model. As it is seen from the document analysis of the human resources department, the organization of the company was reconstructed in August 2006 so that business units could fit the CMMI model. In the old organization, see Figure 16, the Application Development Department consisted of three groups comprising, System Development in which analysts work, Software Development in which programmers write codes and Test where testers work. In the new organization, Figure 17, the Application Development Department formed service units each of which consists of analysts, programmers and testers. In the old organization, groups were physically separated from each other but in the new one, every service is in a room of its own and business groups work together. The organizational transition of the company is discussed with all details in the next section.

Analysis of monthly diary sheets shows that from March 2006 to December 2006, workflow procedures were extracted and documented during institutional performance improvement meetings. Official meeting reports testified to several debates about what to put in business documents. Members of the team of quality studies were chosen from each department as a representative and tasked to provide details about their department's work. Here, the critical point was that only those steps that could be implemented in every circumstance were accepted as a business requirement. Official meeting reports and observation notes give December

2006 as the date these discussions were concluded. Working standards and instructions had been determined and the trial version of the institutional performance improvement project was put into practice at the beginning of December 2006.

From January 2007 onward, personnel were monitored on how they apply working standards and use workflow procedures, which were created, by the institutional performance improvement department and the team of quality studies. According to ISO 9001:2000, two types of auditing, external and internal (Seaver, 2001), were executed through the company. The researcher was charged as one of the internal auditors of the Application Development Department for ISO 9001:2000 and trained for this task. This provided a good opportunity for the researcher to see how much business services realize and implement work procedures and instructions that were first developed by the institutional performance improvement department.

In March 2007, the researcher and his colleague visited eleven application development services and interviewed service administrators using the semi-structured questionnaire as shown in Appendices D, E, F and G. Services were evaluated from four work procedures. The procedures were:

- PRS.01, Requirement Specifications and Development
- PRS.02, Functional Analysis and Design
- PRS.03, Physical Design and Coding
- PRS.04, Functional Testing

As a result of the audit, defects were identified in part PRS.01 concerning the monitoring of process metrics and their registration. The same problem was seen for PRS.02 and additionally the peer reviewing

step was missing. Since gathering metrics and peer reviewing activities were new concepts to the analysts who were responsible for procedures PRS.01 and PRS.02, they could not easily integrate them to the workflow.

PRS.03 is a procedure for software developers (programmers) that incurred the most problems for the company. This was because programmers had not, since the establishment of the company, been tasked with producing comprehensive documentation. Physical design documentation and unit test reports were not written at that time and performance metrics were not registered either. Observation notes showed that programmers were hesitant to produce documentation and it was observed that this procedure was the most difficult to implement. On the other hand, PRS.04 did not meet with problems because the procedure added nothing new to testers.

In the light of the report produced after the internal auditing, the Institutional Performance Improvement department prepared a list of “Corrective and Precautionary Activities” to fulfill the deficiencies. In addition to this, the Software Engineering Process Group (SEPG) was formed to improve work flow procedures. SEPG considered merging, changing or deleting some procedures and documents.

Monthly diary notes kept in the period of June – December 2007 indicate that personnel were occupied with implementing ISO standards and COBIT objects. Since Company A is a firm placed within the finance and banking sector, it is controlled by the Banking Regulation and Supervision Agency (BRSA). The BRSA references COBIT and institutions regulated by the BRSA have to pass COBIT audits. This is the reason why the company was busy with COBIT objectives.

It was recorded into the official meeting notes that the Software Engineering Process Group (SEPG) changed the procedures of the

Application Development unit as below in the context of quality improvement studies:

- PRS.01, Requirement Specifications and Development
- PRS.02, Analysis
- PRS.03, Design Development
- PRS.04, Coding
- PRS.05, Functional Testing

During the preparations for audits of ISO and COBIT, employees had difficulty assembling information on earlier projects due to a lack of documentation. Technically it would constitute another project to prepare documents for such projects.

Question 4 in the interview sheet (see Appendix B):

“What studies do you perform as quality improvement activities in your department?”

This question is parallel with the research question 2

“What is done to integrate CMMI model into the company?”

Answers given to the question 4 summarize general activities undertaken for the integration process of the new model such as:

- Definition of processes
- Production of procedures and standards according to defined processes
- Improvement of processes and procedures

Interview results support observation notes and document analysis.
A manager (M1) described the integration process:

“First of all, we reviewed all our processes. We examined the relation of our processes with other processes of the company. Then, a “to do list” was prepared to improve the processes. We determined inputs, outputs and measurement points of each process. We produced documents.”

“Öncelikle tüm süreçlerimizi gözden geçirdik. Diğer şirket süreçleriyle ilişkileri inceledik. Sonrasında bu süreçlerin etkinliğinin artırılması için yapılması gerekenleri çıkarttık. Her bir sürecin girdilerini, çıktılarını ve ölçüm noktalarını belirledik. Dokümanları hazırladık.”

An expert (E1) summarized the integration process as:

“It was a difficult process. What CMMI Level 3 is clear but how to do is determined by yourself. We searched the internet. We contacted firms that hold CMMI certification and consultants. We obtained education support from an overseas firm. A “gap analysis” was done on the processes we defined. We tried to reveal process by searching constantly.”

“Zor bir süreçti. CMMI Level 3 un ne olduğu açık fakat nasıl olacağını kendiniz belirliyorsunuz. İnternette araştırmalar yaptık. CMMI almış olan şirketlerle ve danışmanlarla görüştük. Yurtdışı firmasından eğitim desteği aldık. Oluşturduğumuz süreçlerle ilgili gap analiz yaptılar. Sürekli araştırarak süreçleri ortaya çıkarmaya çalıştık.”

If sum up, general activities performed for the integration process of the new model are definition of processes and production of procedures. Additionally, a study group was constituted to implement and evaluate produced procedures.

4.3. Workflow change

Research Question 3:

“How does the workflow of the company change during CMMI implementation?”

As it is seen from the document analysis of the human resources department, the organization of the company was reconstructed in August 2006 in order to adapt to the CMMI model. In the old organization, see Figure 16, the Application Development Department consisted of three groups comprising, System Development in which analysts work, Software Development in which programmers write codes and Test where testers work. In the new organization, Figure 17, the Application Development Department formed service units each of which consists of analysts, programmers and testers. In the old organization, groups were physically separated from each other but in the new one, every service is in a room of its own and business groups work together. Personnel were uncomfortable at the beginning due to changing from an accustomed environment, but most of them accepted the new working area easily when they saw that they became more efficient and productive. A programmer reported:

“Before the new organization, I had to go to another room to see my business analyst or had to phone him/her so that I could ask something, but now he/she is with me in the same room. The same situation is also valid for testers.”

“Yeni organizasyondan önce, iş analistime soru sormak için odasına gitmem gerekiyordu, ya da telefon ediyordum fakat artık onunla aynı odadayım. Aynı durum testçiler için de geçerli.”

A service administrator (FL2) stated that:

“Communication among the application development groups went up after the new organization and this helped our productivity.”

“Yeni organizasyondan sonra, uygulama geliştirme grupları arasındaki iletişim artmıştır ve bu üretkenliğe yardımcı olmuştur.”

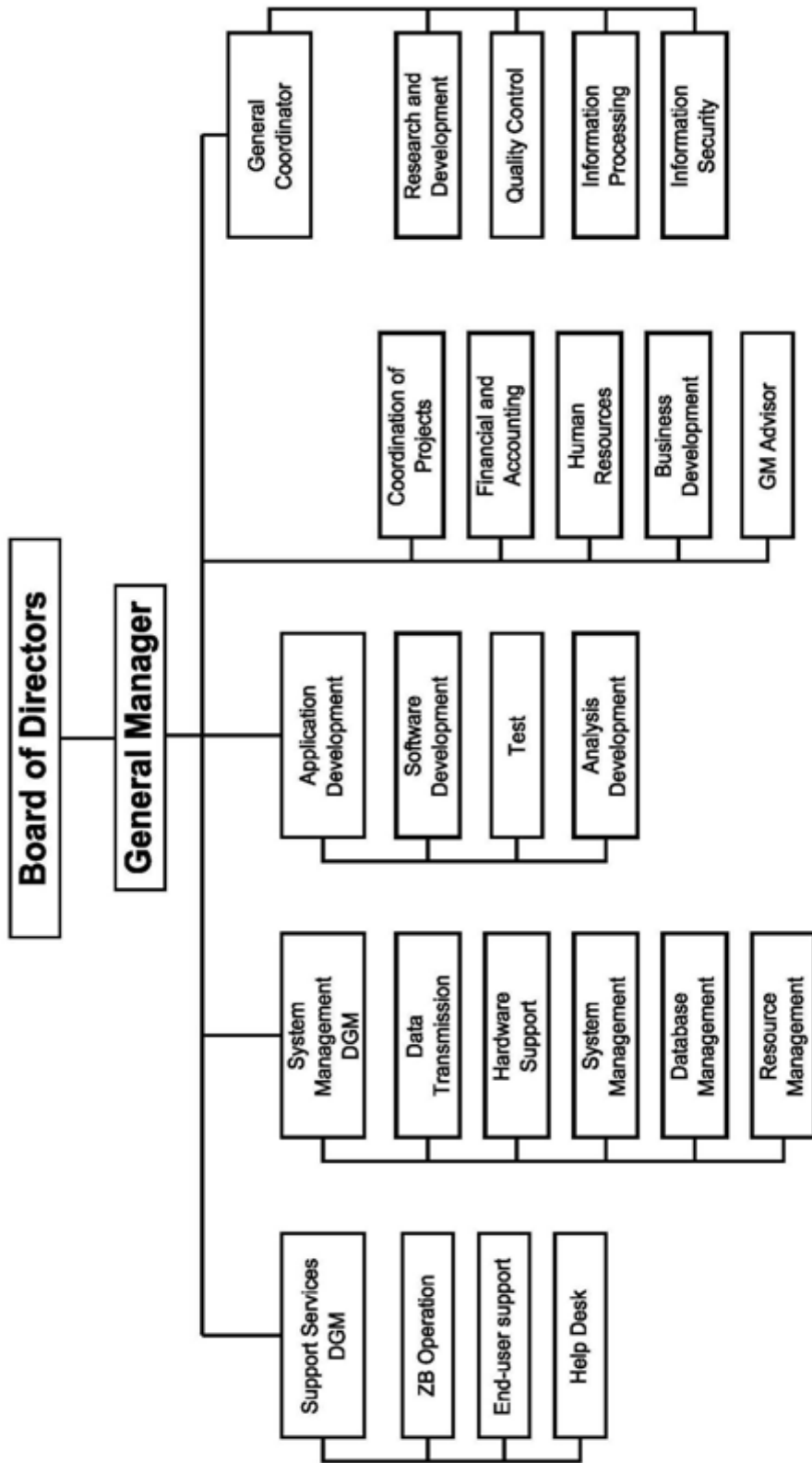


Figure 15. Old organizational chart of Company A.

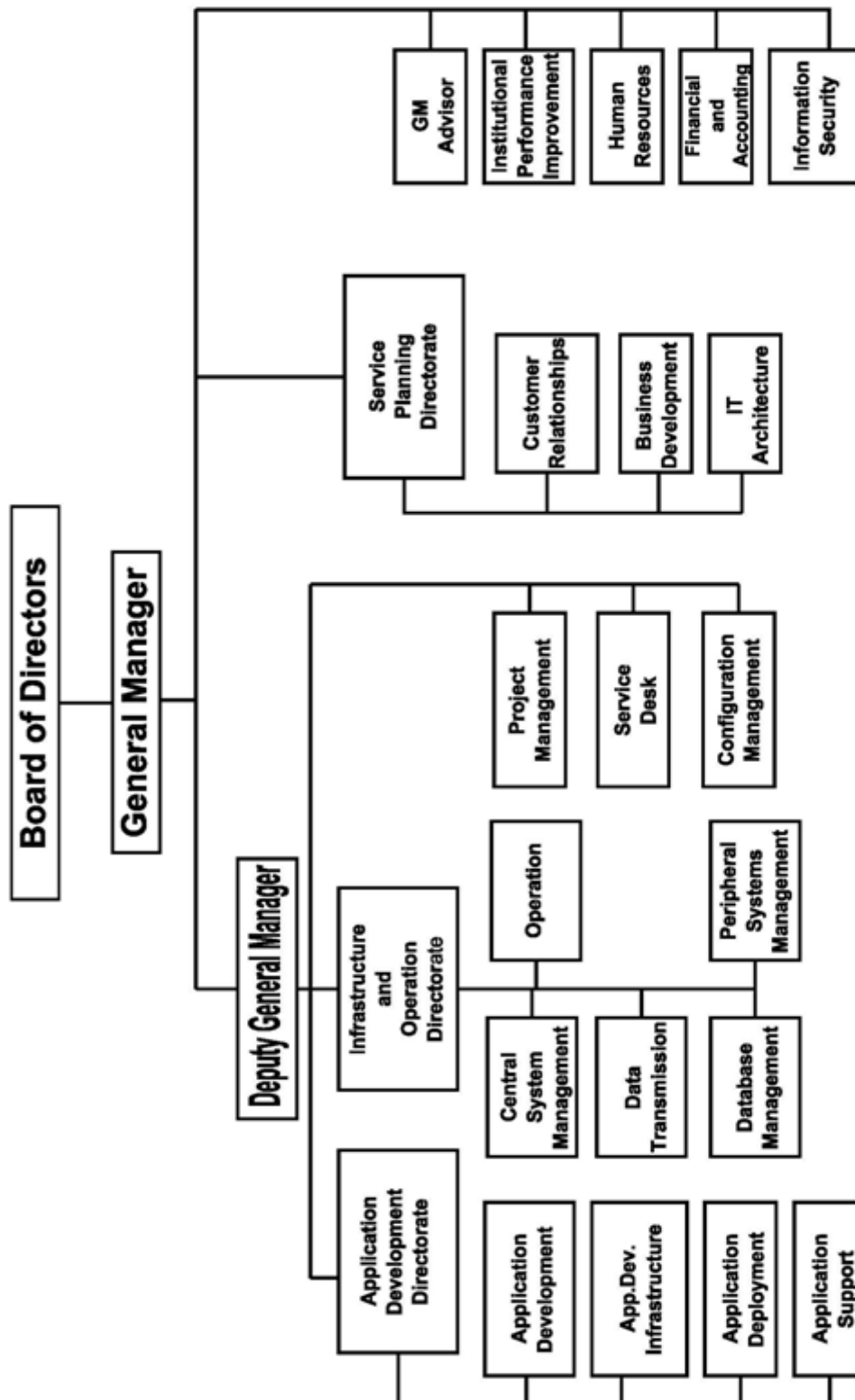


Figure 16. New organizational chart of Company A.

Before the Institutional Performance Improvement Project, Company A was running on a work-based business model that formed its old organizational structure. In this model, work units used to be assigned to an employee group and that group was responsible for the given business service. On the other hand the CMMI model proposes work as a whole and defines clearly production process areas and sees production as a service (CMU/SEI, 2006). To adopt the CMMI model, Company A needed to change its organization constitution and transformed from Figure 15 to Figure 16. As it is illustrated in Figure 17, the new general work flow of the company runs on the base of services after reconstruction.

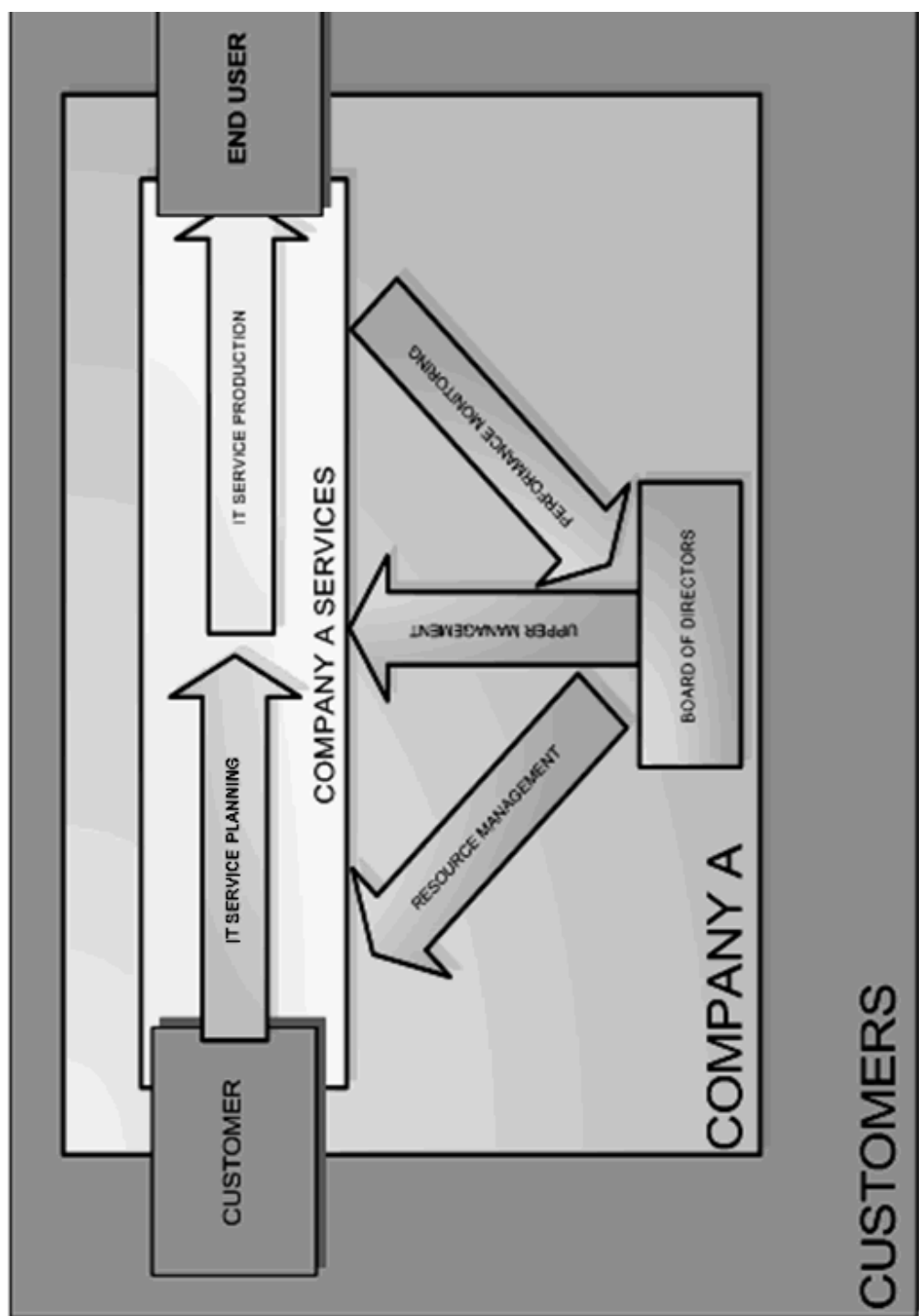


Figure 17. General work flow of Company A.

While Figure 17 depicts the work flow of Company A as a whole, Figure 18 and Figure 19 show the transformation of the Application Development Department as a specific branch of the company. Since it would be very difficult to study the whole structure of the company, the researcher focused on the Application Development Department. The department is seen as a structure made up of three sections (Figure 19) before the change.

- a. *System Development*: Analysts prepare software requirements and analysis of the system,
- b. *Software Development*: Programmers produce software according to analysis,
- c. *Test*: Testers check produced program.

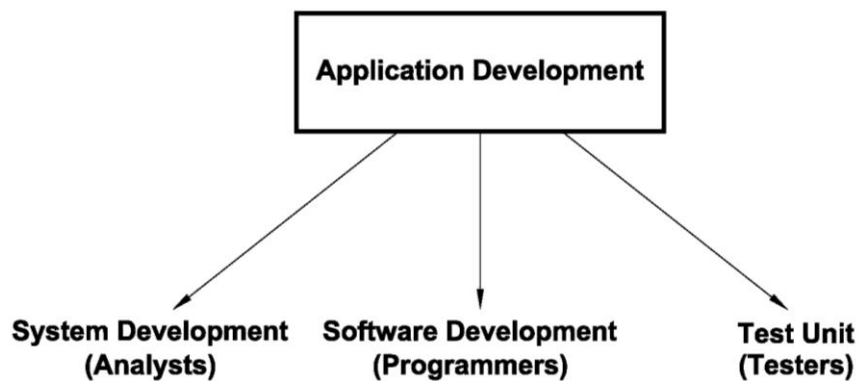


Figure 18. Old structure of the Application Development department

After the change (Figure 20), the department was divided into 16 sub-units; each of which was called a “service”. A service comprises of

analysts, programmers and testers. This structure was formed according to the business-based model stated before.

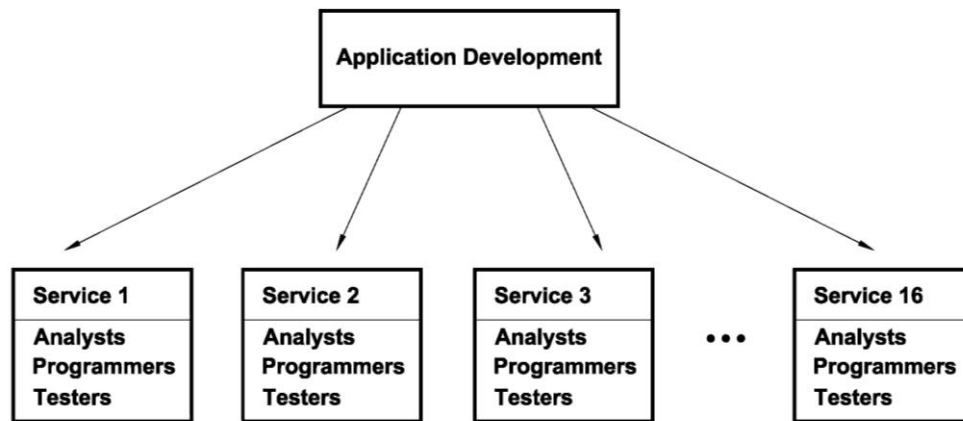


Figure 19. New structure of the Application Development department

Although observation notes and company artifacts say that radical changes occurred throughout the company, interview results exposed two different situations.

- a. Some of the work, especially that performed consistently was more or less defined. So there was not much difference in their workflows.
- b. Departments that had no defined processes created a procedures and documentation repository. They began to work more effectively in accordance with defined work processes. A service administrator (FL3) stated that:

“The old work flow was running on “persons” and those persons were heroes of the company. After the quality management system was brought into use, everything was documented and started to be taken under register. Documentation enables all personnel access and shares knowledge.”

“Eskiden işler kişiler üzerinden yürüyordu ve bu kişiler şirketin kahramanlarıydı. Kalite yönetim sisteminin devreye alınmasından sonra, herşey dokümante edildi ve kayıt altına alınmaya başlandı. Dokümantasyon tüm personelin bilgiye ulaşmasına ve bilgiyi paylaşmasına imkan sağlıyor.”

Figure 20 illustrates the change from the CMMI perspective. The figure shows three states of change process, initial, current and expected. The initial state is equal to CMMI Level 2. At the beginning, most of the processes were not defined, there was little documentation and therefore a lack of measurement. As described in section 4.3, Company A established an organizational policy, planned and documented processes, assigned responsibility and trained people accordingly.

After three years the company was about to achieve CMMI Level 3, it has project management methodology, good documentation, product integration, defined processes and reasonable risk management. What remained was for the company to introduce a project estimation methodology, certain measurements and innovation.

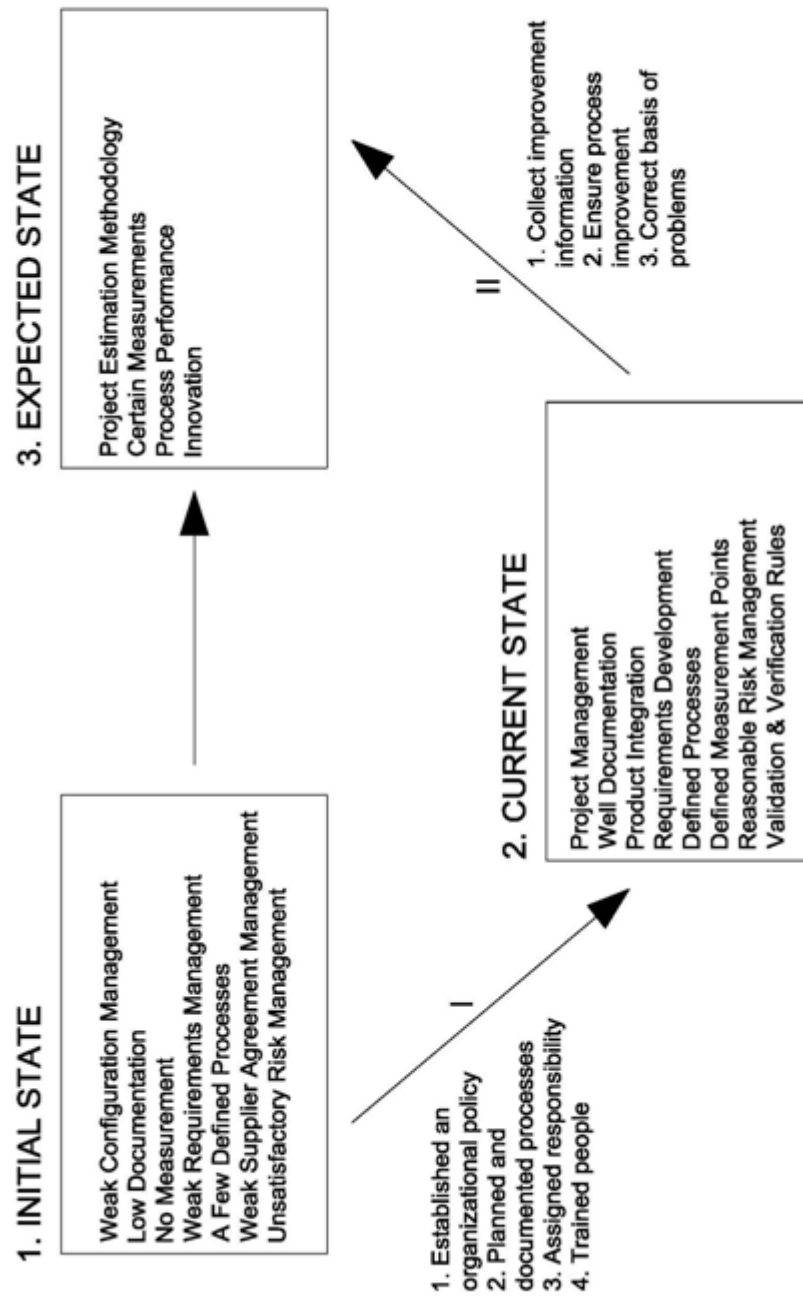


Figure 20. States of change

At the expected state, the company will be close to attaining the CMMI Level 5. To fulfill gaps such as project estimation, certain measurements, process performance and innovation, it should collect improvement information, ensure process improvement and correct basis of problems.

The difficulties in progressing from CMMI Level 3 to Level 5 were also observed during the interviews, an expert (E3) said:

“Since we had already definite standards, we were not forced to achieve CMMI Level 3. Support of top management was positive. Personnel were curious about quality studies and highly motivated hence we were not forced. However, some workers who joined us when the company was growing have resisted the processes.

Speaking with numbers and thinking at the level of digits has been forced on staff when passing to CMMI Level 5. Formerly, progress toward completion of a project was expressed approximately, now it is expressed with exact numbers and personnel are required to quote numbers.”

“CMMI Level 3 için pek zorlanmadık, zaten belli standartlarda çalışıyorduk. Üst yönetimin desteği çok olumluydu. Personel kalite çalışmalarını merak ediyordu ve motivasyonları fazla idi bu yüzden zorlanma olmadı. Fakat şirket büyüdükçe yeni gelen bazı personel süreçlere direndi.

CMMI Level 5’e geçişte ise sayısal düzeyde, rakamlarla düşünmek ve konuşmak insanları biraz zorladı. Eskiden bir isin ne kadarının bittiği yuvarlak laflarla ifade edilirken şimdi sayısal ifade edilmeye başlandığından, personel rakamlarla konuşmakta zorlandı.”

Figure 21 depicts states of change and methods to create change.

4.4. Stages of Change

Research Question 4:

“What are the stages of change?”

Observations showed that the transformation process occurred in four stages: Motivation and Adoption, Adaptation, Acceptance and Implementation, Use and Improvement. Descriptions of each of the phases are set out below, and provide an answer to the research question 4.

4.4.1. Motivation and Adoption

As it was uttered before, the major purpose of a private enterprise is to make profit and increase its profit. Companies are always in a rush to keep or increase market share. In the software development industry, customers know that IT companies are challenged to stay within project limits such as time, budget and specifications (Frederick, 1987). To ensure delivery of software products, customers ask for quality assurance certifications such as CMMI and to hold such a certification enhances companies' opportunity to secure future projects. An expert (E2) mentioned this as:

“It was a critical factor that Turkish Armed Forces and governmental institutions began to ask for CMMI certification when buying software applications.”

“Türkiye’de 2000 li yılların başında Türk Silahlı Kuvvetlerinin ve devlet kuruluşlarının yazılım satın almalarında CMMI belgesi istemeye başlaması önemli bir etken oldu.”

This was the basic motivator factor for Company A. Observation notes (monthly diary sheets) indicated that senior management decided to initiate the Institutional Performance Improvement Project (IPIP) and it was launched in March 2006 at the company. This was announced to the

personnel and necessary briefings were arranged. A quality representative was assigned for each department and the researcher was the quality representative of the Application Development Management department that is one of the production departments. Interviews and observations, which were carried out at the onset of the project, indicated that first line personnel did not perceive the benefits of quality studies to their job while senior management was aware of the value of quality improvement studies. In an interview, a manager (M8) said that:

“It is an essential to have CMMI certification if we want to get new jobs.”

“Şirket olarak yeni işler almak istiyorsak, CMMI sertifikasyonu gerekliliktir.”

On the other hand, a software developer uttered the sentence below, which displays his worries:

“I hope that quality studies do not prevent me from developing software.”

“Bu kalite işleriyle uğraşmaktan, kod yazamaz hele gelmeyiz umarım.”

The section 4.1 tells details of motivator factors.

4.4.2. Adaptation

When a new model of work flow is adopted, organizational structure revision suitable for this model is inevitable. The physical location of personnel changed as a result of the new organization structure; former working groups were modified and new groups were arranged. Details of work flow change are explained in section 4.3. During the period of rearrangement it was observed that managers and administrators needed to be prepared to handle complaints and objections from personnel

because major people feel secure to have stability in their work (Kotter & Schlesinger, 1979). A line level personnel was seen saying that:

“I am pleased to be here, I do not want to go anywhere.”

“Ben yerimden memnumum, başka bir yere gitmek istemiyorum.”

Meanwhile, senior managers continued to advocate the benefits of the new formation. Each service had a separate room and personnel became closer to each other physically. It was noted in observation forms and interview documents that the new workflow model was positively received, particularly the innovation to co-locate project analysts, programmers and testers.

4.4.3. Acceptance and Implementation

Processes had not been defined in the old structure (see Figure 16) and little had been recorded. Work procedures appropriate for the new structure (see Figure 17) were defined during meetings held in the company of the quality team. Meeting reports and observation forms showed that heated discussions took place in these meetings. Each unit attempted to ensure that any work they do was written into the procedures in every detail, however this tendency risked a deviation of procedures, which are a written form of the processes, from their goal. In a meeting report, it was written that:

“Business definitions to be written into the procedures will be arranged such that they reflect main functions of the units.”

“Prosedurlere yazılacak iş tanımları birimlerin ana işlevlerini yansıtabilecek şekilde düzenlenecektir.”

During reviews of procedures, items were carefully selected for definition, paying particular attention to their applicability, and effort was applied to correctly define the workflow for each procedure. Document files

were compiled for the procedures, standards and forms, which show the work processes, input and output of each process. As long as these procedures were used, work flowed regularly. Using of new procedures means that the company was in acceptance period of the change process.

4.4.4. Use and Improvement

It has been observed that the new working system was challenging for personnel in many ways. Interviews have shown that programmers working in the Application Development Management department had the most problems, when compared with other groups. As they had not been required to generate comprehensive documentation under the old version of their work process, they were now faced with the assignment of producing documentation appropriate to the new standards. This took up a lot of their time. A service administrator (FL3) stated that:

“Analysts and testers are more eager to create documentation than programmers.”

“Analistler ve testciler dokumantasyon olustururken, yazilimcilardan daha istekliler.”

It was frequently noted on the observation forms that aside from programmers, other company employees required automation tools for facilitating documentation and to align it with process. To simplify this phase, the company introduced the necessary tools to facilitate this with the help of Application Development Infrastructure Management department. Since the tools were applied, the new system has matured to attain the usage phase of the change process and this remains the current situation in the company at this stage.

In 2008 and 2009 procedures in use were repetitively reviewed with a view to enabling the company to improve its processes. At the beginning of 2009, the company was ready for CMMI certification Level 3. Due to the

increased requests of customers, the application for CMMI certification Level 3 was postponed for some time although the company was almost ready for audit.

4.5. Influences on Change

Research Question 5:

“What are the factors that influence change positively and negatively?”

Analysis of the interviews, observation notes and document artifacts marked influences on the change as *positive* or *negative*.

During the interviews, while half of the respondents complained about “resistance to change” and expressed a low motivation towards the quality project, the remainder claimed that they did not face major difficulties, particularly due to the help and support they had received from senior managers. A manager (M8) said that:

“The change on the organizational chart caused huge argues. Resistance to innovation came out and personnel were reluctant to participate in quality improvement studies.”

“Organizasyon şemasındaki değişiklik, büyük tartışmalara sebep oldu. Yeniye karşı direnç oluştu, personel kalite çalışmalarında yer almada gönülsüz davrandı.”

Some negative aspects were mentioned by another manager (M2):

“Personnel come from different fields of information technology and we have difficulties because we are a very young company with little or no institutional culture.”

“Bilişim teknolojilerinin farklı alanlarından gelen bir personel grubu ve şirketin yeni kurulmuş olmasından kaynaklanan kurum kültürünün olmayışı zorluklar olarak kabul edilebilir.”

This statement has two negative factors such as diversity of personnel expertise and not having an institutional culture because of being a young company. The same manager (M2) also stated:

“Another difficulty is caused by conflicts of defining and changing a running system.”

“Bir diğer zorluk da yürüyen bir sistemin tanımlanarak değiştirilmesinin çakışmasından kaynaklandı.”

He pointed out the difficulty of constructing a new system on a running organization. Negative factors inferred from the data can be summarized as:

- Resistance to change
- Low motivation of personnel to the quality improvement project
- Diversity of personnel expertise
- Not having an institutional culture because of being a young company
- Constructing a new system on a running organization

On the other hand, an expert (E3) talked about positive factors as:

“Major factors are leadership and support of senior management to the quality project.”

“En önemli faktörler, liderlik ve üst yönetimin kalite projesinin arkasında durmasıdır.”

Another expert (E1) from the sector said that:

“First of all, we talk about senior management. If the senior management has not a positive attitude to quality studies, there is no chance to succeed in quality studies.”

“Öncelikle üst yönetimden bahsetmek lazım. Eğer bir şirkette üst yönetim kalite çalışmalarına olumlu bakmıyorsa, çalışmaların başarıya ulaşma şansı yoktur.”

Some other positive factors were explained by a manager (M8) as:

“Well educated characteristics of the personnel increased the knowledge share, which goes up communication.”

“Personel karakteristiğinin teknik ve eğitilmiş olması, bilgi paylaşımını arttırdığı için, iletişim arttı.”

Positive factors can be listed as below:

- Leadership
- Support of senior management to the project
- High level communication
- High education level of the personnel
- Tools

According to the interviews undertaken with managers, general views were positive about the tools since tools enable standardized usage of procedures. A manager (M2) said that:

“The more tools you use, the better application is guaranteed. Using tools, increasing area of tools and automation are our basic aim. Every day, we increase the area. One day, all activities in the company will run over tools.”

“Tabi ne kadar tool kullanırsak o kadar uygulamayı garanti ediyoruz. Tool kullanmak ve tool alanını, otomasyon gereci alanını genişletmek bizim temel hedeflerimizden bir tanesi. Her geçen gün de genişletiyoruz bunu. Bir gün gelecek ki aslında şirketteki tüm faaliyetler çeşitli otomasyon kullanımı üzerine yapılıyor olacak.”

Almost everyone interviewed has a consensus about boosting productivity by tools. However we cannot say that tools are essential, just like an expert (E3) from outside Company A said:

“No tools are required to implement quality processes. It is wrong to say that quality studies cannot be executed without tools.”

“Kalite süreçlerini oturtmak için hiç bir tool olması gerekmiyor. Tool olmadan kalite çalışması yapılamaz demek yanlıştır.”

In this section, it is appropriate to talk about the actions taken by the company to overcome negativity and difficulties during the implementation process. With regard to the answers given to question 8 in the interview sheet (see Appendix B), the improvement of communication is a prominent intervention for overcoming difficulties. Participation of personnel in the quality improvement project provided important contributions to the project and helped solve problems. Employees were persuaded of the benefits and necessity of the quality studies by talking face to face.

A manager (M2) reported:

“Firstly, we wrote a procedure. We said, ‘This will be used’, We saw that it was not used, and then we revised backward the procedure so that it reflects the process. In other words, we have written what is done.”

“Önce prosedürü yazdık. ‘Bunu uygulayacaksınız’, dedik. Baktık uygulanamıyor, prosedürün uygulamayı yansıtmaması için bu sefer prosedürü geriye revize ettik. Tabiri caizse uygulamayı yazılı hale getirdik.”

As it is seen from the quotation, changing the procedure according to the process was sometimes used as a way to solve the difficulty.

So far, resistance from line level personnel has been described. However, resistance to change also originates from middle or upper tiers of management. Egan and Fjermestad (2005) see the root of this problem as new technologies and their translation into new business models, which redefine organizational structure and the distribution of power. Kotter and Schlesinger (1979) named this as “parochial self-interest”. An expert (E2) who gives consultancy service to organizations referred to their attempt to address this problem:

“I told managers that CMMI projects are important for themselves, not for technical staff. I made presentations about this subject and emphasized this during training sessions. Processes are produced for managing companies better. Managers have to delegate to the processes. Many managers object to delegate consciously or unconsciously and want to block sneakingly CMMI studies; because they want themselves to be indispensable for their team naturally unless having guarantee of job.”

“Yöneticilere CMMI projelerinin teknik insanlar için değil kendileri için önemli olduğunu anlattım. Bu konuda sunular yaptım, eğitimlerimde hep bunun üzerinde durdum. Süreçler şirketleri daha iyi yönetmek için üretilir. Yöneticiler birçok yetkilerini süreçlere devir etmek zorundadır. Birçok yönetici bilinçli ya da bilinçsiz olarak bu yetki devrine karşı çıkar ve içten içe CMMI çalışmalarını baltalamak ister, çünkü o ekibini sistematik bir şekilde yönetmeyerek kendini vazgeçilmez kılmak ister doğal olarak, eğer şirket ona bir işten çıkarılmama garantisi vermemiş ise.”

4.6. Impact on Performance

Research Question 6:

“How do the quality improvement studies affect the performance of the company?”

Before looking at performance, the software development life cycle of Company A will be explained briefly. According to the “Life Cycle Standard” document, the company produces software in a process of six steps as seen in Figure 21:

1. *Request Management:* Requests of customers are gathered and organized by the Department of Customer Relations Management (see the section 4.1.3.a)
2. *Requirement Specifications and Development:* The software to be written is defined in detail by the Department of Application Development (see the section 4.1.1.a). Analysts define a system and develop a written document for it.

3. *Analysis and Design Development:* Analysts consider the system defined in the previous step and the functional parts of the system and software architecture are designed.
4. *Physical Design and Coding:* Programmers design an abstract representation of the system and program code for the project.
5. *Functional Testing:* Testers check the written code to remove errors (bugs) from the project.
6. *Deployment and Maintenance:* The software is then applied to the customer's environment by the Department of Application Deployment (see section 4.1.1.c). After deployment, maintenance starts so that the application is kept up to date with environment changes and changing user requirements.

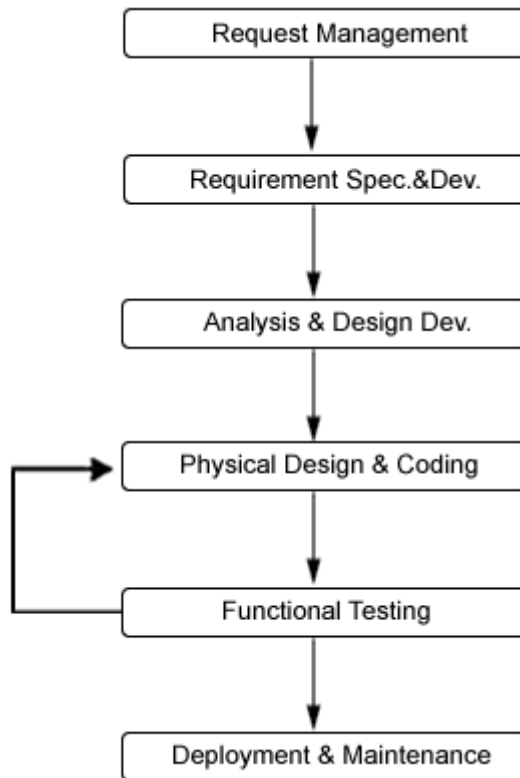


Figure 21. Software life cycle of Company A

The ultimate goal of software production is to yield applications with minimum errors (bugs), ideally with a zero error. Zero error is an ideal case and it is very difficult to achieve. We can therefore use it as a reference point for our measurements. Performance of the company is evaluated by the number of bugs reported from the production environment after deployment, less bugs means better performance. Bug reports created by the Department of Application Deployment are therefore objective evidence for evaluation of performance of Company A.

The Service Desk (see the section 4.1.5.b) handles problems reported by customers and each problem is referred to as a “*Call*”. These calls involve a variety of problems related to software application, data, hardware, networks and communication. The number of total calls in the

first four months of years 2006, 2007, 2008 and 2009 are depicted in Figure 22.

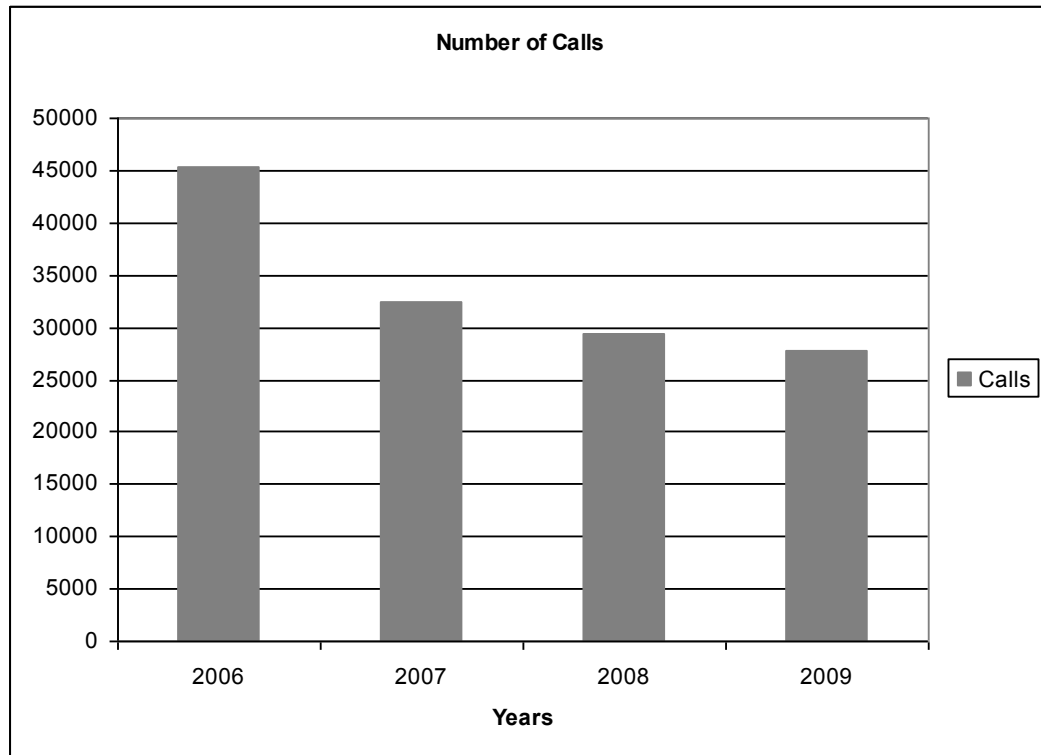


Figure 22. Number of total calls (problems) reported

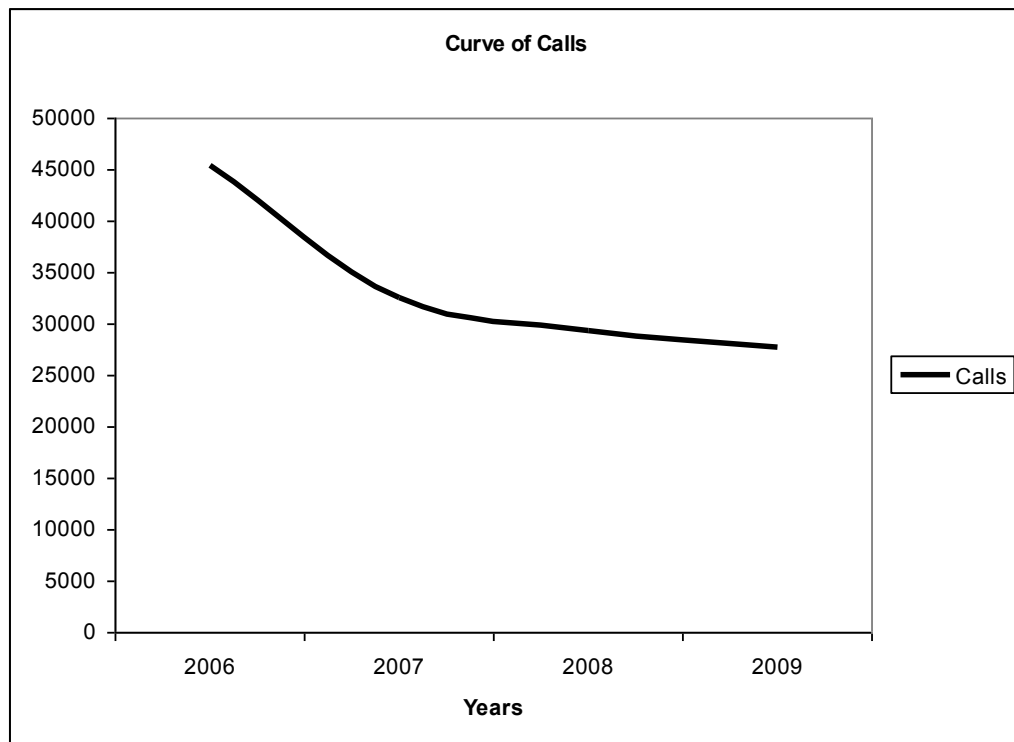


Figure 23. Curve of total calls

Figure 23 shows that there was a sharp decrease in year 2007, thereafter the curve is nearly stable. As these calls involve a variety of problems, it cannot be assumed that the improvement in performance derives from the quality improvement effort as a whole. Figure 24 and Figure 25 show the number of calls concerning the specific area of software application defects.

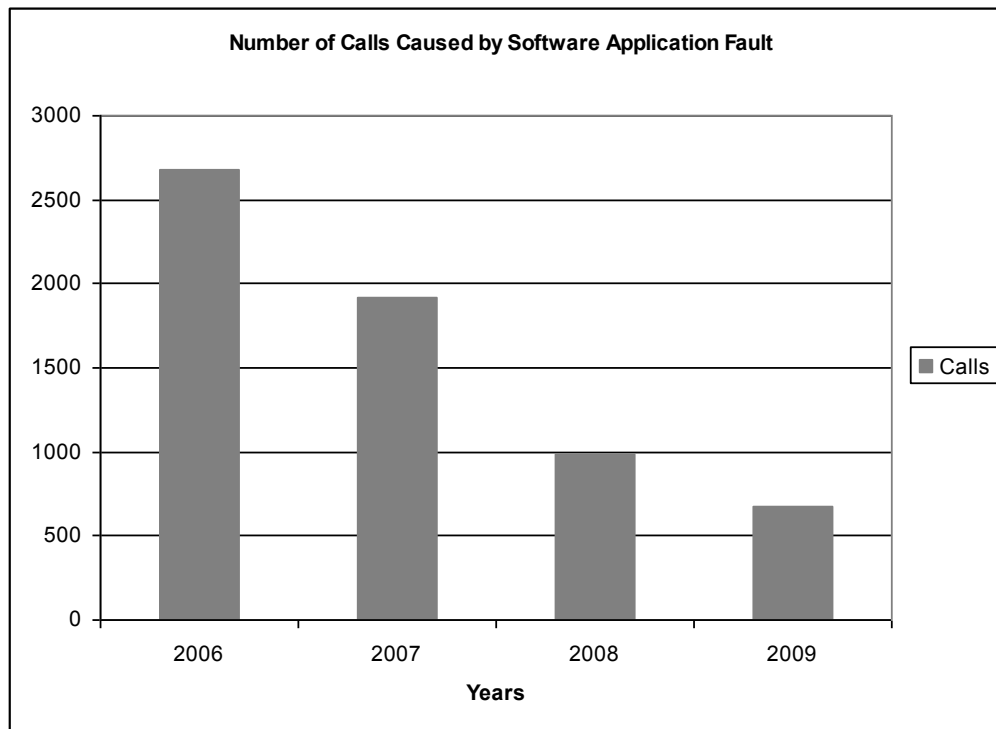


Figure 24. Number of calls caused by Software defects

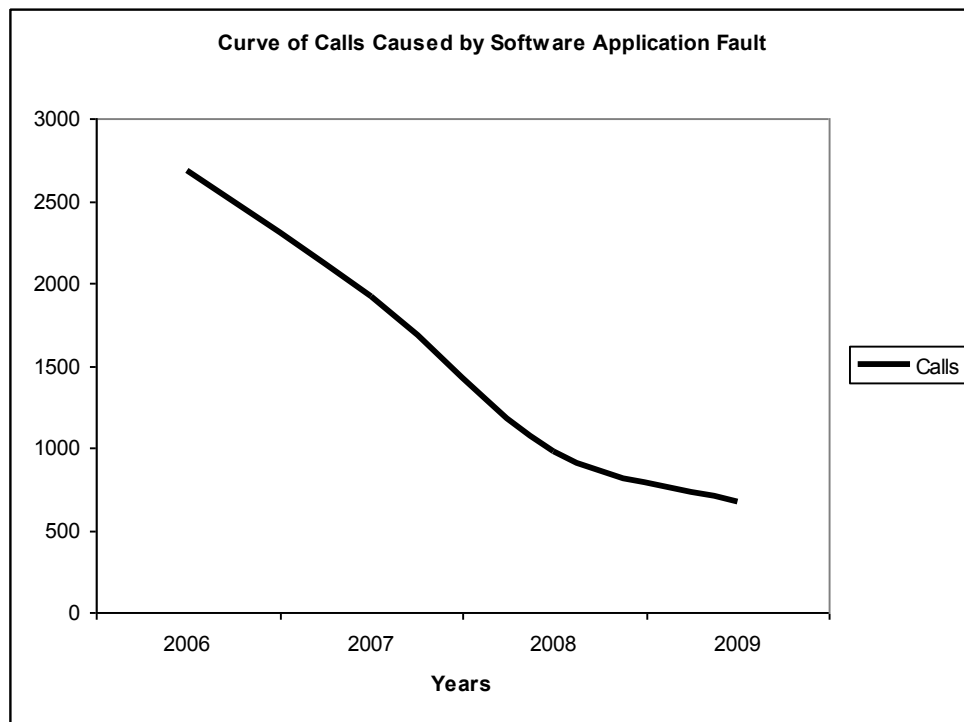


Figure 25. Curve of calls caused by Software Application defects

Software application is the responsibility of the Application Development Directorate (see the section 3.9.1) where quality improvement studies were executed intensively. The curve in Figure 25 decreases sharply in 2007 when the quality improvement project was taken into use. This curve shows that there is a reverse proportion between software application faults and usage of the quality management system.

On the other hand, number of the requests from the customers and software produced by the company present valuable data for the performance of the company. From Table 23, it is seen that there is a steady increase in the number of requests but ratio of faults decreases in the same period.

Table 23*Faults vs requests in 2007, 2008 and 2009*

Year	Number of requests	Number of faults	Percentage
2007	1110	97	8,74%
2008	1158	79	6,82%
2009	1472	99	6,73%

Similar statistics can be seen in Table 24. From 2007 to 2009, increase in deployed software is calculated from the formula:

$$id = \frac{n-m}{m} * 100$$

id: increase in deployed software products

n: number of deployed software products in 2009

m: number of deployed software products in 2007

Putting values:

$$\frac{14518-8148}{8148} * 100 \approx 78,18$$

While number of deployed software increased more than 78%, ratio of faults decreased from 1,19% to 0,68%.

Table 24*Faults vs deployed software products in 2007, 2008 and 2009*

Year	Number of Deployed Software	Number of faults	Percentage
2007	8148	97	1,19%
2008	10543	79	0,75%
2009	14518	99	0,68%

Data obtained from the activity report of the Department of Application Deployment indicate that the quality improvement project has a positive affect on the performance of Company A. At the meeting for the presentation of the report, a manager (M3) was observed saying that:

“The quality improvement system is the major stakeholder of the success in deployment.”

“Yaygınlaştırmada yakaladığımız bu başarı da en büyük pay Kalite Yönetim Sistemine aittir.”

While number of calls, number of requests and number of deployed software were data from the interior of the company, COBIT grades were data from outside of the company. COBIT grade shows that the company uses quality improvement methodologies effectively. COBIT appraises management processes according to internal controls and does not issue certification to individual institutions as do the ISO. The COBIT model permits an organization to evaluate itself from nonexistent (0) to optimized (5). Such potential can be suppressed by auditors to help management complete its IT governance responsibilities (Hardy, 2002). COBIT audits have to be repeated every two-year in Company A who was graded with

average point 2.3 in 2005, 3.24 in 2007 and 3.9 in 2009 auditing as seen in Figure 27.

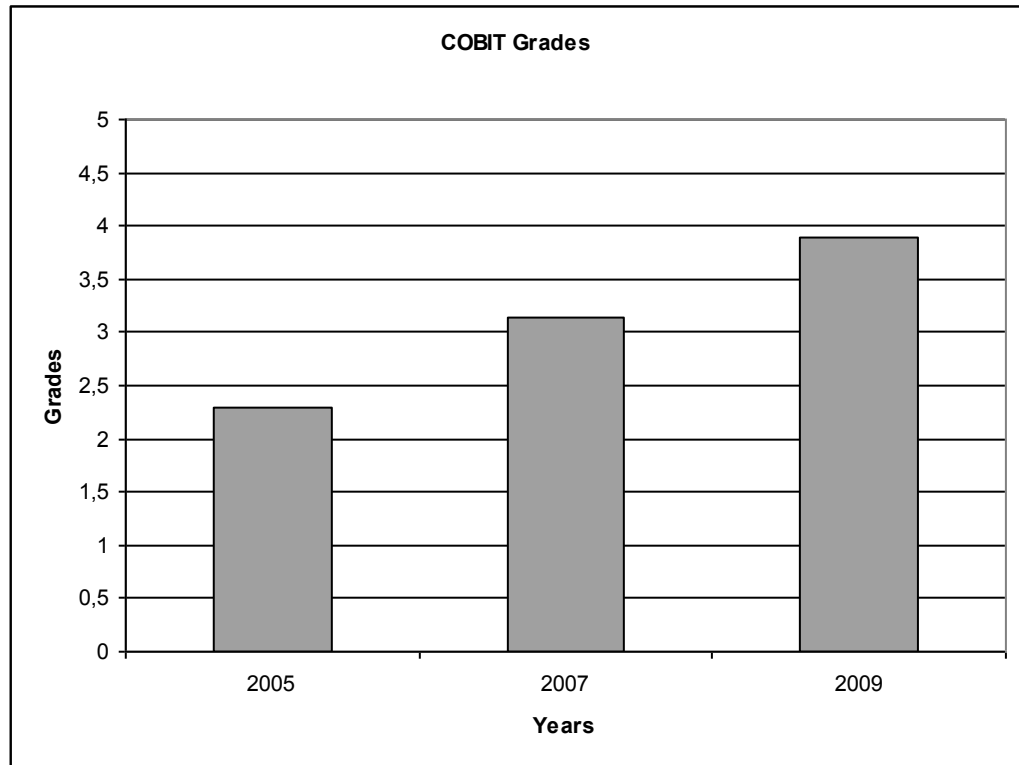


Figure 26. Results of COBIT evaluations

From the findings it was seen that faults in service were going down, while the COBIT grade was rising, which is an indicator of better process management.

4.7. Summary of the Chapter

This chapter presents the findings of the research and a table gives a summary of the findings considering research questions. As it was stated at the previous chapter, the company is mainly composed of three directorates: Application Development, Infrastructure and Operation and

Service Planning. As it is very difficult to elaborate on every part of the company, the research focuses on the Application Development Directorate. This directorate has four sections: Application Development, Application Development Infrastructure, Application Deployment and Application Support.

At the beginning of the Institutional Performance Improvement Project (former quality development project), senior management was aware of the benefits of the project; while in contrast, line level personnel did not believe in the usefulness of the project and there was low enthusiasm for the project. The project was launched in March 2006 and the organization of the company changed from a work-based model to a service-based model as proposed by CMMI. ISO audits and COBIT audits were successfully undertaken in 2007. These two models were milestones for the company's attainment of CMMI Level 3.

The change within the organization was observed in the following steps:

- a. Motivation and Adoption
- b. Adaptation
- c. Acceptance and Implementation
- d. Use and improvement

In 2009 revised procedures and standards were in use and the company was ready for applying CMMI Level 3 certification; however an increased number of requests from customers forced the senior management to prioritize effort on meeting these needs in preference to work on quality studies. For is the reason why they postponed the application.

In the last section of the chapter, performance issues are considered. The number of problems reported by customers was a reference for evaluation of performance. Statistics showed that the quality improvement project had a positive effect on the performance of Company A.

CHAPTER 5

DISCUSSIONS, CONCLUSIONS AND IMPLICATIONS

As the world population grows quickly, as the amount of information expands exponentially and the technology becomes ever more sophisticated, the rate of changes accelerates to an unpredictable level. This enormous change forces organizations to control and improve their processes. Ideally, a good process produces predictable and repeatable results and does not depend on human behavioral factors. Quality management consists of employee empowerment, product and process measurements, and constant process improvements. Formerly, the various elements of quality management had been handled separately, then it was realized that it would be better to integrate elements. Therefore, integration is crucial for ultimate success.

Integration serves like a glue to connect and align all elements of a complex project. Capability Maturity Model *Integration* (CMMI) provides an integrated framework that would enable organizations to more consistently create quality products or services and this pushes CMMI one step forward among other quality improvement approaches. For example, COBIT is an IT governance tool used to appraise the management processes according to internal controls, Total Quality Management (TQM) tries to improve quality by ensuring conformance to internal requirements and Six Sigma focuses on improving quality by reducing the number of defects. However, to use those models as an effective quality tool, organizations should develop an efficient methodology to measure the maturity level of their

processes. On the other hand, CMMI presents a complete framework that would permit organizations always create quality results. CMMI is similar to ISO 9001, an international standard that specifies an effective quality system for software development and maintenance. The main difference between them is that ISO 9001 specifies a minimal acceptable quality level for software processes, while CMMI establishes a framework for measuring continuous process improvement and it is clearer in defining the means to that end. This guarantees quality and many customers requests CMMI certification from their suppliers.

This study explored integration process of CMMI in business environment. Participants of the study were adults and during the study, adult learning attributes were observed but findings were not mentioned in the dissertation since this topic is not in the scope of research questions. However the principles of adult learning have impact on the research because most learning takes place on the job (Rosenberg, 2006). Moreover, Knowles et al. (1998) implied that:

“Andragogy works best in practice when it was adapted to fit the uniqueness of the learners and the learning situation. We see this not as a weakness of the principles, but as a strength. That is, their strength was that these core principles apply to all adult learning situations, provided they were considered in concert with other factors that were present in that situation.” (p. 3)

Personnel generally learn from their peers and work environment. Such behaviors and other adult learning attributes were observed during the study. Knowles et al. (1998) identified those attributes as:

1. The learners' self-concept reflects maturity in adults who are conscious of being responsible for their own lives and decisions.
2. The role of the learners' experience reflects that adults enter an educational activity with wider experience than youths.
3. Readiness to learn reflects that adults readily focus on learning things that enable them to cope effectively with the real situations they face.
4. Adults are life-centered (or task-centered or problem-centered).
5. Motivation reflects that adults respond variously to external motivators such as better jobs, promotions, higher salaries, etc. However, most tend to internal motivators and desires such as job satisfaction and career progression.

In this case study a qualitative research design was used to investigate the change process of integrating CMMI into a technology company. The main purposes of the case study were:

- a. to define the stages of a change process caused by CMMI implementation
- b. to find out the factors that affect change process
- c. to investigate how performance of the company differs

Observations, interviews and documents were used as data sources and *descriptive analysis* was used to define and interpret them. This chapter evaluates the findings that were reported in the previous chapter and discussions are based on the research purposes. This part begins with a discussion about the change process and the key findings obtained in relation to the research questions. It continues with the suggestions for CMMI implementation for a similar company and gives a conclusion. Recommendations for further research and implication of the study for practice are given at the end of the dissertation.

5.1. Discussion about Change Issues

Research Question 1 *What factors are responsible for initiating the change?*

Research Question 2 *What is performed to integrate CMMI model into the company?*

Since the main purpose of a private enterprise is to make profit and maximize its profit, there is always an effort to keep or increase market share and companies are very aggressive in this competition to enlarge their market share. Productivity is one of the top concerns for a company. Many companies seek ways of improving their productivity and in these ways pass through continuously improved processes. Particularly, in the software development industry, it is known that IT companies are challenged to stay within project limits such as time, budget and specifications (Frederick, 1987). To ensure delivery of software products, customers ask for quality assurance certifications such as CMMI and to hold such a certification enhances their opportunity to secure future projects. Efforts to get process improvement certifications force to change, which initializes change throughout the organization.

We cannot say that only a single change approach can fit all organizations. Instead, every organization requires its own model of change corresponding to its needs and issues. When change efforts fail, it is easy to blame organizational resistance but this is an inadequate explanation. Efforts at change can fail for systemic reasons such as poor vision, inadequate communication, insufficient planning and resources, failure to make a compelling case, and inconsistent messages with leaders not following through. Change models can be divided into three categories: top-down; transformational leadership; and strategic approaches (Treasury Board of Canada Secretariat, 2003).

In our case, the top-down model (see section 2.1.1.1) is observed. This model highlights leadership. The senior management can organize relatively rapid change by developing a vision, communicating it and involving employees. The leaders locate goals, explain the desired outcomes, give feedback, present rewards for desired performance and take action when goals are not met. As the momentum for change is driven from the top-down, the role of senior management is crucial for overcoming the potential weaknesses of this approach. In this case study, most of the employees that were interviewed mentioned that senior management provided a high level of support to the quality improvement project. The hierarchical structure of the company is as follows:

- a. Top management (Board of directors and the CEO)
- b. Senior management (Directors and managers)
- c. Second line personnel (Service administrators, project leaders)
- d. First line personnel

The official meeting reports and the observations denote that during the construction of the quality system in the company, upper management and second line personnel were key change agents.

When Company A initiated the quality improvement project in 2006, its processes were almost undefined. After three years of implementation studies, processes reached a manageable level but the goal of the company has not yet been realized or reached the desired state. The snapshot of timeline showing the change states of the company can be seen in Figure 27.

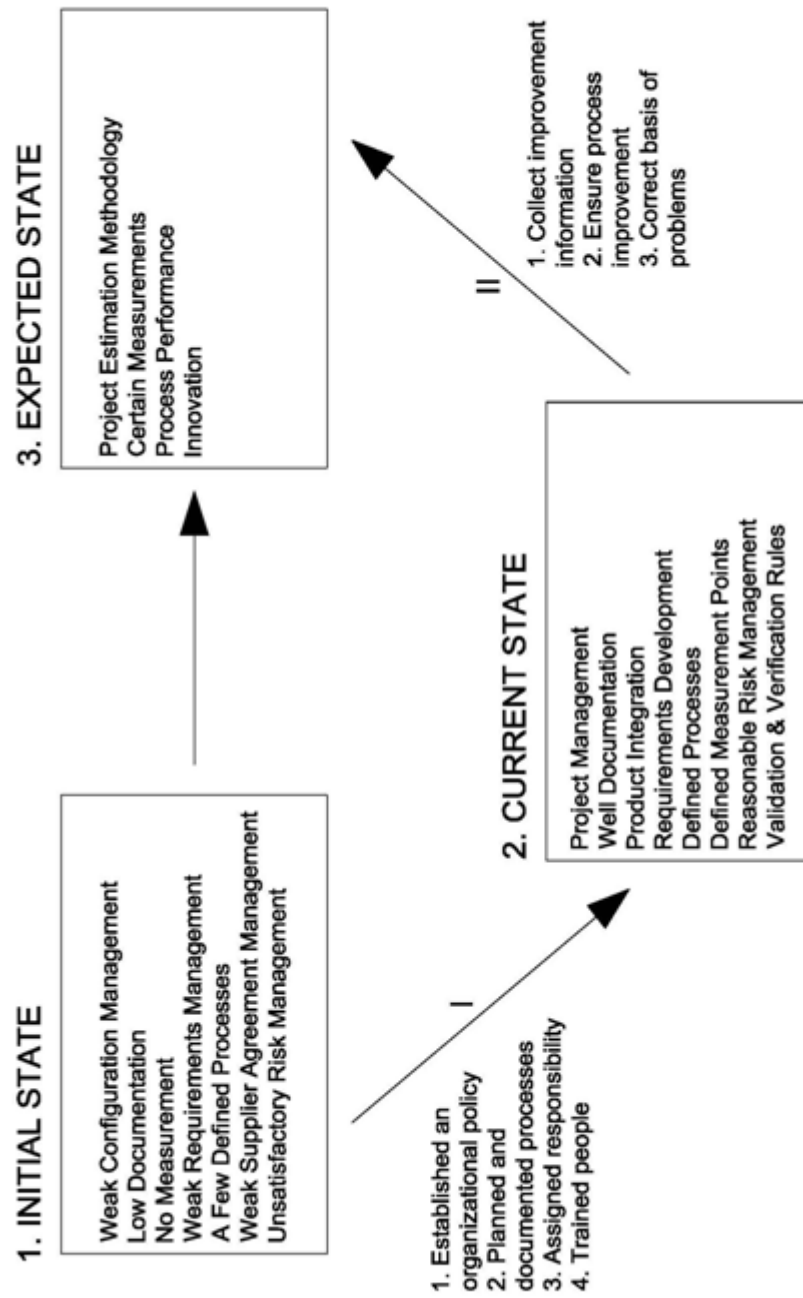


Figure 27. States of change

Figure 27 shows three states of Company A as initial, current and expected. The initial state accords with CMMI Level 2. Initially, most of the processes were not defined, documentation was limited and therefore there was no measurement. As described in section 4.3, Company A established an organizational policy, planned and documented processes, assigned responsibility and trained people (*arrow 1 in Figure 27*).

Three years on the company is close to attaining CMMI Level 3. It has project management methodology, good documentation, product integration, defined processes and reasonable risk management. However, it still lacks a project estimation methodology, certain measurements and innovation in processes.

Table 25
States of the company vs. CMMI Levels

State	Process	CMMI Level
Initial	Weak Configuration Management	2
Initial	Low Documentation	2
Initial	No Measurement	2
Initial	Weak Requirements Management	2
Initial	A few Defined Processes	2
Initial	Weak Supplier Agreement Management	2
Initial	Unsatisfactory Risk Management	2
Current	Project Management	3
Current	Well Documentation	3
Current	Product Integration	3
Current	Requirements Development	3
Current	Defined Processes	3

Table 25 continued,

Current	Defined Measurement Points	3
Current	Reasonable Risk Management	3
Current	Validation and Verification Rules	3
Expected	Project Estimation Methodology	4
Expected	Certain Measurements	4
Expected	Process Performance	4
Expected	Innovation	5

As it is seen in the Table 25, at the expected state, the company will be close to CMMI Level 5. To fulfill its gaps such as project estimation, certain measurements, process performance and innovation, it must collect improvement information, ensure process improvement and correct basis of problems (*arrow II in Figure 28*).

5.1.1. Periods of Change

Research Question 3 *How does the workflow of the company change during CMMI implementation?*

Research Question 4 *What are the stages of change?*

According to data gathered from the company, as shown in Figure 28, change occurred in four phases namely:

1. Motivation and Adoption
2. Adaptation
3. Acceptance and Implementation
4. Use and Improvement

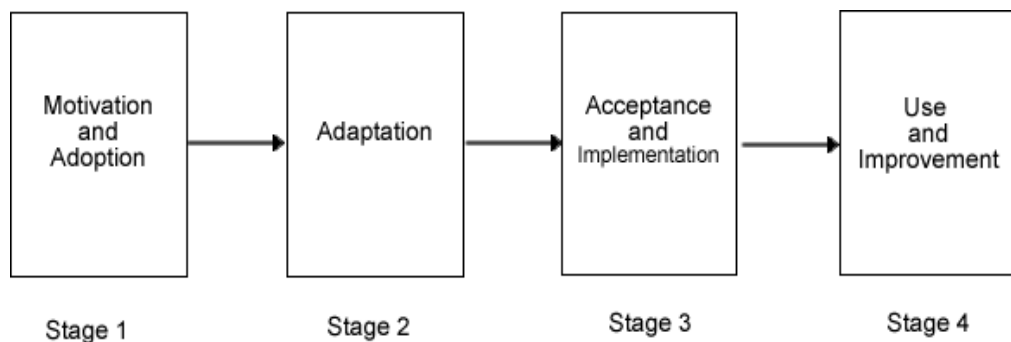


Figure 28. Steps of change

The phases of change presented in the research case was compared with a model from the literature.

Motivation and Adoption: Upper management decided to give a start to the Institutional Performance Development project. This was then announced to the personnel and meetings were held to provide information about the project. A member of personnel was assigned as the quality representative for each department and the researcher was delegated as quality representative of the Application Development Management, which is one of the production departments. At the beginning of the project, interviews and observations showed that the line level personnel had low motivation for the change. During this phase, upper management had to enhance its leadership quality and remain committed to the innovations required and motivate the personnel in order to convince them of the advantages.

Adaptation: Organization revision is anticipated when a new workflow is adopted. The physical working areas of the personnel were changed as a result of the new organization structure; former working groups were modified and new groups were arranged. Meanwhile

management had to be prepared for objections from the personnel. Upper management in particular were mobilized to protect the new formation. As a result of the comparison between the old organization chart and the new one, it is understood that the Application Development Management department was the most affected. Subunits of the management in the former structure were grouped as analysts, programmers and testers and every unit had separate rooms which were physically far away from each other. When the programmer needed to ask an analyst about something they mostly communicated by telephone. In the new structure, job units called “*service*” were established on work based flow and programmer, analyst and tester were assigned for each service. Each service is now located in its own room. It was noted in the observation forms and interview documents that there are positive impacts of the new work flow model and for personnel sharing the same unique place physically.

Acceptance and Implementation: Few processes were defined in the old structure and even those processes that were defined were not applied appropriately. Records of jobs and documents were not systematically. The work procedures of the new structure were defined by arranging meetings in the company. Official meeting reports and observation forms indicated that these meetings were often subject to lively debate. Each unit campaigned to include as much of their work into the procedure documents. This complicated the writing of the procedures, which put the processes into written form, and threatened to depart from their aim. It was necessary to write the most applicable definitions in each instance and to define the work correctly in the procedure. A document file was formed for the procedures, standards and forms. This file exemplifies the work processes, input and output of each process. As long as these procedures are followed, work flows accordingly and means that the change has already been accepted.

Use and Improvement: The researcher observed that the new working system was difficult for the personnel from many points of view. Although most of the personnel, especially the programmers, were not producing documents in the old version of their work process, in the new work flow they were faced with the assignment of producing documents, which took up a lot of their time. It was seen that not only programmers but also company employees in general required automation tools to facilitate the documentation. Tools also were needed to align the documents within the processes. Tools to facilitate documentation and follow up the document were therefore adopted. The company produced most of the necessary tools with the help of the Application Development Infrastructure Management department. The tools were adopted and put into everyday use, meaning that the new system has reached the usage phase. With the attainment of this phase, it is now possible to initiate studies for the improvement of the new system.

These steps can be compared with Ahire & Ravichandran's (2001) model:

1. *Strategy Adoption:* Adoption typically starts with the senior management in the organization and is driven by their commitment and leadership. Top managers drive change by creating values, goals, and systems that lead to satisfied customers and improved organizational performance. The clarity of quality goals in an organization determines the effectiveness of the quality efforts. A top management team committed to quality conveys the philosophy that quality receives priority over cost and schedule and that in the long run, superior and consistent quality leads to improvements in cost and delivery performance. Upper management not only gives quality the highest priority possible but also demonstrates its commitment to quality by providing adequate resources for implementing quality management. In particular, this is accomplished through investments in human and technical resources.

2. *Organizational Adaptation*: To implement a change, the organization has to adapt in several ways. First, organizational values and norms have to change to reflect a commitment to satisfy customer needs. Customer focus is a fundamental principle of quality management systems, and senior management has to ensure that this focus permeates organizational activities. Next, employees in the organization have to be prepared to understand and participate in the quality initiatives. Employee participation is critical for the change program to move beyond senior management initiatives. Third, suppliers must be encouraged to participate in the organization's quality initiatives. Thus, top management commitment should result in organizational adaptation along three dimensions:

- a. increased customer focus transcending all activities in the firm,
- b. comprehensive employee training and institution of a reward system
- c. implementation of supplier quality management strategies that ensure supplier adaptation to conform to higher quality standards.

3. *Organizational Acceptance of the Quality Initiative*: Once the top management commitment has resulted in adaptation of the organization's mindset to the quality orientation, organizational disposition to improve quality follows. This is reflected in the willingness of the employees and suppliers to adopt two critical precepts of quality-focused work: cooperation and learning. These elements have been identified as fundamental prerequisites for any meaningful quality improvement efforts. A technically and psychologically mentored workforce works as a team with the common goal of improving quality. The cooperative attitude of workers is reflected in their internal associations among peers.

4. *Use of Quality-Oriented Techniques:* This phase reflects the assimilation of the quality philosophy by the organization and is evident in the wide spread use of specific quality-oriented techniques and methods. These practices are oriented toward the management of core organizational processes, including product design, manufacturing, and quality control. Several techniques have been told in the quality literature for effective management of these processes. The extent to which organizations use these techniques is reflective of the infusion of the quality philosophy in the core organizational processes.

Table 26
Comparison of steps

Stages	Model of Company A	Ahire & Ravichandran's Model
Stage I	Motivation and Adoption	Strategy Adoption
Stage II	Adaptation	Organizational Adaptation
Stage III	Acceptance and Implementation	Organizational Acceptance of the Quality Initiative
Stage IV	Use and Improvement	Use of Quality-Oriented Techniques

At stage 1, both of the models emphasize the role of senior management that plans the quality improvement project, motivates personnel and provides resources.

At stage 2, both of the models specify organizational structure change, in accordance with the new workflow. While Ahire & Ravichandran's model explains effects on customers and suppliers, our model focuses on the physical change on the company.

At stage 3, Company A's model underlines the implementation of a new system, while the other model draws attention to the promotion of teamwork. Although both models look at the stage from different views, they have a common point in acceptance of the quality system.

At stage 4, both models indicate that a quality management system is in use and absorption of the quality philosophy by the organization is completed. Whereas Ahire & Ravichandran's model does not talk about improvement of the new system, Company A tries to develop procedures and methods in accordance with the quality system.

5.1.2. Factors on Change

Research Question 5 *What are the factors that influence change positively and negatively?*

During the process resistance to change was noted in the company. Conner says that "resistance to change is natural, even if the change is a positive one" (1992, cited in Kalman, 2001). Acceptance of change depends on an individual's point of view and the perception of potential values such as simplicity, compatibility, modifiability, relative advantage and low social impact (Rogers, 1995). Egan and Fjermestad (2005, p.3) explain reasons for resistance to change as follows:

- a. "People resist, because they lack the skills to use and gain benefits from the new technologies.
- b. There is resistance because employees in traditional companies and industries do not understand the 'big picture' and how the application of the new technologies changes how business is done and processes executed.

- c. Finally, resistance, especially in middle and senior management, comes from the fact that new technologies and their translation into new business models redefine the organizational structures and the power bases.”

In this study item (c) was observed and an expert (E2) explained this situation in the interview (see the section 4.5).

Before them, in 1979 Kotter and Schlesinger defined reasons of resistance to change as four items.

- a. **Parochial self-interest:** Some people are more concerned with the implication of the change for themselves and how it may affect their own interests, rather than considering the effects for the success of the business.
- b. **Misunderstanding:** Communication problems; inadequate information.
- c. **Low tolerance of change:** Certain people are very keen on feeling secure and having stability in their work
- d. **Different assessments of the situation:** Some employees may disagree with the reasons for the change and with the advantages and disadvantages of the change process.

In this study, the findings showed that “low tolerance of change” was major reason of resistance to change and this was observed in the first line personnel level (see the section 4.4.2). For the senior management “parochial self-interest” was a factor for resistance to change (see the section 4.5). As general, not seeing the “big picture” was a valid reason that negatively affected the change for every level of the personnel. Problems met during the transformation of the company are summarized in the Table 27 according to the various stages of change.

Table 27
Problems observed

Stages	Implementation	Difficulties
Motivation and Adoption	Upper management started quality project	Natural resistance to change, low motivation to participate
Adaptation	Organization changed	Gripes and objections of the personnel
Acceptance and Implementation	New work flows were documented	Complication of what to write
Use and Improvement	New tools were used to improve products and processes	Documentation and record producing were painful

Besides resistance, negative factors on change which were explained in the Section 4.5 can be listed as:

- Low motivation of personnel to the quality improvement project
- Diversity of personnel expertise
- Not having an institutional culture because of being a young company
- Constructing a new system on a running organization

Recommendations to deal with resistance to change are also given by Kotter and Schlesinger (1979) as follows:

- Education and Communication:** Where there is a lack of information or inaccurate information and analysis. One of the best ways to overcome resistance to change is: to inform and educate people about the change effort beforehand. Preceding

communication and education helps employees see the logic in the change effort. This reduces unfounded and incorrect rumors concerning the effects of change in the organization.

- b. **Participation and Involvement:** Where the initiators do not have all the necessary information to design the change, and where others have considerable power to resist. When employees are involved in the change effort they are more likely to want change rather than resist it. This approach is likely to decrease resistance of those, who merely acquiesce in the change.
- c. **Facilitation and Support:** Where people experience adjustment problems. By being supportive of employees during difficult times, managers can prevent potential resistance. Managerial support helps employees to deal with their fear and anxiety during a transition period. The basis of resistance to change is likely to be: the perception that there will be some form of detrimental effect occasioned by the change in the organization. Typical for this approach are special training and counseling, outside normal office premises.
- d. **Negotiation and Agreement:** Where someone or some group may lose out because of a change, and where that individual or group has considerable power to resist. Managers can combat resistance by offering incentives to employees not to resist change. This can be done by allowing people who are resisting the change to veto certain elements of change that are threatening. Or the people who are resisting the change can be offered incentives to leave the company through early buyouts or through retirements. In order to avoid the experience of the

change effort. This approach will be appropriate where those resisting change are in a position of power.

- e. **Manipulation and Co-optation:** Occurs where other tactics will not work or are too expensive. Kotter and Schlesinger suggest that an effective manipulation technique is: to co-opt with people who are resisting the change. Co-optation involves bringing a person into a change management planning group for the sake of appearances rather than their substantive contribution. This often involves selecting leaders of the people who are resisting the change, to participate in the change effort. These leaders can be given a symbolic role in decision-making, without threatening the change effort. Note this: if these leaders feel that they are being tricked, they are likely to push resistance even further than if they were not included in the change effort leadership.
- f. **Explicit and Implicit Coercion:** Where speed is essential and to be used only as last resort. Managers can explicitly or implicitly force employees into accepting change, by making clear that resistance to change can lead to: jobs losses, dismissals, employee transfers, or not promoting employees.

In Company A, “*participation and involvement*”, “*education and communication*” approaches were the main interventions for overcoming problems. The managers fostered the personnel to participate in quality improvement activities. Sometimes training, counseling and workshop activities were given by the managers and the Department of Institutional Performance Improvement as “*facilitation and support*”.

Negativities regarding the change were explained above. On the other hand, there were positive factors that affected the change. From the results of the study, we can list the positive factors as:

- Leadership
- Support of upper management to the project
- High level communication
- High education level of the personnel
- Tools

These affirmatives helped management of the change.

5.2. Discussion about Performance Issues

Research Question 6 *How do the quality improvement studies affect the performance of the company?*

As previously stated, the study considered six sub-questions:

- a. What factors are responsible for initiating the change?
- b. What is done to integrate the CMMI model into the company?
- c. How does the workflow of the company change during CMMI implementation?
- d. What are the stages of change?
- e. What are the factors that influence change positively and negatively?
- f. How do the quality improvement studies affect the performance of the company?

The first five were related with the change concept and they were discussed in the previous section. The sixth one concerns the effect of quality improvement studies on organization performance. In the literature

(Easton and Jarrell, 1998; Kaydos, 1991; Selladurai, 2002) pointed out that there is a positive effect of quality improvement studies on organizational performance. The results of the study are parallel to these findings in the literature.

Section 4.6 went over the methods of measuring performance. Problems reported by customers are considered a reference point for performance monitoring. Figure 29 and 30 display the graphics of reported problems. Figure 29 shows the total calls that include software application problems, data problems, hardware problems, network problems and communication problems. It is seen that there is a sharp decrease in year 2007 and thereafter the curve is nearly stable. Critics could claim that this better performance did not result from the quality improvement studies because the processes that data were gathered from also include hardware problems, network problems and data problems that were not subjected to process improvement studies. On the other hand, Figure 30 indicates purified data since it relates only to software application faults; the software application development process was however included in the quality improvement project.

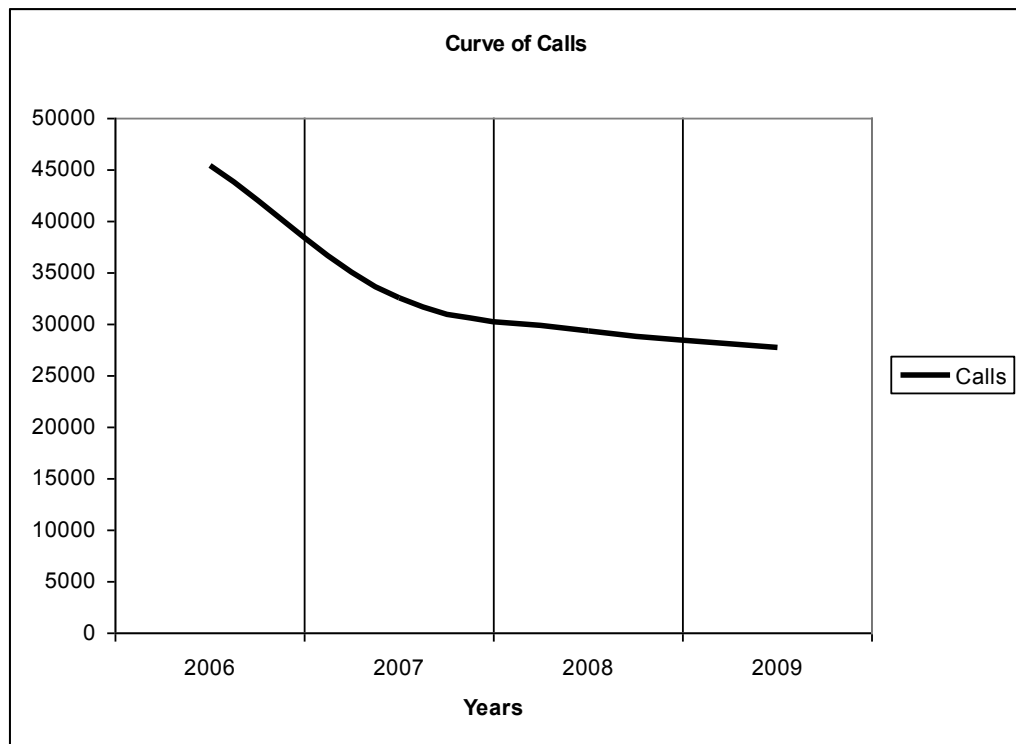


Figure 29. Curve of total calls

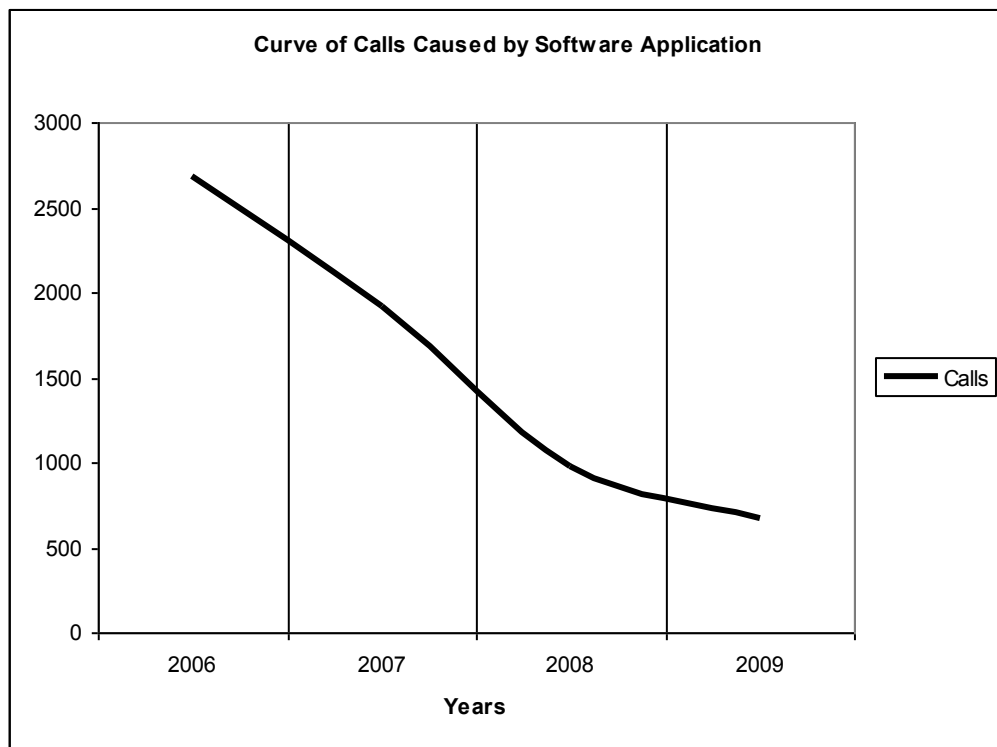


Figure 30. Curve of Software Application defect calls

Requests from the customers and software products deployed are triangulation data for problems reported by the customers (calls). Table 28 gives a summary of requests and produced software products for three years.

Table 28

Matrix of requests, deployed software and faults

Year	Number of faults	Number of requests	Percentage of faults	Number of deployed software	Percentage of faults
2007	97	1110	8,74%	8148	1,19%

Table 28 continued

2008	79	1158	6,82%	10543	0,75%
2009	99	1472	6,73%	14518	0,68%

As it is seen from Table 28, number of requests increased from 1110 to 1472, however percentage of faults decreased from 8,74% to 6,73%. Similarly, number of deployed software increased from 8148 to 14518 while fault percentage decreased gradually from 1,19% to 0,68% between 2007 and 2009. Those statistics indicates that load of job increased in three years but fault percentages decreased, which means quality of service given by Company A went up in this period. These results are parallel to “calls” and supports findings acquired from “calls”.

Short of long, after quality improvement studies was taken into use, performance of the company has boosted. Just like the literature says, quality improvement studies have a positive impact on the performance for this case.

5.3. Suggested Steps Should be Taken for the Implementation of CMMI in Similar Companies

An accurate guideline is necessary for the successful implementation of process improvement. From the results of the study, the roadmap below is suggested for organizations that want to acquire improvement of CMMI.

i. Reorganize your organization

It is important to run on a process based business model. If your organization runs on a function based model or request-based model, it is difficult to adapt the CMMI processes to your organization. Workflow of the organization should be changed to one that is process based and processes should be handled as services. If you can define processes then it is possible to apply CMMI methodologies to improve processes. If necessary, the framework of the organization can be altered, as it was done in the research case.

ii. Position quality improvement department over senior management

During the period of process improvement studies, new workflows and business models can emerge. A quality department can plan and organize the new workflow but it needs to be independent. Independency enables the department to audit other units and this department should be hierarchically over them. Its location could be under top management but should be over senior management or at the same level. It was seen that in the study that support of senior management is crucial for the success of quality improvement studies. If the management level follows the quality procedures, this ensures that line level personnel obeys the rules. In this context, there must be an agent to force senior management to follow the quality procedures.

iii. Emphasize leadership

Since people are typically resistant to change (Kalman, 2001), there must be incentives that activate the change process. Among the conditions found in the literature, leadership is the most commonly identified factor involved in empowering the change (Senge, 1990). It should be also noted that in interviews conducted during the study,

everyone said that top management and senior management must support quality improvement processes. Leadership was seen as a crucial positive factor on the change. No matter how you plan and change your workflow, it would not be accepted unless leaders in the organization use the new model. Leadership should be open throughout the change process and leaders preserve the process by motivating staff to transform.

iv. Perform gap analysis

Process improvement is a long journey. There will be moments that are necessary to stop and check where you are. It is important to elicit the state of your organization in terms of processes. Once you know where you are, it is easier to draw a route to your destination. Gap analysis shows in which state you are and should be performed periodically. This helps you build a business strategy and plan interventions.

v. Plan interventions

After gap analysis, you can see a variety of deficiencies in your organization. It is vital to plan the interventions that are appropriate to fulfilling perceived deficiencies. If you want to see whether you improve or not, you ought to be able to compare states of change. Comparison is possible by measurement. It is important to define measurement points for creating planned interventions. Without effective interventions, you cannot improve your processes.

Goals and *practices* presented in the CMMI framework are good references for planning remedial interventions. Goals and practices are categorized as generic and specific. Specific goals and practices are specific to a process area. Generic goals and practices are part of every process area. A process area is satisfied when organizational processes cover all of the generic and specific goals and practices for that process area. For detailed information about goals and practices, refer to the guide

to CMMI (CMU/SEI, 2006) published by Carnegie Mellon Software Engineering Institute.

vi. Spread responsibilities and encourage involvement

According to the literature, interviews and observations, the most common pitfall during quality improvement concerns the distribution of responsibilities. Mostly, a single person shoulders the major load of quality works and others expect him to handle the problem of process improvements. All personnel should be engaged in quality studies and encouraged to participate at the desired level. Incentives for encouragement should be included in intervention plans.

In Company A, *“participation and involvement”*, *“education and communication”* approaches were the main methods to overcome problems. The managers and the leaders assigned small tasks to each member of staff so as to help ensure their participation in quality improvement activities. Sometimes training, counseling and workshop activities were given by the managers and the Quality Department as *“facilitation and support”*.

vii. Be human focused, tools are auxiliary

Continuous achievement in the innovation industry demands a lot from the human mind. As people and intellectual property are key assets of the service sector their performance is complex and needs to be understood and nurtured. Although interviews executed in Company A showed that tools are important and helpful for implementing quality process improvement, this is valid for later phases of the process. First of all, people must be persuaded of the benefits of quality improvement studies and should be willing to use tools. Tools are not magic wands and they just help the people in performing their tasks. It should not be forgotten

that tools do not create committed, able, capable and responsible people. Our subject is human and our approach must be human-focused.

viii. Keep motivation of personnel high

A consultant in the sector, who was interviewed as an expert (E2), said that at the beginning of the process improvement project, everybody is excited about CMMI but after awhile the excitement diminishes. Managers and leaders in the organization should therefore find ways of keeping the motivation of personnel high.

5.4. Conclusions

This research examines the process of integrating CMMI (Capability Maturity Model Integration) Level 3 into a company that provides information technologies service to the finance sector. At the beginning, the company had no quality standards; most of the business processes were not documented or appeared consistent if they had been. The aim of this research was to find out the stages and factors that arise as a result of the change process that come about with the integration of CMMI. Before CMMI Level 3 certification preparations, Company A passed COBIT and ISO audits. These quality improvement models made useful contributions to CMMI preparations.

In this case study data was gathered via observations, interviews and the examination of relevant documents. Data were analyzed by *descriptive analysis* which defines and interprets the data. The results of the research indicate that resistance to change emerged naturally and transformation occurred in four stages namely, motivation and adoption, adaptation, acceptance and implementation, use and improvement.

It should be noted that the study results are specific to this case and cannot be generalized. The research showed that it is crucial to be human focused because management of change and execution of processes are related to the individuals in the organization. Rather than forcing the personnel to apply quality improvements rules, it is better to persuade them of the benefits of quality improvement studies. Since it was observed during the research that motivation is a key factor for successful transformation, staff of the organization should believe in the usefulness of quality studies; therefore their motivation should be kept high. Leadership and setting up correct business objectives are more important than concentrating on certification. Tools for improving process are essential but they are not everything. Participation and involvement are important concepts for breaking resistance to change; so responsibilities should be given evenly.

The results from numerical data supported the findings in the literature. There is a strong relationship between quality improvement studies and productivity. After the quality improvement model was put in use, problems reported by the customers decreased steadily. Fewer problems mean better service and high performance for the organization.

5.5. Recommendations for Further Research

Even though the findings of the study can not be generalized, some implications of this study can be offered. Findings showed that change occurred in four phases such as:

- a. Motivation and Adoption
- b. Adaptation
- c. Acceptance and Implementation
- d. Use and Improvement

Furthermore, quality improvement studies have a positive impact on the performance of the organization. However more studies should be undertaken in order to understand the affects of quality improvement studies on organizations. In future studies, more qualitative research methods like observations, documents analysis and interviews can be used. While, in this study, findings were examined by descriptive analysis, new qualitative researches might use content analysis. Also, some quantitative methods can be included such as motivational surveys that gauge reactions of participants to change. Mixed type studies may deepen the gathering of data.

With respect to this current study, similar research studies can be conducted to compare results. As long as educational systems are becoming more computerized and technology based, they will need new technology integration models. Research on the affects of technology integration on educational and other systems will be crucial for successful transformations.

5.6. Implications for Practice

Completing and delivering a software product on time is a major challenge for software development firms and a major concern of customers. Complete failure of a project is frequently seen (Dorsey, 2006). Many of the larger customers such as the military and government organizations want to minimize risk and have begun to request CMMI certification from their contractors. As stated in section 1.4, CMMI is a new concept for the business world, and companies require a helping hand with implementation.

CMMI brings change to the traditional production methodologies in many companies. Moreover, many enterprises have to accept change programs in response to pressures from competition and their customers. An uncoordinated, unplanned approach does not work in a complex

environment. Disciplined attention to some important aspects of managing change is essential for success (Small, Downey, 2001). In order to make a plan, all agents of change should be defined. In this context, it is significant to identify the factors (agents) that affect the change process while the stages of change specified by CMMI implementation are determined. As the process is relatively new, it is hoped that the findings of this research will provide practical information for organizations that are trying to attain CMMI certification. The research shows the positive and negative faces of change, which can be used to inform other organizations preparing for CMMI. This is the practical side of the research.

Our main topic is to improve productivity. In organizations which produce service products such as software development houses and education institutions, human activities and performance are much more important than in a factory where production is largely undertaken by machines. Human Performance Technology (see section 2.3) is a discipline that focuses on improving the productivity of people and Pershing (2006) defines Human Performance Technology (HPT) as a systematic approach to improve individual and organizational performance. HPT is a research field in which Instructional Technologists also have an interest. Understanding the change process triggered by integration of CMMI is important for supplying the right interventions to improve the performance of workers at a technology company, and this is an issue of interest to the field of Instructional Technology. Organizations continue to look for improvements in the way they design and build products and services and use ever more complex computerized systems to achieve this. Computerized education and training is therefore an important component of change. The findings of this study highlight problems that can be encountered when new instructional models are designed and implemented.

For a successful process improvement, Kalaycı (2007) defined seven factors. These factors will be explained, compared and combined with the findings of this study.

a. Business Objectives & Leadership

As it is seen in our case, motivation is one of the key factors for success. All personnel are drivers of change, however a process improvement program lacking strong business objectives is unlikely to gain the sponsorship of the top management. Businesses are typically motivated by reduced cost, faster delivery, and higher quality. A successful process improvement program will incorporate such aspirations.

Change should start from the top. The leader is the one who should change first. Leadership, with the whole management team, should be the role model for the new way of working. There may be many barriers on the road to change. Nothing should be used as an excuse not to change. The leader and the management team should personally be involved in the process improvement activities and always support them. From the interviews, it was seen that almost all interviewees thanked top management for their support to the process improvement studies. The common notion was that without the support of top management, change would have been much more difficult.

b. Separation of Powers & Ceasing Over-Commitment

There is always a balance problem between resources in hand and resources required. Organizations at lower maturity have a tendency to promise more than their abilities. Their inabilities generally come from both their weakly designed organizational structure and lack of sufficient resources. For a successful process improvement program organizations should assign managerial tasks, quality assurance and auditing tasks to different people. In the case of study, senior management had the

managerial tasks, department of Institutional Performance Improvement coordinated quality assurance activities and a team was formed for auditing tasks. An organization with over loaded personnel should delay the process improvement program for a period of time and unload workers for process improvement within the organization. Distributing responsibilities also enables the involvement of everyone to the process improvement studies.

c. Result Oriented Processes

The period of quality improvement integration studies showed that correct definition of the scope of a process is crucial for a successful process improvement. The boundaries of a process should be drawn from the top to the bottom of the organization. There should be no process that does not generate revenue for the organization. All other activities not generating revenue for the organization should be considered a sub-process of a process. Sub-processes are defined as components of a larger defined process. For example, Company A's development process can be defined as request development, requirement specifications and development, analysis and design development, physical design and coding, functional testing and deployment and maintenance. On the other hand, peer reviewing could be defined as a sub-process.

d. Wide Spread Involvement & Award System

Everybody in the organization has the right and responsibility of being a part of the process improvement program. In Company A, a quality representative was chosen from each department to form the "team of quality studies" and a group (Software Development Process Group) was constructed in the Application Development Management department. A quality development team (QDT) should be constructed for companies implementing a quality development system. This team disseminates the new system through the organization.

Participation and involvement (Kotter & Schlesinger, 1979) are important concepts for breaking resistance to change. Awarding people who are supporting change is crucial (Modgil & Modgil, 1987). People should clearly know that they are invited to take part in the change and participants who are leading the change and adapting the change in front lines should be awarded. This important action was missing in Company A and should have been taken into consideration.

e. Correct Planning for Transformation

Transformation is not a short trip; on the contrary it is a long and difficult journey. However quick wins should be provided and the progress should be realized in a short period of time. If possible, small successes should be recognized and celebrated. Change stages should be planned and implemented according to plan. Firstly, identifying the reason for change is crucial; then the organizational structure for change management is defined. In diagnosing, a gap analysis comparing the current state of the organization with the desired state will help to plan the transformation through implementation.

Process improvement is like any other project. It requires planning, resource allocation, monitoring, verification, validation, configuration of management, etc. A unit should be constructed within the organization so that the process improvement project could be implemented. In Company A, department of Institutional Performance Improvement was responsible unit for executing the quality project.

f. Tools are just tools!

Interviews executed in Company A showed that tools are important and helpful for implementing quality process improvement. Although identifying, acquiring, and using the correct tools are vital, this process belongs to later phases of process improvement. First of all, people must

be persuaded of the benefits of quality improvement studies and should be eager to use them. Tools should then follow to help these people in performing their tasks. We should not forget that tools will not create committed, able, capable and responsible people. Our subject is human and our approach must be human-focused.

g. Sustainable Transformation

While science and technology develop and affect our daily and business lives, change is inevitable. Successful transformation is essential for a sustainable transformation, new and challenging targets should be set whenever a target for change has been reached. A few years after a successful transformation, new challenging targets for change should be located. Change is continuous, if you do not go up, this means that you will go down. As Heraclitus said:

“Change is the only constant.”

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APPENDIX A

MONTHLY DIARY SHEET

Observation Period (Monthly)	
Activities	
Tangible Changes	
Intangible Changes	
Reactions to Change	
Administrators	
Staff	

Comments	
Notes	

APPENDIX B

INTERVIEW GUIDE FOR THE MANAGERS

Görüşülen Kişi :

Görüşmeyi Yapan :

Tarih & Saat :/...../ 200....&

Görüşme Süresi :

Merhaba,

ODTÜ Bilgisayar ve Öğretim Teknolojileri Eğitimi Lisansüstü Programı'nda Doktora öğrenimimi sürdürmekteyim. Öncelikle “Bütünleşik Yetenek Olgunluk Modeli'nin (CMMI®) Bir Teknoloji Şirketine Entegrasyonunun Değişim Süreci” konulu tez çalışmamda görüşlerinizi benimle paylaşmayı kabul ettiğiniz için teşekkür ediyorum. Bu konudaki kişisel deneyimleriniz, görüş ve düşünceleriniz araştırmam için büyük önem taşımaktadır. Başlamadan önce bazı noktaları vurgulamak istiyorum.

- Yapacağımız görüşme sadece araştırma amaçlı kullanılacaktır ve vereceğiniz tüm bilgiler tamamen gizli tutulacaktır. Söyleyeceğiniz hiç bir şey üçüncü şahıslara ileilmeyecek ve çalışmada kesinlikle isminiz kullanılmayacaktır. Araştırma tamamlandıktan sonra ilgili analiz, sonuç ve tavsiyelerimizi eğer isterseniz sizlerle paylaşmaktan mutluluk duyacağız.
- İzin verirsiniz görüşmeyi kaydetmek istiyorum. Sizce sakıncası var mı? İsterseniz görüşmeyi yazılı metin haline getirdikten sonra size gösterebilirim.

Sormak istediğiniz bir soru var mı?

1. Eğitiminiz nedir?
2. Kaç yıllık yöneticilik tecrübeniz var?
3. Şirketimizde kurumsal performansın kalite yönetim sistemi üzerinden geliştirilmesine neden gerek duyulduğunu düşünüyorsunuz?
4. Bölümünüzde kalite faaliyetleri kapsamında yapılan çalışmalar nelerdir?
5. Kalite Yönetim Sistemi kurulmadan önceki ile sistemin uygulamaya alınmasından sonraki iş akış modellerinizi kıyaslayabilir misiniz?
6. Kalite yönetim sisteminin planlanması (yeni iş süreçlerinin tanımlanması ve birimlerin yeniden yapılandırılması vs.) sırasında karşılaştığınız zorluklar nelerdi?
 - a. Sizin şahsi olarak karşılaştıklarınız
 - b. Personelinizin karşılaştıkları

7. Kalite geliştirme faaliyetlerinin uygulanması (yeni iş süreçlerinin uygulanması ve ilgili kayıtların oluşturulması vs.) sırasında karşılaştığınız zorluklar nelerdir?
 - a. Sizin şahsi olarak karşılaştıklarınız
 - b. Personelinizin zorlandıkları
8. Planlama ve uygulama aşamalarında karşılaşılan sorunları aşmak için ne gibi çalışmalar yaptınız?
9. Kalite geliştirme çalışmaları sırasında kullanıma alınan otomasyon araçlarının iş yapış süreçlerine etkisi nasıl oldu?
10. Kalite geliştirme sürecini olumlu ve olumsuz olarak etkileyen etmenler nelerdir (personel karakteristiği ve motivasyonu, teknolojik alt yapı, iletişim, şirket yapılanması vs.)?

Görüşme bitmiştir, katılımınız için tekrar teşekkürler.

APPENDIX C

DOCUMENT ANALYSIS WORKSHEET

Type of Document	Mail _____ Meeting Record _____ Presentation _____ Report _____ Work Procedure _____ Other _____												
Physical Quality	<table border="0"> <tr> <td><u>Printed</u></td> <td></td> <td><u>Electronic</u></td> <td></td> </tr> <tr> <td>Official</td> <td>_____</td> <td>Official</td> <td>_____</td> </tr> <tr> <td>Nonofficial</td> <td>_____</td> <td>Nonofficial</td> <td>_____</td> </tr> </table>	<u>Printed</u>		<u>Electronic</u>		Official	_____	Official	_____	Nonofficial	_____	Nonofficial	_____
<u>Printed</u>		<u>Electronic</u>											
Official	_____	Official	_____										
Nonofficial	_____	Nonofficial	_____										
Date													
Author (Creator)													
Position (Title) of Author													
Target Audience													

Document Information	
Notes	

APPENDIX D

AUDIT QUESTIONNAIRE OF PROCEDURE 1 FOR THE SERVICE ADMINISTRATORS

Tetkik tarihi	Tetkik Rapor No: KPG/UG-07/1
Tetkik Yapılan Bölüm/İlgili Prosedürler UG/PRS_UG_01_Ger. Bel ve Geliştirme Prs.	Bölüm Sorumlusu:
Tetkik Ekibi Lideri	Tetkik Ekibi:
Tetkik Tipi Uygunluk Tetkiki	
Tetkik Soruları	Tetkik Sonuçları
1. Kapsam dökümanının hazırlanma aşamasında şartlar (fonksiyon şartları, performans şartları, yasal mevzuat şartları v.b. gibi) ne şekilde ve kimler tarafından belirlenmektedir ?	Değerlendirme:
2. Sürece ait prosedürlerin oluşturulmasında kalite yönetim sistemi açısından öne çıkan hususlar (müşteri beklenti/memnuniyetinin sağlanması, verilere dayalı karar verme, sürekli iyileştirme v.b. gibi) nelerdir ?	Değerlendirme:
3. Süreç için atanan kaynakların nitelik/nicelik olarak yeterli olup olmadığı ne şekilde kontrol edilmektedir ?	Değerlendirme:

4. Süreç performans kriterleri ne şekilde izlenmekte ve kayıt altına alınmaktadır ?	Değerlendirme:
5. Kapsam dökümanının müşteri tarafından onaylanması ne şekilde kayıt altına alınmaktadır ?	Değerlendirme:
6. Son plan işgücü kestiriminin ilk plan işgücü kestiriminden % 15'den fazla aşmış olması durumunda ne yapılmaktadır ?	Değerlendirme:
7. Gerçekleşen işgücünün en son onaylı baz plandaki işgücü kestiriminden %10'un üzerinde aşması durumunda ne yapılmaktadır ?	Değerlendirme:
8. Süreç çıktısı dökümanlar nerede saklanmakta ve korunmaktadır? Dökümanların muhafazasından kim sorumludur?	Değerlendirme:
9. Süreç çıktısı dökümanların güncelliği nasıl sağlanmaktadır ? Güncel olup/olmadığının kontrolü konusunda sorumluluklar belirlenmiş midir ?	Değerlendirme:
10. Süreç sorumluları arasında iç iletişim ne şekilde sağlanmaktadır ?	Değerlendirme:
11. Sürecin sürekli iyileştirilmesi amaçlı yapılan çalışmalar nelerdir ?	Değerlendirme:
12. Dökümanların Fintek içi onay süreci ne şekilde kayıt altına alınmaktadır ?	Değerlendirme:
13. Kapsam dökümanının müşteri tarafından onaylanması aşamasından sonra gündeme gelebilecek müşteri revizyon talepleri kim tarafından ne şekilde değerlendirilmektedir ?	Değerlendirme:
14. UG zaman planı değerlendirme aşamasında sapma tespit edilmesi durumunda ne şekilde işlem yapılmaktadır ?	Değerlendirme:
15. Değişiklik gerektiren her müşteri talebi için, değişiklik için üretime başlamadan önce değişiklik yetkilendirme onayı alınıyor mu?	Değerlendirme:

16. UG Md.leri üretim öncesinde üretim veya proje planı oluşturulmuş olmasını sağlıyor mu?	Değerlendirme:
Genel Değerlendirme:	
İlgili Bölüm Sorumlusu	Tetkik Ekip Lideri
(Adı Soyadı, İmza)	(Adı Soyadı, İmza)

APPENDIX E

AUDIT QUESTIONNAIRE OF PROCEDURE 2 FOR THE SERVICE ADMINISTRATORS

Tetkik tarihi	Tetkik Rapor No: KPG/UG-07/1
Tetkik Yapılan Bölüm/İlgili Prosedürler UG/PRS_UG_02_Fonk. Analiz_Tasarım	Bölüm Sorumlusu:
Tetkik Ekibi Lideri	Tetkik Ekibi:
Tetkik Tipi Uygunluk Tetkiki	
Tetkik Soruları	Tetkik Sonuçları
1. Analiz ve tasarım aşamasında şartlar (fonksiyon şartları, performans şartları, yasal mevzuat şartları v.b. gibi) ne şekilde ve kimler tarafından belirlenmektedir ?	Değerlendirme:
2. Ürüne (hazırlanacak yazılım) bağlı şartlar sürecin hangi aşamasında belirlenmektedir ?	Değerlendirme:
3. Ürün (hazırlanacak yazılım) kalitesini etkileyecek işleri yapan personelin yetkinlik ölçütleri ne şekilde belirlenmiştir ?	Değerlendirme:
4. Sürece ait prosedürlerin oluşturulmasında kalite yönetim sistemi açısından öne çıkan hususlar (müşteri beklenti/memnuniyetinin sağlanması, verilere dayalı karar verme,	Değerlendirme:

sürekli iyileştirme v.b. gibi) nelerdir ?	
5. Sürecin girdileri, çıktıları, sorumluları belirlenmiş midir ? Süreç için atanan kaynakların nitelik/nicelik olarak yeterli olup olmadığı ne şekilde kontrol edilmektedir ?	Değerlendirme:
6. Süreç performans kriterleri ne şekilde izlenmekte ve kayıt altına alınmaktadır ?	Değerlendirme:
7. Analiz dökümanının müşteri tarafından onaylanması ne şekilde kayıt altına alınmaktadır ?	Değerlendirme:
8. Uygulama test faaliyetleri sırasında çıkan hataların içerisinde analiz/tasarım kaynaklı hataların oranının % 10'dan fazla olması durumunda ne yapılmaktadır ?	Değerlendirme:
9. Süreç çıktısı dökümanlar nerede saklanmakta ve korunmaktadır? Sorumlusu kimdir?	Değerlendirme:
10. Son üç ayda prototip uygulama hazırlanan çalışmaların tüm çalışmalar içindeki oranı nedir?	Değerlendirme:
11. Eşdeğer gözden geçirme sürecindeki çalışmalar ne şekilde kayıt altına alınmaktadır ?	Değerlendirme:
12. Dokümanların Fintek içi ve müşteri onay süreci ne şekilde kayıt altına alınmaktadır ?	Değerlendirme:
13. Fonksiyonel test senaryolarının uygunluğu kim tarafından nasıl kontrol edilmektedir?	Değerlendirme:
14. Herhangi bir yazılımın sürecin hangi aşamasında (analiz, kapsam, fonksiyonel tasarım, uygulama test v.b. gibi) olduğu ne şekilde takip edilmektedir ?	Değerlendirme:
15. Süreç çıktısı dökümanların güncelliği nasıl sağlanmaktadır ? Güncel olup/olmadığının kontrolü konusunda sorumluluklar belirlenmiş midir ?	Değerlendirme:

APPENDIX F

AUDIT QUESTIONNAIRE OF PROCEDURE 3 FOR THE SERVICE ADMINISTRATORS

Tetkik tarihi	Tetkik Rapor No: KPG/UG-07/1
Tetkik Yapılan Bölüm/İlgili Prosedürler	UG/PRS_UG_03_FizikselTasarım_Kodlama
Tetkik Ekibi Lideri	Tetkik Ekibi:
Tetkik Tipi	Uygunluk Tetkiki
Tetkik Soruları	Tetkik Sonuçları
1. Sürece ait prosedürlerin oluşturulmasında kalite yönetim sistemi açısından öne çıkan hususlar (müşteri beklenti/memnuniyetinin sağlanması, verilere dayalı karar verme, sürekli iyileştirme v.b. gibi) nelerdir ?	Değerlendirme:
2. Fiziksel tasarımın analize uygunluğu ne şekilde belirlenmektedir, uygunluk/uygunsuzluk kriterleri belirlenmiş midir ?	Değerlendirme:
3. Kodlamanın “Kodlama Standartı”na uygun olup olmadığı ne şekilde belirlenmektedir ?	Değerlendirme:
4. “Kodlama Standartı”na uygun olmadığı belirlenen kodlar için ne şekilde işlem yapılmaktadır ?	Değerlendirme:

5. Bir uygulamanın yazılımcı testi gerektirip gerektirmediği hususu kim tarafından ve ne şekilde belirlenmektedir ?	Değerlendirme:
6. Birim Test raporları saklanıyor mu, muhafazasından kim sorumlu ?	Değerlendirme:
7. Süreç için atanan kaynakların nitelik/nicelik olarak yeterli olup olmadığı ne şekilde kontrol edilmektedir ?	Değerlendirme:
8. Süreç performans kriterleri ne şekilde izlenmekte ve kayıt altına alınmaktadır ?	Değerlendirme:
9. Eşdeğer gözden geçirme aşamasında 100 satırlık kod incelemesinde tespit edilen hata sayısının 1'den fazla olması durumunda ne yapılmaktadır ?	Değerlendirme:
10. Fiziksel tasarım dökümanı yapılan revizyonların maliyetinin toplam kodlama maliyetinin % 5'ini aşması durumunda ne yapılmaktadır ?	Değerlendirme:
11. Süreç çıktısı dökümanlar nerede saklanmakta ve korunmaktadır ?	Değerlendirme:
12. Süreç çıktısı dökümanların güncelliği nasıl sağlanmaktadır ? Güncel olup/olmadığının kontrolü konusunda sorumluluklar belirlenmiş midir ?	Değerlendirme:
13. Süreç sorumluları arasında iç iletişim ne şekilde sağlanmaktadır ?	Değerlendirme:
14. Sürecin sürekli iyileştirilmesi amaçlı yapılan çalışmalar nelerdir ?	Değerlendirme:

Genel Değerlendirme:	
İlgili Bölüm Sorumlusu	Tetkik Ekip Lideri
(Adı Soyadı, İmza)	(Adı Soyadı, İmza)

APPENDIX G

AUDIT QUESTIONNAIRE OF PROCEDURE 4 FOR THE SERVICE ADMINISTRATORS

Tetkik tarihi	Tetkik Rapor No: KPG/UG-07/1
Tetkik Yapılan Bölüm/İlgili Prosedürler UG/PRS_UG_04_Fonksi_yonel_Test	Bölüm Sorumlusu:
Tetkik Ekibi Lideri	Tetkik Ekibi:
Tetkik Tipi Uygunluk Tetkiki	
Tetkik Soruları	Tetkik Sonuçları
1. Sürece ait prosedürlerin oluşturulmasında kalite yönetim sistemi açısından öne çıkan hususlar (müşteri beklenti/memnuniyetinin sağlanması, verilere dayalı karar verme, sürekli iyileştirme v.b. gibi) nelerdir ?	Değerlendirme:
2. Süreç için atanan kaynakların nitelik/nicelik olarak yeterli olup olmadığı ne şekilde kontrol edilmektedir ?	Değerlendirme:
3. Süreç performans kriterleri ne şekilde izlenmekte ve kayıt altına alınmaktadır ?	Değerlendirme:
4. Test Bulgu dokümanları nasıl ve kim tarafından muhafaza edilmektedir?	Değerlendirme:

5. Prosedür Madde 7.2.3 gereği düzenlenmesi gereken Test Sonuç Değerlendirmesi hangi rapor içinde nasıl saklanmaktadır? Son üç ayda kaç büyük kaç küçük hata tespit edilmiştir?	Değerlendirme:
6. Müşteri kabul test işlemlerinin sonuçları ne şekilde kayıt altına alınmaktadır ?	Değerlendirme:
7. Üretim ortamında fonksiyonel test kaynaklı hata alınması durumunda ne şekilde işlem yapılmaktadır ?	Değerlendirme:
8. Süreç çıktısı dökümanlar nerede saklanmakta ve korunmaktadır ?	Değerlendirme:
9. Süreç çıktısı dökümanların güncelliği nasıl sağlanmaktadır ? Güncel olup/olmadığının kontrolü konusunda sorumluluklar belirlenmiş midir ?	Değerlendirme:
10. Süreç sorumluları arasında iç iletişim ne şekilde sağlanmaktadır ?	Değerlendirme:
11. Sürecin sürekli iyileştirilmesi amaçlı yapılan çalışmalar nelerdir ?	Değerlendirme:
12. Test sonuçlarının değerlendirme aşamasında tespit edilen hataların “büyük” ya da “küçük” hata olduğu hata olduğu kim tarafından, ne şekilde hangi kriterler dikkate alınarak belirlenmektedir ?	Değerlendirme:

Genel Değerlendirme:	
İlgili Bölüm Sorumlusu	Tetkik Ekip Lideri
(Adı Soyadı, İmza)	(Adı Soyadı, İmza)

APPENDIX H

OFFICIAL MEETING REPORT

1. Dağıtım Listesi

Kimden	Tarih	Tel/fax/e-mail

Kime (**)	Etkinlik*	Tel/fax/e-mail

* Etkinlik Kodu: Onay, Gözden geçirme, Bilgilendirme, Dosyalama, Etkinlik gerekiyor, Toplantıya katılım, Diğer (belirtiniz)

** Toplantıya katılanlar

2. Toplantı Bilgileri

Toplantı Tipi:					
Amaç:					
Toplantı Tarihi:		Baş. Saati		Bit. Saati	
Yer:			Tel:		
			Fax:		
Toplantı Yöneticisi:			Tel:		
Yazman			Tel:		

Gündem Maddeleri

Toplantı Tutanağı

3. Toplantı Sonuçları

Sonuç *	Konu	Sorumlu	Tarih **

Semboller

*	**
E Etkinlik	K[tarih] Kontrol tarihi; konu görüşülüp gelişmelere göre tamamlanma tarihi belirlenecektir
K Karar	T[tarih] Öngörülen tamamlama tarihi
D Diğer (belirtiniz)	

4. Ekler

CURRICULUM VITAE

PERSONAL INFORMATION

Nationality : Turkish
Date of Birth : 09 March 1975
Place of Birth : Savaştepe/Balıkesir, TURKEY
Marital status : Married

Phone : +90 533 264 31 27
E-mail : barbocan@yahoo.com

EDUCATION

2003 – 2010, Middle East Technical University, Ankara/TURKEY
Graduate School of Natural and Applied Sciences, Department of
Computer Education and Instructional Technology,
Philosophy of Doctorate,

2000 – 2002, Çankaya University, Ankara/TURKEY
Institute Of Science and Engineering, Department of Computer
Engineering
Master of Science

1994 – 1999, Middle East Technical University, Ankara/TURKEY
Education Faculty, Department of Computer Education
Bachelor of Science

1989 – 1993, Çınarlı Anatolian Vocational High School, Izmir/TURKEY
Electronics Department
High School

WORK EXPERIENCE

05.01.2004 – present, A Software Development Company,
Cankaya/Ankara
Software Developer

02.10.2000 – 31.12.2003, Cankaya University,
Eng.- Arch. Faculty, Computer Engineering Department, Balgat/ANKARA
Research & Teaching Assistant

June 1999-September 1999
"STB Tasarım Hizmetleri Ticaret Limitet Şirketi" (design and advertisement
company),
Sedat Simavi Sok. No:80/10 Cankaya/ANKARA (<http://www.stb.com.tr/>)
Web-site designer and coder

1998 – 1999 MEKSA Education Foundation, Cevad Dundar Cad. No:19
Ostim/ANKARA
Part-time instructor of computer courses

FOREIGN LANGUAGES

English – Advanced

PUBLICATIONS

Can B. (2008). "Yazılım Kalitesi Geliştirme Çalışmalarında Değişim Süreci",
Bilisim '08, Ankara, Turkey.

Can B. (2003). "Bilgisayar Programcılığı Eğitimine Nesne Yönelimli Metot
İle Başlama", UYSM 03, İzmir, Turkey.

COMPUTER SKILLS

System Knowledge: Windows XP and Linux as user

Programming Languages: C#, Java, PHP, HTML

General Applications: MS Office Professional, Adobe Photoshop,
Macromedia Dreamweaver, Macromedia Fireworks

Database Applications: Oracle 10g, PL SQL Developer 7.0, IBM DB2 V7.1
(certificated), MS Access, MySql