DOKUZ EYLÜL UNIVERSITY
GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

RELIABILITY ASSURANCE PROGRAMS AND AN APPLICATION OF FAILURE MODE AND EFFECTS ANALYSIS IN SERVICE ORGANIZATIONS

by
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İZMİR

RELIABILITY ASSURANCE PROGRAMS AND AN APPLICATION OF FAILURE MODE AND EFFECTS ANALYSIS IN SERVICE ORGANIZATIONS

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We have read the thesis entitled **"RELIABILITY ASSURANCE PROGRAMS AND AN APPLICATION OF FAILURE MODE AND EFFECTS ANALYSIS IN SERVICE ORGANIZATIONS"** completed by **ESİN ALKAYA** under supervision of **YARD. DOÇ. DR. SÜLEYMAN ALPAYKUT** and we certify that in our opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Science.

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RELIABILITY ASSURANCE PROGRAMS AND AN APPLICATION OF FAILURE MODE AN EFFECTS ANALYSIS IN SERVICE ORGANIZATIONS

ABSTRACT

As service concept is showing up in our daily life, it composes the focal point of the social life. However, the intangibility feature of service concept makes difficulties in perceiving and measuring features of service. Standardizing of services that have different features is considerably hard. The servqual instrument that combines to form five service quality dimensions including tangibles, reliability, responsiveness, assurance and empathy achieves measurement of service quality.

Reliability can be considered for mechanical systems whose performances could be measured in quantity, as well as service companies whose performances are measured in efficiency criteria.

All performance criteria must be determined for a service process to be able to determine its reliability. Quality Function Deployment (QFD) is used in determining the performance criteria and Failure Mode and Effects Analysis (FMEA) is used in preventing potential failures of the process. In routine service processes where service is equally given to customers such as schools or banks, use of Failure Mode and Effects Analysis is applicable.

In this thesis, researches and statistical analyses for service quality analysis on students residing in Buca Female Student Hostel associated to Dokuz Eylül University Service Department of Culture, Health and Sports with the use of Servqual technique and a FMEA application in the officer on duty service process is discussed.

Keywords: FMEA, Service Quality, Servqual, Reliability, Hostel's Service.

GÜVENİLİRLİK GÜVENCESİ PROGRAMLARI VE HİZMET İŞLETMELERİNDE HATA TÜRÜ VE ETKİLERİ ANALİZİ UYGULAMASI

ÖZ

Günlük yaşamımızın içerisinde de sürekli karşımıza çıkan hizmet kavramı, toplum yaşamının odak noktasını oluşturmasına rağmen, hizmet kavramının soyutluluğu, hizmet özelliklerinin algılanmasında ve ölçülmesinde güçlükler yaratmaktadır. Hizmet kalitesinin müşteri tarafından değerlendirilmesi, imalat ürünlerinin kalitesinin değerlendirilmesinden çok daha zordur. Dokunabilirlik, güvenilirlik, heveslilik, güvence ve empati boyutlarını birleştiren Servqual tekniği, hizmet kalitesinin ölçümünü sağlamaktadır.

Güvenilirlik, performansları sayısal olarak değerlendirilen mekanik sistemler için ele alınabileceği gibi, performansları etkinlik ölçütleriyle değerlendirilen hizmet işletmelerine de uygulanabilmektedir.

Bir hizmet sürecinin güvenilirliğinin belirlenmesinde, sürecin tüm performans ölçütleri belirlenmelidir. Sürecin karşılaması gereken performans ölçütlerinin belirlenmesinde Kalite Fonksiyon Göçerimi (KFG), sürecin potansiyel hataları önlemekte ise Hata Türü ve Etkisi Analizi (HTEA) ile kullanılmaktadır. Herkese aynı şekilde ulaştırılan rutin hizmet süreçlerinde müşteri ile karşılıklı etkileşim oldukça düşüktür. Bu tür hizmet süreçlerinde Hata Türü ve Etkisi Analizinin kullanılması uygun görülmektedir.

Bu çalışmada, Dokuz Eylül Üniversitesi Sağlık, Kültür ve Spor Dairesi Başkanlığı'na bağlı Buca Kız Öğrenci Yurdu'nda barınmakta olan öğrenciler üzerinde Servqual Tekniği ile hizmet kalitesini ölçmeye yönelik araştırmalar ile bunlara ilişkin istatistiksel analizler ve nöbetçi memur hizmet sürecinde bir HTEA uygulaması yer almaktadır.

Anahtar Sözcükler: FMEA, Hizmet Kalitesi, Servqual, Güvenilirlik, Yurt Hizmeti.

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CHAPTER ONE
INTRODUCTION

The increasingly high quality level of Japanese products and systems has resulted from the quality control efforts made by each company. However, in coping with quality-related problems in the new era of quality, conventional quality control activities may be inadequate.

Quality assurance (QA) is about managing business processes so that both the supplier and the customer are satisfied with the quality and consistency of the goods or services provided. For suppliers, QA means consistent production and delivery of a product or service. For customers, QA nurtures confidence in consistently receiving a product or service that meets their specifications.

Service companies must be able to face the challenge to offer error-free services to their customers. According to Service definition, the customer is always present during the processes and delivery of the service . If something goes wrong it will happen in the presence of the customer (Rotondaro & Oliveira, 2001).

Service industries face a special challenge: meeting customer needs while remaining economically competitive. While automated processes can make an impact, service industries are still labor-intensive, and there can be no substitute for high-quality personal interaction between service employees and customers.

Failure Mode and Effects Analysis is a technique frequently used in manufacturing sector. Especially in automotive sector its use has become quite common. It is obvious that its uses in different sectors would be beneficial since this technique enables the failures to be prevented before being presented to the end user. The costs of this technique's usage would be much lower than defective product or service being presented to the customer. Also, the prestige of the company will be sustained because the risk of presenting defective product or service is eliminated.

FMEA can also be applied to non-production areas. In general, FMEA is applied to potential product designs and manufacturing processes where the benefits are more obvious and significant. It primarily considers these applications but the scope of FMEA is much wider (The Society of Motor Manufacturers and Traders Limited [SMMT], 1989).

In FMEA for service organizations, service quality gap (Gap 5) and the other gaps creating the Gap 5, and the antecedents of each gap taken as a potential failure mode. This integration of Servqual technique and FMEA is carried out and ensured applicability of FMEA in service organizations.

The organization of this thesis is as follows: In this chapter chapter one it is given general information about Servqual technique and FMEA. Chapter two defines the service concept, features and types and implies service quality and Servqual Technique concerning its measurement. Chapter three contains definition and history of reliability, briefly implies analyses using for design and improvement of reliability; Fault Tree Analysis (FTA), Quality Function Deployment (QFD) and Failure Mode and Effects Analysis. In the fourth chapter, Failure Mode and Effects Analysis (FMEA) is explained in detail. Chapter five contains an application of Servqual Techniques, to measure Buca Female Student Hostel's Service Quality, FMEA concerning officer on duty service in hostel and some statistical analyses on statistical software programs Minitab and SPSS. It is concluded in Chapter six by consisting the results obtained in this research and some suggestions.

1.1 Servqual Technique

Managers in the service sector are under increasing pressure to demonstrate that their services are customer-focused and that continuous performance improvement is being delivered. Given the financial and resource constraints under which service organisations must manage it is essential that customer expectations are properly understood and measured and that, from the customers' perspective, any gaps in service quality are identified. This information then assists a manager in identifying

cost-effective ways of closing service quality gaps and of prioritizing which gaps to focus on – a critical decision given scarce resources.

SERVQUAL consists of a model developed by Parasuraman, Zeithaml and Berry (1986) which helps measure service quality through a series of steps. It concentrates on the notion of perceived quality. Perceived quality refers to a consumer's judgment about a product's overall excellence. Perceived quality is more subjective than other definitions of quality. Through research conducted with focus groups, the researchers asked about the characteristics a service provider should have in order to have high quality. They found out that consistently all of the members of the focus group had similar criteria. With these findings, they created 10 quality dimensions. Later on, researchers found that these ten dimensions overlapped and that customers could only distinguish five dimensions. This perception of service quality builds up from attitudes developed by customers over time towards a product or service. The other element present is consumer satisfaction that has been achieved by the actual use of a product or service.

One of the aims of this technique involves the use of SERVQUAL instrument in order to ascertain any perceived gaps between customer expectations and perceptions of the service offered. Another aim of this technique is to point out how management of service improvement can become more logical and integrated with respect to the prioritized service quality dimensions and their affections on increasing/decreasing service quality gaps.

1.2 Failure Mode and Effects Analysis (FMEA)

Failure Mode and Effects Analysis (FMEA) is a process improvement technique. It is a systematic and analytical quality planning tool for identifying potential problems that could be encountered and their associated causes during the process, design, production and service stages. The technique of FMEA was first developed for the aerospace and defense industries and was subsequently widely adopted as one of the key process improvement tools in other industries such as the automotive,

electronics, etc. This technique is also widely used in the Six Sigma Breakthrough Methodology initiatives.

For years, failure mode and effects analysis (FMEA) has been an integral part of engineering designs. For the most part, it has been an indispensable tool for industries such as the aerospace and automobile industries. Although there are many types of FMEAs (design, process, etc.).

FMEA is a technique used to identify, prioritize, and eliminate potential failures from the system, design or process before they reach the customer, and to take corrective actions. FMEA was one of the first systematic techniques for failure analysis. FMEA is the most widely used reliability analysis technique in the initial stages of product/system development.

CHAPTER TWO

SERVICE AND SERVICE QUALITY

2.1 Concept of Service

At the present day, concept of service is becoming more important and content. As service concept is showing up in our daily life, it composes the focal point of the social life. However, the intangibility feature of service concept makes difficulties in perceiving and measuring features of service. Standardizing of services that have different features is considerably hard. Even producing and presenting services from the same producer can be different from each others.

Service is the results generated, by activities at the interface between the supplier and the customer and by supplier internal activities, to meet customer needs (International Organization for Standardization [ISO], 1991).

Service delivery is those supplier activities necessary to provide the service (ISO, 1991).

Services contain a lot more different features than products. For example, services are intangibility. This means that service can not be tangible, audible, transportable and can not be seen, and physically laid out. Consequently one service, can not be thought as seperate from its producer and marketed in the most of fields. These different features in service require different approchements for management point of view.

In service companies, there are several activities for distributing a service, that service managers are responsible. Generally, first, defining a service concept that the company is plannig to provide and forming a distribution system must be handled. Second, components of the service distribution system should be planned and

alayzed, and then, strategies for management of the supply and demand in system of service delivery should be defined and applied.

2.2 Service and Service Delivery Characteristics

Service and manufacturing companies concerning a product or service management, have different features in both of techniqual and managerial issues from each other.

Key differences between service and manufacturing companies are as followed:

- In service organisations, production and consumption are simultaneous,
- Services are intangible,
- There are no inventories in production of service,
- There can be considerable variability in service delivery,
- Service usually consists of substantive and peripheral components.

Key differences between service and manufacturing companies in terms of managerial issues are as followed:

- In service organisations, marketing and operations functions are simultaneous,
- The customer has to come to the service delivery location,
- Intangible aspects are difficult to quantify or measure,
- In service, quality control is a mayor challenge,
- In service businesses, emphasis on key service aspects is important.

In service organisations, production and consumption are simultaneous. This is very different from a manufacturing situation. For example in a restaurant, production and consumption of the service are taked place at the same time. However, in most manufacturing operations, there are inventories between each stage of production, and a finised goods inventory. When it is started with the raw materials and begun the production process, in the end of stage one it is obtained

semi-finished goods that go into an inventory. The semi processed and finished goods might be in inventories for a considerable amount of time. There would be a considerable lag between the time the product was produced and the time it was consumed. That is the fundamental difference between manufacturing and service businesses.

Services are intangible. When it is bought something that is manufactured, it has a size and a shape and it is observed by customers. They can touch it, see it, and it is very tangible in nature. For the services, the attitude and the feelings that are part of the whole experience are intangible. So there are no possibility that the customers can see it and measure its productivity before they buy it. Intangibility feature in services is a problem for the customers.

There are no inventories in production of service. In manufacturing businesses, if the demand suddenly decreases, that inventory is the buffer between production and the demand. The goods stay in inventory and sell later. It is not possible to hoard services. For example, if there are too many seats on an airline or if the airplane is too large for the demand, it can not been saved those seats for later. When that flight takes off without passengers, those seats are gone. In this situation, the company's cost of a flight substantially increases.

There can be considerable variability in service delivery. This has a lot to do with the fact that many of the important aspects of service are intangible. There can be considerable variability due to human nature and how people are feeling at different points in time, the pressure they are under or how they are treated by their employer. So it is much more difficult to get consistency in delivering a service than in producing a physical product in a manufacturing system where there are detailed specifications and tight quality control.

Service usually consists of substantive and peripheral components. For example, in a restaurant, the substantive components would be the food. The peripheral components would include such things as the comfort, the ambiance, etc.

In service organisations, marketing and operations functions are simultaneous. Marketing and operations are very closely linked because production and consumption take place at the same time. The service provider that are involved in the production of the service are actually marketing the service while they are delivering it. Many employees are both production workers and sales/marketing staff as they perform their duties.

The customer has to come to the service delivery location. For example, if a customer want a haircut he or she has to go to a place where they cut hair. Customers' participation is necessary during the service delivery. But in the present day, with the technological developments and electronic service, there is a whole new world of service businesses from which it will been able to access or are already accessed services. These services, which are different from the traditional ones, can be used right in costomers' houses. These services create a whole new set of challenges for the managers of service businesses.

Intangible aspects are difficult to quantify or measure. With a physical product that comes off the production line, it can be looked at the product, subjected it to testing, examined it for defects, and easily measured whether or not it meets the specifications. But from a manager's point of view, unlike with the manufacturing business, it is much more difficult to know if a service meets customer expectations.

In service, quality control is a mayor challenge. In service businesses quality control is a much greater challenge than in manufacturing businesses because many services include intangible aspects and it is difficult to quantify and measure.

In service businesses, emphasis on key service aspects is important. Depending on the kind of service package it is offered the customer, there are certain things that are vital to the service and they have to be emphasized in its delivery. For example, a cargo firm emphasizes speed and reliability.

2.3 An Open-Systems View of Services

The role of the service operations manager includes the functions of both production and marketing in an open system with the customer as a participant. When considering services, the traditional manufacturing separation of the production and marketing functions, with finished-goods inventory as the interface, is neither possible nor appropriate. Marketing performs two important functions in daily service operations (Fitzsimmons, 1994):

1. educating the customer to play a role as an active participant in the service process,
2. promoting demand smoothing to match service capacity.

The customer, as shown in Figure 2.1, is viewed as an input transformed by the service process into an output with some degree of satisfaction.

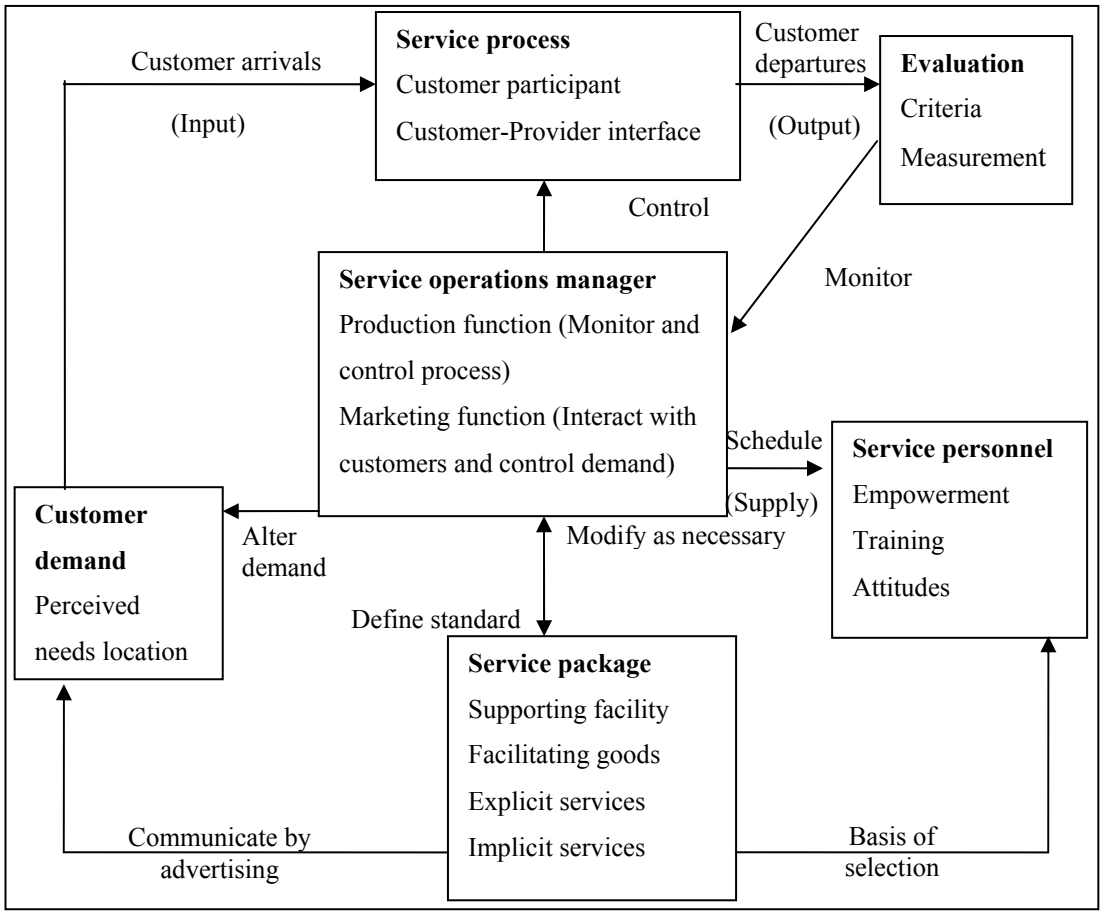


Figure 2.1 Open-systems view of service operations (Fitzsimmons, 1994)

Marketing activity must be coordinated with scheduling staff levels and controlling and evaluating the delivey process. By necessity, the operations and marketing functions are integrated for service organizations. For services, the process is the product. The presence of the customer in the service process negates the closed-system perspective taken in manufacturing. Techniques to control operations in an isolated factory producing a tangible good are inadequate for services. No longer is the process machine-paced and the output easily measured for compliance with specifications. Instead, customers arrive with different demands on the service; thus, multiple measures of performance are necessary. Service employees interact directly with the customer, with little opportunity for management intervention. This requires extensive training and empowerment of employees to act appropriately in the absence of direct supervision (Fitzsimmons, 1994).

2.4 Classifying Services

Classifying of service companies and manufacturing companies are different from each other. In manufacturing companies, classifications such as mass production, batch production, and flow production can be done easily, however, this is harder in service companies (Taşpınar, 1999).

A general discussion of service strategy is complicated by the diversity of service firms in the economy and by their differing customer relationships. However, strategic insights that transcend industry boundaries are needed to avoid the myopic view, which is prevalent among service managers, that concepts do not translate from one industry to another (Fitzsimmons, 1994).

2.4.1 Classifying Services for Nature of The Service Act

As shown in Table 2.1, the service act can be considered across two dimensions: who or what is the direct recipient of the service and the tangible nature of the service. This creates four classification possibilities (Fitzsimmons, 1994):

1. tangible actions directed to the customer,
2. tangible actions directed to the customer's possessions,
3. intangible actions directed at the customer's intellect,
4. intangible actions performed on customer's assets.

This classification scheme raises questions about the traditional way services have been delivered. For example, does the customer need to be present physically throughout the service, only to initiate or terminate the transaction, or not at all? If customers need to be present physically, then they must travel to the service facility and become part of the process, or the server must travel to the customer. This has significant implications for facility design and employee interaction because the impressions made will influence the perceptions of the service. In addition, questions are raised concerning the impact of facility location and business hours on customer convenience (Fitzsimmons, 1994).

Table 2.1 Classifying services for nature of the service act (Fitzsimmons, 1994)

Nature of the Service Act	**Direct Recipient of the Service**	
	People	Things
Tangible actions	**Services directed at people's bodies:** Health care Passenger transportation Beauty salons Exercise clinics Restaurants Haircutting	**Services directed at goods and other physical possessions:** Freight transportation Industrial equipment repair and maintenance Janitorial services Laundry and dry cleaning Landscaping/lawn care Veterinary care
Intangible actions	**Services directed at people's minds:** Education Broadcasting Information services Theaters Museums	**Services directed at intangible assets:** Banking Legal services Accounting Securities Insurance

2.4.2 Classifying Services for Relationship with Customers

Service firms have the opportunity to build long-term relationships because service customers conduct their transactions directly with the provider, most often in person. In contrast, manufacturers have traditionally been isolated from the eventual end user by a distribution channel consisting of some combination of distributors, wholesalers, and/or retailers. Table 2.2 contrasts the nature of the customer's membership with the nature of the service delivery. The value to the firm of customer membership is captured in this table (Fitzsimmons, 1994).

Knowing its customers is a significant competitive advantage to the service organization. Having a data base of customers' names and addresses and their service use permits target marketing and individual treatment of customers.

Table 2.2 Classifying services for relationship with customers (Fitzsimmons, 1994)

	Type of Relationship between Service Organization and Its Customers	
	Membership relationship	No formal relationship
Contiuous delivery of service	Insurance Telephone subscription College enrollment Banking Association services	Radio station Police protection Lighthouse Public highway
Nature of Service Delivery Discrete transactions	Commuter ticket or transit pass Sports club	Car rental Mail service Toll highway Movie theater Restaurant

2.4.3 Classifying Services for Customization

An opportunity exists to tailor the service to the needs of the customer because services are created as they are consumed, and the customer is often a participant in the process. A service permits customization. For example, in a fast-food restaurant, there are menus for children and adults. These services are customized for customers' ages. The contributions that customization of services provides to service company, in two dimensions, are shown in Table 2.3. But in practise, characteristic of service or service personnel is inefficient in customazition of the provided service.

Table 2.3 Classifying services for customization (Fitzsimmons, 1994)

		Extent to Which Service Characteristics Are Customized	
		High	Low
Extent to Which Customer Contact Personnel Exercise Judgement in Meeting Individual Customer Needs	High	Professional services Surgery Taxi service Plumber Education (tutorials) Gourmet restaurant	Education (large classes) College food service
	Low	Telephone service Hotel services Family restaurant	Public transportation Movie theater Spectator sports Fast-food restaurant

2.4.4 Classifying Services for Nature of Demand and Supply

The time perishability of service capacity creates a challenge for service managers because they lack the option avaliable to manufacturers of producing and storing inventory for future sale. But the extent of demand and supply imbalances varies across service industries, as shown in Table 2.4.

2.4.5 Classifying Services for Method of Service Delivery

As shown in Table 2.5, the method of service delivery has both a geographic components and a level of customer interaction component. Services with multiple sites have significant management implications for ensuring quality and consistency in the service offering.

Table 2.4 Classifying services for nature of demand and supply (Fitzsimmons, 1994)

Extent to Which Supply Is Constrained	Extent of Demand Fluctuation over Time: Wide	Extent of Demand Fluctuation over Time: Narrow
Peak demand can usually be met without a major delay	Electricity Natural gas Telephone Hospital maternity unit Police and fire emergencies	Insurance Legal services Banking Laundry and dry cleaning
Peak demand regularly exceeds capacity	Accounting and tax preparation Passenger transportation Hotels and motels Restaurants Theaters	Services similar to those above but with insufficient capacity for their base level of business.

The classification schemes described above are useful in suggesting strategic alternatives and avoiding industry myopia. However, before a service strategy can be formulated an understanding of the competitive nature of the industry must be appreciated (Fitzsimmons, 1994).

Table 2.5 Classifying services for method of service delivery (Fitzsimmons, 1994)

Nature of Interaction between Customer and Service	Availability of Service Outlets: Single site	Availability of Service Outlets: Multiple site
Customer goes to service organization	Theater Barbershop	Bus service Fast-food chain
Service organization comes to customer	Taxi Lawn care service Pest control service	Mail delivery Emergency repairs
Customer and service organization transact at arm's length	Credit card company Local TV station	Broadcast network Telephone company

2.5 Structure of Service Quality System

In most cases the control of service and service delivery characteristics can only be achieved by controlling the process that delivers the service. While remedial action is sometimes possible during service delivery, it is usually not possible to rely on final inspection to influence service quality at the customer interface where customer assessment of any nonconformity is often immediate (ISO, 1991).

Figure 2.2 illustrates that the customer is the point of the three key aspects of a quality system. It also illustrates that customer satisfaction can only be assured when there is harmony of interaction between the management responsibility, the personnel and material resources and the quality system structure.

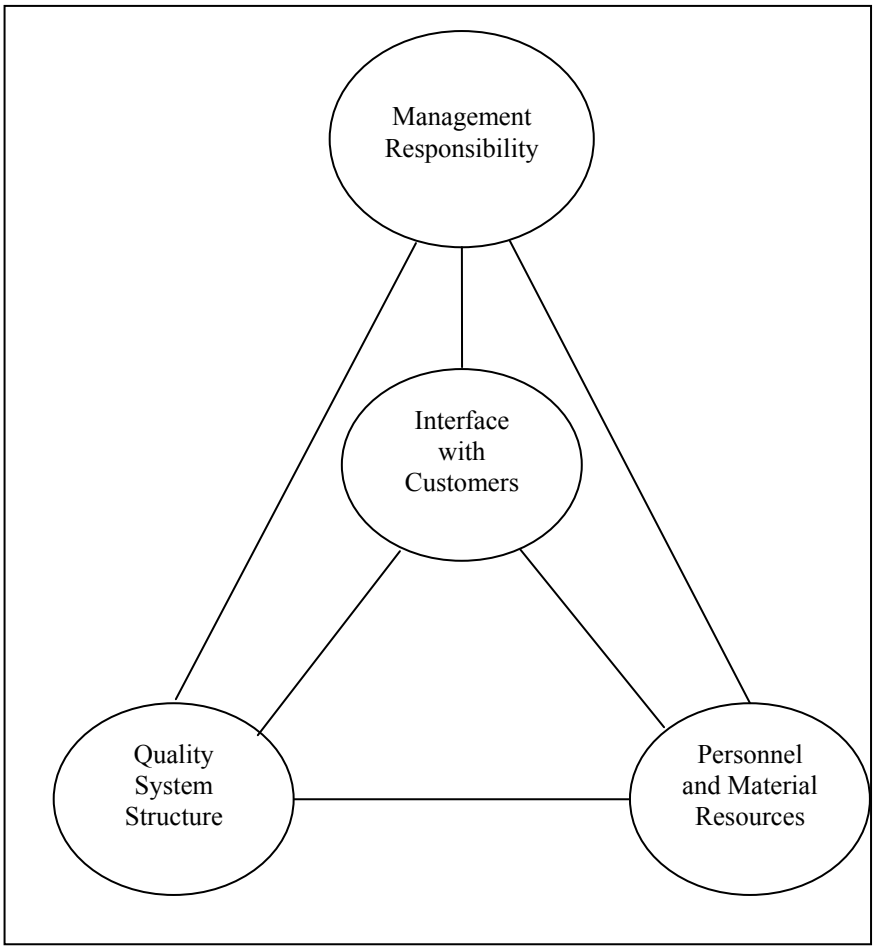


Figure 2.2 Key aspects of a quality system (ISO, 1991)

2.5.1 Management Responsibility

Management is responsible for establishing a policy for service quality and customer satisfaction. Successful implementation of this policy is dependent upon management commitment to the development and effective operation of of a quality system. The responsibility for and commitment to a quality policy for the service organization belongs to the highest level of management (ISO, 1991).

Management of company should form goals of quality to perform the quality policy, prioritize this goals, and perform the primary goals as quality activities. Primary goals should include:

- customer satisfaction consistent with professional standards and ethics,
- continuous improvement of the service,

- giving consideration to the requirements of society and the environment,
- efficiency in providing the service.

To achieve the quality objectives, management should establish a quality system structure for the effective control, evaluation and improvement of service quality throughout all stages of the provision of a service (ISO, 1991).

General and specific responsibility and authority should be explicitly defined for all personnel whose activities influence service quality. This should include ensuring effective customer and supplier relationships at all interfaces within, and external to, the service organization. It is required the involvement, commitment and effective interworking of all personnel in the service organization to achieve continuouns improvement.

Management reviews should consist of well-structured and comprehensive evaluations encompassing all relevant sources of information, including (ISO, 1991):

- findings of service performance analysis; information on the overall effectiveness and efficiency of the service delivery process in achieving service requirements and customer satisfaction,
- findings of internal audits on the implementation and effectiveness of all elements of the quality system in meeting stated objectives for service quality,
- changes brought about by new technologies , quality concepts, market strategies and social or environmental conditions.

2.5.2 Personnel and Material Resources

Management should provide sufficient and appropriate resources to implement the quality system and achieve the quality objectives. A most important resource in any organization is that of the individual members of personnel involved. This is especially important in a service organization where the behaviour and performance of individuals directly impacts on the quality of service.

As a spur to the motivation, development, communication and performance of personnel, management should (ISO, 1991):

about performance and motivation;

- select personnel on the basis of capability to satisfy defined job specifications,
- provide a work environment that fosters excellence and a secure work relationship,
- implement career planning and development of personnel,
- establish planned actions for updating the skills of personnel,
- periodically assess the factors which motivate personnel to provide quality of service.

about training and development;

- provide training executives in quality management, including quality-related costs and evaluation of the effectiveness of the quality system,
- provide training of personnel (this should not be restricted to those solely concerned with quality responsibilities),
- provide education of personnel on the service organization's quality policy, objectives and concepts of customer satisfaction,
- provide training in process control, data collection and analysis, problem identification and analysis, corrective action and improvement, team working and communication methods.

Service personnel, especially those directly involved with the customer, should have adequate knowledge and the necessary skills in communication. Team activities, such as quality improvement, can be effective for improving communication between personnel. Regular communication within the service organization should be a feature at all levels of management. The existence of an appropriate information system is an essential tool for communication and for service operations (ISO, 1991).

To achieve the quality goals, one of the resources that is necessary for service organisations is material resources. These resources are service provisioning

equipments and operational needs such as accomadition provisions, transport, and information systems and operational/technical documentation.

2.5.3 Quality System Structure

The service organization should develop, establish, document, implement and maintain a quality system. The quality system elements should be structured to establish adequate control and assurance over all operational processes affecting service quality. The quality system should emphasize preventive actions that avoid the occurrence of problems.

Quality system procedures should be established to specify the performance requirements for all service processes including the three main provisioning processes (marketing, design and service delivery) which can be shown to be operating in a service quality loop, as illustrated in Figure 2.3.

The quality of service is directly influenced by actions arising from those service quality feedback measures which contribute to service quality improvements, namely (ISO, 1991):

- supplier's assessment of the service provided,
- customer's assessment of the service received,
- quality audits of the implementation and effectiveness of all elements of the quality system.

Quality feedback should also be established between interacting elements in the quality loop.

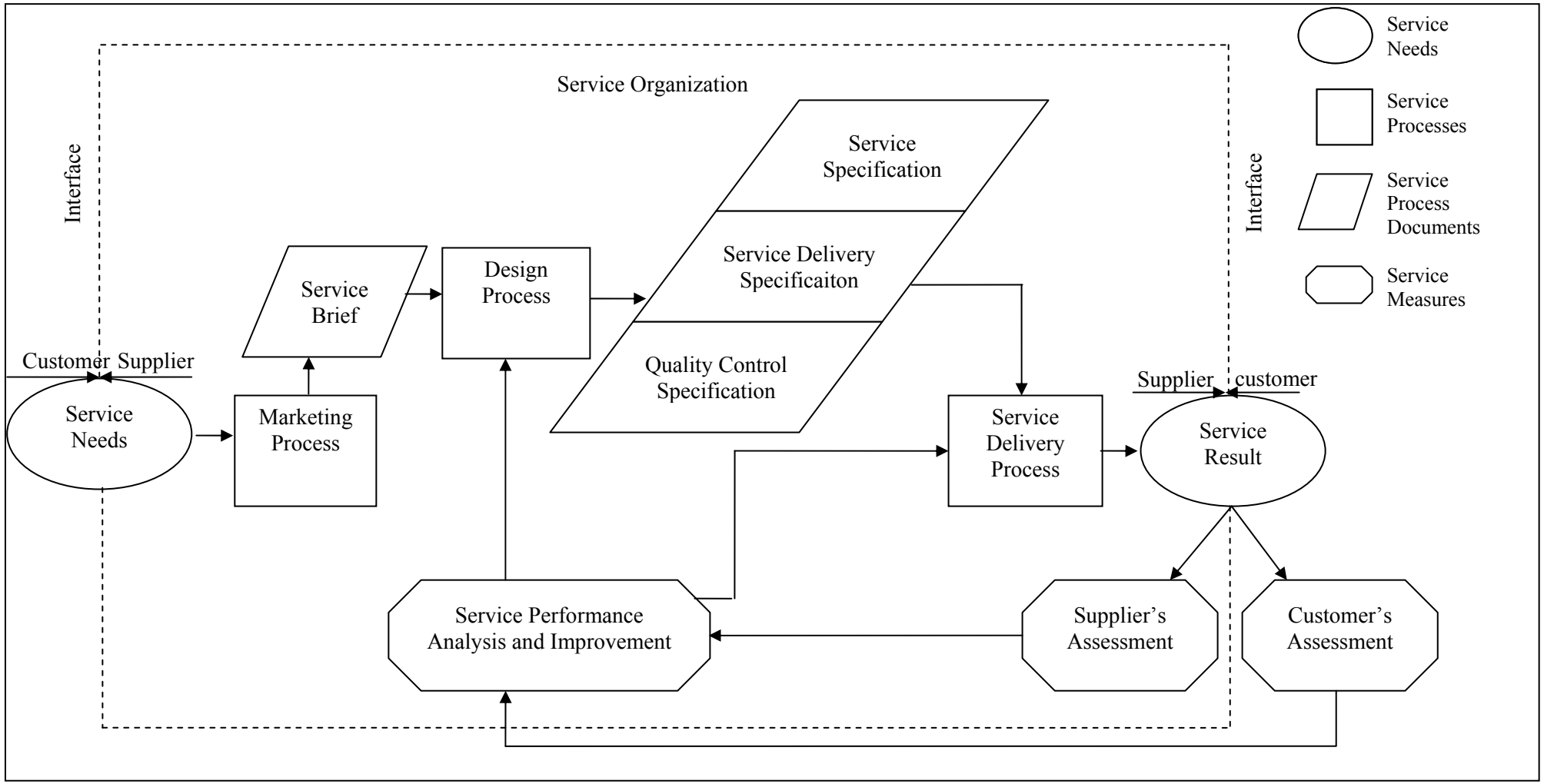


Figure 2.3 Service quality loop (ISO 9004-2, 1991)

2.5.4 Interface with Customers

Management should establish effective interaction between customers and the service organization's personnel. Personnel with direct customer contact are an important source of information for the ongoing quality improvement process. Management should regularly review the methods used for promoting contacts with customers (ISO, 1991).

2.6 Service Quality

Service quality, as perceived by a customer, can be defined as extent of the discrepancy between customer's expectations or desires and their perceptions (Zeithaml, Parasuraman, & Berry, 1990).

There are some important points about the intangible service quality. Service quality is more difficult for customers to evaluate than goods quality. Service quality perceptions stem from how well a provider performs customers' expectations about how the provider should perform. Customer do not evaluate service quality solely on the outcome of a service (how a customer's hair looks after a hair cut); they also consider the process of service delivery (how involved, responsive, and friendly the hair stylist is during the hair cut).

Managers of service enterprises know that the quality of service involves comparison of expectations and performance. The quality of service is the measurement of the extent of the provided service's accordance to the customer's expectations. Providing quality service means accommodating the service frame to the customer's expectations.

As a result quality control principles, while pertinent to evaluating and ensuring goods quality, were inadequate for understanding service quality. This inadequacy stems from the three fundamental ways services differ from goods in terms of how

they are produced, consumed, and evaluated (Zeithaml, Parasuraman, & Berry, 1990):

- First, services are basically intangible. Because they are performances and experiences rather than objects, precise manufacturing specifications concerning uniform quality can rarely be set. Unlike manufacturing products, services cannot be measured, tested, and verified in advance of sale to assure quality,
- Services –especially those with a high labor content- are heterogeneous: their performance often varies from producer to producer, from customer to customer, and from day to day,
- Production and consumption of many services are inseparable. Quality in services often occurs during service delivery, usually in an interaction between the customer and the provider.

For the customers, evaluating the quality of service is more difficult than evaluating the quality of a manufactured product. Determining the value of the quality of a given service from the customer's perspective is much more complex than determining the value of a goods (Zeithaml, Parasuraman, & Berry, 1990).

Customer satisfaction with service quality can be defined by comparing perceptions of service received with expectations of service desired. When expectations are exceeded, service is perceived to be of exceptional quality and also to be a pleasant surprise. When expectations are not met, service quality is deemed unacceptable. When expectations are confirmed by perceived service, quality is satisfactory (Fitzsimmons, 1994).

There are certain factors that influence the customer's expectations. The customers' communication with other customers (friends, neighbors etc.) who have purchased the service before may alter their expectations. Another factor affecting the expectations of the customers is personal needs. Some customers' priority may be reliability whereas others demand accessibility. Past experiences with similar services also have an influence on the customers' expectations from the service. A customer who has purchased the service before will have modified his/her

expectations from the service depending on the previous experience. The messages that service companies give directly or indirectly through commercial marketing (advertisements, brochures, warranty certificates, etc.) form an opinion as to shape the expectations of the customer. These factors that affect the expectations of the customers are listed in Figure 2.4.

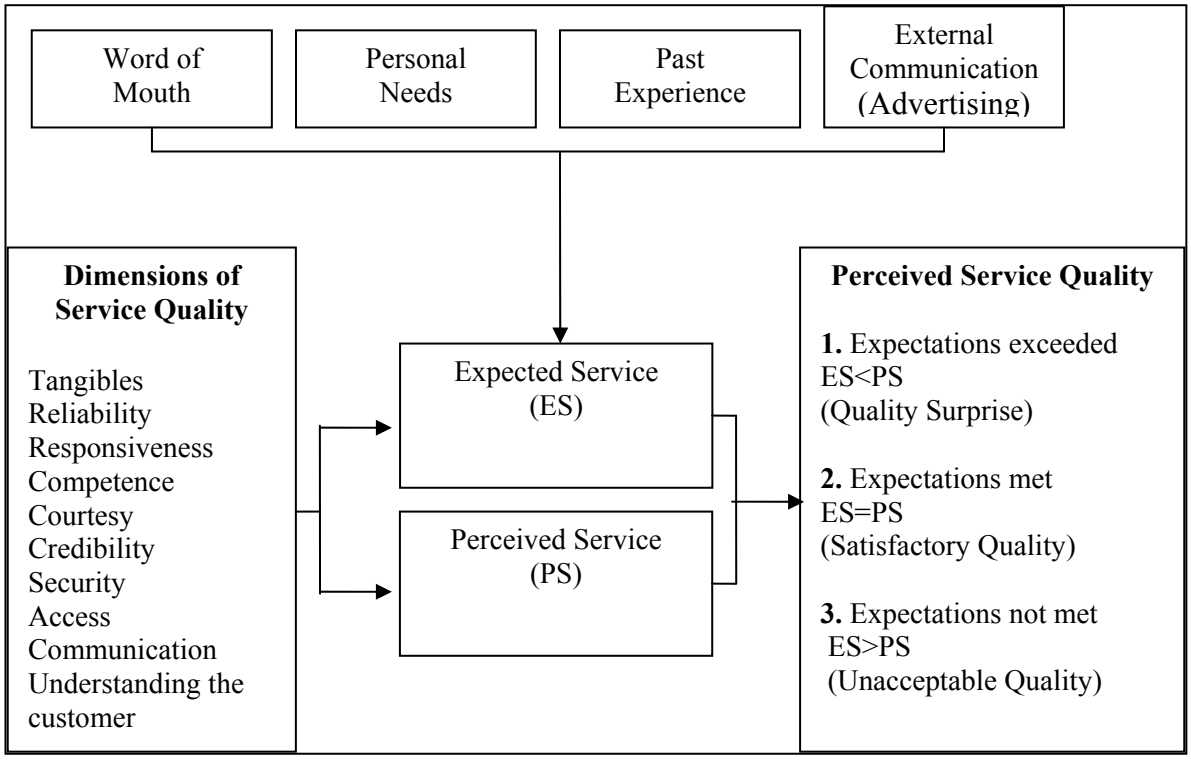


Figure 2.4 Customer assessment of service quality (Zeithaml, Parasuraman, & Berry, 1990)

2.6.1 Dimensions of Service Quality

Examining the service quality includes; the key features of the service quality from the perspective of the service company's managers as well as from the perspective of the customers and whether or not there are differences in the customers' and the service providers' views on the service.

Despite the difficulties in defining service quality, similar criteria are usually used in determining the quality regardless of the type of service. The ten dimensions

defined and illustrated in Figure 2.4 are not necessarily independent of one another (Zeithaml, Parasuraman, & Berry, 1990):

- Tangibles,
- Reliability,
- Responsiveness,
- Competence,
- Courtesy,
- Credibility,
- Security,
- Access,
- Communication,
- Understanding the customer.

These dimensions of service quality provide to be possible specifying service quality as a quantitative measure.

Reliability is defined as ability to perform the promised service dependably and accurately. The agreement of the company's image and activities, what it tells and does are considered according to this criteria. The questions that need be answered concerning the dimension are:

- ✓ Is the service carried out properly, are there failures?
- ✓ Are the demands and the directives of the customer regarded?
- ✓ Is the service done correctly at the first time?

Tangibles is defined as appearance of physical facilities, equipment, personnel, and communication materials that use during the service delivery. The questions that need be answered concerning the dimension are:

- ✓ Is the service building modern?
- ✓ Is the service provider dressed accordingly to his/her job?
- ✓ Are the documents given to the customers concerning the service comprehensible?
- ✓ Do the materials used in the providing of the service have a modern appearance?

Access means the service being easy to get to. It defines the customer's ability to get in contact with the service provider. The questions that need be answered concerning the dimension are:

- ✓ How much time does it take to reach the service building?
- ✓ Are the service providers available to be called by phone at all times?
- ✓ Is the service building well located and easily reached?
- ✓ Are the work shifts appropriate?

Courtesy means the personnel being kind, respectful and friendly in relations with the customers. The questions that need be answered concerning the dimension are:

- ✓ Are the service providers' conducts satisfactory for the customer?
- ✓ Are the service providers that go to the customer presenting a decent attitude?

Responsiveness means the eagerness in helping out the customer and quickly providing the service. The questions that need be answered concerning the dimension are:

- ✓ When a problem occurs in the process of the service, is it solved quickly?
- ✓ Are the questions coming from the customers answered with willingness?
- ✓ Is special attention and service given in case of emergencies?

If the customers are kept waiting for no considerably important reason, this creates a negative condition in means of quality. When a failure occurs in the service delivery, the ability professionally and quickly removing it creates an advantage for quality of service. For example, serving the customers complimentary drinks during a delayed flight can change the potential poor customer satisfaction in favor of the firm.

Competence means having the adequate knowledge and skills to perform the service. It denotes the extent of the service carried out according to the necessities. The questions that need be answered concerning the dimension are:

- ✓ Do the service providers have the adequate skill to carry out the service without any failure?

- ✓ Do the service providers have the adequate knowledge and capacity to carry out the service accurately?

Credibility means the company being reliable, credible and trustworthy. This includes: the quality and level of the personnel's interrelations, the attitudes that they show each other and the organizational identity formed as a result. The questions that need be answered concerning the dimension are:

- ✓ Does the service company have a good reputation?
- ✓ Does the service company give warranty to the service it provides?

Security means an environment free of danger, risk and uncertainty. This dimension involves physical security, financial security and confidentiality. The questions that need be answered concerning the dimension are:

- ✓ How safe are the equipment and the materials used in the service delivery?
- ✓ Are informational, technical, financial and legal security demands answered?

Communication means listening to the customers, speaking understandably and constantly informing the customer. The questions that need be answered concerning the dimension are:

- ✓ Are the service providers using incomprehensible technical terms while they are communicating with customers?
- ✓ Are the service providers listening to the problems of the customer sufficiently?
- ✓ Are the service providers informing the customers in a way that meets the necessities of the service?

Understanding the customer means making effort to understand the expectations and needs of the customer. The questions that need be answered concerning the dimension are:

- ✓ Do the service providers give consideration to the special needs and demands of the customers?
- ✓ Do the service providers aim to find out and specify the special needs of the customers?

This dimension means informing the customers in a language they will understand and listening to their needs. The company should adjust the terminology in a way to make the customers understand. Complexity and content should be increased when communicating with a well educated customer and decreased when communicating with a less experienced customer.

The various statistical analyses conducted in constructing SERVQUAL revealed considerable correlation among items representing several of the original ten dimensions. Figure 2.5 shows the correspondence between the original ten dimensions and SERVQUAL's five dimensions. When it is examined the content of the final items making up the two new dimensions (assurance and empathy), found that the items still represented key features of the seven dimensions that were consolidated (Zeithaml, Parasuraman, & Berry, 1990).

Assurance means that the service providers have adequate knowledge and skill and thus they are able to reassure the customer. This dimension includes the dimensions of competence, courtesy, credibility and security among the ten dimensions.

Empathy means the service company giving attention to each and every customer and maintaining that attention. This dimension includes accessibility, communication and the ability to understand the customer.

2.6.2 Gaps in Service Quality

The service model is constructed upon the gaps in the customer's perception of the service quality he/she expects and receives. This model comprises the process starting with expectations of the customer and the management's consideration of these expectations, the performing of the service and the customer's view of the service upon completion. Certain losses and hindrances that occur during the process in which service quality is sought are defined as gaps.

Servqual Dimensions / Original Ten Dimensions	Tangibles	Reliability	Responsiveness	Assurance	Empathy
Tangibles	■				
Reliability		■			
Responsiveness			■		
Competence Courtesy Credibility Security				■	
Access Communication Understanding the customer					■

Figure 2.5 Correspondence between Servqual dimensions and original ten dimensions for evaluating service quality (Zeithaml, Parasuraman, & Berry, 1990)

Customers use the five dimensions described above to form their judgments of service quality, which are based on a comparison of expected service and perceived service. The gap between expected service and perceived service is a measure of service quality: satisfaction is either negative or positive (Fitzsimmons, 1994).

Measurement of the gap between expected service and perceived service is a routine customer feedback process practiced by leading service companies. In the most of customer feedback prosesses, it is used questionnaire technique. These questionnaires are devoted to obtain the all customers' expectations before they recieve the service and perceptions after they recieve the service.

In Figure 2.4 the gap between customer exceptations (ES) and perceptions (PS) is defined as Gap5 and depend on the size and direction of the four gaps associated with the delivery of the service.

Gap 5 is related four key internal shortfalls or gaps that can contribute to poor quality of service as perceived by customer: Gap 1, the discrepancy between customers' expectations and managements' perceptions of those expectation; Gap 2, the discrepancy between managements' perceptions of customers' expectations and service-quality specifications; Gap 3, the discrepancy between service-quality specifications and actual service delivery; and Gap 4, the discrepancy between actual service delivery and what is communicated to customers about it. Customer-perceived quality shortfalls (Gap 5) is linked to these four gaps in the form of a conceptual model of service quality. The conceptual model serves as a concise framework for understanding, measuring, and improving service quality (Zeithaml, Parasuraman, & Berry, 1990).

The conceptual model in Figure 2.6 conveys a clear message to managers wishing to improve quality of service: The key to closing Gap 5 is to close Gaps 1 through 4 and keep them closed. The conceptual model also implies a logical process which companies can employ to measure and improve quality of service. This process is diagrammed in Figure 2.7. The sequence of questions in the five boxes on the left side of Figure 2.7 correspond to the five gaps embedded in the conceptual model in Figure 2.6. Spesifically, the process begins with gaining an understanding of the nature and extent of Gap 5 and then successively searching for evidence of Gaps 1 through 4, taking corrective action wherever necessary.

2.6.2.1 Gap 1: Gap Between Customers' Expectations and Management's Perceptions of Those Expectations

The first gap is the discrepancy between customer expectations and management perceptions of these expectations. Gap 1 arises from management's lack of a full understanding of how customers formulate their expectations on the basis of a number of sources: advertising, past experience with the firm and its competitors, personel needs, and communications with friends (Fitzsimmons, 1994).

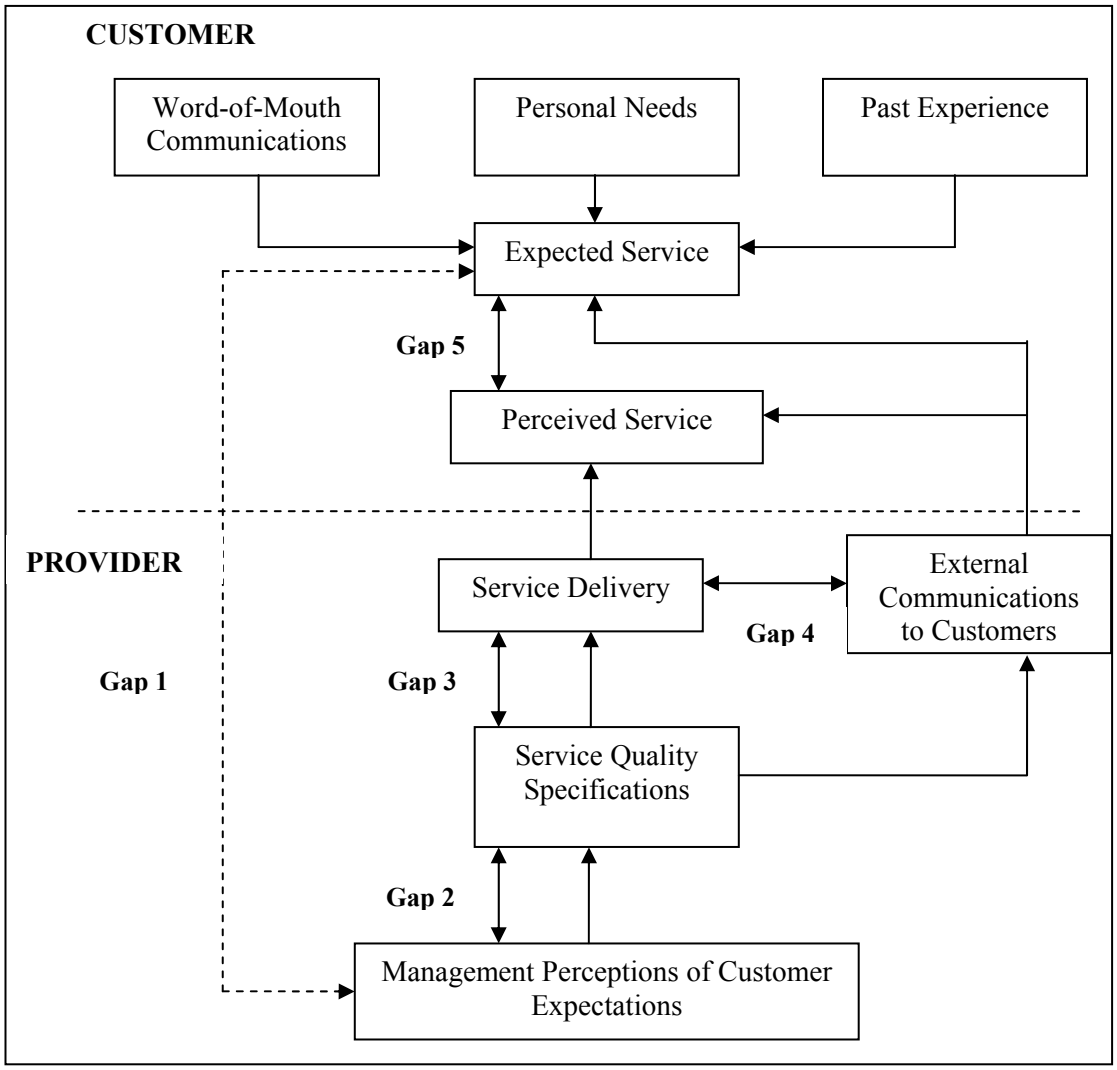


Figure 2.6 Conceptual model of service quality (Zeithaml, Parasuraman, & Berry, 1990)

It is not always easy for service providing firms to understand exactly what the customers want. The properties that a service should have to meet the consumer needs and what kind of performance should be put forth are research issues confronting the managers. The necessary first step in improving quality of service is for management to acquire accurate information about customers' expectations.

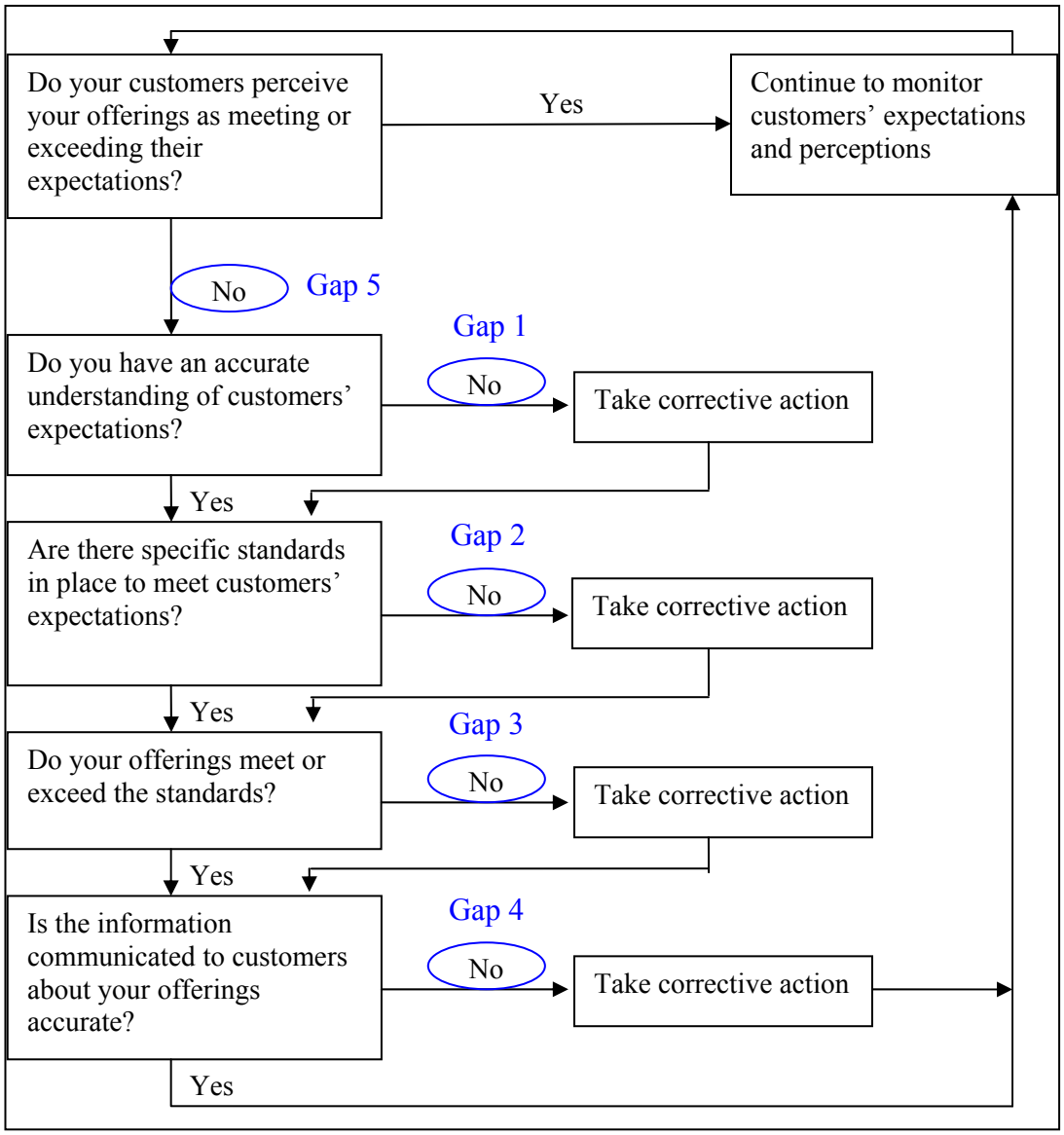


Figure 2.7 Process model for continuous measurement and improvement of service (Zeithaml, Parasuraman, & Berry, 1990)

The reseach focussing on the provider's side of the gaps model indicates that three conceptual factors contribute to Gap 1. These factors, illustrated in Figure 2.8, are (Zeithaml, Parasuraman, & Berry, 1990):

1. lack of marketing reseach orientation, evidenced by insufficient marketing research, inadequate use of research findings, and lack of interaction between management and customers,
2. inadequate upward communication from contact personnel to management,
3. too many levels of management separating contact personnel from top managers.

Table 2.6 defines these factors and presents several specific issues pertaining to them.

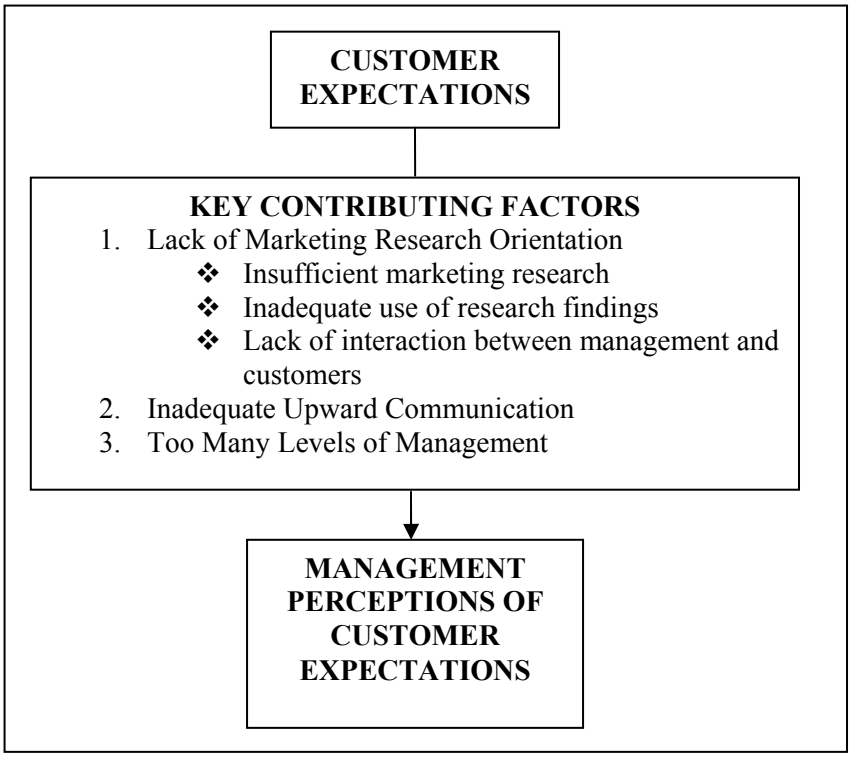


Figure 2.8 Key factors contributing to Gap 1 (Zeithaml, Parasuraman, & Berry, 1990)

To close this gap, it can be performed corrective actions on service quality issues such as researching customers' expectations, using marketing research findings effectivelly, increasing interaction between management and customers, improving upward communication from contact personnel to management, and reducing the number of levels between contact personnel and management.

Table 2.6 Conceptual factors pertaining to Gap 1 (Zeithaml, Parasuraman, & Berry, 1990)

Factor and Definition	Specific Illustrative Issues
Marketing Research Orientation: Extent to which managers make an effort to understand customers' needs and expectations through formal and informal information-gathering activities.	• Is research conducted regularly to generate information about what customers want? • Does the marketing research a company conducts focus on quality of service delivered by it? • Do managers understand and utilize the research findings?
Upward Communication: Extent to which top management seeks, stimutates, and facilitates the flow of information from employees at lower levels.	• Do managers enourage suggestions from customer contact personnel concerning quality of service? • Are there formal and informal opportunities for customer contact personnel to communicate with management? • How frequently do managers have face-to-face contact with customer contact personnel?
Levels of Management: Number of managerial levels between the topmost and bottommost positions.	• Do too many managerial levels separate top managers from those responsible for dealing with and serving customers?

2.6.2.2 Gap 2: Gap Between Management's Perceptions of Customers' Expectations and Service Quality Specifications

The second gap results from management's inability to formulate target levels of service quality to meet perceptions of customer expectations and to translate these into workable specifications. Gap 2 may result from a lack of management commitment to service quality or a perception of the infeasibility of meeting customers' expectations (Fitzsimmons, 1994).

Management's correct perceptions of customers' expectations is necessary, but not sufficient, for achieving superior quality service. Another prerequisite for

providing high service quality is the presence of performance standards mirroring management's perceptions of customers' expectations. However, a recurring theme that emerges from the executive interviews is difficulty the executives experienced in translating their understanding of customers' expectations into service-quality specifications.

Management's correct perceptions of customers' expectations is the first step in high quality service delivery. Managers use this information to form the high quality standards as a second step after accurately understanding customers' expectations.

The quality of service delivered by customer-contact personnel is critically influenced by the standards against which they are evaluated and compensated. Standards signal to contact personnel what management's priorities are and when types of performance really count. When service standards are absent or when the standards in place do not reflect customers' expectations quality of service as perceived by customers is likely to suffer (Zeithaml, Parasuraman, & Berry, 1990).

Gap 2 is a wide gap in many companies. The four conceptual factors on the gap are shown in Figure 2.9. The conceptual factors which are the reasons of Gap 2 (Zeithaml, Parasuraman, & Berry, 1990):

1. inadequate commitment to service quality,
2. lack of perception of feasibility,
3. inadequate task standardization,
4. absence of goal setting.

Table 2.7 contains the conceptual factors which are the reasons of Gap 2 and its illustrative issues.

To close this gap, it can be performed corrective actions on service quality issues such as committing to service quality by management, gaining commitment of middle management, creating possibilities for commitments, standardizing tasks, and setting service-quality goals.

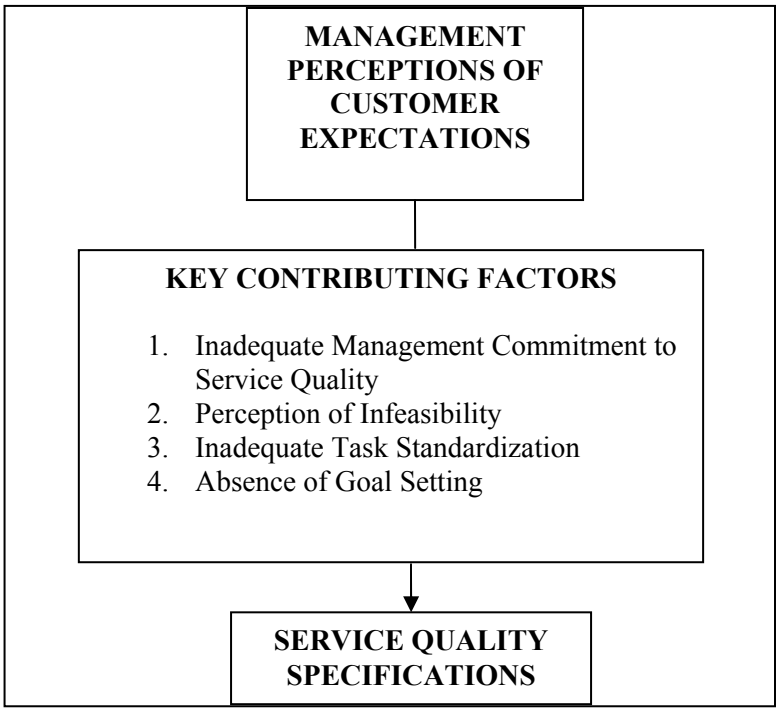


Figure 2.9 Key factors contributing to Gap 2 (Zeithaml, Parasuraman, & Berry, 1990)

Table 2.7 Conceptual factors pertaining to Gap 2 (Zeithaml, Parasuraman, & Berry, 1990)

Factor and Definition	Specific Illustrative Issues
Management Commitment to Service Quality: Extent to which management views service quality as a key strategic goal.	• Are resources committed to departments to improve service quality? • Do internal programs exist for improving the quality of service to customers? • Are managers who improve the quality of service to customers more likely to be rewarded than other managers? • Are upper and middle managers committed to providing quality service to their customers?

Perception of Feasibility: Extent to which managers believe that customer expectations can be met.	• Does the company have the necessary capabilities to meet customer requirements for service? • Do existing operations systems enable customer expectations to be met? • Can customer expectations be met without hindering financial performance? • Are resources and personnel available to deliver the level of service that customers demand? • Does management change existing policies and procedures to meet the needs of customers?
Task Standardization: Extent to which hard and soft technology are used to standardize service tasks.	• Is automation used to achieve consistency in serving customers? • Are programs in place to improve operating procedures so that consistent service is provided?
Goal-Setting: Extent to which service quality goals are based on customer standards and expectations rather than company standards.	• Is there a formal process for setting quality of service goals for employees? • Does the company measure its performance in meeting its service quality goals? • Are service quality goals based on customer-oriented standards rather than company-oriented standards?

2.6.2.3 Gap 3: Gap Between Service-Quality Specifications and Service Delivery

Completely understanding the expectations of the customers and reflecting this to the service quality specifications is not enough. Gap 3 is the difference that occurs between the specifications determined for the service, and the real provided service, and is named the service performance gap.

Clearly then, even when guidelines exist for performing services well and treating customers correctly, high-quality service performance is not a certainty. A service-performance gap (Gap 3) is still likely due to a number of constraints (poorly

qualified employees, inadequate internal systems to support contact personnel, insufficient capacity to serve). To be effective, service standards must not only reflect customers' expectations but also be backed up by adequate and appropriate resources (Zeithaml, Parasuraman, & Berry, 1990).

There are seven key conceptual factors contributed Gap 3. These factor are illustrated in Figure 2.10 (Zeithaml, Parasuraman, & Berry, 1990):

1. role ambiguity,
2. role conflict,
3. poor employee-job fit,
4. poor technology-job fit,
5. inappropriate supervisory control systems,
6. lack of perceived control,
7. lack of teamwork.

Table 2.8, defines these factors and presents several specific issues about them.

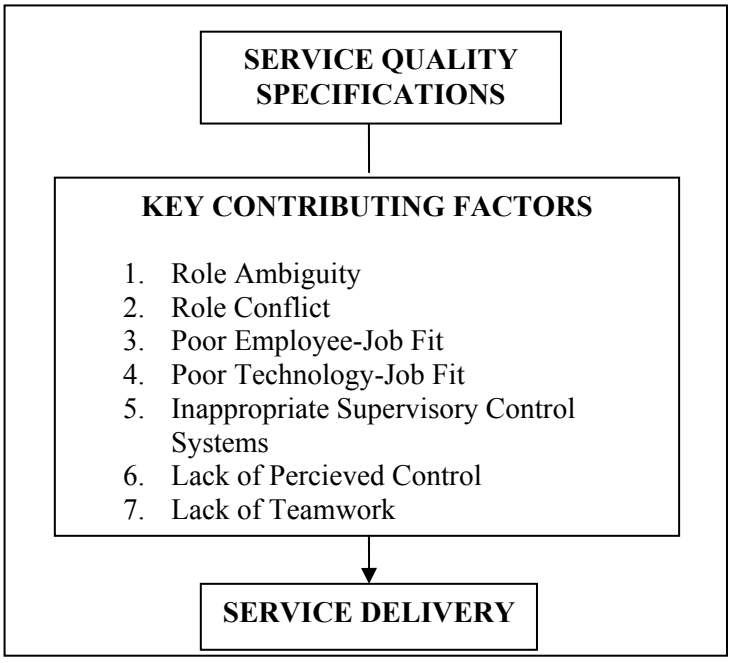


Figure 2.10 Key factors contributing to Gap 3 (Zeithaml, Parasuraman, & Berry, 1990)

Table 2.8 Conceptual factors pertaining to Gap 3 (Zeithaml, Parasuraman, & Berry, 1990)

Factor and Definition	Specific Illustrative Issues
Role Ambiguity: Extent to which employees are uncertain about what managers or supervisors expect from them and how to satisfy those expectations.	• Does management provide accurate information to employees concerning job instruction, company policy and procedures, and performance assessment? • Do meployees understand the products and services offered by the company? • Are employees able to keep up with changes that affect their jobs? • Are employees trained to interact effectively with customers? • How often does management communicate company goals and expectations to employees? • Do employees understand what managers expect from them and how to satisfy those expectations?
Role Conflict: Extent to which employees perceive that they cannot satisfy all the demands of all the individuals (internal and external customers) they must serve.	• Do customers and managers have the same expectations of employees? • How often do customer-contact employees have to depend on other support services employees to provide quality service to customers? • Do employees have more work to do than they have time to do it? • Do too many customers want service at the same time?
Employee-Job Fit: The match between the skill of employees and their jobs.	• Do employees believe that they are able to perform their jobs well? • Does the company hire people who are qualified to do their jobs? • Does management devote sufficient time and resources to the hiring and selection of employees?
Technology-Job Fit: The appropriateness of the tools and technology that employees use to perform their jobs.	• Are employees given the tools and equipment needed to perform their jobs well? • How often does equipment fail to operate?

Supervisory Control Systems: The appropriateness of the evaluation and reward systems in the company.	• Do employees know what aspects of their jobs will be stressed most in performance evaluations? • Are employees evaluated on how well they interact with customers? • Are employees who do the best job serving customers more likely to be rewarded than other employees?
Perceived Control: Extent to which employees perceive that they can act flexibly rather than by rote in problem situations encountered in providing services.	• Do employees spend time in their jobs trying to resolve problems over which they have little control? • Are employees given the freedom to make individual decisions to satisfy customers' needs? • Are employees encouraged to learn new ways to better serve their customers? • Are employees required to get approval from another department before delivering service to customers?
Teamwork: Extent to which employees and managers pull together for a common goal.	• Do employees and managers contribute to a team effort in servicing customers? • Do support services employees provide good service to customer-contact personnel? • Are employees personally involved and committed to the company • Are employees encouraged to work together to provide quality service to customers?

To close this gap, it can be performed corrective actions on service quality issues such as providing role clarity, eliminating role conflict, improving employee technology-job fit, measuring and rewarding service performance, empowering service employees, and improving teamwork.

2.6.2.4 Gap 4: Gap Between Service Delivery and External Communications to Customers About Service Delivery

Advertisements made via media and other types of communication with the customer are effective on consumer expectations. If the customers cannot find the features in the service that they were informed with in advance, this will affect their perceptions on the quality of the service. In short, external communications can affect not only customers' expectations about a service but also customers' perceptions of the delivered service.

Discrepancy between service delivery and external communications about Gap 4 adversely affect customers' assessment of service quality (Gap 5). Gap 4 essentially reflects an underlying breakdown in coordination between those responsible for delivering the service and those in charge of describing and/or promoting the service to customers. When the latter group of individuals do not fully understand the reality of the actual service delivery, they are likely to make exaggerated promises or fail to communicate to customers aspects of the service intended to serve them well. The result is poor service-quality perceptions. Effectively coordinating actual service delivery with external communications, therefore, narrows Gap 4 and hence favorably affects Gap 5 as well (Zeithaml, Parasuraman, & Berry, 1990).

There are two key conceptual factors contributed Gap 3 and illustrated in Figure 2.11. Table 2.9 defines these factors and presents several specific issues pertaining to them. These factors are (Zeithaml, Parasuraman, & Berry, 1990):

1. inadequate horizontal communication,
2. propensity to overpromise.

To close this gap, it can be performed corrective actions on service quality issues such as opening channels of communication between advertising and operations, sales and operations, human resources, marketing and operations.

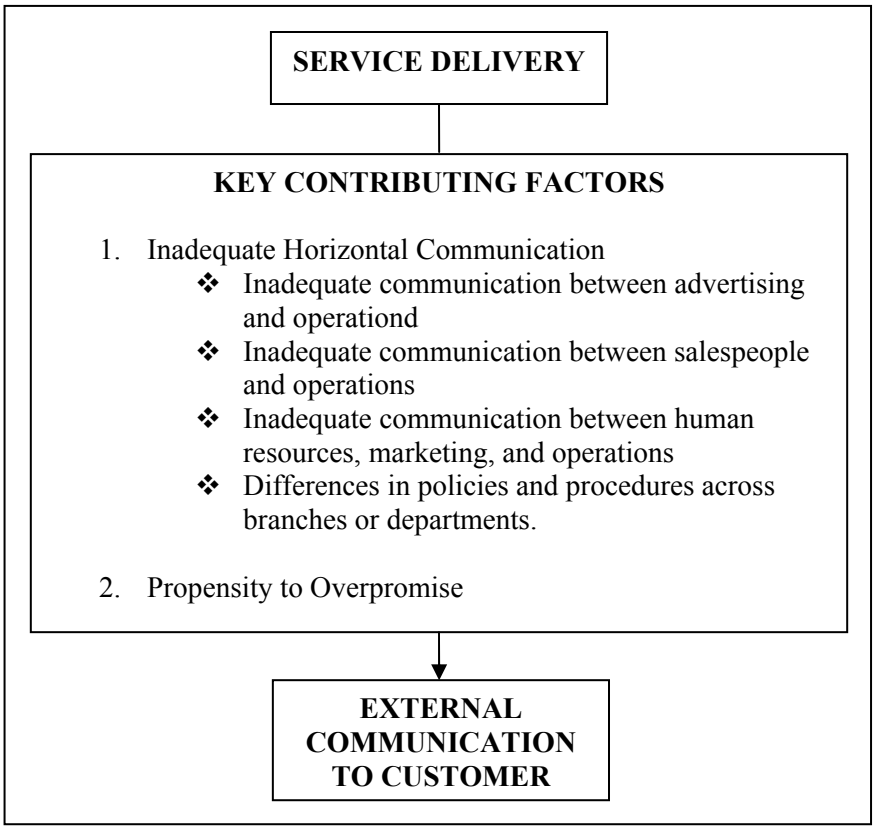


Figure 2.11 Key factors contributing to Gap 4 (Zeithaml, Parasuraman, & Berry, 1990)

Table 2.9 Conceptual factors pertaining to Gap 4 (Zeithaml, Parasuraman, & Berry, 1990)

Factor and Definition	Specific Illustrative Issues
Horizontal Communication: Extent to which communication occurs both within and between different departments of a company.	• Do customer contact personnel have input in advertising planning and execution? • Does the salesforce interact with customer contact personnel to discuss the level of service that can be delivered to customers? • Are the policies and procedures for serving customers consistentacross departments and branches?
Propensity to Overpromise: Extent to which a company's external communications do not accurately reflect what customers receive in the service encounter.	• Is there increasing pressure inside the company to generate new business? • Do competitors overpromise to gain new customers?

2.6.2.5 Extended Gap Model of Service Quality

Is one or more of the four managerial gaps more critical than the others in affecting perceived service quality? To answer this question, firms can use Servqual to capture customers' perceptions and the measure of Gaps 1 through 4 for employees' and managers' perceptions. Intuitively, it would seem that the first three gaps must be closed in order: customers' expectations must be understood before managers can set appropriate standards(Gap 2) and employees must be trained, motivated, compensated, and informed to close Gap 3. A logical progression, then, in closing the gaps is to try to close Gaps 1 through 3 sequentially. Gap 4, however, can be closed before working on the others by managing customers' expectations (Zeithaml, Parasuraman, & Berry, 1990).

What are the main organizational factors responsible for the size of each of the four service-quality gaps? A key managerial question involves the relative importance of the specific factors in delivering high-quality service to customers. If a company can implement only a few of the many organizational factors, which ones should be undertaken? To answer this question, they should be create measures of the organizational factors and related them to the measures of the four gaps. Figure 2.12 is an extended model of service quality, shows tha various organizational factors and their relationships to the service-quality gaps.

To overcome the difficulties that hinder achievement of service quality the gaps in the model must be closed. Since the reasons that cause the occurrence of the gaps are known, it is possible to define the work that must be done to remove them.

To close Gap 1, customers' demands must be known. Marketing Researches are the most efficient way to define the expectations of the customers. Questionnaires and interviews are made for this purpose, to determine the priorities of the customers' expectations.

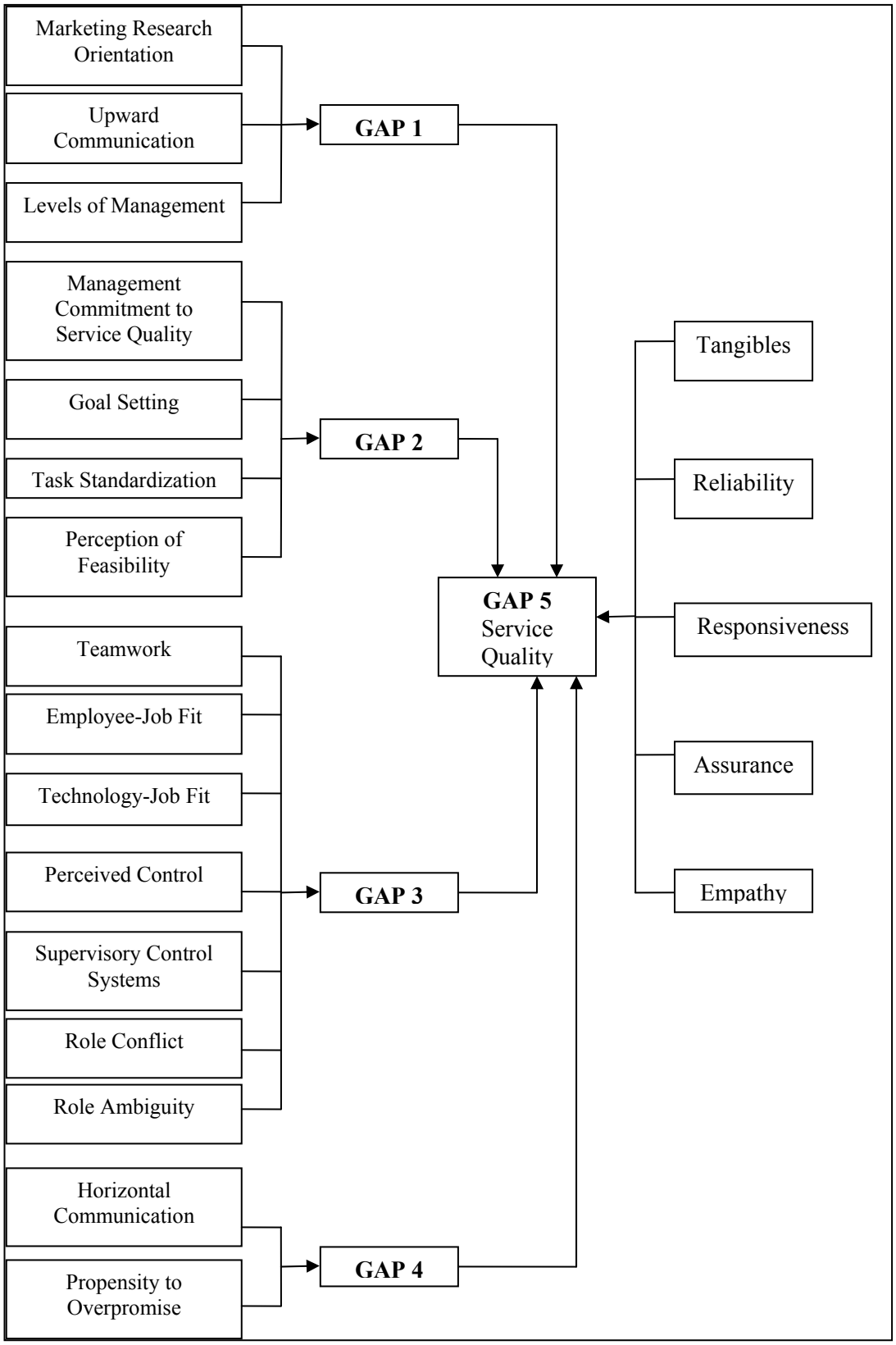


Figure 2.12 The extended gaps model of service quality (Zeithaml, Parasuraman, & Berry, 1990)

Closing Gap 2 is possible by means of process design. Quality Function Deployment, (QFD) is converting the customer requirements and expectations to technical applications in service design. QFD is adapting the customer requirements to service quality specifications and thus closing Gap 2.

Gap 3 can be closed by process control. One of the most useful tools of process control is Statistical Process Control. Statistical Process Control enables the problems to be immediately recognized and taken care of.

Closing Gap 4 is possible through accurate information flow. Gap 4 is mainly caused by deficiencies in horizontal information flow. As in Gap 3 when Statistical Process Control is maintained, it is possible for Gap 4 to be closed.

Closing of Gap 5 is possible through accurate recognition and closing of the other four gaps. Gap 1 can be indirectly determined however Gaps 2 through 4 can only be measured within the company.

2.6.3 Measuring Gaps in Service Quality

Measuring service quality is a challenge because customer satisfaction is determined by many intangible factors. Unlike a product with physical features that can be objectively measured, service quality contains many psychological features. The multiple dimensions of service quality are captured in the SERVQUAL instrument, which is an effective tool for surveying customer satisfaction that is based on the service quality gap model (Fitzsimmons, 1994).

SERVQUAL is a concise multiple-item scale with good reliability and validity that companies can use to better understand the service expectations and perceptions of their customers. As such, it provides a basic skeleton through its expectations/perceptions format encompassing statements for each of the five service-quality dimensions (tangibles, reliability, responsiveness, assurance, and empathy). The skeleton, when necessary, can be adapted or supplemented to fit the

characteristics or specific research needs of a company (Zeithaml, Parasuraman, & Berry, 1990).

To evaluate customer satisfaction in service quality, a questionnaire that includes Servqual scale is applied to customers. This questionnaire was developed by Berry, Zeithaml and Parasuraman between 1983-1990 intended to measure the difference between the expected and perceived service (Gap 5). The questionnaire is used for service delivery in many different sectors and fields, and generalized to measure the customer satisfaction on these varying service structures.

The authors of the service quality gap model developed a multiple-item scale called Servqual for measuring the five dimensions of service quality. This two-part instrument, shown in Appendix 1, has an initial section to record customer expectations for a class of services followed by a second section to record a customer's perceptions for a particular service firm. The 22 statements in the survey describe aspects of the five dimensions of service quality. A score for the quality of service is calculated by computing the differences between the ratings that customers assing to paired expectation and perception statements. This score is referred to as Gap 5. Scores for the other four gaps can also be calculated in a similar manner (Fitzsimmons, 1994).

The Servqual statements (both the expectations and perceptions sections are grouped into the five dimensions as follow (Zeithaml, Parasuraman, & Berry, 1990):

Dimensions:	Statements Pertaining to The Dimension:
Tangibles	Statements 1-4,
Reliability	Statements 5-9,
Responsiveness	Statements 10-13,
Assurance	Statements 14-17,
Empathy	Statements 18-22.

Assessing the quality of service using Servqual involves computing the difference between the ratings customers assign to the paired expectation/perception statements.

Specifically, a Gap 5 or Servqual score for each statement pair, for each customer, is computed as follows (Zeithaml, Parasuraman, & Berry, 1990):

SERVQUAL Score = Perception Score – Expectation Score

A company's quality of service along each of the five dimensions can then be assessed across all customers by averaging their Servqual scores on statements making up the dimension. For instance, if *N* customers responded to a Servqual survey, the average Servqual score along each dimension is obtained through the following two steps (Zeithaml, Parasuraman, & Berry, 1990):

1. For each customer, add the Servqual scores on the statements pertaining to the dimension and divide the sum by the number of statements making up the dimension,
2. Add the quantity obtained in step 1 across all *N* customers and divide the total by *N*.

The Servqual scores for the five dimensions obtained in the preceding fashion can themselves be averaged (summed and divided by five) to obtain an overall measure of service quality. This overall measure is an unweighted Servqual score because it does not take into account the relative importance that customers attach to the various dimensions. An overall weighted Servqual score that takes into account the relative importance of the dimensions is obtained through the following four steps:

1. For each customer, compute the average Servqual score for each of the five dimensions. This step is the same as the first step in the two-step procedure obtained earlier,
2. For each customer, multiply the Servqual score for each dimension (obtained in step 1) by the importance weight assigned by the customer to that dimension. The importance weight is simply the points the customer allocated to the dimension divided by 100,
3. For each customer, add the weighted Servqual scores (obtained in step 2) across all five dimensions to obtain a combined weighted Servqual score,
4. Add the scores obtained in step 3 across all *N* customers and divide the total by *N* (Zeithaml, Parasuraman, & Berry, 1990).

2.6.3.1. Measuring of Gap 1

From a measurement standpoint, Gap 1 is different from the other three service-provider gaps because it crosses the boundary between the customer and provider sides of the conceptual model. Specifically, its measurement requires a comparison of responses pertaining to expectations from two different samples- customers and managers.

As the directions for the first two sections of Appendix 2 imply, the data generated from those sections pertain to managers' perceptions of customers' expectations and the relative importance customers attach to the five quality dimensions. The extent of Gap 1 can, therefore, be measured by determining the discrepancy between the managers' ratings and the customers' ratings on the corresponding questions on the Servqual Questionnaire (Appendix 1). Specifically, a Gap 1 score along each of the five dimensions is computed as follows (Zeithaml, Parasuraman, & Berry, 1990):

1. Determine the average expectation score along the dimension for the customer sample. (This can be done by using a procedure similar to the two-step procedure for determining the average Servqual score along each dimension.),
2. Determine the average expectation score along the dimension as percieved by the manager sample, using the same procedure as under step 1 but on data from the manager sample,
3. Subtract the average score determined in step 1 from the average score determined in step 2. The resulting difference is the Gap 1 score along the dimension (the more negative the Gap 1 score, the worse the gap).

An overall Gap 1 score can also be computed by first averaging the scores across the five dimensions for each sample separately and then computing the difference between the two sample average. To compute a weighted overall Gap 1 score, one needs to first compute a weighted expectation score for each sample separately (using a procedure similar to the four step procedure for computing a weighted Servqual score) and then compute the difference between the two weighted sample

scores. The weighted overall Gap 1 score captures the discrepancies between customers and managers on both expectations along the five dimensions and the relative importance of the dimensions (Zeithaml, Parasuraman, & Berry, 1990).

2.6.3.2 Measuring of Gaps 2 Through 4

It is measured Gaps 2 through 4 by asking samples of employees in the companies participating in this phase of this research to directly indicate their perceptions of the extent of those gaps. Specifically, for each gap, employees respondents used a seven-point scale to indicate the extent of the gap along each of the five service quality dimensions. Appendix 3 contains the questionnaires that are used to measure Gaps 2, 3, and 4. on these scales, higher numbers imply smaller gaps. An overall measure of each gap is obtained by averaging the scores across the five rating scales pertaining to the gap. Gaps 1 and 2 are managerial gaps in that the key company employees to whom they pertain are managers. Gap 1 stems from managers' lack of understanding of customers'expectations and Gap 2 represents managers' failure to set appropriate service specifications. Gaps 3 and 4, in contrast, pertain more to first-line service employees because they are the ones whose service-delivery performance may fall short of service specifications (Gap 3) and/or promises made to customers through external communications (Gap4). Therefore, on the basis of closeness to and knowledge about the various gaps, the most appropriate survey respondents are managers for measuring Gaps 1 and 2 and customer-contact personnel for measuring Gaps 3 and 4 (Zeithaml, Parasuraman, & Berry, 1990).

2.6.3.3 Measuring Antecedents of Gaps

Appendix 4 contains the set of statements in the questionnaire it is used to survey managers. These statements pertain to potential antecedents of the two managerial gaps (Gaps 1 and 2). The specific antecedents and statements on the questionnaire pertaining to them follow (Zeithaml, Parasuraman, & Berry, 1990):

Antecedents of Gap 1:	Corresponding Statements:
Marketing Research Orientation	Statements 1-4,

Upward Communication	Statements 5-8,
Levels of Management	Statement 9,
Antecedents of Gap 2	Corresponding Statements,
Management's Commitment to Service Quality	Statements 10-13,
Goal Setting	Statements 14-15,
Task Standardization	Statements 16-17,
Perception of Feasibility	Statements 18-20.

Appendix 4 also contains the set of statements in the questionnaire that it is used to survey contact personnel. These statements pertain to potential antecedents of the two gaps representing performance shortfalls on the part of contact personnel (Gaps 3 and 4). The specific antecedents and the questionnaire statements pertaining to them follow (Zeithaml, Parasuraman, & Berry, 1990):

Antecedents of Gap 3:	Corresponding Statements:
Teamwork	Statements 1-5,
Employee- job Fit	Statements 6-7,
Technology- job Fit	Statement 8,
Perceived Control	Statements 9-12,
Supervisory Control Systems	Statements 13-15,
Role Conflict	Statements 16-19,
Role Ambiguity	Statements 20-24,
Antecedents of Gap 4	Corresponding Statements,
Horizontal Communication	Statements 25-28,
Propensity to Overpromise	Statements 29-30.

The average score for each antecedent (on a scale of 1 to 7 on which the higher the score the more favorable the current status of the antecedent) can be computed through the following three steps:

1. For negatively worded statements pertaining to the antecedent, reverse the ratings given by the respondents (score 7 as 1, 6 as 2, etc.),

2. For each respondent, add the scores on the statements comprising the antecedent and divide the total by the number of statements,
3. Add the scores obtained in step 2 across all respondents and divide the total by the number of respondents (Zeithaml, Parasuraman, & Berry, 1990).

CHAPTER THREE

RELIABILITY

3.1 Definition of Reliability

In our day, social, cultural, economic and technological developments have caused the working conditions of companies and the environment in which they are situated to become much more complex than the earlier times. Due to this, the complexity in the products and services has become much more complex in correlation. Therefore the endurance of products or the services produced in the market is dependant on their ability to meet the requirements of the customers. One of the important aspects for the customer is reliability. For a product or a service to be functional in the required level and duration it has to be reliable.

Quality and reliability are not free, but poor quality and reliability usually cost much more than good quality and reliability. Warranties, liabilities, recalls, and repairs cost millions of dollars each year because quality and reliability were not given enough emphasis during the design , manufacture, and use stages of product development to attain customer satisfaction. Just as in medicine, the cost of preventing poor quality and reliability is usually much less than the resulting costs of inferior quality and reliability (Ireson, Coombs, & Mess, 1996).

Starting in the early 1950s, the word reliability acquired a highly specialized technical meaning in relation to the control of quality of manufactured product. Many formal definitions have been proposed that are similar in their general intent but differ a bit in their exact phrasing. Three of these are as follows (Grant & Leavenworth, 1996):

- "Reliability is the probability of a device performing its purpose adequately for the period of time intended under the operating conditions encountered."

- “The reliability of a (system, device, etc.) is the probability that it will give satisfactory performance for a specified period of time under specified operating conditions.”
- “Failure is the inability of an equipment to perform its required function, and reliability is the probability of no failure throughout a prescribed operating period.”
- Bazovsk states the modern concept of reliability in popular language as fallows: “Reliability is the capability of an equipment not to break down in operation.”

One obvious point in common among these definitions is that reliability is defined as a probability. Another important point is that all the definitions imply the need for an exact statement of what constitutes failure (that is, inadequate or unsatisfactory performance).

In our day, the quality in the product or the service has become much more important than its price. Good quality and high reliability, especially in the competitive sectors of the market, is known to be more important than the price. A product’s economic validity duration and life are among the factors that determine its levels of quality. Since in real life nothing is certain, the product’s validity is considered as its probability of working within its lifetime without breaking down.

Reliability could be regarded from the qualitative and the quantitative views. Reliability from the qualitative view is comparatively being without functional failures. In quantitative view, it is possible to express the general definition:
“Reliability is the possibility of a system’s, a product’s or a component’s carrying out its expected function in a determined time, environment and working conditions without malfunctioning” (Zacks, 1992).
Consequently, three parameters are thought on reliability,

1. The expected performance or task from the product or the service (function),
2. Working and environment conditions,
3. The working duration.

"Reliability is defined in many different ways, but the most widely accepted definition states that it is the ability or capability of the product to perform the specified function in the designated environment for a minimum length of time or minimum number of cycles or events" (Ireson, Coombs, & Mess, 1996).

Therefore reliability is one of the important characteristics of the quality applicable for products, systems and services.

3.2 Reliability in Services

Reliability can be considered for mechanical systems whose performances could be measured in quantity, as well as service companies whose performances are measured in efficiency criteria.

Service companies are structurally made of processes. All their subsystems are therefore processes. Because of this, the reliability of the service companies can be measured with the reliability of the processes it contains. The service processes are also meeting the reliability definitions. But it has a difference in measuring and calculating of performance. In accordance to this,
"The reliability of a service process is the value in time of its effectiveness of meeting the expected performance criteria" (Taşpınar, 1999).

In service companies reliability requires some practices. For example, service must have reliable design, reliable tools, reliable service providers, reliable supervisory program, reliable data analysis, reliable informational feedback and accurate procedure. For those reasons reliability has an important role in designing, production and operation phases of a system.

In a service manager's making decision process on the given service's reliability requirements, the most important factor is the customer's voice. The information coming from the customer about performance give ideas to the provider on which conditions reliability can be achieved. The customers want the process in which they

are using a product to be long and free of problems. To maximize the customer satisfaction and to meet the requirements of the customer efficiently is possible by providing error-free service.

To ensure the reliability of a service providing firm;

1. establishing of a reliability program,
2. monitoring and controlling of purveyor firms,
3. establishing of an error reporting system,
4. proper error analysis,
5. carrying out of corrective actions,
6. construction of an error investigating system,
7. execution of FMEA completely.

are necessary.

3.3 The Importance of Reliability

In present day, social, cultural, technological and economic advancements have resulted in the importance of cost, changing customer expectations and increase in quality due to competition. Therefore importance of reliability expectancy has correlatively increased in service companies. In recent years reliability has even become more important. In the development of large weapon systems reliability is the most important focus. Electrical, electronic and mechanical equipments is used in a number of fields –in industry for the control of processes, in computers etc.

Most of the product and service providers know that the success of an company depends on the customer's satisfaction from the service or the product, and also related to the demanded cost. The slogan "doing it right the first time" has been accepted by firms who have attained the awareness of the importance of quality and reliability. In accordance to this, the companies have become structures that construct reliability programs in which reliability requirements take part, have departments on reliability that apply these principles, and give education on development of reliability asset.

A formal reliability program plan is as necessary as a quality assurance plan. In processes of production and service, equipments and subsystems must work consistently at all times. Otherwise major losses are inevitable. For example scientific and technologic advancements in military and medicine fields have resulted in use of complicated systems composed of a great number of subsystems and parts. These systems are used to save lives in a war in military field and medicine field. Any mistake caused by the system or any part of the system's malfunctioning can cause major losses such as human life. The reliability of the system is correlated to the reliability of the integral parts and its subsystems. Thus if any part of the system's reliability decreases it will affect the whole of it.

The failures that occur as a result of lack of reliability may cause more than the predicted amount of cost to a company. For example, a plane's take off delayed due to a mechanical or electronic failure will cause passengers food and accommodation costs, also poor satisfaction of customers and decrease in the reliability of the firm.

Lack of reliability also has psychological effects along with cost. An unreliable firm or product will be unsuccessful. Premature failures will cause the firm to lose prestige. Unsatisfactory events caused by lack of reliability will result in customer dissatisfaction and employment loss. For example, a service company whose customers have found the service satisfactory will leave contented, and the service company will maintain long term success.

As a result, reliability is one of the most important factors in the quality of a product or a service. A service or a product may carry out its function and yet be unreliable. There have also been major disasters caused not by mechanical or electronic malfunctions but human error. These kinds of errors might be caused by operators', division chiefs', inferior or superior management departments.

3.4 The History of Reliability

Reliability theory and engineering has developed with complicated war machinery and modern technology's requirements, especially after World War II. Soon after the Second World War NUCCI(1954) pointed out, however, that many failures were mechanical rather than electirical in origin. Great improvements in reliability were obtained in the 1950s. In this period statistical life data analysis has been the issue. To eliminate the problems on machine maintenance and to revise the system, Poisson distribution has been used. The wearing out and deterioration of material in time led to the use of Weibull distribution. The theoretical basis has been established by the studies of MOORE, SHOOMAN and VON NEUMANN.

The early development of equipment reliability has been described by SHOOMAN (1968). This rapid expansion in the use of electronic equipment during and after the Second World War took place universally and involved all branches of the armed forces. In the United States Air Force, repair and maintenance over the lifetime of electronic equipment were costing ten times the capital expenditure on the equipment (Cox & Tait, 1991).

In war conditions electronic components had exposed to effects such as collision, resonance, extremely high and low temperatures, humidity and corrosive environments and different atmospheric pressure conditions. The failures caused by these effects have generated the need for reliability in military vehicles. In 1970s MINUTANON has dominated the field of reliability engineering by developing and applying the fault tree model for projectile systems.

With the development of computer system networks in 1980s, the use of graphic modeling and theoretical methods has become significant. In this period reliability engineering which is closely related to reliability theory has gained much importance.

3.5 Design for Reliability

There are five key areas of effort affecting the achievement of a reliable end item. They are design, production, measurement and test, maintenance, and field operations. Design is tme most important of the key areas (Hansen, 1966).

Reliability test and evaluation, though important as reliability activities, may not actually increase the reliability of the product or the service. In relations to this, rather than putting this much effort in reliability engineering, an orientation towards natural reliability in design has begun to be preferred. The statistical methods to reliability analysis are helpful in anticipating reliability from various alternative designs. These methods help the design engineers to make their decisions. Best possible decisions can be inspired by these predictions (Taşpınar, 1999).

It is essential for the predictions to be specific and clear. Otherwise deficient and poorly designed products may be produced. For example a flawed door hinge will cause problems to occur and return from premature failures. The door hinge that is designed wrongly will also give rise to cause more costs than required by the steel with heavy diameter. This means the price of the product in the market will increase.

The design should be as simple as possible. Error rate is directly proportional to complexity. The greater the number of components the greater the chance of failure. Components or subsystems should be designed considering the defence against failures, because it is important how failures will occur. The design must be made so that the failures that may occur must not harm the personnel and cause a disaster.

“Redundancy” is a way of achieving reliability. This is the provision of standby or parallel components or assemblies to take over in the event of failure of the primary item. Auxiliary power generators are examples of redundant items. They are put into service when the primary system fails and improved whole system’s reliability (Hansen, 1966).

An item protected from extremes of environmental conditions will have increased reliability. The item must be able to withstand environmental stresses. Frequently it cannot withstand these extremes without some type of protection. Thus, the pilots of supersonic spacecraft are protected from the effects of extremes of heat and load. Electric motors of common household appliances are rubber mounted to protect them from vibration (Hansen, 1966).

"Maintainability" and "serviceability" are important considerations in designing for reliability. Ease of maintenance and service contributes to higher field reliability. The easier and faster necessary maintenance becomes, the longer an item of known reliability may remain in effective service. Also, it is evident that an item which is easy to maintain will naturally receive better maintenance and service. Items should be designed with these characteristics in mind (Hansen, 1966).

Reliability provides a numerical measure of "degree of excellence" through time. It is a facet of quality that works at the interface between design and specification. Quality and reliability are not separate matters. Experts in reliability are given advice on improving the "degree of excellence" by preventing design errors.

When an equipment works well, and works whenever called upon to do the job which it was designed, such equipment is said to be reliable (Grant & Leavenworth, 1996).

In designing of reliability, all of the characteristics are treated to optimize the reliability. The desires for a high degree of reliability in each of the characteristics must be considered in terms of the cost of obtaining the reliability desired. High reliability cost provides a very reliable product or service but it is not economical.

Considering the costs; improving the reliability will cause reduction in some costs and increase in others. As the reliability of the equipment improves, the cost of design and production will increase, however maintenance and reparation costs will decrease.

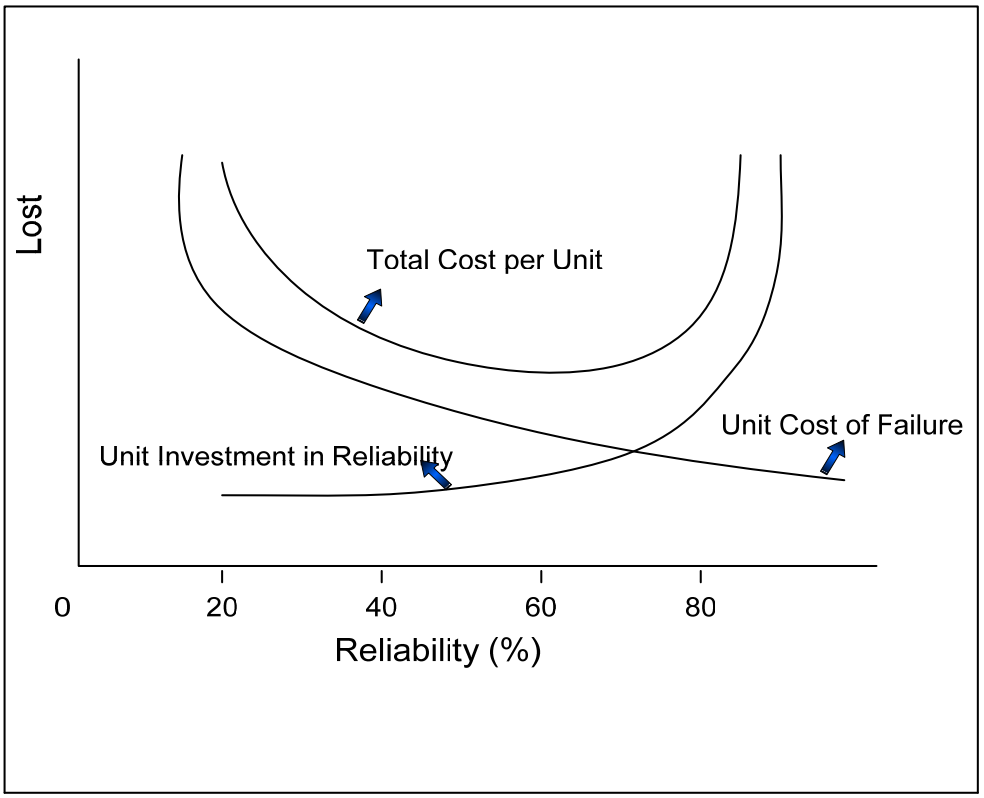


Figure 3.1 Basic model of optimum reliability determination with total cost as determining factor (Hansen, 1966)

Figure 3.1 illustrates a general model for trade-off of reliability for reduced cost. Total cost can be the criterion in any case. It may be that a particular cost is difficult to quantify. For instance, the cost of serious injury to operating personnel is very high but just how high? There has to be some probability point where one must make the decision to pay no more for a very slight improvement in reliability. If it were possible to get equal return in safety for equal investment in reliability, there might be little reason for argument. However, the investment in reliability is exponentially proportional to the return on the investment, that is, it becomes increasingly more expensive to obtain reliability (Hansen, 1966).

As a result, reliability is just a characteristic of quality; it is an indicator of a particular product/service's quality. The other characteristics are performance, style, convenience and similar things. However reliability is very different from these in a way. Reliability is not a definite characteristic, it is obscure and questionable. It requires a lot of qualification and provision descriptions. For this reason, though the

management looks forward to making the right decisions depending on experiences, reliability will always reflect a contradiction.

3.6 Maintenance and Reliability

Maintenance is described as the sustenance of functionality of an asset through proper servicing by means of predetermined procedures and resources. Even if the equipment design is competent and the equipment is operated strictly within the limitations set in the specification, reliability will still depend strongly on the standards of maintenance and on the maintenance regime undertaken (Cox & Tait, 1991).

The total reliability of the equipment in the field is a function of design, maintenance, and field operation reliability; that is, (Hansen, 1966)

$$P_s = f(D,M,F_0)$$

Maintainability plays an important part in the job of achieving reliability in the use system. Simply stated, it refers to the relative ease with which an item may be kept in operation. An item with high maintainability is one which is easy to keep in operation; one with low maintainability is exactly the opposite. An item which is difficult to maintain will not be maintained as well and will require much more time for necessary maintenance. It should be designed in form of ease of maintenance. In addition, the environmental conditions and operating personnel have an important effect on maintainability. Thus, it should be susceptible to the same types of reliability controls as the manufacturing operation. There are three types of maintenance performed (Hansen, 1966):

1. Corrective: repair adjustment, or replacement as a result of unsatisfactory equipment operation,
2. Preventive: repair adjustment or replacement on satisfactory equipment to prevent future, occurrences of unsatisfactory operation,
3. Monitor: check for condition of equipment to determine need for preventive or corrective maintenance. This is essentially an inspection operation.

Maintainability is up to accurate and consistent decisions on whether or not maintenance is necessary. These decisions are obtained through studies made in the monitor and preventive phases. For previsions to be realistic, some performance measuring techniques are used. Besides in the design phase redundancy which is a way to improve reliability plays a role in lessening the need for maintenance.

3.7 Reliability Function and Some Definitions in Reliability

3.7.1 Reliability Function

The word "reliability" is used differently in various settings. If used for a person, it stands for the person's ability to accomplish a certain task in particular standards. If this concept is used for a product, machine, service or a larger system; it means the ability of the components to keep performing their function. Looking broadly at the concept of reliability, it is seen that reliability is a probability and so it can be explained in terms of probability.

If any performance criterion is unable to perform its function, it is an indicator of the system or any component of the system's failure. In this case, component or the system can be defined in two ways:

1. Functions are performed as desired, "up" situation,
2. Functions are not performed as desired, "down" situation.

The time variable here is the moment T, when the component or the system has lost function.

When lifetime is considered as a design variable , the cumulative distribution function of the design random variable is closely related to the reliability of a component or the system and is called life distribution. Probability of failure when taken as a function of time can be defined as below:

$$P(T \leq t) = F(t) \qquad t \geq 0$$

Here F(t) is the component's or the system's probability of failure, not being able to carry out its function as desired in time interval t. This is called "Failure Distribution Function".

"Reliability Function" R(t) is the probability of the component or the system's functioning as desired in time interval t, so it is component or the system' probability of success

$$R(t) = P(T>t) = 1-F(t)$$

With the help of probability distribution which is defined according to the failure time, predictions are made.

Estimating with certain levels of significance is very much dependent on correct determination of the number of parameters. For example, first of all it is important to choose the appropriate distribution for the data. If not, the results will not be reliable. Confidence, dependent on the sample size, should be convenient for right decision making. On its own, the component of failure rate is dependent on an adequate amount of population and its ability to mirror the present situation correctly. Reliability engineering today, although used in practical forms, can be summarized as containing statistics excessively (Ireson, Coombs, & Mess, 1996).

Before going into calculating of reliability, some related definitions have to be made.

3.7.2 Some Definitions in Reliability

- **Failure:** System's lack of ability to carry out one or more of its performance criteria. For example a computer system's breakdown, an ambulance's tardiness, a hotel staff member's lack of hygiene, are all failures. Some failures may be critical and cause harm to life whereas others are less critical where performance criteria are not met. For example in a hospital, giving rotten food to patients is a critical failure whereas delivering the food late is not.

- **Fault:** A component's inadequacy in performing its function. Failure thus is a broader concept that contains fault. Failure occurs as a result of a fault. For example in a hospital, ill-conditioned food storage is a fault, and delivering rotten food is a failure.
- **Failure Rate:** Rate of failing units in the whole unit.

  Failure Rate = Number of Failure / Number of Total Functioning Units
- **Bathtub Curve:** Shows typical lifetime of a complicated systems.

In complicated systems, change in the rate of failures in time has a similar distribution. If life distribution is assumed to be continuous, failure rate defines the life distribution all by itself. To find out the life distribution of any system, product or service, times at which failures occurred must be recorded starting from first use. Since the failure rate changes in time through the duration of the service or the lifetime of the product, with the help of the curve, as shown Figure 3.2, failure rate in time is obtained. This curve reflects three types of periods in time that indicate the life distribution; "Early Mortality Period" "Useful Life Period" and "Wear Out Period" (Taşpınar, 1999).

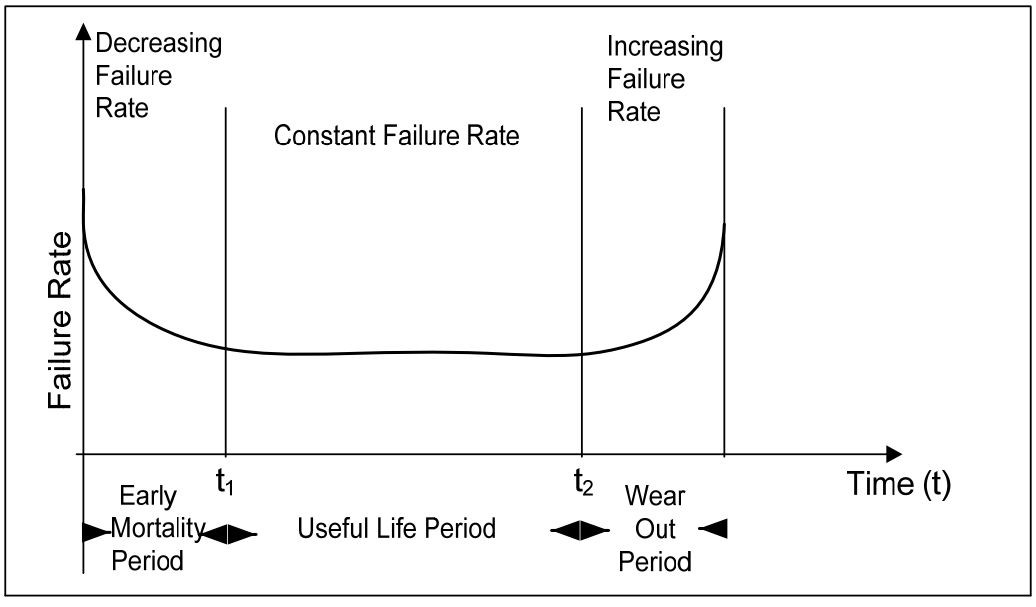


Figure 3.2 Bathtub curve

In reliability these failure rates are said to be, as seen in Figure 3.2, resembling a "Bathtub". The three periods occurring due to changing the failure rate's in the product or the service's lifetime are as below (Dhillon & Reiche, 1985):

1. **Early Mortality Period:**

   When a service or product is purchased, it is possible for the components or the whole system to have high failure rate in the beginning. The failure rate decreases rapidly and stabilizes approaching t_1 moment. This period when the failure rate is high or fluctuating is called "Early Mortality Period", "Early Failure Period" "Burn-in" or "Pre-test". To understand the early failures, the causes must be explored. The causes are identified as bad craftsmanship and materials, insufficient pre-testing, poor production techniques and faults that occur during production.

2. **Useful Life Period:**

   In this period, the components reach the minimum level of failure rate. These failures are the ones that occur in the duration of the product or the service at various time intervals. Deficiencies that escape notice in early mortality period result in unfulfilled functionality. However in this period failures are least expected and occur by chance. The rate of occurrence of these failures is tested in the all of the components, subsystems and equipments. These failures are defined as; higher than predicted pressures, less than expected durability, defects that the best present inspection methods could not detect, human errors, faults that were not observed during pre-test, unexplainable faults and faults that were impossible to be discovered.

3. **Wear Out Period:**

   The failure rate increases in this period. Most products are designed to endure until the end of useful life period. t_2 is defined as the end of useful life period or the beginning of wear out period. Failure rate increases rapidly from this point. Compared to failures in the other periods, failures that occur in this stage are mostly inevitable. These failures occur due to the change in the expected performance criteria in time and the system's wearing out, and because of physical and chemical causes.

In the first period of the bathtub curve, the failures occurring in the primary stage of production are eliminated before the product or the system is delivered to the consumer and before the consumer recognizes these failures. This stage is called “elimination of defects period”. The following stage is the period where the product or the system works efficiently with minimum chance of failure occurrence. This stage is called “random failure period”. Fault rate is constant. It slightly increases during the transition to the wear out period. The failures occurring in this period are minimized with proper designing. The last stage is the increasing failure rate period where the failures due to wearing out point of starting to take place and shows that the system is nearing the end of its life. This stage could be called “wear out failure period”. The failures that occur in this stage may be reduced by preventive maintenance actions, however subsequently it may entail greater costs.

3.8 The Method of Calculating Reliability

In the calculation method used for products, predictions are made with respect to probability distribution defined by time of failure. To estimate a product’s reliability, the distributions according to failures are determined by failure rates that are encountered in different stages of the product’s life curve. Reliability estimation is made according to the failure distribution function obtained by these distributions and the reliability function. In the analysis phase, data are obtained with the help of various measurement instruments and lab tests. However because of their interactive nature, service processes cannot be modeled. For this reason, by using Quality Function Deployment (QFD) and Failure Mode and Effects Analysis (FMEA) the critical failure points in the service processes are modeled by means of possible failures.

It is very difficult to obtain data by testing the service processes using a set of measurement instruments. For these processes customer feedback is essential and is obtained by various methods. One of them is acquiring data by questionnaire forms.

The data tests made for products, components or systems can demonstrate continuous distributions, whereas the service processes where these tests are not done do not. Other than the service processes that rely on time, most services are independent from time. The expectance from these processes is no failure to occur. It is also hard to determine the precise occurrence time of the failures in service processes. For processes independent of time factor, the failure rate can be used without determining a distribution (Taşpınar, 1999).

3.9 Analyses Using for Design and Improvement of Reliability

All performance criteria must be determined for a service process to be able to determine its reliability. Quality Function Deployment (QFD) is used in determining the performance criteria and Failure Mode and Effects Analysis (FMEA) is used in preventing potential failures of the process. With these two methods the failures in the process are detected and failure rates can be estimated.

In service companies, like hospitals, where interaction with the customer is high and in professional services that require expertness such as attorneyship and medical doctor attendance, Quality Function Deployment method is used. In these types of service processes the service providers do not exactly know the criteria of failure for the customer. In these processes listening to the customer's voice is essential. In routine service processes where service is equally given to customers such as schools or banks, use of Failure Mode and Effects Analysis is applicable.

QFD and Fault Tree Analysis which is often used in computer system security are mentioned below. FMEA is observed in detail in the following section.

3.9.1 Quality Function Deployment (QFD)

Quality Function Deployment is first developed in 1966 in Japan, by Yoji Akao and spread in western countries afterwards.

Quality Function Deployment is a method concerning satisfaction of the customer and improving the quality of design by transforming the demands of the customer into design objectives and quality assurrance points that can be used in production. QFD is a way to guarantee the design quality in the designing stage (Mizuno & Akao, 1994).

QFD aims to involve the customer in the designing stage of the product or the service he/she wants to purchase and thus provide the quality the customer seeks in all components of the product or the service. To reach this goal, organizational focus is maintained and by ensuring necessary coordination planning and communication processes are systematically constituted. This method is used for developing a new product or service, or renewing an existing one for customer satisfaction and going beyond customer's expectations.

The customer's thoughts, demands, aspirations and complaints about the service or the product are called "voice of the customer" in QFD. Since the customer is going to be with the product or the service in its duration as well as monetary sacrifice, he/she will have demands and requests about it. Questionnaire forms can be used to know the voice of the customer directly.

QFD is transforming the "voice of the customer" into the supplier's activities to meet the customer's needs. This transformation is made using a matrix that compares the customer's demands and how the supplier is going to supply them. This basic matrix can be broadened to enhance the supplier's understanding and be improved by developing a series of matrices to determine the process parameters that ensure the customer's critical demands (Şen, Deveci, Tenginol, & Gürkaynak, 1999).

The construction of this matrix, called "House of Quality" is a step by step process. These steps can be listed as below:

- ✓ Plan, determine the purposes and the necessary data,
- ✓ Collect the data,
- ✓ Use QFD to form information; analyze and understand the data,

- ✓ Spread the information in the organization,
- ✓ Use the information in decision making,
- ✓ Evaluate the information and the process,
- ✓ Improve the process.

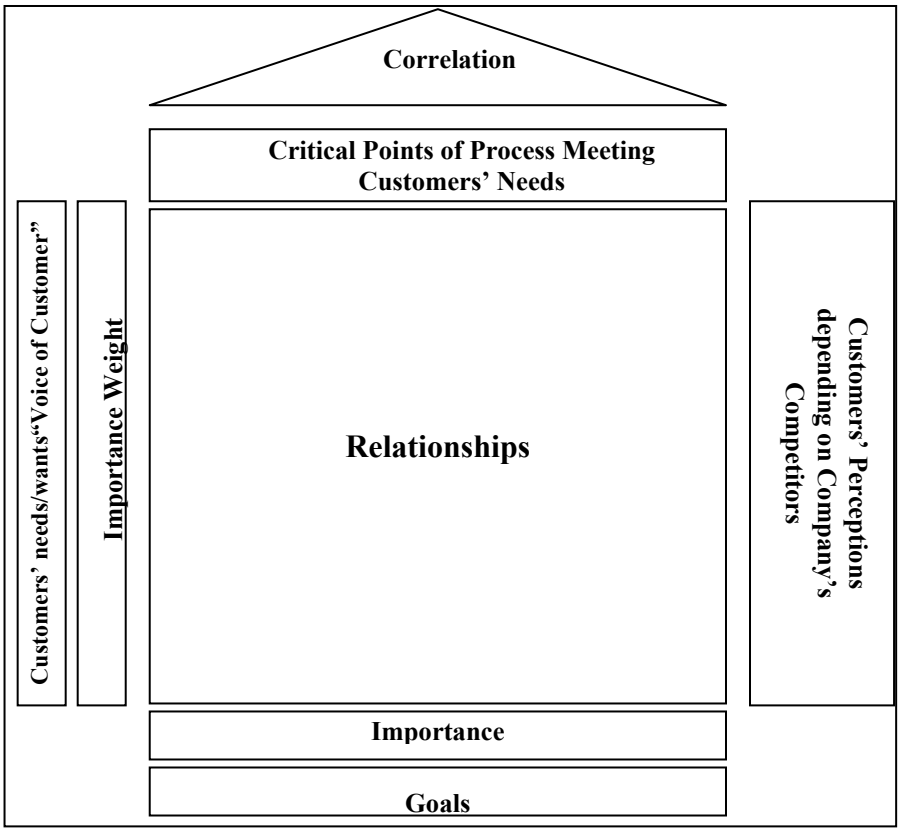


Figure 3.3 House of quality

The rows in the house of quality is the part where "voice of the customer" is set. In this part the demands and needs of the customer are listed. In the columns the critical points to meet the customer's demands are placed. What activities should be taken by the provider are listed here. In the trunk of the house of quality, the customer's demands and needs and the provider's actions are interlinked. In the process a set of symbols are used. These symbols are: Θ strong, 9 points; O medium 3 points; Δ weak 1 point. They are situated in the trunk of the matrix.

Service companies attempt to learn about the customer satisfaction and increase the number of repurchase, and improve loyalty to the firm. With QFD use service

companies can act in advance while improving the present services or designing a new service and estimate the requests of the customer before the customer gets the service, thus provide quality service and ensure high customer satisfaction.

3.9.2 Fault Tree Analysis (FTA)

Fault Tree Analysis (FTA) is used in finding out whether or not a failure is caused by combination of other failures when any effect of the failure is seen; identifying points that could cause a failure in the design stage of a product or a service and strengthening the present design; recognizing the risks in the system and consequently reducing the risks.

FTA, first used in Bell telephone firm in 60's, is a deduction technique that is developed in space industry that can demonstrate graphically all the negative circumstances that affect or could affect the problems.

FTA is a technique that is used in analysis of complicated failures that occur due to combination of various failures, and can be used in place of FMEA. However there has to be a critical effect that must be eliminated or reduced. Also, there are examples of FTA and FMEA simultaneously used.

Fault Tree Analysis, or FTA, provides a method of breaking down these chains of failures, with a key addition for identifying combinations of faults that cause other faults. Combinations of faults come in two main types (Straker, n.d.):

1. Where several items must fail together to cause another item to fail (an "AND" combination),
2. Where only one of a number of possible faults need happen to cause another item to fail (an "OR" combination).

The FTA diagram shows faults as a hierarchy, with two other symbols to show the AND and OR combinations.

In Figure 3.4, OR symbol means that event A happens when one or more of events B, C or D happen. AND symbol means that event D happens only when both event E and event F happens (Straker, n.d.).

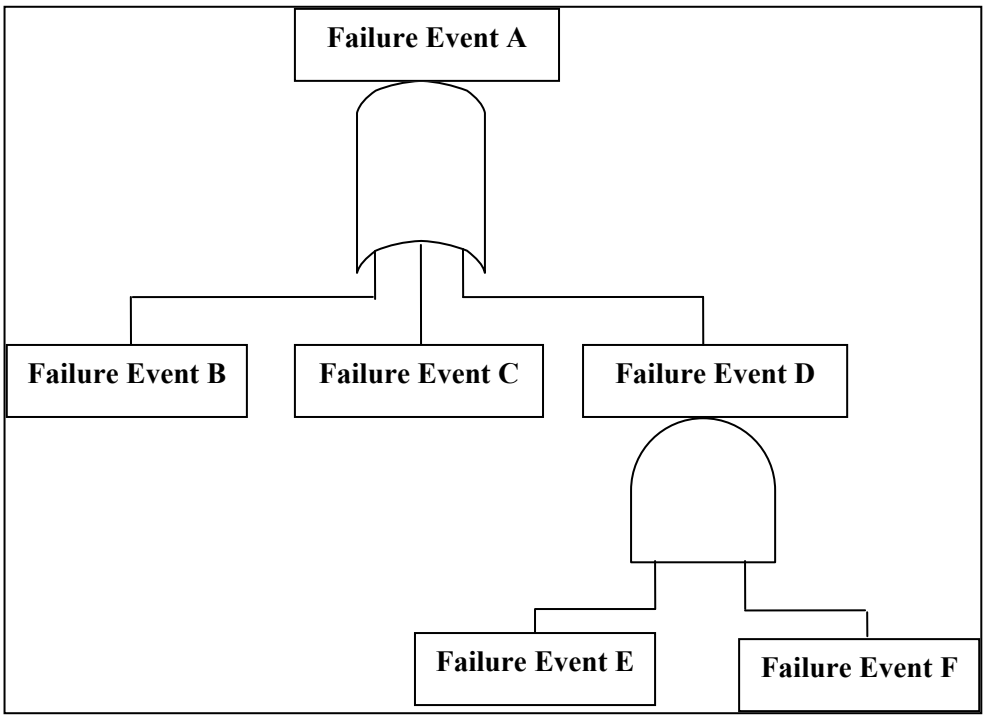
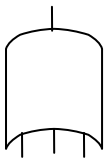
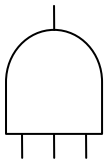
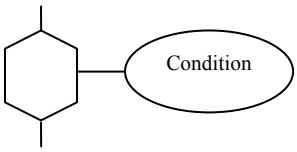
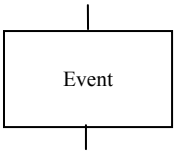
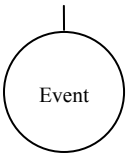
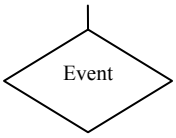
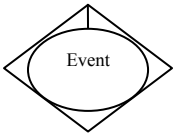
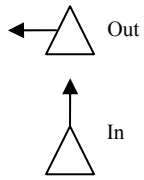
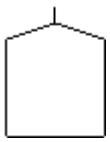


Figure 3.4 Logical “and” and “or” in fault tree analysis (Straker, n.d.)

The AND and OR combinations are also called gates. These gates and the other gates in the FTA diagram are shown in Table 3.1.

Table 3.1 FTA symbols (Straker, n.d.)

Symbol	Name	Meaning
	AND Gate	Event above happens only if all events below happen.
	OR Gate	Event above happens if one or more of events below are met.
	Inhibit Gate	Event above happens if event below happens and conditions described in oval happen.
	Combination Gate	Event that results from combination of events passing through gate below it.
	Basic Event	Event that does not have any contributory events.
	Undeveloped Basic Event	Event that does have contributory events, but which are not shown.
	Remote Basic Event	Event that does have contributory events, but which are shown in another diagram.

	Transferred Event	A link to another diagram or to another part of the same diagram.
	Switch	Used to include or exclude other parts of the diagram which may o may not apply in specific situations.

With the help of formed FTA diagram by using the different means of the symbols in the table, systematically, all of the potential causes are determined and inspected.

FTA is a useful tool for discovering such failures, as it looks back down the chain of events to find possible failures in all areas. For example, a company president recognized that its personnel evaluation system was not effective at motivating its employees, and charged the personnel department with improving it. As a part of the initial analysis of the existing system, they use FTA to identify the different ways that the evaluation system can fail and lead to demotivation. Created fault tree is shown in Figure 3.5. Identified failure areas were investigated further, and the new system based on a correction of these failures. As a result, motivation increased significantly.

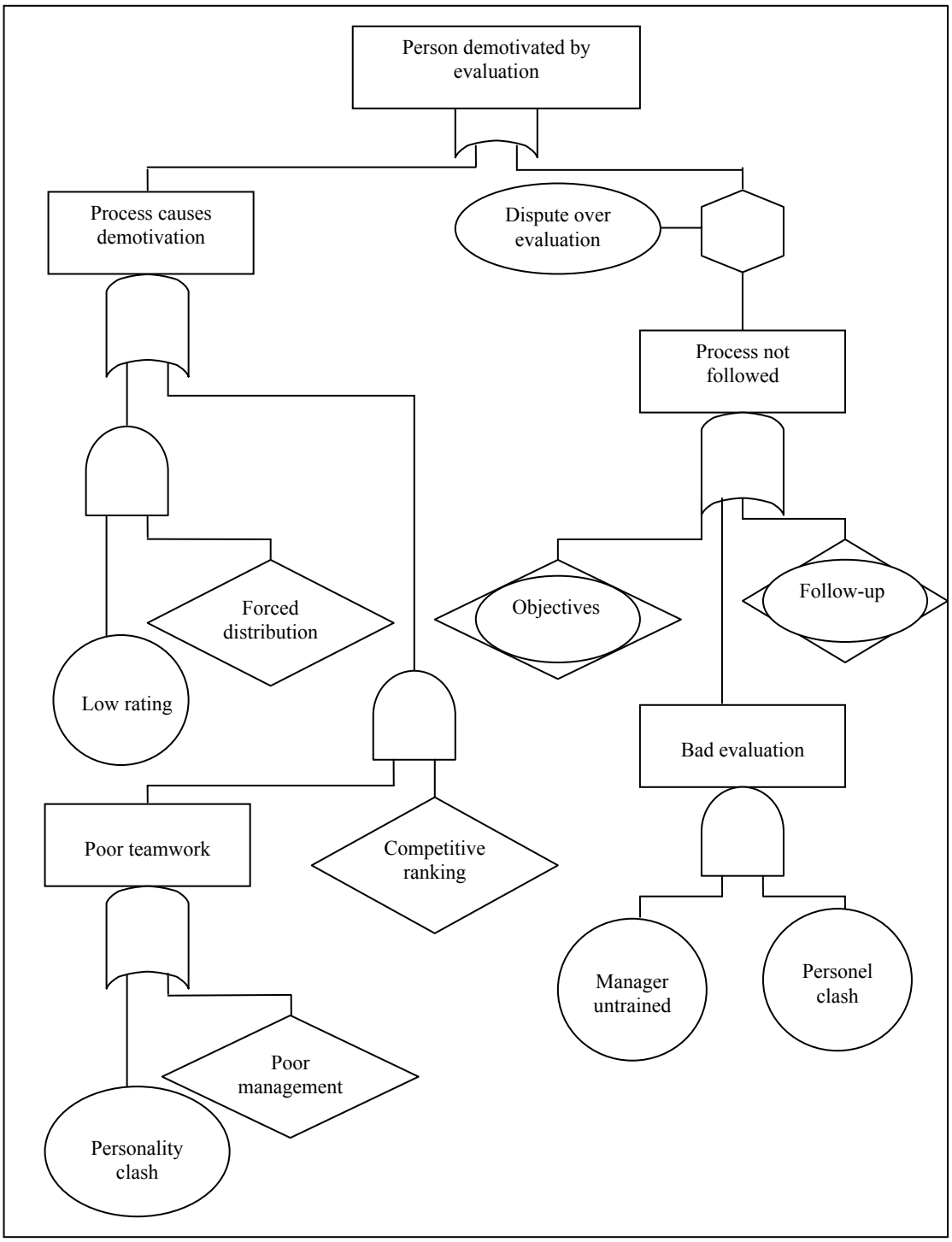


Figure 3.5 Example of fault tree (Straker, n.d.)

In FTA use, different from FMEA, deduction is used whereas induction is used in FMEA. The meaning of this is that hierarchy is observed from top to bottom. Related to this, steps in FTA use have a different aspect than that of FMEA. The steps for the application of FTA are by the way:

1. It is identified the failure effect to be analyzed. Typically this will be a critical effect that must be eliminated or reduced. It should be a complex failure, which may be caused by combinations of other failures, rather than a low-level failure with simple causes,
2. It is written the failure effect in a box at the top-center of the diagram area. It is made this a clear phrase that describes the effect as precisely as possible, describing not only what the failure is, but how it occurs. For example, carburetor fails when engine reaches full temperature,
3. Failures are listed that may directly contribute to the failure described in step 2,
4. It is divided the list of failures in the list derived in step 3 into seperate groups,
5. For each failure which has no connections below it, it is decided whether or not to develop this further by finding other failures which may contribute to it. If the failure is not to be developed on the diagram, drawed it in an appropriate box,
6. When the diagram is complete, examined is to draw conclusions and planned for appropriate actions.

After FTA diagram is formed, with the participation of those who are technically in charge, brainstorming is done to form a fitting plan frame for eliminating and reducing the failures and their effects.

3.9.3 Failure Mode and Effects Analysis (FMEA)

In the design stage for a product or a service, and improvement of this design, FMEA is an effective method of reliability analysis used to prevent the failures. The purpose of using this method is to reduce the potential failure risks and define estimable failure modes in the designing stage and figuring the production by these means.

FMEA are the systematic courses of action enabling recognition and evaluation of potential failure modes and their effects, during product design and manufacturing, determining the preventive actions to be taken for elimination or minimizing of the

potential failure, and the documentation of the process (Şen, Deveci, Tenginol, & Gürkaynak, 1999).

The purpose of the companies is ensuring customer satisfaction. The course to achieve customer satisfaction is delivering error-free product or service to them. FMEA identifies the potential failures and their effects and the corrective actions to be taken in advance order to give better products or service and pioneering improvement in customer satisfaction.

FMEA estimates the probability of a failure, the severity of its effects, and the probability of detecting a defect caused by the identified failure in order to prioritize the riskiest potential failures. This analytic approach typically implodes from greater detail to less detail. To assure that both design quality and manufacturing quality meet the customer-demanded quality, one must not stop wşth the eliminationof failures; broader issues must be analyzed and deployed (Mizuno & Akao, 1994).

Instead of revision plans for many types of failures FMEA is a technique used for prioritizing the failures that affect the product or the service more. To research all failure modes and their effects on the product or the service and planning corrective actions for each failure is extremely expensive. FMEA handles the failure occurrence risks and helps to determine the priority of a failure mode.

The steps in FMEA use, generally, are listed below:

1. Product, service and functions are defined,
2. Possible failure modes are identified,
3. The effects of these failure modes are defined,
4. The causes for each failure mode are defined,
5. Risk Priority Number (RPN) are calculated using these causes,
6. Corrective actions for high RPNs are defined.

Many problems are caused by systems which fail in unexpected ways, which can result in significant costs. An example of this could be where a new roofing

compound is decomposed by acid rain, with the result that the manufacturers have to pay substantial warranty costs, as well as gaining a reputation for poor products. A detailed analysis of the possible ways in which a system might fail, and the possible effects of these failures may thus save significant future costs (Straker, n.d.).

The failures that may occur during the service delivery will come out in presence of the customer. For this reason in service companies failures must be prevented in advance and the customer must be given error-free service. The reason for the necessity of error-free service is because of the nature of the service being different from a product.

The service is not tangible like a product, therefore cannot be stock or inspect after production. Besides, in the service process since the customer's interaction is involved the customer may recognize the failure. Finally the production and delivery of the service are simultaneous. Therefore it is not possible to intervene with the service afterwards. In this manner, FMEA has a great deal of importance in prevention of potential failures. FMEA is examined in detail in Chapter 4.

CHAPTER FOUR

FAILURE MODE AND EFFECTS ANALYSIS

4.1 What Is Failure Mode and Effects Analysis?

In our day the service providing or product manufacturing companies have to meet the constantly changing customer needs and expectations to compete with other companies. One of the most important features that meet the customer's expectations is reliability. To ensure the reliability of a product or a service; a reliability program must be established, supplier firms must be monitored and controlled, an error report system must be devised, proper error analysis must be made, corrective actions must be taken, corrective activities must be carried out, an error investigating system should be constructed, and Failure Mode and Effects Analysis (FMEA) must be used.

Ownership quality is the customers' perspective of quality during the use of the product. Reliability, maintainability, and serviceability are essential attributes of ownership quality and customer satisfaction. Probabilistic methods for reliability assessment have been a mainstay of engineering systems development for many years. Product development teams need to build-in reliability at the early stages of design and Failure Mode and Effects Analysis (FMEA) can help adress this challenge (Kmenta & Ishii, 1998).

FMEA is important technique for a reliability assurance programme. It can be applied to a wide range of problems which may occur in technical systems, and can be carried out in varying degrees of depth, or modified, to suit a particular purpose. The analysis is carried out in a limited way during the conception, planning, and definition phases and more fully in the design and development phase. It is however important to remember that the FMEA is only part of a reliability and maintainability programme which requires many different tasks and activities. FMEA is an inductive

method of performing a qualitative system reliability or safety analysis from a low to a high level (British Standards Institution [BSI], 1991).

Traditionally, reliability has been achieved through extensive testing and use of techniques such as probabilistic reliability modeling. These are techniques done in the late stages of development. The challenge is to design in quality and reliability early in the development cycle. " Failure Mode and Effects Analysis (FMEA) is methodology for analyzing potential reliability problems early in the development cycle where it is easier to take ections to overcome these issues, thereby enhancing reliability through design." FMEA is used to identify potential failure modes, determine their effect on the operation of the product, and identify actions to mitigate the failures. A crucial step is anticipating what might go wrong with a product. The early and consistent use of FMEAs in the design process allows the engineer to design out failures and produce reliable, safe, and customer pleasing products. FMEAs also capture historical information for use in future product improvement (Crow, 2002).

FMEA is a technique practised by those companies that have adopted the philosophy of "Total Quality Management". This technique identifies potential problems and opportunities for early corrective action. FMEA will lead to a better product or service and improved customer satisfaction (SMMT, 1989).

FMEA is an analytical technique used by engineers to ensure that potential problems have been considered and addressed. An FMEA is a summary of the engineer's thoughts as he or she designs a component or a system, or develops a process. This systematic approach parallels and formalises the mental discipline that an engineer normally goes through when developing a design or process (SMMT, 1989).

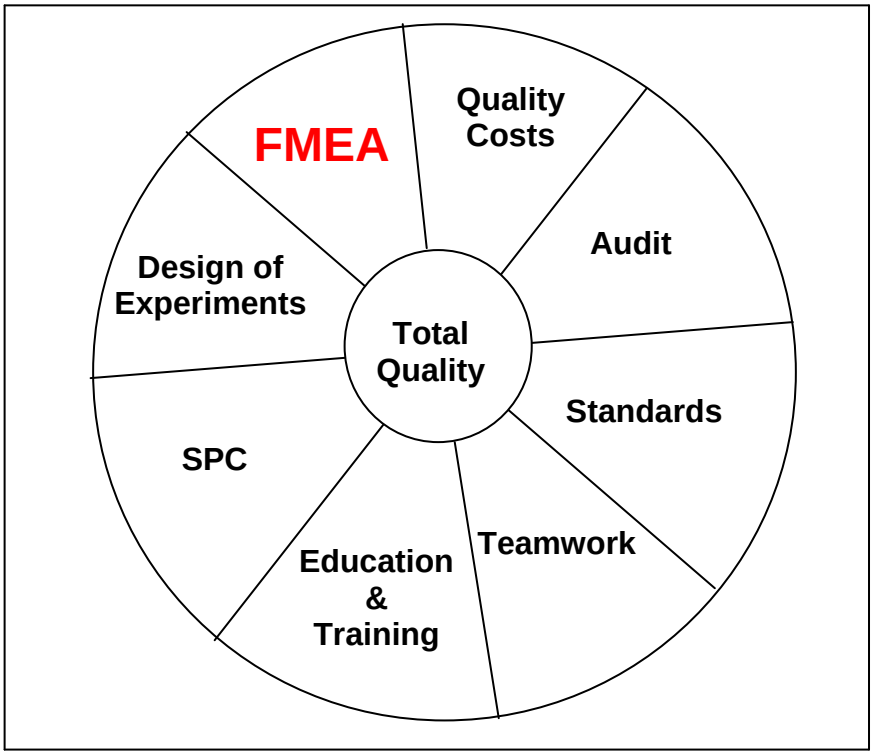


Figure 4.1 Position of FMEA in total quality (SMMT, 1989)

4.2 Purposes of The Failure Mode and Effects Analysis

Failure Mode and Effects Analysis is a technique focusing mainly on the elimination of failure risk in the production and development stages of products and services and documenting actions on this purpose. This analysis is concerned with priority actions.

It is observed that the firms lose money and prestige due to problems occurring in their products or services. To avoid the results the firms must foresee these problems and eliminate them. FMEA is a technique that can be used to recognize the problems in the initial stage and to take corrective actions.

Since the purpose of the firm is to ensure customer satisfaction, providing error-free products or service will ensure the firm's quality. Therefore FMEA which

determines the preventations to be taken against potential problems is used for purposes mentioned below (Crow, 2002):

- To develop product or process requirements that minimize the likelihood of those failures,
- To evaluate the requirements obtained from the customer or other participants in the design process to ensure that those requirements do not introduce potential failures,
- To identify design characteristics that contribute to failures and design them out of the system or at least minimize the resulting effects,
- To develop methods and procedures to develop and test the product/process to ensure that the failures have been successfully eliminated,
- To track and manage potential risks in the design. Traking the risks contributes to the development of corporate memory and the success of future products as well,
- To ensure that any failures that could occur will not injure or seriously impact the customer of the product/process.

4.3 Basic Principles of Failure Mode and Effects Analysis

The following concepts are essential to FMEA:

- breakdown of the system into elements,
- a diagram of the system's functional structure and identification of the various data which are needed to perform the FMEA,
- the failure mode concept (a part may have several failure modes or a failure mode may involve several parts),
- identification of new physical features or new requirements,
- the criticality concept and the measure to be used (if criticality analysis is required).

Further; it is essential to specify the existing links between the FMEA and other qualitative and quantitative analytical methods within the overall reliability programme. Very few designs are wholly new. Most are to some extent

developments of old designs. FMEA should use the information on existing systems and draw attention to the need for tests, etc. for the new parts (BSI, 1991).

4.4 Failure Mode and Effects Analysis Timing

The FMEA is a living document. Throughout the product development cycle change and updates are made to the product and process. These changes can and often do introduce new failure modes. It is therefore important to rewiev and/or update the FMEA when:

- A new product or process is being initiated (at the begining of the cycle),
- Changes are made to the operating conditions the product or process is expected to function in,
- A change is made to either the product or process design. The product and process are interrelated. When the product design is changed the process is impacted and vice-versa,
- New regulations are instituted,
- Customer feedback indicates problems in the product or process (Crow, 2002).

4.5 History of Failure Mode and Effects Analysis

Failure Mode and Effects Analysis discipline is developed in the US army. The Military Procedure MIL-P-1629 that is called The Procedures on Failure Mode and Effects Analysis has been put in progress on November 9th 1949. It is used as a reliable evaluation technique for specifying effects of the system and hardware failures. The failures are classified according to mission success and effects on the personnel/hardware safety (Anonim, n.d.).

Failure Mode and Effects Analysis was used on 1960 by NASA in US Apollo Space Program. After its ten years of use in confidentiality, it has begun to be used in industrial field. Its first use in industry was in a Japanese computer firm NEC in

1975, then on 1980 FORD, 1985 FIAT SPA, has also used the technique. Subsequently its use has spread in automotive sector.

FMEA is a key design method to help engineers improve quality of ownership. FMEA is an engineering technique used to define, identify, and eliminate known and/or potential failures, problems, and errors from the system, design, or process before they reach the customer. What is a failure mode? A failure mode is essentially an undesired cause,effect chain of events. Once the development teams identify and prioritize failure modes, they can make design decisions leading to improved reliability, quality, and sefety. Table 4.1 explains the three main phases of FMEA (Kmenta & Ishii, 1998).

Table 4.1 Three aspects of FMEA (Kmenta & Ishii, 1998)

Phase	**Question**	**Output**
Identify	What can go wrong?	Failure Modes
Analyze	How likely is a failure mode and what are the consequences?	RPN (Likelihood x Severity x Detection Difficulty)
Act	What can be done to eliminate the causes or alleviate the severity?	Design Solutions, Test Plans, Manufacturing Changes, Error Proofing, etc

FMEA teams frequently identify failure modes by assessing component failures and their effects. Unfortunately, detailed information on the constituent components is available only after completion of layout design. At this late stage, causes of failures identified by FMEA can be very expensive or impossible to correct. Figure 4.2 compares the early and continuous application of FMEA to what often happens: performing the FMEA late or not at all (Kmenta & Ishii, 1998).

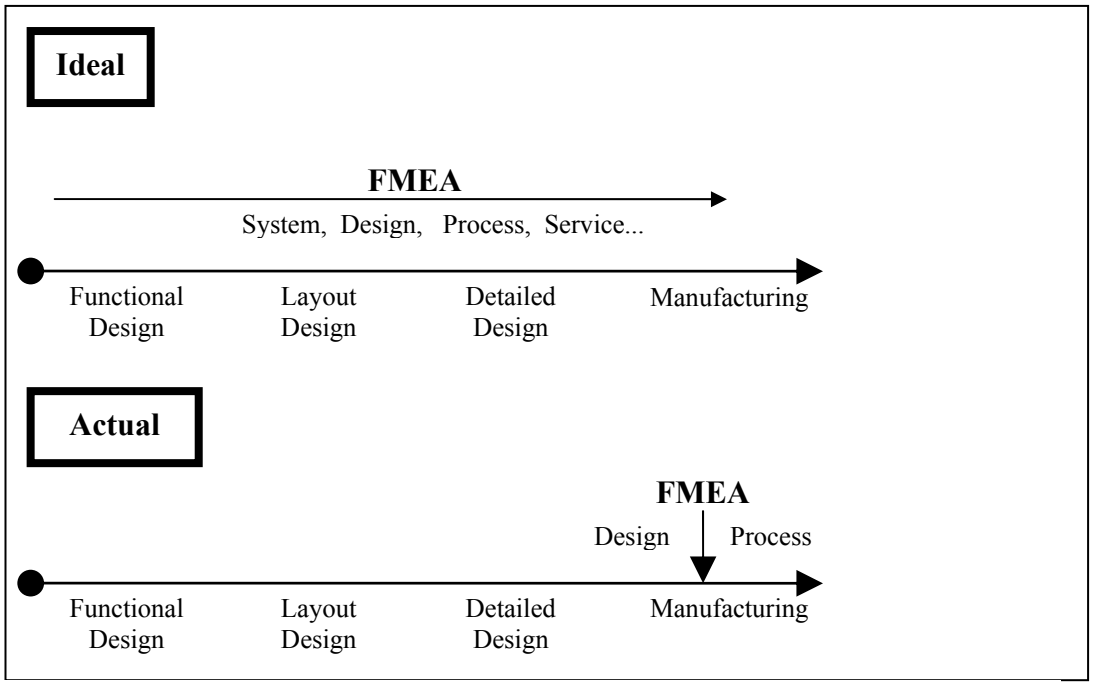


Figure 4.2 Comparison of ideal and actual deployment of FMEA (Kmenta & Ishii, 1998)

4.6 Types of Failure Mode and Effects Analysis

There are several types of FMEAs, some are used much more often than others. FMEAs should always be done whenever failures would mean potential harm or injury to the user of the end item being designed. The types of FMEA are (Crow, 2002):

1. Design FMEA : Focuses on components and subsystems,
2. Process FMEA : Focuses on manufacturing and assembly processes,
3. Service FMEA : Focuses on service functions,
4. System FMEA : Focuses on global system functions.

Design FMEA: It is a method defining the potential failure modes, enabling preventive and corrective actions to be utilized before the production phase (Anonim, n.d.).

Process FMEA: It is a method aiming to create engineering solutions to ensure quality, cost and efficiency criteria defined by the customer (Anonim, n.d.).

Service FMEA: It is a method using to improve customer services with production quality insurance and marketing coordination (Anonim, n.d.).

System FMEA: It is a method using after all the hardware and the designing is completed, to ensure the fluency of systems such as production and quality insurance (Anonim, n.d.).

Essentially FMEA is commonly used in different sectors on Design and Process FMEA. Before completion of the product or the service Design FMEA is utilized. After the report on Design FMEA is prepared, in the production and assembly stages Process FMEA is utilized.

A Design FMEA only considers problems associated with design or material specification. Problems associated with manufacturing or material errors are dealt with in a Process FMEA (SMMT, 1989).

4.6.1 Design Failure Mode and Effects Analysis (DFMEA)

The Design FMEA (DFMEA) supports the design process in reducing the risk of failures by:

- Aiding in the objective evaluation of design requirements and design alternatives,
- Aiding in the initial design for manufacturing and assembly requirements,
- Increasing the probability that potential failure modes and their effects on system and vehicle operation have been considered in the design/development process,
- Providing additional information to aid in the planning of through and efficient design test and development programs,
- Developing a list of potential failure modes ranked according to their effect on the customer , thus establishing a priority system for design improvements and development testing,
- Providing an open issue format for recommending and tracking risk reducing actions,

- Providing future reference to aid in analyzing field concerns, evaluating design changes and developing advanced designs.

A Desing FMEA analyses potential failures associated with a complete assembly, components, and sub-assemblies, as applicable, and as defined in the scope (Chrysler, Ford Motors, & General Motors, 1995).

The Design FMEA is carried out by a team of specialists who meet to discuss the design or process and prepare a design FMEA for issue. For a Design FMEA a typical team could consist of representatives from:
Design Engineering (Chairman),
Development Engineering,
Manufacturing Engineering,
Quality Engineering.
The representatives of design and development engineering are directly involved in the project, the quality and manufacturing engineers are only connected to the project in the recognition of problems (SMMT, 1989).

Ideally the Design FMEA should be carried out at an early stage of the design and progressively updated to reflect each design change (SMMT, 1989).

4.6.2 Process Failure Mode and Effects Analysis (PFMEA)

A Process FMEA analyses potential failure modes associated with deficiences in the planning or operation of a process. A Process FMEA is carried out under the assumption that the product design is correct (SMMT, 1989).

The Process FMEA:

- Identifies potential failure modes related process,
- Assesses the potential customer effects of the failures,

- Identifies the potential manufacturing or assembly process causes and identifies process variables on which to focus controls for occurrence reduction or detection of the failure conditions,
- Develops a ranked list of potential failure modes, thus establishing a priority system for corrective action considerations,
- Documents the results of manufacturing or assembly process (Chrysler, Ford Motors, & General Motors, 1995).

The procedure for carrying out a Process FMEA is similar to that required for a Design FMEA and should follow on logically from the Design FMEA. Ideally, it should be carried out at the planning stage and before ordering tooling or manufacturing equipment (SMMT, 1989).

For a Process FMEA a typical team could consist of representatives from:
Manufacturing Engineering (Chairman),
Engineering,
Production,
Quality Engineering,
Laboratory.
If the process involves specialist functions, such as painting, additional representatives may be co-opted to cover those functions (SMMT, 1989).

4.7 Limitations and Scope of Failure Mode and Effects Analysis

Failure Mode and Effects Analysis is a technique frequently used in manufacturing sector. Especially in automotive sector its use has become quite common. It is obvious that its uses in different sectors would be beneficial since this technique enables the failures to be prevented before being presented to the end user. The costs of this technique's usage would be much lower than defective product or service being presented to the customer. Also, the prestige of the company will be sustained because the risk of presenting defective product or service is eliminated.

FMEA can also be applied to non-production areas. In general, FMEA is applied to potential product designs and manufacturing processes where the benefits are more obvious and significant. It primarily considers these applications but the scope of FMEA is much wider (SMMT, 1989).

The scope of an FMEA and any limitations of control should be defined and documented before the start of the study. They form the basis of ground rules for the FMEA. The scope may cover the following points:

- In a Design FMEA, any limitations of design control caused by the customer specifying certain parameters such as overall size, or finish or by not providing adequate information such as interface data. In these situations the FMEA may involve considerations outside the team's control and it becomes one of joint design with the ratings affected by the limited knowledge,
- In a Process FMEA (assembly), whether or not sub-assembly processes should be included or treated as seperate FMEAs,
- The application of the FMEA (Design or Process) to more than one part or assembly,
- The effect of timing on the preparation of the FMEA and the resultant ratings (SMMT, 1989).

A successful FMEA application depends on the expertise levels of analysts and the management's commitment.

4.8 Procedure of Failure Mode and Effects Analysis

FMEA is a systematic approach that identifies potential failure modes under specific conditions, anticipates their effects on the customer, lists potential failure causes by priority and defines corrective actions before the design or process.

FMEA procedure includes the following steps:

- Step 1: Product or service's components and the processes to complete them are defined; information regarding the components and the process is collected,
- Step 2: Potential failure modes, for every process or component that could cause situations that fail to meet the customer needs are listed,
- Step 3: Potential causes of failure, the reasons that cause the defined potential failure modes, how often they occur and their effects on the customer (potential failure effects) and the importance levels of these effects are determined,
- Step 4: For each failure mode, the anticipated number of occurrence is determined and the potential failure modes' determinability by present control systems (detection number) is investigated,
- Step 5: After their Occurrence, Detection and Severity Numbers are determined; Risk Priority Number (RPN) for each failure mode is calculated,
- Step 6: Following the assessment of RPN values the requirements for corrective actions are determined and they are applied to the product, service or the process,
- Step 7: FMEA report is prepared and all the information on the modifications are transferred to the subsequent FMEA studies.

In a FMEA; the design or process is examined in detail and every possible mode of failure, including its effects and potential causes, recorded. A Risk Priority Number (RPN) is established for each potential cause of failure by the use of a simple rating method for the possibilities of the cause occurring, the severity of the effect and the chance of detection of the fault. Those potential causes with high RPN values are selected for corective action to reduce any risk of the problem or failure occurring, leading to improved customer satisfaction (SMMT, 1989).

At the commencement of a FMEA the following preparations should be made:

- The analyst should have avaliable the information as system structure, system initiation, operation, control and maintenance, system environment, modelling, software and system boundary that clearly defines the system to be analysed,
- It will usually be necessary for the analyst to translate the information into some form of funtional, hierarchical or reliability block diagrams. An example of a

functional diagram is shown in Figure 4.3. This diagram shows how the failure effects at the part level form the failure modes at the module level, the failure effects at the module level form the failure modes at the subsystem level, and so on. Such a representation of the system should explicitly identify the system's funtional structure, the system boundary and the inputs and outputs crossing that boundary (BSI, 1991).

It is defined the scope of the FMEA in relation to the functional structure and hierarchical structure of the system as described by the block diagrams. It is essential to define the lowest level in the system's hierarchical structure at which the analysis will start (BSI, 1991).

An FMEA is generally carried out as a team activity, except in a small company where the analysis may be completed by just one or two people. It is important that the team numbers are well chosen and suited to the task. They should be highly experienced and well motivated people. Team members must have the time available to attend the meetings and the authority to conduct investigations necessary for the completion of the study. It is essential that each team member stays with the team for the whole study in order to maintain continuity (SMMT, 1989).

The basis of the FMEA is the form on which the analysis is recorded. An FMEA will therefore benefit from a well designed form which clearly sets out all the important points (SMMT, 1989).

4.8.1 The Failure Mode and Effects Analysis Form

The effectiveness of the analysis is dependent on accurate completion of the form by the FMEA team to ansure that all potential failures are identified and evaluated in a systematic procedure (SMMT, 1989).

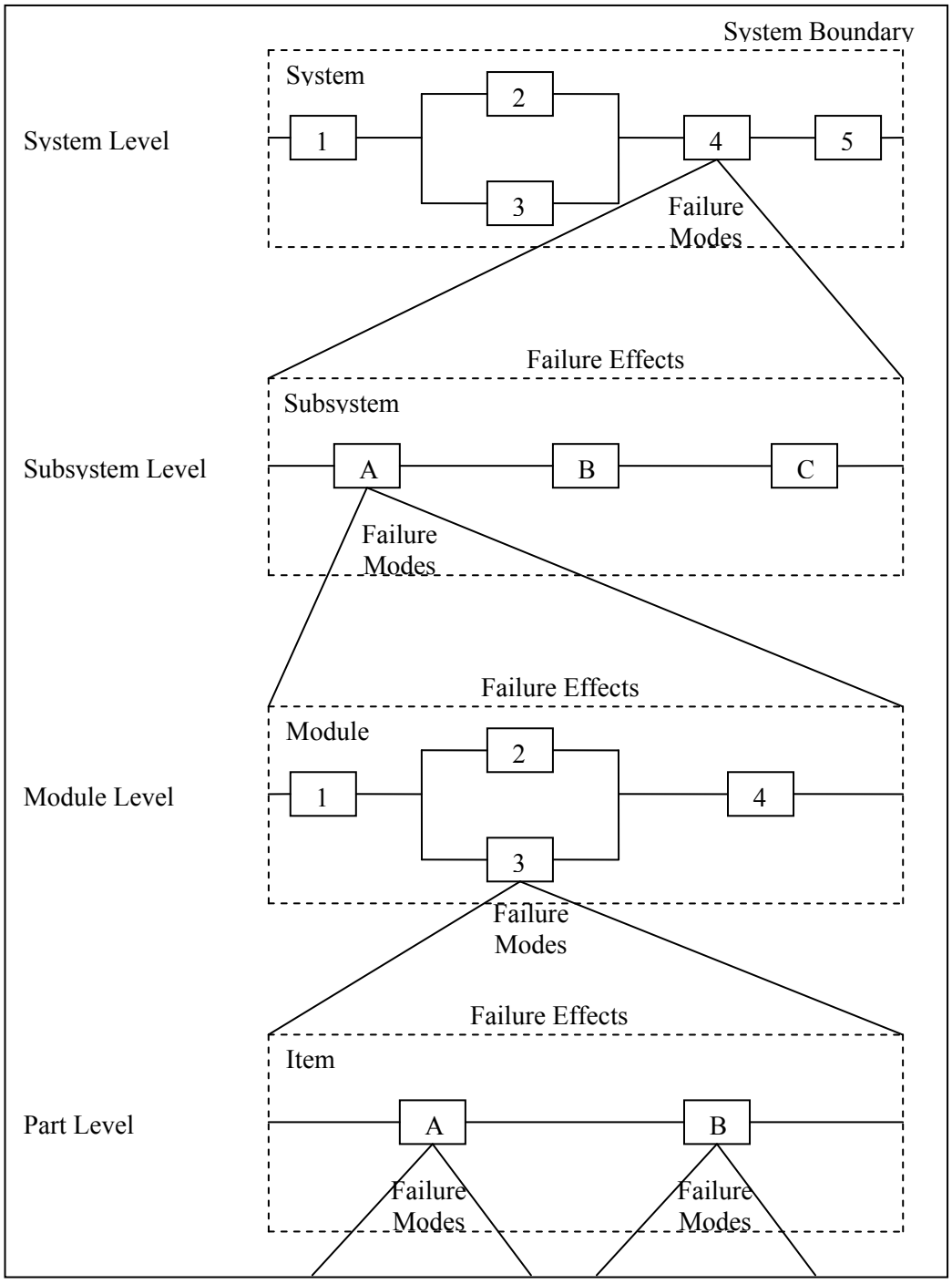


Figure 4.3 Relationship between failure modes and failure effects in a system hierarchy (BSI, 1991)

Although there are differences in progress and presentation, the analysis is usually carried out in a standard way and presented with a FMEA form that includes notable information.

It is illustrated the use of a common format for Design and Process FMEAs with the facility to distinguish between the two types of analysis, however separate forms may be devised for each (SMMT, 1989).

It is recommendedthat certain details are included to identify and describe the item being analysed, such as:

- Item,
- Part Number, Name and Issue,
- Function or Process,
- Failure Mode,
- Effect of Failure,
- Cause of Failure,
- Current Controls,
- Current Status and Guide to Rating,
- Occurrence of Failure,
- Severity of Failure,
- Detection of Failure,
- Risk Priority Number (RPN),
- Recommended Corrective Action,
- Action By,
- Action Taken,
- Revised Status (SMMT, 1989).

Item: An item number should be given to every possible cause of a potential failure.
Part Number, Name and Issue: It is clearly identified every component being studied, which may include assemblies an sub-assemblies.
Function: The function of components, and assembly for Design FMEA and the process, and its purpose for Process FMEA are describe as concisely as possible.

Where the component has numerous functions with different potential failure modes, it is advisable to list the functions separately.

Failure Mode: It is anticipated and described all the possible ways the part could fail, not how it will fail. It is considered how the failure will be observed.

Effect of Failure: It is assumed a failure mode has occurred, considered the effect that the failure could have on the component or assembly and described the effect on the customer. It must also be kept in mind that one failure mode could have more than one effect. Similarly, the same effect could apply to a number of different it is failure modes.

Cause of Failure: Every potential cause of failure are listed for each of the falilure modes.

Current Controls: It is listed those controls which are currently in use for the same or similar components.

Current Status and Guide to Rating: A rating between 1 and 10 is assigned to each column which estimates the probability of occurrence and detection, and the degree of severity. The relative ratings will vary between companies because of the diverse nature of products being manufactured. Provided that a company uses a consistent rating throughout its analyses, the higher risk causes of failure will therefore reflect a higher Risk Priority Number where corrective action should be carried out.

Occurrence of Failure: It is evaluated the design as it is currently stands. Where possible it is considered the history of similar components before assessing the likelihood of a particular cause occurring. The possibility of occurrence is evaluated, using a scale of 1 to 10, where 1 indicates it is unlikely and 10 indicates that it is certain this failure mode will occur.

Severity of Failure: It is considered the consequences of the failure using an evaluation scale of 1 to 10, where 1 indicates no effect and 10 indicates a most severe consequences.

Detection of Failure: It is important to detect and rectify any design fault before manufacture and particularly before the product can reach the customer. The possibility of detection is again rated on a 1 to 10 where 1 indicates a remote probability and 10 indicates certainty that the failure will reach the customer.

FAILURE MODE & EFFECTS ANALYSIS – DESIGN / PROCESS

FMEA Number _____
Sheet _____ of _____

Item	Part No Name Issue	Function or Process	Failure Mode	Effect of Failure	Cause of Failure	Current Failure	Current Status				Recommended Corrective Action	Action By	Action Taken	Revised Status			
							O	S	D	RPN				O	S	D	RPN

Figure 4.4 FMEA form (SMMT, 1989)

Risk Priority Number (RPN): It is calculated the RPN for every cause of failure by multiplying together occurrence, severity and detection ratings. The RPN provides a relative priority of the failure mode. A summary of the most critical items can be developed from the RPNs in order to highlight areas where priority actions must be directed. It should be noted that corrective action may be required on individual high ratings for RPNs.

Recommended Corrective Action: The relative magnitude of the RPNs indicates those items where corrective actions are required. For the causes of failure that have high ratings for RPNs, the corrective actions are listed.

Action By: This column on the FMEA form is used to indicate the individual or the department responsible and the date scheduled for the completion of the corrective action.

Action Taken: This column on the FMEA form is used to show all the actions taken to reduce the RPN value.

Revised Status: When corrective action has been taken, the ratings should be re-assessed and the new RPN calculated. Further courses of action may have to be identified and undertaken in order to achieve an acceptable RPN. When the recommended corrective action is agreed, it may help to estimate the ratings in advance to justify the effectiveness of any proposed action.

The parts included in FMEA form are changeable according to the companies' needs.

4.8.2 Calculating and Evaluating Risk Priority Number (RPN)

Risk priority number (RPN) is calculated with the help of occurrence number, detection number and severity number. Determining of occurrence and detection numbers are for the Design and Process FMEA; severity number is determined by the same criterions for both of them.

4.8.2.1 Occurrence Number

Occurrence is the occurrence frequency of failure mode that a potential cause of failure will be occured.

Occurrence number does not refer to occurrence frequency of any failure, but it expresses meaning in accordance with occurrence number. Occurrence number is obtained by the rating which related to definitions expressing frequency of occurring failure. To obtain occurrence frequency, it is needed some initial informations related to the same or similar products.

The criterions related to determination of occurrence number in Design and Process FMEA are different from each other. It can be seen the occurrence numbers for Design FMEA in Table 4.2 and for Process FMEA in Table 4.3.

In the Process FMEA, occurrence numbers is determined not only by the occurrence frequency of failure but also by using tools of statistical process control.

Table 4.2 Occurrence number of design FMEA (Chrysler, Ford Motors, & General Motors, 1995)

Probability of Failure	Possible Failure Rates	Ranking
Very High: Failure is almost inevitable	1/2	10
	1/3	9
High: Repeated Failures	1/8	8
	1/20	7
Moderate: Occasional Failures	1/80	6
	1/400	5
	1/2.000	4
Low: Relatively Few Failures	1/15.000	3
	1/150.000	2
Remote: Failure is unlikely	≤1/1.500.000	1

Table 4.3 Occurrence number of process FMEA (Chrysler, Ford Motors, & General Motors, 1995)

Probability of Failure	**Possible Failure Rates**	**Cpk**	**Ranking**
Very High: Failure is almost inevitable	≥1/2	<0,33	10
	1/3	≥0,33	9
High: Generally associated with processes similar to previous processes that have often failed	1/8	≥0,51	8
	1/20	≥0,67	7
Moderate: Generally associated with processes similar to previous processes which have experienced occasional failures, but not in major proportions	1/80	≥0,83	6
	1/400	≥1,00	5
	1/2.000	≥1,17	4
Low: Isolated failure associated with similar processes	1/15.000	≥1,33	3
Very Low: Only isolated failures associated with almost identical processes	≤1/150.000	≥1,50	2
Remote: Failure is unlikely. No failures ever associated with almost identical processes	≤1/1.500.000	≥1,67	1

4.8.2.2 Detection Number

Detection is probability that potential design or process failures is detected before the products reach to the customers.

Detection number is related to detection probability of failure mode in Design or Process FMEA before the products reach to the customers. It can be seen the detection numbers for Design FMEA in Table 4.4 and for Process FMEA in Table 4.5.

Table 4.4 Detection number of design FMEA (Chrysler, Ford Motors, & General Motors, 1995)

Probability of Detection	Ranking
Absolute Uncertainty: Desing Control will not and/or can not detect a potential cause and subsequent failure mode; or there is no Desing Control.	10
Very Remote: Very remote chance the Desing Control will detect a potential cause and subsequent failure mode	9
Remote: Remote chance the Desing Control will detect a potential cause and subsequent failure mode	8
Very Low: Very low chance the Desing Control will detect a potential cause and subsequent failure mode	7
Low: Low chance the Desing Control will detect a potential cause and subsequent failure mode	6
Moderate: Moderate chance the Desing Control will detect a potential cause and subsequent failure mode	5
Moderately High: Moderately high chance the Desing Control will detect a potential cause and subsequent failure mode	4
High: High chance the Desing Control will detect a potential cause and subsequent failure mode	3
Very High: Very high chance the Desing Control will detect a potential cause and subsequent failure mode	2
Almost Certain: Desing Control will almost certainly detect a potential cause and subsequent failure mode	1

Table 4.5 Detection number of process FMEA (Chrysler, Ford Motors, & General Motors, 1995)

Probability of Detection	Ranking
Almost Impossible: No known control(s) available to detect failure mode	10
Very Remote: Very remote likelihood current control(s) will detect failure mode	9
Remote: Remote likelihood current control(s) will detect failure mode	8
Very Low: Very low likelihood current control(s) will detect failure mode	7
Low: Low likelihood current control(s) will detect failure mode	6
Moderate: Moderate likelihood current control(s) will detect failure mode	5
Moderately High: Moderately high likelihood current control(s) will detect failure mode	4
High: High likelihood current control(s) will detect failure mode	3
Very High: Very high likelihood current control(s) will detect failure mode	2
Almost Certain: Current control(s) almost certain to detect the failure mode. Reliable detection controls are known with similar processes.	1

4.8.2.3 Severity Number

Severity is effect degree of a potential failure mode on the customers.

Severity number is used for rating severity of potential failure mode on the customers. Severity number for Design and Process FMEA is indicated in the Table 4.6.

Table 4.6 Severity number of design and process FMEA (Chrysler, Ford Motors, & General Motors, 1995)

Severity of Effect	Ranking
Hazardous-without Warning: Very high severity ranking when a potential failure mode effects safe vehicle operation and/or involves noncompliance with government regulation without warning.	10
Hazardous-with Warning: Very high severity ranking when a potential failure mode effects safe vehicle operation and/or involves noncompliance with government regulation with warning.	9
Very High : Vehicle/item inoperable, with loss of primary function.	8
High: Vehicle/item operable, but at reduced level of performance. Customer dissatisfied.	7
Moderate: Vehicle/item operable, but Comfort/Convenience item(s) inoperable. Customer experiences discomfort.	6
Low: Vehicle/item operable, but Comfort/Convenience item(s) operable at reduced level of performance. Customer experiences some dissatisfaction.	5
Very Low: Fit & Finish/Squeak & Rattle item does not confirm. Defect noticed by most customers.	4
Minor: Fit & Finish/Squeak & Rattle item does not confirm. Defect noticed by average customer.	3
Very Minor: Fit & Finish/Squeak & Rattle item does not confirm. Defect noticed by discriminating customer.	2
None: No effect.	1

4.8.2.4 Risk Priority Number (RPN)

Risk Priority Number (RPN) is a risk measure acquired with mulplying by occurrence, detection, and severity numbers. RPN establishes the fields of priority corrective actions by determining critical points. The cause of potential failure which

has a highest RPN is discussed most effective cause of failure and has priority for corrective action.

RPN is calculated as the value between 1 and 1000 ($1 \leq RPN \leq 1000$). In Table 4.7, there is an example related to comment on RPNs. RPN is calculated again after corrective action which is determined with the help of the RPN is taken. FMEA and taking the corrective actions should be continued to apply until RPN is decreased.

The purpose of the corrective actions is to reduce one or all of the occurrence, detection and severity numbers. Upon completion of design confirmation only the detection number reduces. The reduction in occurrence number is effected by the checking and elimination of the failure causes during inspection of the design. The reduction in severity number is only possible through inspection of the design (SMMT, 1989).

4.8.3 Report of Failure Mode and Effects Analysis

In FMEA, an FMEA report is formed after taking the corrective actions determining by prioritizing the RPNs, and the informations concerning all the alterations made is transferred into the next HTEA studies.

The report on the FMEA may be included in a wider study or may stand alone. In either case, the report should include a summary and a detailed record of the analysis and the block or functional diagrams which define the system structure. The report should also contain a list of the drawings on which the FMEA is based (BSI, 1991).

Table 4.7 Example table for evaluating the risk priority numbers

Occurrence Number	**Detection Number**	**Severity Number**	**RPN**
1	**1**	**1**	**1**
Occurrence of failure is not expected	Failure mode and effect are certainly detected	No effect	Corrective action is not necessary
1	**1**	**10**	**10**
Occurrence of failure is not expected	Failure mode and effect are certainly detected	Effect that does not indicate any sign before failure occur	Corrective action is not necessary
1	**10**	**1**	**10**
Occurrence of failure is not expected	Detection of failure mode and effect is impossible	No effect	Corrective action is not necessary
10	**1**	**1**	**10**
Failure is inevitable	Failure mode and effect are certainly detected	No effect	Corrective action is not necessary
10	**1**	**10**	**100**
Failure is inevitable	Failure mode and effect are certainly detected	Effect that does not indicate any sign before failure occur	Corrective actions are necessary, to reduce occurrence and severity numbers the design is revised
1	**10**	**10**	**100**
Occurrence of failure is not expected	Detection of failure mode and effect is impossible	Effect that does not indicate any sign before failure occur	Corrective actions are necessary, to reduce severity number the design is revised and to reduce detection number confirmation activities in design
10	**10**	**1**	**100**
Failure is inevitable	Detection of failure mode and effect is impossible	No effect	Corrective action is not necessary
10	**10**	**10**	**1000**
Occurrence of failure is not expected	Detection of failure mode and effect is impossible	Effect that does not indicate any sign before failure occur	Corrective actions are necessary, to reduce occurrence and severity numbers the design is revised, to reduce detection number confirmation activities in design

The summary should contain a brief description of the method of analysis and the level to which it was conducted, the assumptions and the ground rules. In addition it should include listings of the following:

- recommendations for the attention of designers, maintenance staff, planners and users,
- failures which, when initially occurring alone, result in serious effects,
- failures which have no effect,

design changes which have already been incorporated as a result of the FMEA (BSI, 1991).

An FMEA is a live document and must be updated as changes occur (SMMT, 1989).

In the event that changes occur in the design or during the proess, HTEA should be updated and repeated in accordance with those changes.

4.9 Failure Mode and Effects Analysis and Service Quality

Service companies must be able to face the challenge to offer error-free services to their customers. According to Service definition, the customer is always present during the processes and delivery of the service. If something goes wrong it will happen in the presence of the customer (Rotondaro & Oliveira, 2001).

Three features of the service delivery activity are critical to the quality percieved by the customer:

- Intangibility,
- Customer participation in the process,
- Production and consumption are simultaneous process.

Considering these features, the service company should try to develop an error-free process. Since a previous inspection of the service can not be performed and the corrective actions can only be taken after the error is detected and the customer is

dissatisfied, the service company should use prevention tools in order to detect the critical points likely to give rise to failures in the process and proceed to the necessary changes in order to eliminate them. Some industry have long been successfully using the Failure Mode and Effects Analysis (FMEA) to prevent the occurrence of defects in their processes and projects (Rotondaro & Oliveira, 2001).

In FMEA, service quality gap (Gap 5) and the other gaps creating the Gap 5, and the antecedents of each gap taken as a potential failure mode, Table 4.8 is formed.

4.10 Alternative Review Techniques

Failure Mode and Effects Analysis is one of many review techniques. Except the FMEA, three of the other techniques are given the following:

- Preparatory Product Analysis (PPA),
- Failure Mode, Effect and Criticality Analysis (FMECA),
- Fault Tree Analysis (FTA) (SMMT, 1989).

Preparatory Product Analysis (PPA): PPA is used in the same way as FMEA to define potential failure modes, causes and corrective actions. The basic difference is the omission of rankings for occurrence, severity and detection and the resultant risk priority rating. Each potential failure mode is documented together with its effected part or assembly and cause. The department which has the greatest influence on remedical action is assigned corrective action tasks. These actions are documented on the analysis sheet with target completion dates. The procedures for the allocation and documenting of improvement actions are as for FMEA and the analysis should be similarly maintained and updated (SMMT, 1989).

Table 4.8 FMEA ve service quality gaps

Potential Failure Mode	**Potential Causes of Failure Mode**	**Potential Effects of Failure Mode**
Gap 1 **Not knowing customer's expectations**	• Lack of marketing reseach orientation • Inadequate upward communication • Too many levels of management	Gap 5 widens
Lack of marketing reseach orientation	• Insufficient marketing research • Inadequate use of research findings • Lack of interaction between management and customers	Gap 1 occurs, Gap 5 widens
Inadequate upward communication	• No face-to-face contact between managers and customer contact personnel • Too many levels of management	Gap 1 occurs, Gap 5 widens
Too many levels of management	• Too many managerial levels between the topmost and bottommost positions	Gap 1 occurs, Gap 5 widens
Gap 2 **Falsely** **Forming the service quality standards**	• Inadequate commitment to service quality • Lack of perception of feasibility • Inadequate task standardization • Absence of goal setting	Gap 5 widens
Inadequate commitment to service quality	• Forming commitments that does not fit for in line with customer expectations and service quality	Gap 2 occurs, Gap 5 widens
Lack of perception of feasibility	• Detecting ineffectively whether or not the firm's present system will meet customer expectations • Lack of feasibility study and analyses of costs	Gap 2 occurs, Gap 5 widens
Inadequate task standardization	• Not using an operating system in firm • Using ineffectively the operating systems	Gap 2 occurs, Gap 5 widens
Absence of goal setting	• Lack of setting specific service quality goals • Absence of a formal process for setting quality of service goals in firm	Gap 2 occurs, Gap 5 widens
Gap 3 **Service Performance Gap**	• Role ambiguity • Role conflict • Poor employee-job fit • Poor technology-job fit • Inappropriate supervisory control systems • Lack of perceived control • Lack of teamwork	Gap 5 widens
Role ambiguity	• Lack of training for personnel • Lack of personnel' knowledge about performance criteria	Gap 3 occurs, Gap 5 widens

Role conflict	• Being different customer' expectations and management's exceptions from each other • Too much documentation during service delivery • Lack of communication between customer-contact employees and support services employees	Gap 3 occurs, Gap 5 widens
Poor employee-job fit	• Hiring people who are not qualified to do their jobs • Lack of management's time and resources to the hiring and selection of employees	Gap 3 occurs, Gap 5 widens
Poor technology-job fit	• Lack of management to provide the tools and equipment needed to perform personnel' jobs well • Failing equipments frequently • Lack of resources for equipments	Gap 3 occurs, Gap 5 widens
Inappropriate supervisory control systems	• Performing rewarding system unjustly • Lack of consideration of communication, teamwork etc. during supervision of personnel	Gap 3 occurs, Gap 5 widens
Lack of perceived control	• Lack of Authority of personnel to resolve the problems • Lack of training on problem solving techniques that is provide personnel • Getting approval from another department during service delivery	Gap 3 occurs, Gap 5 widens
Lack of teamwork	• Lack of orientation to teamwork • Too much competition amongst personnel • Lack of sense of belonging to firm for personnel	Gap 3 occurs, Gap 5 widens
Gap 4 **Being different between provided service and committed service**	• Inadequate horizontal communication • Propensity to overpromise	Gap 5 widens
Inadequate horizontal communication	• Inadequate communication between advertising and operations • Inadequate communication between salespeople and operations • Inadequate communication between human resources, marketing, and operations • Differences in policies and procedures across branches or departments	Gap 4 occurs, Gap 5 widens
Propensity to overpromise	• To earn customer, giving overmuch commitments by management	Gap 3 occurs, Gap 5 widens

Failure Mode, Effect and Criticality Analysis (FMECA): FMECA is similar to FMEA but when using FMECA, the components of a design are studied. Against each possible failure mode a "failure rate" and a "failure probability" is given or estimated, together with an "effect" and a "criticality rating". The criticality rating is related to the severity of the effect. This rating may be on a 1 to 5 scale, where 1 is low and 5 is high. Improvement action procedures are the same as for FMEA and the analysis updated as appropriate (SMMT, 1989).

Fault Tree Analysis (FTA): FTA is a technique for system failure analysis where system faults are analysed working downwards through the system from a potential system failure to identify possible causes (rather than working upwards as may be the case when carrying out an FMEA). FTA can consider combanitations of interdependent as well as independent failures (SMMT, 1989).

4.11 Benefits of Failure Mode and Effects Analysis

Failure Mode and Effects Analysis revises failure modes systematically in an effort to obviate even a tiniest harm that may arise in the product or during the service and process. It answers the questions that which failure modes have more critical effects, what is the major harm that may be occured by these effects, and which failure mode have been maken this harm. It also refers to determining how to make high-risk components reliable and establishing for which failure modes to be practised corrective actions.

FMEA is designed to assist the engineer improve the quality and reliability of design. Properly used the FMEA provides the engineer several benefits. These benefits include:

- Improve product/process reliability and quality,
- Increase customer satisfaction,
- Early identification and elimination of potential product/process failure modes,
- Prioritize product/process deficiencies,

- Capture engineering/organization knowledge,
- Emphasizes problem prevention,
- Documents risk and actions taken to reduce risk,
- Provides focus for improved testing and development,
- Minimizes late changes and associated cost,
- Catalyst for teamwork and idea exchange between functions (Crow, 2002).

In addition to engineering benefits, FMEA generally provides several advantages to organisation. FMEA:

- Increases the company's image,
- Provides a competition advantage for the company,
- Increases the customer satisfaction,
- Creates the development desire,
- Develops the organisation's culture.

FMEA's advantages are briefly these:

- Determining insufficient, weak, and deficient points in fields of design and reliability of product, production tecnology and assurance,
- Reducing costs of potential revision; by changing on the paper,it costs lower instead of changing on the production stage,
- Shortening reaching time of the product to the market; by changing on the paper, it is needed less time instead of changing on the production stage,
- Decreasing interior waste products,
- Reducing the risk about product responsibility,
- Increasing the customer satisfaction.

CHAPTER FIVE

APPLICATION

In this chapter, researches for service quality analysis on students residing in Buca Female Student Hostel associated to Dokuz Eylül University Service Department of Culture, Health and Sports with the use of Servqual technique and a FMEA application in the service process is discussed.

Some questionnaire form on students residing in Buca Female Student Hostel is designed based on the service quality dimensons and aiming to conclude how well the students' expectations are met by the hostel. This chapter contains various statistical analyses and constructions based on the data obtained from the questionnaires.

5.1 The Foundation Purpose of Dokuz Eylül University Service Department of Culture, Health, and Sports, Its Function and Service Fields

Service Department of Culture, Health and Sports is run according to code no. 2547 and 2880's 46^{th} and 47^{th} issues on organization of Medico-Social and Health, Culture and Sports Department, administration, operation, personnel' authority and duties, and comprising the general rules no.18301 published on Resmi Gazete on 03.02.1984 "Regulation on Academy Education Institutions, Mediko-Sosyal Health, Culture and Sports Department Execution".

The purpose of the foundation of this department is conserving physical and psychological health of the students, providing medical care, accommodation, food, studies, recreation, leisure time activities, enabling them to gain new hobbies and thus giving them the possibility to improve their skills, health and social conditions and by educating them to become individuals that mind their physical and

psychological health; earning them the habits of working together with discipline, recreation and entertainment.

This department is also an educational establishment that does research for fulfillment of these purposes. Service Department of Culture, Health and Sports is a functional unit that provides service to Dokuz Eylül University students based on their needs concerning social, cultural, sports and health fields.

If the present construct of the department, its service fields and the newly added-on departments are considered, the organization scheme is able to meet the demands. The organizational structure is seen in Figure 5.1.

Duties of Service Department of Culture, Health and Sports:

- Implementation of healthcare and treatment services for students and personnel,
- Meeting the needs of students and personnel on accommodation, food etc.,
- Arranging some activities to meet personnel and students' needs on cultural, sportive and social fields.

The main service areas of Service Department of Culture, Health and Sports;

- Accommodation Services,
- Food Services,
- Health Services,
- Psychological Guidance and Advising,
- Cultural and Arts Activities,
- Sport Activities,
- Social Services,
- Student Education and Recreation Services.

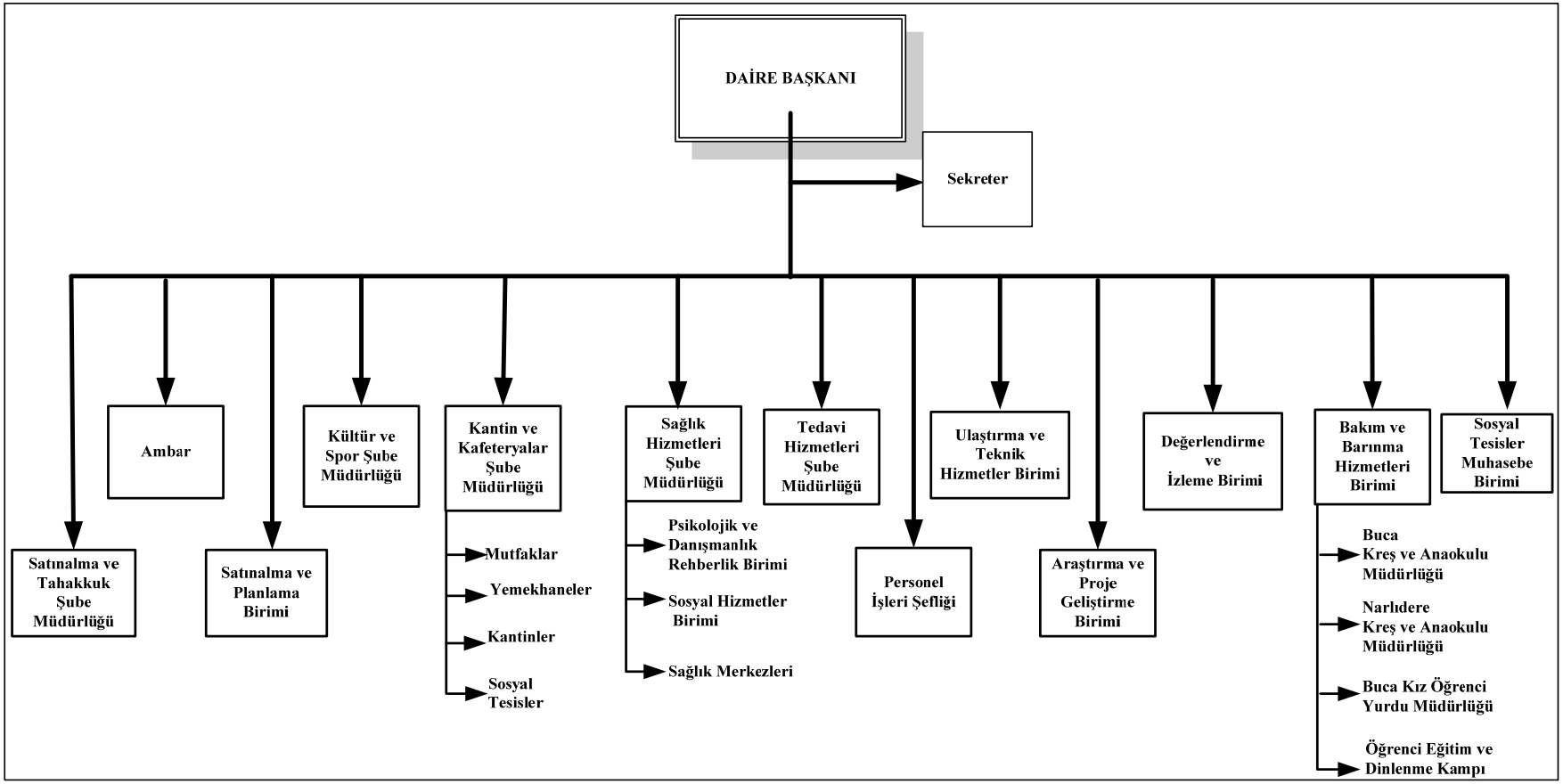


Figure 5.1 Organizational structure of to Dokuz Eylül University service department of culture, health and sports

The department while serving in its required fields and within its financial limits carries out the following basic duties:

- Founds all kinds of health services, institutes healthcare centers with beds,
- Organizes exercises and exhibitions on fine arts and sports,
- Provides scholarship and loan; food, housing, exercise, recreation, leisure time activities, transportation and employment to students,
- Gives psychological advising and guidance services, endeavors to solve the students' personal and familial problems,
- Implements researches and practices in the areas it is concerned with and publishes the notable ones,
- Organizes educational programs for personnel, for their improvement and growth.

5.2 Hostel Service and Buca Female Student Hostel

Hostel service can be defined as a communal housing system to provide accommodation to female and/or male students. In this context, the purpose of the hostels is contributing to the students' education by providing them with the comfortable environment that is healthy, modern, peaceful, hygienic, tranquil and warm and that will not make them long for home.

There are the female student hostel and kindergartens on accommodation service in the Service Department of Culture, Health and Sports.

Dokuz Eylül University Service Department of Culture, Health and Sports Administration of Hostel is responsible on the regulation, operation and supervision of hostels associated to D.E.U., except for the dorms that School of State Conservatory high school students reside in.

The hostel that provides housing to the female students, is comprised of two blocks in Buca Faculty of Education, A and B. It has a capacity of 496, and the

rooms are made for 2-4 residents. In block A there are 65 rooms for 4, and in B there are 18 for 2 and 50 for 4. Study chambers, TV room and canteen are present in the dorms. A kitchen is present in each floor and there is one laundry.

In Buca Female Student Hostel Administration, within the constitution of De-Kart project, all the resident students' personal information, their faculties and departments, permission and toll info are kept under record. With the assistance of the security cameras, the entranced and exits are under surveillance and the security is maintained.

The services given in Buca Female Student Hostel are:
Registration processes–to the hostel,
Student permission processes,
Student vacation check-out processes,
Registration renewal processes,
Telephone Service,
Advising Service,
House-cleaning service,
Officer on duty service,
Boiler room service,
Laundry service.

In this study, there are an application of process FMEA for the officer on duty service and Servqual Technique application to measure the quality of service. The work fluency form for the officer on duty service is seen in Figure 5.2.

Doküman No: SKS-KP-07-14 **Yayın Tarihi:** **Revizyon Tarihi/ No: -** **Sayfa No:** 2/3	**Bölüm Adı:** BUCA KIZ ÖĞRENCİ YURDU MÜDÜRLÜĞÜ **İşin Adı:** Nöbetçi Memur Hizmeti **Yetkili Personel:** Yurt Müdürü	**İşin Kısa Açıklaması:** Nöbet sırasında nöbetçi memurun çalışmaları	**Hazırlayan:** Candan ACAR-B.İbrahim GÜRSOY **Onaylayan:** Yönetim Temsilcisi

Geldiği Birim	Açıklama	İşlem	Dağıtım / Kişi	İlgili Form	Kişi Paraf	İlgili Mevzuat (Yasa, Yönetmelik v.b.)
		A				
	Arıza giderilemez ise konu hakkında SKS bilgilendirilir, - teknisyen veya teknik servis gönderilmesi için-	IS08				
	Çözülebilecek bir sorunla karşılaşılması durumunda Kazan Dairesinde çalışan personelin duruma müdahale etmesi sağlanır.	IS09				
	Olağanüstü hallerde talimatlara uygun olarak gerekli tedbirleri alır, durumu yurt müdürüne ve ilgili mercilere bildirir, emir ve direktiflere göre hareket eder.	IS10				
	Öğrencilerin sağlık sorunlarıyla karşılaşmaları durumunda, gerekli tedbirleri alarak kişinin en yakın sağlık kuruluşuna gönderilmesini sağlar.	IS11				
	Gerekli gördüğü zamanlarda oda ve dolapların denetimini yapar.	IS12				
	Yurt blok giriş kapılarını idarece belirlenen saatte kapattırır.	IS13				
		A				

ONAYLAYAN: DEÜ REKTÖRÜ

Figure 5.2 Officer on duty service in Buca Female Student Hostel

Doküman No: SKS-KP-07-14 **Yayın Tarihi:** **Revizyon Tarihi/ No:** - **Sayfa No:** 2/3	**Bölüm Adı:** BUCA KIZ ÖĞRENCİ YURDU MÜDÜRLÜĞÜ **İşin Adı:** Nöbetçi Memur Hizmeti **Yetkili Personel:** Yurt Müdürü	**İşin Kısa Açıklaması:** Nöbet sırasında nöbetçi memurun çalışmaları	**Hazırlayan:** Candan ACAR-B.İbrahim GÜRSOY **Onaylayan:** Yönetim Temsilcisi

Geldiği Birim	Açıklama	İşlem	Dağıtım / Kişi	İlgili Form	Kişi Paraf	İlgili Mevzuat (Yasa, Yönetmelik v.b.)
		A				
	Arıza giderilemez ise konu hakkında SKS bilgilendirilir, - teknisyen veya teknik servis gönderilmesi için-	IS08				
	Çözülebilecek bir sorunla karşılaşılması durumunda Kazan Dairesinde çalışan personelin duruma müdahale etmesi sağlanır.	IS09				
	Olağanüstü hallerde talimatlara uygun olarak gerekli tedbirleri alır, durumu yurt müdürüne ve ilgili mercilere bildirir, emir ve direktiflere göre hareket eder.	IS10				
	Öğrencilerin sağlık sorunlarıyla karşılaşmaları durumunda, gerekli tedbirleri alarak kişinin en yakın sağlık kuruluşuna gönderilmesini sağlar.	IS11				
	Gerekli gördüğü zamanlarda oda ve dolapların denetimini yapar.	IS12				
	Yurt blok giriş kapılarını idarece belirlenen saatte kapattırır.	IS13				
		A				

ONAYLAYAN :DEÜ REKTÖRÜ

Figure 5.2 Officer on duty service in Buca Female Student Hostel (continued)

Doküman No: SKS-KP-07-14 **Yayın Tarihi:** **Revizyon Tarihi/ No: -** **Sayfa No:** 3/3	**Bölüm Adı:** BUCA KIZ ÖĞRENCİ YURDU MÜDÜRLÜĞÜ **İşin Adı:** Nöbetçi Memur Hizmeti **Yetkili Personel:** Yurt Müdürü	**İşin Kısa Açıklaması:** Nöbet sırasında nöbetçi memurun çalışmaları	**Hazırlayan:** Candan ACAR-B.İbrahim GÜRSOY **Onaylayan:** Yönetim Temsilcisi

Geldiği Birim	Açıklama	İşlem	Dağıtım / Kişi	İlgili Form	Kişi Paraf	İlgili Mevzuat (Yasa, Yönetmelik v.b.)
		A				
	Öğrenci yoklamalarını yapar, öğrencilerin imza föyüne imza atmalarına nezaret eder.	IS14				
	Öğrenci mevcudunu belirler, nöbet defterine kaydeder.	IS15				
	Nöbet sırasındaki olay, faaliyet ve gözlemlerini nöbet defterine kaydeder, imzalar.	IS16				
		SKS-KP-07-14				

ONAYLAYAN :DEÜ REKTÖRÜ

Figure 5.2 Officer on duty service in Buca Female Student Hostel (continued)

5.3 Measuring of Service Quality by Servqual Scale in Buca Female Student Hostel

Before FMEA was exercised for service process in Buca Female Student Hostel, the quality of the service was measured by comparing students' expectations and their perception on the quality of the service and the management and the personnel's opinions on the quality of the service by using Servqual Technique.

The Servqual Technique which enables numeric expression of the customer satisfaction, using five service quality dimensions defined by Parasuraman, Zeithaml and Berry, is used for hostel service in this study.

5.3.1 Objective of The Research

The objective of this study is to measure Buca Female Student Hostel's quality of service according to the service quality dimensions inspecting the difference between the expected service and the perceived service, how the expected service is perceived by management and how the service providers evaluates the quality.

5.3.2 Model of The Research

Servqual technique works by a routine feedback process applied to three groups. The first group is the students (customers) who are in the decisive position on the service quality evaluation. Second is the hostel's managers and the third is the hostel's personnel who provide the service. The part of the questionnaires applied on the students is to measure the provided service quality. The part applied to the managers and the personnel is done to discover the causes of lack of service quality.

Service quality is defined as the extent of difference in the expectations of the students from an accommodation service and their perceptions from the service in the hostel that they recide.

Service Quality = Perceived Service – Expected Service

The model of the research is simply demonstrated in Figure 5.3.

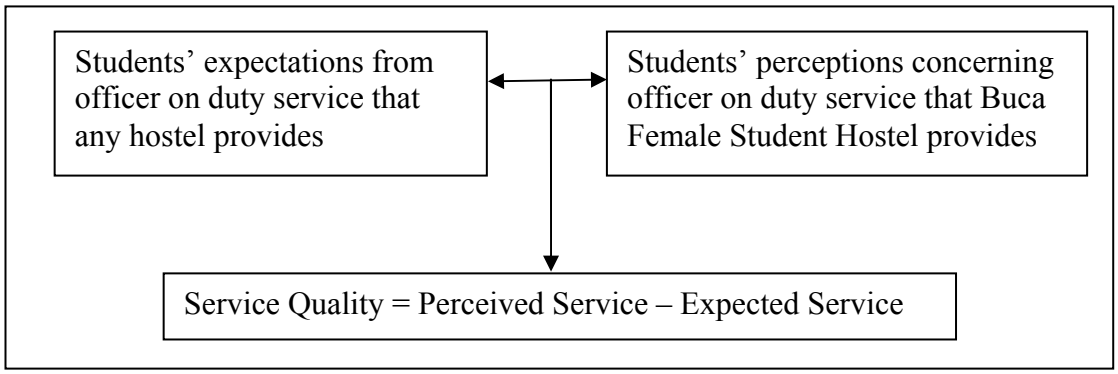


Figure 5.3 The model of the research

5.3.3 Sampling Method of The Research and Collecting of Data

Research includes students residing in Dokuz Eylül University Buca Female Student Hostel, the personnel providing the service and the managers being responsible from administration of the hostel.

Measurement of the gap between ecpected service and perceived service is a routine customer feedback process practiced by leading service companies. In most of the customer feedback processes questionnaire technique is used. These questionnaire are to obtain all the customers' service expectations before the service is provided and their service perceptions after they purchase the service (Fitzsimmons, 1994).

The questionnaire, shown in Appendix 5, developed for measuring of the service quality, is adapted to the officer on duty service of the hostel and applied to the students. In the first part of the questionnaire, which is composed of two parts, the

students' expectations from the officer on duty service and their perceptions concerning this service in the hostel is explored in 22 questions. Likert scale was used in the questionnaire which grades levels of expectation and perception in a scale of 1 to 5. "Strongly agree" statement represents 5 points and "strongly disagree" statement represents 1 point. In the second part of the questionnaire the importance graduation of the quality dimensions take place.

209 out of the 496 students residing in Buca Female Student Hostel were reached and applied the questionnaire to them with conductor by one-on-one.

5.3.4 Analysis of The Data

In data analysis SPSS and MINITAB package programs were used. Reliability analysis was conducted to test the reliability of the scale in the research. In reliability analysis, α (alpha) signifying the reliability coefficient is calculated separately for the parts of expectation and perception. The significance of the differences between the expectations and perceptions are analyzed with t test; in the questions and dimensions.

To analyze servqual variables that contains three groups analysis of variance is used.

5.3.5 Reliability Analysis

Reliability puts forth whether if the same scaled questions are consistent, the measurement is freed from random errors, and if there is similarity in measurement. Reliability analysis measures the reliability of the scale used. The reliability of the scale is calculated by Cronbach alpha coefficient "α". It takes values from 0 to 1. It is assessed so that if this coefficient is between;

0 – 0.40, the scale is not reliable,

0.40 – 0.60, the scale has low reliability,

0.60 – 0.80, the scale is reliable,
0.80 – 1, the scale is literally reliable.

In the research, the servqual scale's reliability analysis, α was calculated 0.9698 in expectations and 0.9431 in perceptions. The Cronbach α coefficient, when applied to the whole was calculated to be 0.9225 in the reliability analysis. The coefficients calculated show that the scale is very reliable.

5.3.6 Measuring The Service Quality

Measuring for Gap 5 is obtained by, using two step algorithms for unweighted servqual scores and four step algorithms for weighted servqual scores based on the data acquired from the questionnaire on the students.

In Table 5.1 the unweighted servqual scores are arranged, without taking into consideration the service quality dimensions' importances in the eyes of the students. Also the weighted servqual scores are placed with respect to their degrees of importance.

Table 5.1 Scores of Service Quality

Dimensions	**Unweighted Servqual Scores**	**Weighted Servqual Scores**
Tangibles	-1.3852	-0.2714
Reliability	-1.8250	-0.3929
Responsiveness	-1.5366	-0.3231
Assurance	-1.5947	-0.3187
Empathy	-1.2459	-0.2303
Unweighted Servqual Score	-1.5205	
Weighted Servqual Scores	-0.3080	

Negative values being present in the table show that Gap 5 exists. When the unweighted and weighted servqual scores are taken into consideration, it is seen that the highest value is on dimension of reliability. Assurance and responsiveness dimensions in both unweighted and weighted servqual score are seen to be higher than the other ones. The hostel administration has been consulted for improvement on these three dimensions.

Existence of Gap 5 as a function of the other gaps has made it clear that the other gaps must be analyzed as well.

Gap 5 = f(Gap 1, Gap 2, Gap 3, Gap 4)

According to Parasuraman, Zeithaml and Berry the other four gaps are affecting the service quality gap (Gap 5). In the absence of the other gaps, Gap 5 will be closed. On this basis, the other four gaps on service quality dimensions and their antecedents have been measured. First of all, to understand the management's perceptions of the students' expectations, the questionnaire in Appendix 6 was submitted to the managers. Gap 1 scores are measured according to the difference between the responses obtained from the students on service quality expectations, that took the questionnaire in Appendix 5 and the responses obtained from the managers. Based on the dimensions, unweighted and weighted Gap 1 scores are given on Table 5.2.

Table 5.2 Scores of Gap 1

Dimensions	**Unweighted Gap 1 Scores**	**Weighted Gap 1 Scores**
Tangibles	-0.3225	-0.0967
Reliability	0.0151	0.1000
Responsiveness	0.0817	0.0600
Assurance	-0.2578	-0.0800
Empathy	0.0246	-0.0600
Unweighted Gap 1 Score	-0.0918	
Weighted Gap 1 Score	-0.0200	

According to Gap 1 scores, widest gaps occur in tangibles and reliability dimensions. This situation is showed the service quality gap (Gap 5) that occurs not meeting students' expectations in assurance dimension is due to the management not correctly perceiving the students' expectations in this dimension. When weighted Gap 1 scores are observed tangibles, reliability and empathy dimensions have negative scores. So, the students' expectations regarding these dimensions have not been correctly perceived by the management.

The questionnaires submitted to the personnel and the managers for measuring of gaps 2, 3 and 4 are placed in Appendix 7. The larger scores obtained from the responses concerning these questionnaires mean smaller gaps. Score for Gap 2 is 3.37; for Gap 3 it is 3.77 and for Gap 4 it is 3.57. These scores are quite small. It is noted that the causes of service quality gap (Gap 5) are not service specifications that are not based on expectations, not meeting specifications and service delivery, and not providing service committed by management.

After the measuring of gaps, the two questionnaires in Appendix 8 have been submitted to the personnel who provide the service and managers. With this process, the antecedents of the gaps were measured. The 20-question questionnaire on Appendix 8 was applied to the managers to find out the antecedents of the gaps 1 and 2; and the 30-question questionnaire on Appendix 8 was applied to the personnel to find out the antecedents of the gaps 3 and 4. The scores involving antecedents of gaps 1 and 2 are on Table 5.3; and the antecedents of gaps 3 and 4 are on Table 5.4.

The smallest score for the antecedents of a gap, given that gap exists, is assessed as the most possible cause of the gap to which it belongs. When the scores of the gaps' antecedents in the tables are observed, the smallest scores for antecedents of gaps is obtained in antecedents of, for Gap 1 too many levels of management and inadequate upward communication; for Gap2 inadequate task standardization; for Gap 3 inappropriate supervisory control systems, lack of percieved control, poor technology-job fit; and for Gap 4 propensity to overpromise.

Table 5.3 Scores of antecedents of Gap 1 and Gap 2

Antecedents of Gap 1	**Scores**
Lack of Marketing Research Orientation	4.5833
Inadequate Upward Communication	3.5417
Too Many Levels of Management	3.3333
Antecedents of Gap 2	**Scores**
Inadequate Management Commitment to Service Quality	3.7083
Perception of Infeasibility	3.9167
Inadequate Task Standardization	3.5833
Absence of Goal Setting	4.0556

Table 5.4 Scores of antecedents of Gap 3 and Gap 4

Antecedents of Gap 3	**Scores**
Role Ambiguity	4.3667
Role Conflict	3.5000
Poor Employee-Job Fit	4.3333
Poor Technology-Job Fit	3.2917
Inappropriate Supervisory Control Systems	2.5556
Lack of Percieved Control	3.1250
Lack of Teamwork	3.5000
Antecedents of Gap 4	**Scores**
Inadequate Horizontal Communication	4.0000
Propensity to Overpromise	3.6667

5.3.7 Conclusions and Statistical Analyses On Students' Expectations and Perceptions

The levels of the students' expectations from the service and descriptive statistics are given on Table 5.5. Levels of the students' expectations from the service is quite high. The highest level of expectation is obtained on the fourth statement of empathy

dimension (yurdun bulunduğu yer merkezi olmalıdır) and the least level of expectation is ontained on the third statement of tangibility dimension (yurt personelinin fiziksel görünümü yeterince modern olmalıdır).

Table 5.5 Descriptive statistics for scores of students' expectations

Statement	***N***	**Minimum**	**Maximum**	**Mean**	**Standard Deviation**
Tangibles E1	209	1	5	4.49	0.9152
Tangibles E2	209	1	5	4.32	1.0311
Tangibles E3	209	1	5	3.85	1.1031
Tangibles E4	209	1	5	4.39	0.8820
Reliability E5	208	1	5	4.51	0.8900
Reliability E6	209	1	5	4.64	0.8331
Reliability E7	209	1	5	4.58	0.8290
Reliability E8	209	1	5	4.66	0.7993
Reliability E9	209	1	5	4.52	0.9358
Responsiveness E10	208	1	5	4.55	0.8556
Responsiveness E11	208	1	5	4.60	0.8108
Responsiveness E12	208	1	5	4.57	0.8367
Responsiveness E13	208	1	5	4.61	0.8446
Assurance E14	206	1	5	4.56	0.7861
Assurance E15	209	1	5	4.67	0.8103
Assurance E16	208	1	5	4.64	0.7984
Assurance E17	209	1	5	4.60	0.8087
Empathy E18	208	1	5	4.68	0.8266
Empathy E19	208	1	5	4.66	0.9396
Empathy E20	208	1	5	4.44	0.9910
Empathy E21	209	1	5	4.71	0.8582
Empathy E22	207	1	5	4.63	0.8188

On Table 5.6, descriptive statistics for levels of students' perceptions concerning the provided service are given. The highest level of perception concerning the service that the hostel provides is obtained on the fourth statement of empathy dimension (yurdun bulunduğu yer merkezidir) and the lowest level of perception is obtained on

the second statement of tangibles dimension (yurtta kullanılan ekipman ve araç-gereçler yeterince moderndir ve göze hoş görünür).

Table 5.6 Descriptive statistics for scores of students' perceptions

Statement	*N*	Minimum	Maximum	Mean	Standard Deviation
Tangibles P1	209	1	5	2.47	0.9808
Tangibles P2	209	1	5	2.40	0.9564
Tangibles P3	209	1	5	3.34	1.0901
Tangibles P4	209	1	5	3.28	1.0478
Reliability P5	208	1	5	2.85	1.1101
Reliability P6	209	1	5	2.75	1.1624
Reliability P7	209	1	5	2.84	1.0797
Reliability P8	209	1	5	2.67	1.2638
Reliability P9	209	1	5	2.66	1.1496
Responsiveness P10	208	1	5	3.12	1.2511
Responsiveness P11	208	1	5	2.85	1.1429
Responsiveness P12	208	1	5	3.51	1.2315
Responsiveness P13	208	1	5	2.70	1.1703
Assurance P14	206	1	5	3.19	1.0598
Assurance P15	209	1	5	2.68	1.2270
Assurance P16	208	1	5	3.25	1.2059
Assurance P17	209	1	5	3.02	1.2107
Empathy P18	208	1	5	3.17	1.3024
Empathy P19	208	1	5	2.96	1.5142
Empathy P20	208	1	5	2.69	1.2052
Empathy P21	209	1	5	4.36	1.0426
Empathy P22	206	1	5	3.72	1.1754

To determine whether or not there is a significant difference in between the means of expectation and perception scores, t test is applied for 0.05 significance level.

H_0: x_i'th statement's expectation and perception means do not have a significant difference.

H_1: x_i'th statement's expectation and perception means do have a significant difference.
(for all i; i:1,…,22)

H_0 is denied for all statements according to results t test. For all of the statements, it is determined that there is a significant difference between students' expectations and perceptions levels.

The mean values of the students' expectations for each dimension and other descriptive statistics are given on Table 5.7. When the results on the table are observed, the highest mean value for expectations is belonging to the empathy dimension and also highest perception mean value is belonging to the empathy dimension. To determine whether or not there is a significant difference in between the means of expectation and perception for each servqual dimension, t test is applied for 0.05 significance level.

H_0: The means of expectation and perception for the dimension do not have a significant difference.
H_1: The means of expectation and perception for the dimension do have a significant difference.

According to the results of the test, H_0 is denied for all dimensions and the significant difference between means of expectation and perception is noted.

Table 5.7 Descriptive statistics concerning students' expectation and perception scores for each dimension

Dimensions	***N***	**Minimum**	**Maximum**	**Mean of Expectation**	**Standard Deviation**
Tangibles	209	1	5	4.26	0.7632
Reliability	209	1	5	4.58	0.7441
Responsiveness	209	1	5	4.58	0.7732
Assurance	209	1	5	4.62	0.7202
Empathy	209	1	5	4.63	0.7419

Dimensions	*N*	Minimum	Maximum	Mean of Perception	Standard Deviation
Tangibles	209	1	5	2.88	0.7910
Reliability	209	1	5	2.75	0.9658
Responsiveness	209	1	5	3.05	0.9831
Assurance	209	1	5	3.04	1.0036
Empathy	209	1	5	3.38	0.8094

5.3.8 Variance Analysis

During the questionnaire on measuring of service quality gap (Gap 5) students were asked to give the statements a score of 1 to 5, according to the likert scale. The service quality gap score is calculated by subtracting the perception score from expectation score for each statement. This results have been obtained as scores varying from -4 to +4.

For Parasuraman, Zeithaml and Berry's measurement of service quality that depends on a scale of 7, the results are range from -6 to +6. When service quality gap scores take values of -6 to 0, they are evaluated as bad quality, 0 is good quality and 0 to +4 is excellent quality.

In the study on Buca Female Student Hostel, scores for gaps ranging from -4 to 0 are evaluated as bad quality, 0 is good and 0 to +4 are evaluated as excellent quality. Based on the dimensions the measurement on the unweighted and weighted servqual scores, according to the values for the mentioned three groups are:

H_0: There is no significant difference between group mean values for the dimension.
H_1: There is a significant difference between group mean values for the dimension.

Hypotheses are tested with one-way variance analysis method for 0.05 significance level.

Depending on the result of the analysis on the unweighted servqual scores, for tangibles, reliability and assurance dimensions, it is determined that the first group (bad quality) is significantly different from second (good quality) and the third (excellent quality), there is no significant difference between the second and the third groups. For other dimensions a significant difference were found amongst the three groups.

According to the analyzed results on weighted servqual scores; only in empathy dimension, a significant difference were found amongst the three groups. In other dimensions the first group (bad quality) is significantly different from second (good quality) and the third (excellent quality), there is no significant difference between the second and the third groups.

5.4 The FMEA Pertaining to Buca Female Student Hostel's Officer On Duty Service

After measuring of the service quality, FMEA analysis is applied to close the gaps caused by the antecedents and to suggest corrective actions.

For Buca Female Student Hostel's officer on duty service, FMEA is applied. To carry out process FMEA the work fluency form of officer on duty service in Buca Female Student Hostel is determined and shown in Figure 5.2.

To carry out the process FMEA; tables pertaining to occurrence, detection and severity numbers, have been adapted to Buca Female Student Hostel and these are demonstrated in tables 5.10, 5.11, 5.12.

Table 5.10 Occurrence numbers for Buca Female Student Hostel

Hata Olasılığı	Puanlama
Çok Yüksek: Hata oluşumu kaçınılmazdır.	10
	9
Yüksek: Hata oluşumu çok sıktır.	8
	7
Orta: Bazı durumlarda hata oluşur.	6
	5
	4
Düşük: Hata olasılığı düşüktür.	3
Çok Düşük: Hata olasılığı oldukça düşüktür.	2
Çok Az: Hata oluşumu görülmez.	1

Table 5.11 Severity numbers for Buca Female Student Hostel

Etkinin Önemi	Puanlama
Çok Yüksek : Kurumun işleyişine zarar veren etki.	10
	9
Yüksek: Öğrencilerin memnuniyetsizliği ve hizmet süreçlerinde düşük performansa neden olan etki.	8
Orta: Öğrencilerin memnuniyetsizliğine neden olabilen etki.	7
	6
	5
	4
Düşük: Öğrencilerin farkına varabildiği ancak düşük oranda memnuniyetsizlik yaratan etki.	3
	2
Etkisiz: Hata türünün etkisi yok veya öğrenciler etkinin farkına varmaz.	1

Table 5.12 Detection numbers for Buca Female Student Hostel

Belirlenme Olasılığı	Puanlama
İmkansız: Hata türünü belirleyecek bir kontrol mekanizması yoktur veya mevcut kontrol mekanizmasının hata türünü belirlemesi mümkün değildir.	10
Çok Düşük: Mevcut kontrol mekanizmasının hata türünü belirleme olasılığı oldukça düşüktür.	9
Düşük: Mevcut kontrol mekanizmasının hata türünü belirleme olasılığı düşüktür.	8
	7
Orta: Mevcut kontrol mekanizması hata türünü belirleyebilir.	6
	5
Yüksek: Mevcut kontrol mekanizmasının hata türünü belirleme olasılığı yüksektir.	4
	3
Çok Yüksek: Mevcut kontrol mekanizmasının hata türünü belirleme olasılığı çok yüksektir.	2
Kesin: Mevcut kontrol mekanizması hata türünü kesin olarak belirler.	1

Potential failure modes on process FMEA, the effects and causes of these failure modes should be identified. In this practice on the service process, the antecedents constituting the service quality gaps (conceptual factors) are taken as potential failure modes. The potential failure modes have been analyzed through a process FMEA form and causes, effects and control mechanisms and risk priority numbers are noted on the form. In Table 5.13 the process FMEA form is given.

Using tables 5.10, 5.11 and 5.12 the occurrence, detection and severity numbers are defined and multiplying these numbers (O x D x S) the risk priority numbers (RPN) are calculated and noted is on the process FMEA form.

Risk priority numbers take values between 1 and 1000. For the causes providing the condition RPN $\geq$ 100, by a hierarchical order that is created from larger to smaller, suggestions for corrective actions are given for the failure causes with the

highest values of RPN. In Table 5.14, corrective and preventive actions are listed for the RPN values higher than 100.

Table 5.13 Process FMEA Form for Buca Female Student Hostel

Potansiyel Hata Türü	Potansiyel Hata Türünün Nedeni	Potansiyel Hata Türünün Etkisi	Kontrol Mekanizması	Önemlilik	Oluşum	Belirlenme	Risk Öncelik Puanı
Pazarlama Araştırmalarının Yönlendirme Yetersizliği	Araştırmanın yalnızca yılda bir defa yapılması	Öğrencilerin hizmetine ilişkin beklentilerinin geç karşılanması ve iyileştirme çalışmalarının gecikmesi	Kalite İyileştirme Toplantıları	6	7	2	84
	Araştırma sonuçlarının yöneticiler tarafından anlaşılmayacak teknik terimler içermesi	Bulguların yanlış kullanılması ve kaynakların doğru yönlendirilmemesi	Mevcut Bir Kontrol Mekanizması Yok	8	3	8	192
	Araştırmanın kalite amaçlarına yönelik olmaması	Araştırma bulgularının kalite hedeflerini gerçekleştirmeye yönelik olarak kullanılamaması	Kalite İyileştirme Toplantıları, İç kontrol Mekanizması	10	8	2	160
	Şikayet ve önerilerin kayıt altına alınmaması	Şikayetlerin sıklığının belirlenememesi ve benzer şikayetlerin tekrarlanması	İç Kontrol Mekanizması	6	4	4	96
	Yurt personeli ve öğrencilerin yapılan araştırmalarda yeterince objektif yanıtlar vermemesi	Beklentilerin gerçeği yeterince yansıtmaması, iyileştirmenin doğru noktalarda yapılamaması	Mevcut Bir Kontrol Mekanizması Yok	10	7	7	490
Yukarı Doğru İletişim Eksikliği	Yurt personelinin, yöneticilerin önerilerini yeterince dikkate almaması	Çatışma ve hizmet süreçlerinin aksaması	Mevcut Bir Kontrol Mekanizması Yok	10	2	3	60
	Bürokrasinin yoğunluğundan dolayı doğru iletişimin sağlanamaması	Hizmetin zamanında sunulamaması	Yönetim Kurulu Toplantıları	4	8	3	96
	Yöneticilerin yurt personelini ve	Öğrenci ve yurt personeline ait	Mevcut Bir Kontrol	6	6	2	72

	öğrencileri yeterince dikkate almaması	beklentilere odaklanılamaması, öğrenci ve personel memnuniyetsizliği	Mekanizması Yok				
	Yurt bünyesinde, öneri ve sikayetleri yöneticilere iletebilecek birisinin bulunmaması	Yönetimin, öğrencilerin hizmetlerle ilgili problemlerden haberdar olmaması ve iyileştirme faaliyetlerinin gecikmesi	Yönetim Takım toplantıları, İç kontrol Mekanizması	4	5	2	40
Yönetim Kademelerinin Fazla Olması	Karar verme mekanizmalarının yurdun bazı noktalarında fazla olması	Öğrencilerin öneri ve şikayetlerine ilişkin değerlendirmelerin ve iyileştirme çalışmaları için karar sürecinin uzaması	Yönetim Takım Toplantıları,Yönetim Kurulu Toplantıları	5	9	2	90
Hizmet Kalitesi İçin Verilen Taahhütlerin Yetersizliği	Bürokratik engellerden dolayı geribildirimlerin sonuçlanmaması ve taahhütlerin zamanında verilmemesi	Öğrencilerin hizmetlerden memnuniyetsizliği	Yönetim Takım Toplantıları,Yönetim Kurulu Toplantıları	5	6	3	90
	Yurdun kaynaklarının yetersiz olması nedeniyle taahhütlerin verilememesi	Öğrencilerin hizmetlerden memnuniyetsizliği, yurt personelinin hizmet sunarken taahhütleri dikkate almaması	Yönetim Takım Toplantıları	10	8	3	240
	Yurt personelinin, yöneticiler tarafından, hizmet kalitesi gelişimine katkıda bulunmalarına göre takdir görmemesi	Yurt personelinin hizmet kalitesini arttırmaya yönelik çabalarının azalması, motivasyon düşüklüğü	Yönetim Takım Toplantıları, İç kontrol Mekanizması	7	8	3	168
Firma Beklentilerinin Karşılanmasında,	Yurt hizmet kalite hedeflerinin, yapılabilirliği sorgulanmadan oluşturulması	Yurt hizmetlerine ilişkin kalite hedeflerinin gerçekleştirilememesi, yeni hedefleri oluşturmada belirsizlik	Kalite İyileştirme Toplantıları, İç Kontrol Mekanizması	10	7	7	490

Beklentilerin Uygulanabilirliğinin Yöneticiler Tarafından Eksik Algılanması	Yurdun hizmet kalite hedeflerinin ihtiyaçlara göre revize edilmemesi	Öğrencilerin ve yurt personelinin beklentilerinin gerçekleşmemesi, şikayetlerin tekrarlanması	Kalite İyileştirme Toplantıları, İç Kontrol Mekanizması	9	6	4	216
Görev Standartlaştırılmasında Yetersizlik	Yurdun otomasyon sistemlerinin (turnikeler, güvenlik kameraları vb.) sıklıkla arızalanması	Hizmetlerin aksaması, yurt personeli ile öğrenciler arasında çatışma	İç Kontrol Mekanizması	8	7	3	168
	Otomasyon sistemlerinin amaca uygunluğunda yetersizlik	Yurt personelinin iş yükünün artması	İç Kontrol Mekanizması	6	8	8	384
	Otomasyon sistemlerinin arızalarının kayıt altına alınmaması	Otomasyon sistemlerinde oluşan arızaların tekrarlanması	İç Kontrol Mekanizması	5	5	3	75
Hizmet Kalitesi Hedeflerinin Eksik Belirlenmiş Olması	Yöneticilerin, öğrencilerin beklentilerini karşılayacak nitelikte hizmet sağlamanın maliyetinin oldukça fazla olacağını düşünmeleri	Öğrencilerin hizmetlerden memnuniyetsizliği	Mevcut Bir Kontrol Mekanizması Yok	9	7	6	378
	Yöneticilerin; yurdun, öğrencilerin gereksinimlerini karşılayacak yeteneklere sahip olmadığını düşünmeleri	Kaynakların yetersiz olduğunun düşünüldüğü noktalarda iyileştirme yapılmaması	Mevcut Bir Kontrol Mekanizması Yok	8	8	5	320
Belirsizliğin Rolü	Görev tanımlarının açık, yazılı ve kesin olmaması	Yetki ve sorumluluklarda karmaşayı arttırır, yurt personelinin kendi içerisinde ve yöneticilerle çatışması	İç Kontrol Mekanizması	7	6	2	84

	Görev çeşitliliğinin fazla olması	Yurt personelinin performans düşüklüğü ve hizmet sunumunda aksama	İç Kontrol Mekanizması	6	5	5	150
	Rotasyonun yoğun olması	Yurt personelinin işinde uzmanlaşmasının zorlaşması, performans düşüklüğü	İç Kontrol Mekanizması	6	3	2	36
	Yurt personelinin revizyona adapte olamaması	Yurt hizmetlerinde yapılan iyileştirmelerin uygulanmasını geciktirmesi	İç Kontrol Mekanizması	5	4	4	80
	Hizmet içi eğitimlerin yetersizliği	Yurt personelinin mesleki ve kişisel gelişimini engellemesi, kuruma katkısını azaltması	Eğitim Programları	5	4	3	60
	Oryantasyon eğitiminin yetersizliği	Yurt personelinin işe uyumunu zorlaştırması, kurum kültürünü benimsemede zorluk	İç Kontrol Mekanizması	6	6	2	72
	Yurt personelinin, performans değerlendirme ölçütleri konusunda bilgi sahibi olmaması	Yurt personelinin öz değerlendirme yapamaması ve kişisel hedeflerini doğru belirleyememesi	Performans Değerlendirme Sistemi	8	9	7	504
Anlaşmazlığın Rolü	Öğrencilerin beklenti ve algılarının, kurumun beklenti ve algılarından farklı olması	Öğrencilerin kuruma güveninin ve sadakatinin azalması, beklentilerin karşılanmaması sonucu öğrencilerin memnuniyetsizliği	Anketler, Geribildirim Formları	10	8	4	320
	Hizmet sunumu sırasında	Hizmetin sunumunun süresini uzatması,	İç Kontrol Mekanizması	7	8	1	56

	dokümantasyonun yoğun olması	yurt personeli için fazla iş yükü ve zaman kaybı					
	Personel sayısının azlığı	Hizmet sunumunun süresini uzatması, personel ve öğrenci şikayetlerinin artması	İç Kontrol Mekanizması	8	7	3	168
	Personelin ve öğrencilerin iletişim becerilerinin eksikliği	Yurt personeli ile öğrenciler arasında çatışma, öğrenci şikayetlerinin artması	İç Kontrol Mekanizması	10	3	2	60
	Personelin bir işe ilişkin algıları ile yönetimin aynı işe dair algıları arasındaki farklılık	Kurum ile yurt personeli arasında çatışma, hizmette standartlaşmayı engellemesi	Mevcut Bir Kontrol Mekanizması Yok	10	8	8	640
İşe Uygun Personelin Yetersizlik	Yurt personelinin işe uygun bilgi, beceri ve uzmanlığa sahip olmaması	Hizmetlerin doğru ve etkin bir biçimde sunulamaması, öğrenci ile yurt personeli arasında iletişimde sorun	İç Kontrol Mekanizması	8	5	2	80
	Yurt personelinin yeterli motivasyona sahip olmaması	Takım çalışmasına katkı sağlamada yetersizlik, hizmet sunumunda etkinliği azaltması	İç Kontrol Mekanizması	6	9	6	324
	Kurumun işe uygun personeli seçmedeki yetersizliği	Yurt personelinin kendi içerisinde adaletsiz iş bölümü ve çatışma	İç Kontrol Mekanizması	9	5	2	90
İşe Uygun Teknolojinin Yetersizliği	Yurt personeline işe uygun ekipman, araç ve gereçlerin yeteri kadar sağlanmaması	Yurt personelinin performansının düşmesi, hizmetin sunulmasında sorunlar	İç Kontrol Mekanizması	9	7	6	378
	Yurdun ekipman, araç ve gereçlerinin	Hizmet sunumunda zaman kaybı	İç Kontrol Mekanizması	8	4	1	32

	sıklıkla arızalanması						
Uygun Olmayan Denetim ve Kontrol Sistemi	Yurt personelini denetleyen kişilerin, yurt personeline, değerlendirme ölçütleri hakkında bilgi vermemeleri	Yurt personelinin hatalarının tekrarlanması, personel için belirsizlik	Mevcut Bir Kontrol Mekanizması Yok	8	1	4	32
	Yurt personelinin öğrencilerle iletişiminin, denetleyen kişiler tarafından dikkate alınmaması	Yurt personelinin iletişim becerileri konusunda iyileştirmelerin yapılamaması	Mevcut Bir Kontrol Mekanizması Yok	7	2	4	56
	Yurt personeli için bir ödüllendirme sisteminin bulunmaması	Yurt personelinin motivasyonunun düşmesi, performans konusunda iyileştirmelerin yapılamaması	İç Kontrol Mekanizması	8	5	2	80
	Yurt personeline yönelik ödüllendirme sisteminin adil bir şekilde uygulanmaması	Yurt personelinin kendi içerisinde ve kurum ile personel arasında çatışma, personelin motivasyon düşüklüğü	Mevcut Bir Kontrol Mekanizması Yok	9	2	4	72
Kontrolün Anlaşılmasında Yetersizlik	Yurt personelinin problemler karşısında karar yetkisinin olmaması veya kısıtlı olması	Yurt personeli için belirsizlik, problemin büyümesi, zaman kaybı	Mevcut Bir Kontrol Mekanizması Yok	7	4	3	84
	Yurt personelinin, problemleri çözümleyebilmek için başka birimlere ve personele bağımlı kalmaları	Problemin, departmanlar arasındaki geçişte niteliğinin değişmesi, problemin çözümünde zaman kaybı	İç Kontrol Mekanizması	8	10	4	320
	Yurt personelinin kontrol mekanizmasını geliştirmede yönetim tarafından yeterince teşvik edilmemesi	Acil çözüm gerektiren problemlerde personelin kontrolü sağlayamaması	Yönetim Takım Toplantıları, İç Kontrol Mekanizması	6	4	4	96

	Yurt personelinin problemleri çözmede yeterince zamana sahip olmamaları	Problemlerin zamanında çözülememesi, öğrenci şikayetlerinin artması	Mevcut Bir Kontrol Mekanizması Yok	7	2	4	56
Yetersiz Takım Çalışması	Yurt personelinin kendilerini takımın önemli bir parçası olarak hissetmemeleri	Yurt personelinin bireysel çalışmaya yönelmesi, motivasyon düşüklüğü ve verimsiz hizmet sunumu	Mevcut Bir Kontrol Mekanizması Yok	8	2	5	80
	Yönetimin, yurt personelini takım çalışmasına yeterince teşvik etmemesi ve yönlendirmemesi	Yurt personelinin takım çalışmasında sinerji yaratamaması, bireysel çalışmaya yönelme	Mevcut Bir Kontrol Mekanizması Yok	5	3	5	75
Yetersiz Yatay İletişim	Yurt personelinin, kendi aralarında yurt hizmetlerine ilişkin fikir alışverişi yapmamaları	Hizmet sunumunda standartlaşmanın sağlanamaması	Mevcut Bir Kontrol Mekanizması Yok	6	2	5	60
	Yurt hizmet birimi ile kurumun ilgili departmanları arasındaki iletişim eksikliği	Problemlerin önemliliğinin yeterince anlaşılamaması	Mevcut Bir Kontrol Mekanizması Yok	8	2	5	80
Çok Fazla Taahütte Bulunmaya Eğilim	Öğrencilere taahhüt edilen hizmet ile gerçekleşen hizmet arasında farklılık olması	Kurumun imajının öğrenciler tarafından olumsuz algılanması, öğrenci memnuniyetsizliği	Mevcut Bir Kontrol Mekanizması Yok	10	5	8	400
	Kurumun öğrencilere çok fazla taahhütte bulunması	Öğrencilerin kuruma güvensizliği, memnuniyetsizlik	Yönetim Takım Toplantıları	10	4	1	40

Tablo 5.14 Prioritized RPN values higher than 100 and corrective actions

Potansiyel Hata Türü	Potansiyel Hata Türünün Nedeni	RÖS	Düzeltici Faaliyetler
Anlaşmazlığın Rolü	Personelin bir işe ilişkin algıları ile yönetimin aynı işe dair algıları arasındaki farklılık	640	Yönetimin ve personelin birlikte yer alacağı bir toplantıda hizmet tanımının yeniden oluşturulması ve hizmette standartlaşmanın sağlanması
Belirsizliğin Rolü	Yurt personelinin, performans değerlendirme ölçütleri konusunda bilgi sahibi olmaması	504	Yurt personelini denetleyen yurt müdüresinin, performans değerlendirme ölçütlerine ilişkin personele bilgi vermesi
Firma Beklentilerinin Karşılanmasında, Beklentilerin Uygulanabilirliğinin Yöneticiler Tarafından Eksik Algılanması	Yurt hizmet kalite hedeflerinin, yapılabilirliği sorgulanmadan oluşturulması	490	Bir sonraki yıla ilişkin kalite hedeflerinin, yurt yönetimi tarafından yurdun kaynakları göz önünde bulundurularak oluşturulması
Pazarlama Araştırmalarının Yönlendirme Yetersizliği	Yurt personeli ve öğrencilerin yapılan araştırmalarda yeterince objektif yanıtlar vermemesi	490	Anketlerin uygulanması esnasında, anketörler tarafından öğrencilere ve personele gizlilik taahhütünün verilmesi
Çok Fazla Taahütte Bulunmaya Eğilim	Öğrencilere taahhüt edilen hizmet ile gerçekleşen hizmet arasında farklılık olması	400	Yurdun tanıtımlarının, gerçekleşen hizmete göre oluşturulacak olan taahhütler çerçevesinde yeniden oluşturulması
Görev Standartlaştırılmasında Yetersizlik	Otomasyon sistemlerinin amaca uygunluğunda yetersizlik	384	Otomasyon sistemlerinin, kurulma amaçları kapsamında gözden geçirilmesi ve amaca uyguluğu sağlayacak iyileştirmelerin yapılması
Hizmet Kalitesi	Yöneticilerin, öğrencilerin beklentilerini		Kalite maliyetlerine ilişkin bir çalışma yapılarak, bütçe planlaması

Hedeflerinin Eksik Belirlenmiş Olması	karşılayacak nitelikte hizmet sağlamanın maliyetinin oldukça fazla olacağını düşünmeleri	378	oluşturulması ve yöneticilere sunulması
İşe Uygun Teknolojinin Yetersizliği	Yurt personeline işe uygun ekipman, araç ve gereçlerin yeteri kadar sağlanmaması	378	Yetersiz olan ekipmanın, kurumun ilgili birimlerinden karşılanması, aksi takdirde bütçe kapsamında gerekli ekipmanın temin edilmesi
İşe Uygun Personelin Yetersizliği	Yurt personelinin yeterli motivasyona sahip olmaması	324	Yönetimin, yurt personelinin motivasyonunu arttırıcı aktiviteler düzenlemesi, adil bir ödüllendirme sisteminin oluşturulması
Hizmet Kalitesi Hedeflerinin Eksik Belirlenmiş Olması	Yöneticilerin; yurdun, öğrencilerin gereksinimlerini karşılayacak yeteneklere sahip olmadığını düşünmeleri	320	Yurdun kaynaklarının yetersiz olduğu noktalarda iyileştirmelerin yapılması
Anlaşmazlığın Rolü	Öğrencilerin beklenti ve algılarının, kurumun beklenti ve algılarından farklı olması	320	Yönetime, öğrencilerin beklenti ve algılarına ilişkin bilgi sağlayan anket ve geribildirimlerin rapor olarak sunulması
Kontrolün Anlaşılmasında Yetersizlik	Yurt personelinin, problemleri çözümleyebilmek için başka birimlere ve personele bağımlı kalmaları	320	Yurtta yirmi dört saat boyunca, birer adet temizlik görevlisi ve teknik personelin bulunması
Hizmet Kalitesi İçin Verilen Taahhütlerin Yetersizliği	Yurdun kaynaklarının yetersiz olması nedeniyle taahhütlerin verilememesi	240	Yurdun kaynaklarının gözden geçirilmesi, yöneticilerle yapılacak bir toplantıda kaynak sağlama çalışmalarına karar verilmesi, var olan kaynaklar kapsamında taahhütlerin yeniden oluşturulması
Firma Beklentilerinin Karşılanmasında, Beklentilerin Uygulanabilirliğinin Yöneticiler Tarafından Eksik Algılanması	Yurdun hizmet kalite hedeflerinin ihtiyaçlara göre revize edilmemesi	216	Bir sonraki yıla ilişkin kalite hedefleri oluşturulurken, yurt yönetiminin araştırma bulguları ile geribildirim kayıtlarını göz önünde bulundurması
Pazarlama	Araştırma sonuçlarının yöneticiler tarafından		Yöneticilerin, teknik konular kapsamında eğitim programlarına

Araştırmalarının Yönlendirme Yetersizliği	anlaşılmayacak teknik terimler içermesi	192	katılımının sağlanması
Hizmet Kalitesi İçin Verilen Taahhütlerin Yetersizliği	Yurt personelinin, yöneticiler tarafından, hizmet kalitesi gelişimine katkıda bulunmalarına göre takdir görmemesi	168	Kalite iyileştirme çalışmalarına katkı sağlayan personel için bir ödüllendirme sisteminin oluşturulması
Görev Standartlaştırılmasında Yetersizlik	Yurdun otomasyon sistemlerinin (turnikeler, güvenlik kameraları vb.) sıklıkla arızalanması	168	Yurtta yirmi dört saat bulunacak teknik elemanların istihdam edilmesi
Anlaşmazlığın Rolü	Personel sayısının azlığı	168	Kurumun insan kaynakları departmanının, ihtiyaç duyulan personel sayısına ilişkin yönetime bilgi vermesi, belirlenen posizyonlarda işe alım yapılması
Pazarlama Araştırmalarının Yönlendirme Yetersizliği	Araştırmanın kalite amaçlarına yönelik olmaması	160	Anketlerin, kalite amaçlarına uygun olacak şekilde revize edilmesi
Belirsizliğin Rolü	Görev çeşitliliğinin fazla olması	150	Kurumun insan kaynakları biriminin, iş tanımlarını yeniden gözden geçirmesi

CHAPTER SIX

CONCLUSIONS AND SUGGESTIONS

In the application scope of this theses, Buca Female Student Hostel' quality of service has been measured with the use of Servqual Scale and suggestions of corrective actions have been given with Failure Mode and Effects Analysis.

Using Servqual scale the expected and perceived service quality levels have been measured. By the results of this research, the Servqual scale is verified to be a reliable method of measuring the quality levels of expected and perceived service.

In the continuation of the study achieved with Servqual scale, the unweighted and weighted servqual scores of the dimensions for the hostel's officer on duty service have been measured. As seen in Table 5.1, all the unweighted and weighted servqual scores were obtained as negative values. In this situation, it can be said that Buca Female Student Hostel cannot meet the expectations of the students for all dimensions. According to the results, the highest negative value of the unweighted and weighted servqual scores has been calculated in reliability dimension.

After measuring of service quality gap (Gap 5), the means of the expectations and perceptions of all the students have been examined. Looking at tables 5.5 and 5.6, it is seen that the highest expectation level is in statement of "yurdun bulunduğu yer merkezi olmalıdır" pertaining to the empathy dimension; and the lowest expectation level is statement of "yurt personelinin fiziksel görünümü yeterince modern olmalıdır" pertaining to the tangibles dimension. When the mean values for perceptions are taken into consideration, the highest perception level has taken place in the empathy dimension, statements of "yurdun bulunduğu yer merkezidir", and the lowest level is obtained in the statements of "yurtta kullanılan ekipman ve araç-gereçler yeterince moderndir ve göze hoş görünür" pertaining to the tangibles dimension.

Also looking at the tables 5.5 and 5.6, on a scale of five the mean values for expectations are between 3.85 and 4.71 whereas the mean values for perception are between 2.40 and 4.36. From these results, it is possible to say that the hostel are not meeting students' expectations. Since the unweighted and weighted servqual scores for all dimensions are negative, it also denotes that the hostel are not meeting students' demands.

Looking at the mean values of expectations and perceptions, shown in Table 5.7, the greatest difference between expected service level and the hostel's performance (perceived service) is determined in reliability dimension and the least is obtained in empathy.

Looking at Table 5.2 management's perceptions concerning the students' expectations in the tangibility and reliability dimensions, the scores are observed to be negative. The management is advised on these two dimension that widen the service quality gap; the advices for tangibles dimension are improving the physical appearance of the hostel, the personnel and the materials; for assurance are hostel' personnel to be educated in communication skills.

For antecedent scores of gaps see table 5.3 and 5.4, the most possible causes that create gaps are lack of technology for the job, personnel's being unaware of regulation criteria, and lack of a reward mechanism for personnel in the hostel.

In the conclusion of t test, for all statements a significant difference has been found in the expectation and perception mean values of the students. In the basis of service quality dimensions looking at the mean values of expectation and perceptions, a significant difference is noted. According to the results of the variance analysis, for tangibles, reliability, and assurance dimensions it is determined that first group (bad quality) has significantly different from second (good quality) and the third (great quality), however the second and the third groups do not have a significant difference between them. For empathy dimension,there is a significant difference amongst the three groups. For other dimension, responsiveness, according

to unweighted servqual scores significant differences were found amongst the three groups and according to weighted servqual scores first group has significantly different from second and the third groups, however the second and the third groups do not have a significant difference between them.

After the service quality of Buca Female Student Hostel is measured, FMEA has been applied. Service quality gaps and antecedents of gaps are taken as potential failure modes on table 5.13, causes and effects of each failure mode have been determined. The occurrence and detection possibilities of the failures and the severity degrees of their effects have been identified on tables 5.10, 5.11, and 5.12 and their risk priority numbers are calculated. The failure modes with RPN values higher than 100 have been put in order and prioritized and corrective actions have been suggested for these failure modes.

The failure mode with highest RPN (shown on Table 5.14), role conflict that is one of the antecedents of Gap 3. The role conflict, lack of perception of feasibility, lack of marketing reseach orientation, propensity to overpromise and inadequate task standardization have been the failure modes that were priorly advised corrective actions on. The antecedents that have highest RPN also cause Gap 5 to widen.

After FMEA, looking at the corrective actions advised to Buca Female Student Dorms (shown on Table 5.14), these are standardization in service, informing personnel on performance evaluation criteria, forming of quality goals after their feasibility is inspected, ensuring confidentiality to a student or a staff member when a research is carried out, commitment of privacy is given to personnel and students in the questionnaire process, based on commitments reforming advertisement of the hostel and improving the operating systems.

After the corrective actions are taken and the it is concluded on the gap forming dimensions, continuity of these study should be ensured. To reach the goals of FMEA, it must be repeated continually in certain time intervals.

In this study especially the application process of questionnaires for service quality measurement, several difficulties are occur.

Firstly during application of questionnaires, given commitments concerning secrecy of students' and personnel' responses were not sufficient. So, indeed of applying the questionnaires by one who conducts the survey these should be submitted to the students and personnel.

On the applied questionnaire to measure service quality gap (Gap 5), the statements concerning expectations and perceptions taken part on a joint questionnaire (Appendix 5). For reliability of the survey, it is suggested that the this should be applied as two separate questionnaires.

The other problem that appeared during the data collecting process was lack of dating plan. Participation to the survey applied to the students was lower than expected because the questionnaire applied on examination term. It is suggested that these should be applied with an adequate dating plan.

REFERENCES

Baş, T., & Ardıç, K. (January 7, 2006). *Sağlık sektöründe hizmet kalitesinin (müşteri tatmininin) ölçülmesi*. Retrieved March 17, 2006, from http://www.bilgiyonetimi.org/cm/.

British standards institution [BSI]. (1991). Part 5: Guide to failure modes, effects and criticality analysis (FMEA and FMECA). In *Reliability of systems equipment and components-BS 5760* (5-19). BSI.

Chrysler corporation, Ford motor company and general motors corporation. (1995). *Potential failure mode and effects analysis (FMEA)-Reference Manual* (2nd ed.). Chrysler corporation, Ford motor company and general motors corporation.

Cox, S.J., & Tait, N.R.S. (1991). Introduction. In *Reliability*, *safety and risk management-an integrated approach* (1-11). Great Britain: Butterworth-Heinemann Ltd.

Crow, K. (2002). *Failure modes and effects analysis (FMEA)*. Retrieved April 18, 2005, from http://www.npd-solutions.com/fmea.html.

Dummer, G.W.A., & Winton, R.C. (1990). The importance of reliability; Definitions of reliability; The effect of operating conditions and environments. In *An elementary guide to reliability* (4th ed.) (1; 4-7; 29-31). Pergamon Press.

Erginel, N.M. (2004). Tasarım hata türü ve etkileri analizinin etkinliği için bir model ve uygulaması. *Makine mühendisleri odası endüstri mühendisliği dergisi*, *15* (3), 17-26.

Failure modes and effects analysis, (n.d.). Retrieved April 18, 2005, from http://www.roseinformatik.com/fmea.html.

Fitzsimmons, J.A., & Fitzsimmons, M.J. (1994). *Service management for competitive advantage*. Singapore: McGraw-Hill Inc.

Grant, E.L., & Leavenworth, R.S. (1999). Introduction and overview; Some aspects of life testing and reliability. In *Statistical quality control* (7th ed.) (3-5; 602-607). Singapore: McGraw-Hill Inc.

Hansen, B.L. (1966). Reliability. In *Quality control theory and applications* (329-341, 357-360). New Delhi: Prentice-Hall Inc.

International Organization for Standardization [ISO]. (1991). *ISO 9004-2 International Standard.* Switzerland: ISO.

Ireson, V.G., Coombs, C.F., & Moss, R.Y. (1996). Introduction, definitions and relationships. In *Handbook of reliability engineering management* (2nd ed.) (1-11). NY: McGraw-Hill Companies Inc.

Kmenta, S., & Ishii, K. (1998). Advanced FMEA using meta behavior modeling for concurrent design of products and controls. *Proceedings of DECT'98 1998 ASME design engineering technical conferences*, 1-9.

Lowndes, M. (2000). The effect of negative statements on services quality dimensionality. *ANZMAC 2000 Visionary Marketing for the 21th century*: *Facing the challenge*, 718-723.

Mizuno, S., & Akao, Y. (1994). Quality and quality function deployment-Introduction. In *QFD the customer-driven approach to quality planning and deployment* (3-16). Hong Kong: The Asian Productivity Organization.

Production strategy concepts, (n.d.). Retrieved November 9, 2006, from http://www.unb.ca/jhsc/resourcectr/TME_courses/tme3113/production/m5s1-29.htm.

Rotondaro, R.G., & Oliveira, C.L. (2001). Using failure mode effect analysis (FMEA) to improve service quality-service operations management. *Proceedings of the twelfth annual conference of the production and operations management society, POM 2001*. 1-8.

Straker, D. *Failure mode and effects analysis* (*FMEA*): *When to use it*. (n.d.). Retrieved December 21, 2006, from http://www.syque.com/quality_tools/ toolbook/FMEA/fmea.htm.

Straker, D. *Fault tree analysis: When to use it*. (n.d.). Retrieved December 21, 2006, from http://www.syque.com/quality_tools/toolbook/FTA/fta.htm.

Şen, A., Deveci, İ., Yenginol, F., & Gürkaynak, Y. (1999). Bir sistem tasarımında KFG, HMEA ve güvenilirlik tekniklerinin tasarım güvencesi amacı ile kullanılması. *Marmara üniversitesi IV. ulusal istatistik ve ekonometri sempozyumu*, 1-6.

Taşpınar, A. (2003). *Güvenilirlik güvencesi programları ve hata türü ve etkisi analizi uygulaması.* İzmir: Dokuz Eylül Üniversitesi.

The society of motor manufacturers and traders limited [SMMT]. (1989). *Guidelines to failure mode and effects analysis*. London: SMMT.

Zacks, S. (1992). System effectiveness. In *Introduction to reliability analysis-probability models and statistical methods* (1-11). NY: Verlag New York Inc.

Zeithaml, V.A., Parasuraman, A., & Berry, L.L. (1990). *Delivering quality service balancing customer perceptions and expectations*. NY: The Free Press A Division of Macmillian Inc.

APPENDICES

Appendix-1 Servqual Questionnaire to Measure Service Quality Gap (Gap 5)

Expectations

Direction: Based on your experiences as a customer of ..... services, please think about the kind of ..... company that would deliver excellent quality of service. Think about the kind of ..... company with which you would be pleased to do business. Please show the extent to which you think such a ..... company would possess the feature described by each statement. If you feel a feature is not at all essential for excellent ..... companies such as the one you have in mind, circle the number 1. If you feel a feature is absolutely essential for excellent ..... companies, circle 7. If your feelings are less strong, circle one of the numbers in the middle. There are no right or wrong answers- all we are interested in is a number that truly reflects your feelings regarding companies that would deliver excellent quality of service.

	Statements	Strongly Disagre						Strongly Agree
1	Excellent ..... companies will have modern-looking equipment.	1	2	3	4	5	6	7
2	The physical facilities at excellent ..... companies will be visually appealing.	1	2	3	4	5	6	7
3	Employees at excellent ..... companies will be neat-appearing.	1	2	3	4	5	6	7
4	Materials associated with the service (such as pamphlets or statements) will be visually appealing in an excellent ..... company.	1	2	3	4	5	6	7
5	When excellent ..... companies promise to do something by a certain time, they will do so.	1	2	3	4	5	6	7

6	When a customer has a problem, excellent ..... companies will show a sincere interest in solving it.	1 2 3 4 5 6 7
7	Excellent ..... companies will perform the service right the first time.	1 2 3 4 5 6 7
8	Excellent ..... companies will provide their services at the time they promise to do so.	1 2 3 4 5 6 7
9	Excellent ..... companies will insist on error-free records.	1 2 3 4 5 6 7
10	Employees in excellent ..... companies will tell customers exactly when services will be performed.	1 2 3 4 5 6 7
11	Employees in excellent ..... companies will give prompt service to customers.	1 2 3 4 5 6 7
12	Employees in excellent ..... companies will always be willing to help customers.	1 2 3 4 5 6 7
13	Employees in excellent ..... companies will never be too busy to respond to customers' requests.	1 2 3 4 5 6 7
14	The behavior of employees in excellent ..... companies will instill confidence in customers.	1 2 3 4 5 6 7
15	Customers of excellent ..... companies will feel safe in their transactions.	1 2 3 4 5 6 7
16	Employees in excellent ..... companies will be consistently courteous with customers.	1 2 3 4 5 6 7
17	Employees in excellent ..... companies will have the knowledge to answer customers' questions.	1 2 3 4 5 6 7
18	Excellent ..... companies will give customers individual attention.	1 2 3 4 5 6 7
19	Excellent ..... companies will have operating hours convenient to all their customers.	1 2 3 4 5 6 7
20	Excellent ..... companies will have employees who give customers personel attention.	1 2 3 4 5 6 7
21	Excellent ..... companies will have the customer's best interests at heart.	1 2 3 4 5 6 7
22	The employees of excellent ..... companies will understand the spesific needs of their customers.	1 2 3 4 5 6 7

Appendix-1 (Continued)

Directions: Listed below are five features pertaining to ..... companies and the services they offer. We would like to know how important each of these features is to you when you evaluate a ..... company's quality of service. Please allocate a total of 100 points among the five features according to how important each feature is to you-the more important a feature is to you, the more points you should allocate to it. Please ensure that the points you allocate to the five features add up to 100.

	Features	**Points**
1	The appearance of the ..... company's physical facilities, equipment, personnel, and communication materials	
2	The ..... company's ability to perform the promised service dependably and accurately	
3	The ..... company's willingness to help customers and provide prompt service	
4	The knowledge and courtesy of the ..... company's employees and their ability to convey trust and confidence	
5	The caring, individualized attention the ..... company provides its customers	
Total Points		100

- Which one feature among the above five is most important to you? (please enter the feature's number) .....
- Which feature is second most important to you? (please enter the feature's number) .....
- Which feature is least important to you? (please enter the feature's number) .....

Appendix-1 (Continued)

Perceptions

Directions: The following set of statements relate to your feelings about XYZ Company. For each statement, please show the extent to which you believe XYZ Company has the feature described by the statement. Once again, circling a 1 means that you strongly agree. You may circle any of the numbers in the middle that show how strong your feelings are. There are no right or wrong answers- all we are interested in is a number that best shows your perceptions about XYZ Company.

	Statements	Strongly Disagree						Strongly Agree
1	XYZ Co. has modern-looking equipment.	1	2	3	4	5	6	7
2	XYZ Co.'s physical facilities are visually appealing.	1	2	3	4	5	6	7
3	XYZ Co.'s employees are neat-appearing.	1	2	3	4	5	6	7
4	Materials associated with the service (such as pamphlets or statements) are visually appealing at XYZ Co.	1	2	3	4	5	6	7
5	When XYZ Co. promises to do something by a certain time, it does so.	1	2	3	4	5	6	7
6	When you have a problem, XYZ Co. shows a sincere interest in solving it.	1	2	3	4	5	6	7
7	XYZ Co. performs the service right the first time.	1	2	3	4	5	6	7
8	XYZ Co. provides its services at the time it promises to do so.	1	2	3	4	5	6	7
9	XYZ Co. insists on error-free records.	1	2	3	4	5	6	7
10	Employees in XYZ Co. tell you exactly when services will be performed.	1	2	3	4	5	6	7
11	Employees in XYZ Co. give you prompt service.	1	2	3	4	5	6	7
12	Employees in XYZ Co. are always willing to help you.	1	2	3	4	5	6	7

13	Employees in XYZ Co. are never too busy to respond to your requests.	1 2 3 4 5 6 7
14	The behavior of employees XYZ Co. instills confidence in you.	1 2 3 4 5 6 7
15	You feel safe in your transactions with XYZ Co.	1 2 3 4 5 6 7
16	Employees in XYZ Co. are consistently courteous with you.	1 2 3 4 5 6 7
17	Employees in XYZ Co. have the knowledge to answer your questions.	1 2 3 4 5 6 7
18	XYZ Co. gives you individual attention.	1 2 3 4 5 6 7
19	XYZ Co. Has operating hours convenient to all its customers.	1 2 3 4 5 6 7
20	XYZ Co. Has employees who give you personel attention.	1 2 3 4 5 6 7
21	XYZ Co. Has your best interests at heart.	1 2 3 4 5 6 7
22	Employees of XYZ Co. understand your spesific needs.	1 2 3 4 5 6 7

Appendix-2 Questionnaire to Measure Service Performance Gap (Gap 1)

Directions: This portion of the survey deals with how you think your customers feel about a ..... company that, in their view, delivers excellent quality of service. Please indicate the extent to which your customers feel that excellent ..... companies would possess the feature described by each statement. If your customers are likely to feel a feature is not at all essential for excellent ..... companies, circle the number 1. If your customers are likely to feel a feature is absolutely essential, circle 7. If your customers' feelings are likely to be less strong, circle one of the numbers in the middle. Remember, there are no right or wrong answers- we are interested in what you think your customers' feelings are regarding ..... companies that would deliver excellent quality of service.

	Statements	Our Customers Would Strongly Disagree						Our Customers Would Strongly Agree
1	Excellent ..... companies will have modern-looking equipment.	1	2	3	4	5	6	7
2	The physical facilities at excellent ..... companies will be visually appealing.	1	2	3	4	5	6	7
3	Employees at excellent ..... companies will be neat-appearing.	1	2	3	4	5	6	7
4	Materials associated with the service (such as pamphlets or statements) will be visually appealing in an excellent ..... company.	1	2	3	4	5	6	7
5	When excellent ..... companies promise to do something by a certain time, they will do so.	1	2	3	4	5	6	7
6	When a customer has a problem, excellent ..... companies will show a sincere interest in solving it.	1	2	3	4	5	6	7
7	Excellent ..... companies will perform the service right the first time.	1	2	3	4	5	6	7

8	Excellent ..... companies will provide their services at the time they promise to do so.	1 2 3 4 5 6 7
9	Excellent ..... companies will insist on error-free records.	1 2 3 4 5 6 7
10	Employees in excellent ..... companies will tell customers exactly when services will be performed.	1 2 3 4 5 6 7
11	Employees in excellent ..... companies will give prompt service to customers.	1 2 3 4 5 6 7
12	Employees in excellent ..... companies will always be willing to help customers.	1 2 3 4 5 6 7
13	Employees in excellent ..... companies will never be too busy to respond to customers' requests.	1 2 3 4 5 6 7
14	The behavior of employees in excellent ..... companies will instill confidence in customers.	1 2 3 4 5 6 7
15	Customers of excellent ..... companies will feel safe in their transactions.	1 2 3 4 5 6 7
16	Employees in excellent ..... companies will be consistently courteous with customers.	1 2 3 4 5 6 7
17	Employees in excellent ..... companies will have the knowledge to answer customers' questions.	1 2 3 4 5 6 7
18	Excellent ..... companies will give customers individual attention.	1 2 3 4 5 6 7
19	Excellent ..... companies will have operating hours convenient to all their customers.	1 2 3 4 5 6 7
20	Excellent ..... companies will have employees who give customers personel attention.	1 2 3 4 5 6 7
21	Excellent ..... companies will have the customer's best interests at heart.	1 2 3 4 5 6 7
22	The employees of excellent ..... companies will understand the spesific needs of their customers.	1 2 3 4 5 6 7

Appendix-2 (Continued)

Directions: Listed below are five features pertaining to ..... companies and the services they offer. We would like to know how important each of these features is to your customers when they evaluate a ..... company's quality of service. Please allocate a total of 100 points among the five features according to how important each feature is to your customers-the more important a feature is likely to be to your customers, the more points you should allocate to it. Please ensure that the points you allocate to the five features add up to 100.

	Features	**Points**
1	The appearance of the ..... company's physical facilities, equipment, personnel, and communication materials	
2	The ..... company's ability to perform the promised service dependably and accurately	
3	The ..... company's willingness to help customers and provide prompt service	
4	The knowledge and courtesy of the ..... company's employees and their ability to convey trust and confidence	
5	The caring, individualized attention the ..... company provides its customers	
Total Points		100

- Which one feature among the above five is most important to you? (please enter the feature's number) .....
- Which feature is second most important to you? (please enter the feature's number) .....
- Which feature is least important to you? (please enter the feature's number) .....

Appendix-3 Questionnaires to Measure Gaps 2 through 4

Questionnaire to Measure Gap 2

Directions: Performance standards in companies can be formal- written, explicit, and communicated to employees. They can also be informal- verbal, implicit, and assumed to be understood by employees. For each of the following features, circle the number that best describes the extent to which performance standards are formalized in your company. If there are no standards in your company, check the appropriate bow.

Features	Informal Standards			Formal Standards				No Standards Exist
1- The appearance of the company's physical facilities, equipment, personnel, and communication materials	1	2	3	4	5	6	7	( )
2- The ability of the company to perform the promised service dependably and accurately	1	2	3	4	5	6	7	( )
3- The willingness of the company to help customers and provide prompt service	1	2	3	4	5	6	7	( )
4- The knowledge and courtesy of the company's employees and their ability to convey trust and confidence	1	2	3	4	5	6	7	( )
5- The caring, individualized attention the company provides its customers	1	2	3	4	5	6	7	( )

Appendix-3 (Continued)

Questionnaire to Measure Gap 3

Directions: Listed below are the same five features. Employess and units sometimes experience difficulty in achieving the standards established for them. For each feature below, circle the number that best represents the degree to which your company and its employees are able to meet the performance standards established. Remember, there are no right or wrong answers- we need your candid assessments for this question to be helpful.

Features	Unable to Meet Standards Consistently				Able to Meet Standards Consistently			No Standards Exist
1- The appearance of the company's physical facilities, equipment, personnel, and communication materials	1	2	3	4	5	6	7	( )
2- The ability of the company to perform the promised service dependably and accurately	1	2	3	4	5	6	7	( )
3- The willingness of the company to help customers and provide prompt service	1	2	3	4	5	6	7	( )
4- The knowledge and courtesy of the company's employees and their ability to convey trust and confidence	1	2	3	4	5	6	7	( )
5- The caring, individualized attention the company provides its customers	1	2	3	4	5	6	7	( )

Appendix-3 (Continued)

Questionnaire to Measure Gap 4

Directions: Salespeople, advertising, and other company communications often make promises about the level of service a company will deliver. In some organizations, it is not always possible to fulfill these promises. For each feature below, we want to know the extent to which you believe that your company and its employees deliver the level of service promised to customers. Circle the number that best describes your perception.

Features	Unable to Meet Promises Consistently				Able yo Meet Promises Consistently		
1- The appearance of the company's physical facilities, equipment, personnel, and communication materials	1	2	3	4	5	6	7
2- The ability of the company to perform the promised service dependably and accurately	1	2	3	4	5	6	7
3- The willingness of the company to help customers and provide prompt service	1	2	3	4	5	6	7
4- The knowledge and courtesy of the company's employees and their ability to convey trust and confidence	1	2	3	4	5	6	7
5- The caring, individualized attention the company provides its customers	1	2	3	4	5	6	7

Appendix-4 Questionnaire to Measure Antecedents of Gaps 1 through 4

Questionnaire to Measure Antecedents of Gaps 1 and 2

Directions: Listed below are a number of statements intended to measure your perceptions about your company and its operations. Please indicate the extent to which you disagree or agree with each statement by circling one of the seven numbers next to each statement. If you strongly disagree, circle 1. If you strongly agree, circle 7. If your feelings are not strong, circle one of the numbers in the middle. There are no right or wrong answers. Please tell us honestly how you feel.

	Statements	Strongly Disagree						Strongly Agree
1	We regularly collect information about the needs of our customers.	1	2	3	4	5	6	7
2	We rarely use marketing research information that is collected about our customers. (-)	1	2	3	4	5	6	7
3	We regularly collect information about the service-quality expectations of our customers.	1	2	3	4	5	6	7
4	The managers in our company rarely interact with customers. (-)	1	2	3	4	5	6	7
5	The customer-contact personnel in our company frequently communicate with management.	1	2	3	4	5	6	7
6	Managers in our company rarely seek suggestions about serving customers from customer-contact personel. (-)	1	2	3	4	5	6	7
7	The managers in our company frequently have face-to-face interactions with customer-contact personel.	1	2	3	4	5	6	7
8	The primary means of communication in our company between contact personnel and upper-	1	2	3	4	5	6	7

	level managers is through memos. (-)	
9	Our company has too many levels of management between contact personnel and top management. (-)	1 2 3 4 5 6 7
10	Our company does not commit the necessary resources for service quality. (-)	1 2 3 4 5 6 7
11	Our company has internal programs for improving the quality of service to customers.	1 2 3 4 5 6 7
12	In our company, managers who improve quality of service are more likely to be rewarded than other managers.	1 2 3 4 5 6 7
13	Our company emphasizes selling as much as or more than it emphasizes serving customers. (-)	1 2 3 4 5 6 7
14	Our company has a formal process for setting quality of service goals for employees.	1 2 3 4 5 6 7
15	In our company, we try to set specific quality of service goals.	1 2 3 4 5 6 7
16	Our company effectively uses automation to achieve consistency in serving customers.	1 2 3 4 5 6 7
17	Programs are in place in our company to improve operating procedures so as to provide consistent service.	1 2 3 4 5 6 7
18	Our company has the necessary capabilities to meet customers' requirements for service.	1 2 3 4 5 6 7
19	If we gave our customers the level of service they really want, we would go broke. (-)	1 2 3 4 5 6 7
20	Our company has the operating systems to deliver the level of service customers demand.	1 2 3 4 5 6 7

Appendix-4 (Continued)

Questionnaire to Measure Antecedents of Gap 3 and 4

Directions: Listed below are a number of statements intended to measure your perceptions about your company and its operations. Please indicate the extent to which you disagree or agree with each statement by circling one of the seven numbers next to each statement. If you strongly disagree, circle 1. If you strongly agree, circle 7. If your feelings are not strong, circle one of the numbers in the middle. There are no right or wrong answers. Please tell us honestly how you feel.

	Statements	Strongly Disagree						Strongly Agree
1	I feel that I am part of a team in my company.	1	2	3	4	5	6	7
2	Everyone in my company contributes to a team effort in servicing customers.	1	2	3	4	5	6	7
3	I feel a sense of responsibility to help my fellow employees do their jobs well.	1	2	3	4	5	6	7
4	My fellow employees and I cooperate more often than we compete.	1	2	3	4	5	6	7
5	I feel that I am an important member of this company.	1	2	3	4	5	6	7
6	I feel comfortable in my job in the sense that I am able to perform the job well.	1	2	3	4	5	6	7
7	My company hires people who are qualified to do their jobs.	1	2	3	4	5	6	7
8	My company gives me the tools and equipment that I nees to perform my job well.	1	2	3	4	5	6	7
9	I spend a lot of time in my job trying to resolve problems over which I have little control. (-)	1	2	3	4	5	6	7

10	I have the freedom in my job to truly satisfy my customers' needs.	1 2 3 4 5 6 7
11	I sometimes feel a lack of control over my job because too many customers demand service at the same time. (-)	1 2 3 4 5 6 7
12	One of my frustrations on the job is that I sometimes have to depend on other employees in serving my customers. (-)	1 2 3 4 5 6 7
13	My supervisor's appraisal of my job performance includes how well I interact with customers.	1 2 3 4 5 6 7
14	In our company, making a special effort to serve customers well does not result in more pay or recognition. (-)	1 2 3 4 5 6 7
15	In our company, employees who do the best job serving their customers are more likely to be rewarded than other employees	1 2 3 4 5 6 7
16	The amount of paperwork in my job makes it hard for me to effectively serve my customers. (-)	1 2 3 4 5 6 7
17	The company places so much emphasis on selling to customers that it is difficult to serve customers properly. (-)	1 2 3 4 5 6 7
18	What my customers want me to do and what management wants me to do are usually the same thing.	1 2 3 4 5 6 7
19	My company and I have the same ideas about how my job should be performed.	1 2 3 4 5 6 7
20	I recieve a sufficient amount of information from management concerning what I am supposed to do in my job.	1 2 3 4 5 6 7
21	I often feel that I do not understand the services offered by my company. (-)	1 2 3 4 5 6 7
22	I am able to keep up with changes in my company that effect my job.	1 2 3 4 5 6 7
23	I feel that I have not been well trained by my company in how to interact effectively with	1 2 3 4 5 6 7

	customers. (-)	
24	I am not sure which aspects of my job my supervisor will stress most in evaluating my performance. (-)	1 2 3 4 5 6 7
25	The people who develop our advertising consult employees like me about the realism of promises made in the advertising.	1 2 3 4 5 6 7
26	I am often not aware in advance of the promises made in our company's advertising campaigns. (-)	1 2 3 4 5 6 7
27	Employees like me interact with operations people to discuss the level of service the company can deliver to customers.	1 2 3 4 5 6 7
28	Our company's policies on serving customers are consistent in the different officies that service customers.	1 2 3 4 5 6 7
29	Intense competition is creating more pressure inside this company to generate new business. (-)	1 2 3 4 5 6 7
30	Our key competitors make promises they cannot possibly keep in an effort to gain new customers. (-)	1 2 3 4 5 6 7

Appendix-5 Questionnaire to Measure Officer on Duty Service Quality Gap (Gap 5) in Buca Female Student Hostel

Aşağıda, yurda ilişkin ifadeler yer almaktadır. Bu ifadelerle ilgili olarak; B kolonunda, barınma hizmeti veren her hangi bir yurttan beklentilerinizi, M kolonunda ise hizmet almakta olduğunuz yurttan memnuniyetinizi belirtiniz. Bu seçimi aşağıdaki ölçeği kullanarak yapınız. Beklenti ve memnuniyet düzeyleri bakımından, ifadelere ilişkin görüşlerinizi kesinlikle katılıyorum ise 5, katılıyorum ise 4, kararsızım ise 3, katılmıyorum ise 2 ve kesinlikle katılmıyorum ise 1 olarak işaretleyiniz.

	B					**M**				
	Sizin için ne kadar önemli?					**Ne kadar memnunsunuz?**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
F1. Yurtta kullanılan ekipman ve araç-gereçler yeterlidir.										
F2. Yurtta kullanılan ekipman ve araç-gereçler yeterince moderndir ve göze hoş görünür.										
F3. Yurt personelinin fiziksel görünümü yeterince moderndir.										
F4. Yurtta kullanılan ekipman, araç-gereçler ve yurt personelinin fiziksel görünümü temiz ve düzgündür.										
R5. Yurt personeli, kişisel ihtiyaçlarımı yeterince karşılayabilmektedir.										
R6. İhtiyaç duyulan hizmet zamanında sunulmaktadır.										
R7. Sunulan hizmet ilk seferinde doğru ve										

eksiksiz yerine getirilmektedir.										
R8. Sunulan hizmete ilişkin sikayetler yeterince dikkate alınmaktadır.										
R9. Şikayetlere ilişkin yeterince çözüm önerisi geliştirilmektedir.										
Y10. Yurt personeli hizmetin ne zaman sunulacağı konusunda kesin bilgi verir.										
Y11. Yurt personeli ihtiyaç duyulan hizmeti en hızlı şekilde yerine getirir.										
Y12. Yurt yöneticisi ve personellerini aradığımda yerinde bulabiliyorum.										
Y13. Yurt personeli isteklerime cevap vermek için hevesli ve hazırdırlar.										
G14. Yurt personeli, kişisel ihtiyaçlarımı karşılayabilecek yeterli bilgi ve yeteneğe sahiptir.										
G15. Yurt personeli her zaman güler yüzlü, nazik ve saygılıdır.										
G16. Yurt personeli dürüsttür ve personelin davranışları güven telkin eder.										
G17. Yurt personeli yeterli iletişim becerisine sahiptir.										
E18. Yurt personeli tüm öğrencilere eşit şekilde ilgilenmektedir.										
E19. Yurda giriş-çıkış saatleri programıma uygun olacak şekilde düzenlenmiştir.										
E20. Yurt personeli benimle kişisel olarak birebir ilgilenmekte ve şikayetlerim hemen çözümlenmektedir.										
E21. Yurdun bulunduğu yer merkezidir.										
E22. Yurt çalışanları tarafından, yaşadığım sorunlar gizli tutulmaktadır.										

Appendix-5 (Continued)

Aşağıdaki beş özellik, öğrencilere yurt hizmeti veren firma ve kuruluşlar ile ilgilidir. Lütfen sizin için önem seviyesine göre bu özellikleri derecelendiriniz. **Özelliklere verdiğiniz önem derecesini, çok önemli ise 5, önemli ise 4, emin değilseniz 3, az önemli ise 2, çok az önemli ise 1'i işaretleyerek belirtiniz.**

Özellikler	**1**	**2**	**3**	**4**	**5**
1. Öğrenci yurtlarının fiziksel özelliklerinin, ekipmanlarının, personelinin ve materyallerinin görünüşleri					
2. Öğrenci yurtlarının vaat ettiği hizmetleri gerçekleştirebilme gücü					
3. Öğrenci yurtlarının öğrencilerine yardımcı olmaları ve hızlı hizmet sağlamaları					
4. Öğrenci yurtlarının ve personellerinin kendi güven ve itimatlarını ifade edebilecek yetenekte olmaları					
5. Öğrenci yurtlarının öğrencileriyle bireysel olarak ilgilenebilmeleri					

- Yukarıdaki beş özellikten hangisi sizin için en önemlidir? (Lütfen numarasını yazınız).....
- Yukarıdaki beş özellikten hangisi sizin için ikinci sıradadır? (Lütfen numarasını yazınız).....
- Yukarıdaki beş özellikten hangisi sizin için en az öneme sahiptir? (Lütfen numarasını yazınız).....

Appendix-6 Questionnaire to Measure Officer on Duty Service Performance Gap (Gap 1) in Buca Female Student Hostel

Bu anket; 2006-2007 eğitim öğretim yılı içerisinde, öğrencilerin barınma hizmeti veren bir yurttan beklentilerinin yönetim tarafından ne kadar anlaşıldığına ilişkindir. Ankette yer alan ifadeler için öğrencilerinizin yurt hizmetleri hakkındaki fikir, his veya düşüncelerini nasıl algıladığınızı aşağıdaki ölçeği kullanarak değerlendiriniz. **Öğrencilere yurt hizmeti veren firma ve kuruluşları göz ününde bulundurarak, ifadelere ilişkin görüşlerinizi kesinlikle katılıyorum ise 5, katılıyorum ise 4, kararsızım ise 3, katılmıyorum ise 2 ve kesinlikle katılmıyorum ise 1 olarak işaretleyiniz.**

	Beklentiler				
	1	**2**	**3**	**4**	**5**
F1. Yurtta kullanılan ekipman ve araç-gereçler yeterli olmalıdır.					
F2. Yurtta kullanılan ekipman ve araç-gereçler yeterince moderndir ve göze hoş görünmelidir.					
F3. Yurt personelinin fiziksel görünümü yeterince modern olmalıdır.					
F4. Yurtta kullanılan ekipman, araç-gereçler ve yurt personelinin fiziksel görünümü temiz ve düzgün olmalıdır.					
R5. Yurt personeli, öğrencinin kişisel ihtiyaçlarını yeterince karşılayabilmelidir.					
R6. İhtiyaç duyulan hizmet zamanında sunulmalıdır.					
R7. Sunulan hizmet ilk seferinde doğru ve eksiksiz yerine getirilmelidir.					
R8. Sunulan hizmete ilişkin sikayetler yeterince dikkate alınmalıdır.					
R9. Şikayetlere ilişkin yeterince çözüm önerisi geliştirilmelidir.					
Y10. Yurt personeli hizmetin ne zaman sunulacağı konusunda öğrenciye kesin bilgi vermelidir.					
Y11. Yurt personeli ihtiyaç duyulan hizmeti en hızlı şekilde yerine getirmelidir.					

Y12. Öğrenciler, yurt yöneticisi ve personelini aradığında yerinde bulabilmelidir.					
Y13. Yurt personeli, öğrencinin isteklerine cevap vermek için hevesli ve hazır olmalıdır.					
G14. Yurt personeli, öğrencinin kişisel ihtiyaçlarını karşılayabilecek yeterli bilgi ve yeteneğe sahip olmalıdır.					
G15. Yurt personeli her zaman güler yüzlü, nazik ve saygılı olmalıdır.					
G16. Yurt personeli dürüst olmalı ve personelin davranışları güven telkin etmelidir.					
G17. Yurt personeli yeterli iletişim becerisine sahip olmalıdır.					
E18. Yurt personeli tüm öğrencilerle eşit şekilde ilgilenmelidir.					
E19. Yurda giriş-çıkış saatleri öğrencinin programıma uygun olacak şekilde düzenlenmelidir.					
E20. Yurt personeli öğrenciyle kişisel olarak birebir ilgilenmeli ve öğrencilerin şikayetleri hemen çözümlenmelidir.					
E21. Yurdun bulunduğu yer merkezi olmalıdır.					
E22. Yurt çalışanları tarafından, öğrencinin yaşadığı sorunlar gizli tutulmalıdır.					

Appendix-6 (Continued)

Aşağıdaki beş özellik, öğrencilere yurt hizmeti veren firma ve kuruluşlar ile ilgilidir. Lütfen sizin için önem seviyesine göre bu özellikleri derecelendiriniz. Bu değerlendirmeyi aşağıdaki ölçeği kullanarak yapınız.**Özelliklere verdiğiniz önem derecesini, çok önemli ise 5, önemli ise 4, emin değilseniz 3, az önemli ise 2, çok az önemli ise 1'i işaretleyerek belirtiniz.**

Özellikler	**1**	**2**	**3**	**4**	**5**
1. Öğrenci yurtlarının fiziksel özelliklerinin, ekipmanlarının, personelinin ve materyallerinin görünüşleri					
2. Öğrenci yurtlarının vaat ettiği hizmetleri gerçekleştirebilme gücü					
3. Öğrenci yurtlarının öğrencilerine yardımcı olmaları ve hızlı hizmet sağlamaları					
4. Öğrenci yurtlarının ve personellerinin kendi güven ve itimatlarını ifade edebilecek yetenekte olmaları					
5. Öğrenci yurtlarının öğrencileriyle bireysel olarak ilgilenebilmeleri					

- Yukarıdaki beş özellikten hangisi sizin için en önemlidir? (Lütfen numarasını yazınız).....
- Yukarıdaki beş özellikten hangisi sizin için ikinci sıradadır? (Lütfen numarasını yazınız).....
- Yukarıdaki beş özellikten hangisi sizin için en az öneme sahiptir? (Lütfen numarasını yazınız).....

Appendix-7 Questionnaires to Measure Gaps 2 through 4 for Officer on Duty Service in Buca Female Student Hostel

Questionnaire to Mesure Gap 2

Bu anket; 2006-2007 eğitim öğretim yılı içerisinde, Buca Kız Öğrenci Yurdu'ndaki performans standartlarının usule uygun olmasını (resmi olarak onaylı, yazılı, açık, kesin, çalışanların anlayabileceği ve iletişim içinde olabileceği bir yapıda) veya usule uygun olmamasını (resmi olarak onaylı olmayan, sözlü, karmaşık ve çalışanlar tarafından algılanması zor) değerlendirmeye yöneliktir. Ankette yer alan ifadeler için usule uygun standartların bulunup bulunmadığını aşağıdaki ölçeği kullanarak değerlendiriniz. **Buca Kız Öğrenci Yurdu'nu göz ününde bulundurarak, ifadelere ilişkin görüşlerinizi usule uygun olmayan standartlar için 1 ve usule uygun standartlar için 5 olmak üzere aşağıdaki skalayı kullanarak belirtiniz. Eğer yurt hizmetlerinize ilişkin hiç standart yoksa uygun seçeneği işaretleyiniz.**

Özellikler	**1**	**2**	**3**	**4**	**5**	**Standart Yok**
1. Yurdun fiziksel özelliklerinin, ekipmanlarının, personelinin ve materyallerinin görünüşleri						
2. Yurdun, vaat ettiği hizmetleri doğru ve güvenilir olarak gerçekleştirebilme gücü						
3. Yurdun, öğrencilerine yardımcı olmaya ve hızlı hizmet sağlamaya karşı olan istekliliği						
4. Yurt personelinin bilgisi, nezaketi ve güven sağlamaya yönelik yetenekleri						

5. Yurdun öğrencileriyle bireysel olarak ilgilenebilmeleri						

Appendix-7 (Continued)

Questionnaire to Measure Gap 3

Bu anket; 2006-2007 eğitim öğretim yılı içerisinde, Buca Kız Öğrenci Yurdu'ndaki hizmet performans standartlarının karşılanıp karşılanmadığını değerlendirmeye yöneliktir. Ankette yer alan ifadeler için standartların karşılanıp karşılanmadığını aşağıdaki ölçeği kullanarak değerlendiriniz. **Buca Kız Öğrenci Yurdu'nu göz ününde bulundurarak, ifadelere ilişkin görüşlerinizi standartlar devamlı olarak karşılanmıyor için 1 ve standartlar devamlı olarak karşılanıyor için 5 olmak üzere aşağıdaki skalayı kullanarak belirtiniz. Eğer yurt hizmetlerinize ilişkin hiç standart yoksa uygun seçeneği işaretleyiniz.**

Özellikler	**1**	**2**	**3**	**4**	**5**	**Standart Yok**
1. Yurdun fiziksel özelliklerinin, ekipmanlarının, personelinin ve materyallerinin görünüşleri						
2. Yurdun, vaat ettiği hizmetleri doğru ve güvenilir olarak gerçekleştirebilme gücü						
3. Yurdun, öğrencilerine yardımcı olmaya ve hızlı hizmet sağlamaya karşı olan istekliliği						
4. Yurt personelinin bilgisi, nezaketi ve güven sağlamaya yönelik yetenekleri						
5. Yurdun öğrencileriyle bireysel olarak ilgilenebilmeleri						

Appendix-7 (Continued)

Questionnaire to Measure Gap 4

Bu anket; 2006-2007 eğitim öğretim yılı içerisinde, Buca Kız Öğrenci Yurdu için yapılan tanıtım faaliyetlerinde hizmet kalite seviyesine ilişkin verilen vaatlerin karşılanıp karşılanmadığını değerlendirmeye yöneliktir. Ankette yer alan ifadeler için verilen sözlerin karşılanıp karşılanmadığını aşağıdaki ölçeği kullanarak değerlendiriniz. **Buca Kız Öğrenci Yurdu'nu göz ününde bulundurarak, ifadelere ilişkin görüşlerinizi vaatler devamlı olarak karşılanmıyor için 1 ve vaatler devamlı olarak karşılanıyor için 5 olmak üzere aşağıdaki skalayı kullanarak belirtiniz.**

Özellikler	**1**	**2**	**3**	**4**	**5**
1. Yurdun fiziksel özelliklerinin, ekipmanlarının, personelinin ve materyallerinin görünüşleri					
2. Yurdun, vaat ettiği hizmetleri doğru ve güvenilir olarak gerçekleştirebilme gücü					
3. Yurdun, öğrencilerine yardımcı olmaya ve hızlı hizmet sağlamaya karşı olan istekliliği					
4. Yurt personelinin bilgisi, nezaketi ve güven sağlamaya yönelik yetenekleri					
5. Yurdun öğrencileriyle bireysel olarak ilgilenebilmeleri					

Appendix-8 Questionnaires to Measure Antecedents of Gaps 1 through 4 for Officer on Duty Service in Buca Female Student Hostel

Questionnaire to Measure Antecedents of Gaps 1 and 2

Bu anket; 2006-2007 eğitim öğretim yılı içerisinde, Buca Kız Öğrenci Yurdu'na ait operasyonlar hakkındaki algılarınızı ölçmeye yöneliktir. Ankette yer alan ifadeleri aşağıdaki ölçeği kullanarak değerlendiriniz. **İfadelere ilişkin görüşlerinizi kesinlikle katılıyorum ise 5, katılıyorum ise 4, kararsızım ise 3, katılmıyorum ise 2 ve kesinlikle katılmıyorum ise 1 olarak işaretleyiniz.**

İfadeler	1	2	3	4	5
1. Biz düzenli olarak müşteri ihtiyaçları hakkında bilgi toplarız.					
2. Öğrencilerimiz hakkında toplanan bilgileri nadiren kullanırız. (-)					
3. Öğrencilerimizin hizmet kalitesi konusundaki beklentilerine ilişkin verileri düzenli olarak toplarız.					
4. Yurdumuzun yöneticileri nadiren öğrencilerle karşılıklı iletişim kurarlar. (-)					
5. Öğrencilerle bire bir çalışan personel, yönetimle oldukça sıkı iletişim kurar.					
6. Yurdumuzdaki yöneticiler, nadiren yurt hizmetleri hakkında öğrencilerle bire bir çalışan personelden öneri arayışı içerisine girer. (-)					
7. Yurdumuzdaki yöneticiler, öğrencilerle bire bir çalışan personel ile yüz yüze iletişim kurar.					
8. Öğrenci ile bire bir çalışan personelle üst düzey yöneticiler					

arasındaki iletişim önceliklidir.Yurdumuzda bu iletişim yönetimden öğrenciye doğrudur.(Yukarıdan aşağıya)					
9. Yurdumuzda, öğrencilerle bire bir çalışan personel ve yönetim arasında çok sayıda yönetimsel kademe vardır. (-)					
10. Yurdumuz, hizmet kalitesi için gerekli kaynakları temin edemez.(-)					
11. Yurdumuzda, hizmet kalitesinin arttırılması, geliştirilmesi için iç programlar uygulanır.					
12. Yurdumuzda, hizmet kalitesinin gelişimine katkıda bulunan yöneticiler, diğer yöneticilerden daha fazla ödüllendirilerek takdir görürler.					
13. Yurdumuzda dolu yatak sayısı (satış), öğrencilere hizmetten daha fazla vurgulanmaktadır. (-)					
14. Yurdumuzda, çalışanlar için hizmet kalitesi amaçlarının belirlenmesine yönelik resmi ve uygun prosesler vardır.					
15. Yurdumuza özel hizmet kalitesi amaçları oluşturmaya çalışmaktayız.					
16. Yurdumuz, öğrencilerine bire bir hizmet vermek dışında, insana gerek duyulmayan otomatik sistemler vasıtasıyla da (internet vs.) hizmet verebilmektedir.					
17. Yurdumuzda, hizmetin devamlılığını sağlamak için hizmet dağıtım prosedürlerinin geliştirilmesine yönelik çalışmalar yapılmaktadır.					
18. Yurdumuz, hizmet açısından öğrencilerin gereksinimlerini karşılayacak yeteneklere sahiptir.					
19. Eğer öğrencilerimizin istedikleri seviyede hizmet veriyorsak, maddi kayıplara uğruyoruz demektir. (-)					
20. Yurdumuz, öğrencilerimizin isteklerinin seviyelerini belirleyebilecek bir sisteme sahiptir.					

Appendix-8 (Continued)

Questionnaire to Measure Antecedents of Gaps 3 and 4

Bu anket; 2006-2007 eğitim öğretim yılı içerisinde, Buca Kız Öğrenci Yurdu'na ait operasyonlar hakkındaki algılarınızı ölçmeye yöneliktir. Ankette yer alan ifadeleri aşağıdaki ölçeği kullanarak değerlendiriniz. **İfadelere ilişkin görüşlerinizi kesinlikle katılıyorum ise 5, katılıyorum ise 4, kararsızım ise 3, katılmıyorum ise 2 ve kesinlikle katılmıyorum ise 1 olarak işaretleyiniz.**

İfadeler	**1**	**2**	**3**	**4**	**5**
1. Kendimi yurttaki takımın bir parçası gibi hissediyorum.					
2. Yurttaki herkes öğrencilere hizmet vermek için bir takımda bireysel güçlerini ortaya koyuyor.					
3. Yakın çalıştığım personelin kendi işlerini daha iyi yapmaları için, kendimde onlara yardımcı olma zorunluluğunu hissediyorum.					
4. Yakın çalıştığım personel ve ben, birbirimizle rekabet etmekten daha çok dayanışma içinde çalışıyoruz.					
5. Bu yurdun önemli üyelerinden biri olduğumu hissediyorum.					
6. İşimde kendimi rahat hissediyorum, bu anlamda işimi daha iyi yapabiliyorum.					
7. Yurdumuz, işinde uzmanlaşmış insdanlardan yardım almaktadır.					
8. Yurdumuz, işimi yapmamda gerekli olan araçları ve ekipmanları sağlamaktadır.					
9. İşimde, kontrolü kaybettiğim problemleri					

çözümleyebilmek için oldukça fazla zaman harcıyorum. (-)					
10. Öğrencilerin ihtiyaçlarını tamamen karşılayabilmek ve memnuniyetlerini sağlayabilmek için işimde özgürce davranabiliyorum.					
11. Bazı zamanlarda kendi işimin üstünde kontrolümü kaybettiğim oluyor. Çünkü, birçok öğrenci isteği hizmetlerim sırasında aynı anda geliyor. (-)					
12. İşimdeki memnuniyetsizliklerimden biri de öğrencilere hizmet verirken başka personele bağımlı kalmamdır.					
13. İşimdeki performansı ölçen ve denetleyen kişiler, öğrenciler ile iletişimi nasıl sağladığımı da dikkate almaktadırlar.					
14. Yurdumuzda, öğrenciye hizmet sağlarken özel bir çaba harcarsak, bu çabanın karşılığında ekonomik karşılık veya takdir göremeyiz. (-)					
15. Yurdumuzda, öğrenciye hizmet sağlarken daha çok çaba harcayan ve işini daha iyi yapan personel, diğer personelden daha çok ödüllendirilir.					
16. İşimde, öğrenciye etkili olarak hizmet eden kağıtların yoğunluğu beni oldukça zorluyor. (-)					
17. Yurt tarafından öğrencilere hizmet satışının oldukça çok vurgulanması, öğrencilere hizmet etmemizi oldukça güçleştiriyor. (-)					
18. Öğrencilerimizin benden yapmamı istedikleri ile yöneticimin benden yapmamı istedikleri genellikle aynı şeylerdir.					
19. Kurumum ile ben, işimin nasıl yapılacağı konusunda aynı fikirdeyiz.					
20. İşimi nasıl yapacağım konusundaki anlamlı bilgileri yönetimden edinebiliyorum.					
21. Yurdumuz tarafından teklif edilen hizmetleri, sıklıkla anlamadığımı hissediyorum. (-)					
22. Yurtta işimi de etkileyen değişimlerin devamlılığını					

sağlayabiliyorum.					
23. Öğrencilerle nasıl etkili iletişim kuracağımın eğitiminin, kurumum tarafından bana verilmediğini oldukça sık hissediyorum. (-)					
24. Beni denetleyenlerin, performansımı değerlendirirken, işimin gereklerinden hangisinin üstünde daha çok duracağı konusunda her hangi bir fikrim yok. (-)					
25. Yurdumuz için tanıtım hazırlayan benim gibi personel, gerçekçi tanıtımlar oluşturmaya önem gösterirler.					
26. Yurdumuzun tanıtımlarından, her zaman ileriye dönük vaatlerin farkına varamıyorum. (-)					
27. Benim gibi aynı hizmetler için çalışan personel, kendi aralarında öğrencilere sağlanan hizmetin seviyesini tartışmaktadır.					
28. Yurdun diğer hizmet birimlerinde (kantin vs.), öğrenciye sunulan hizmet politikalarımız istikrarlıdır.					
29. Yurt içerisindeki güçlü rekabet, yeni işlerin üretilmesi konusunda personel üzerinde yüksek baskı yaratmaktadır. (-)					
30. Yurt tanıtımları hizmet konusunda çeşitli vaatler içeriyor ama yeni öğrenciler kazanmak için belki de hiç çaba sarf edilmiyor. (-)					