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서비스 부문의 물류 도입 방안

Applying Logistics to the Service Sector

指導敎授 南 奇 燦

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韓國海洋大學校 大學院

物流시스템工學科

Nina Maria Brannkarr-Friberg

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委員長 工學博士　　郭 圭 錫　　印

委員 工學博士　　金 煥 成　　印

委員 工學博士　　南 奇 燦　　印

2005 年 6 月

韓國海洋大學校 大學院

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List of Abbreviations

4PL = 4th Party Logistics

ABC = Activity Based Costing

ASP = Applications Service Providers

CCR = Critical Customer Requirements

CIT = Critical Incident Technique

CM = Constraint Management

DBR = Drum Buffer Rope, scheduling technique in CM

DMAIC cycle = Define-Measure-Analyze-Improve-Control

DPMO = Defects per Million Opportunities, Sigma levels of performance

E-business = Electronic business

GNP = Gross National Product

GPA = Grade Point Average

IS = Information System

ISO = International Organization for Standardization

IT = Information Technology

JIT = Just in Time

LSP = Logistics Service Providers

Mgmt = Management

Muda = from Japanese; means 7 wastes

PDCA cycle = Plan-Do-Check-Act (Shewart cycle = Deming cycle = Control cycle)

QLF = Quality Loss Function (used in approximating hidden costs of poor quality)

QR = Quick Response

Sigma = statistical measure of variations

SW = software

TBC = Time Based Competition

TQC = Total Quality Control

TQM = Total Quality Management

TQS = Total Quality Service

www = the World Wide Web

서비스 부문의 물류 도입 방안

Nina Maria Brannkarr-Friberg

초 록

서비스 부문은 매우 광범위하고 지속적으로 성장하고 있다. 전통적으로 우리는 제조업 내에서 물류를 보아왔다. 그러나 서비스 부문의 규모와 중요성은 서비스 부문에 물류를 도입할 수 있는 가능성을 제시하고 있다. 이 논문의 목적은 서비스 내에서 가능한 물류 해결책을 조사하여 서비스 부문에 물류 원리를 적용하고 평가함으로써 얻을 수 있는 혜택과 이익을 도출하는 것이다.

이 논문이 다루는 내용은 다음과 같다:

- 서비스의 특성
- 프로세스 향상 기술의 분석
- 서비스 산업에서 적용 가능한 물류 솔루션의 분석
- 이익 분석, 비용 분석과 가능한 비용 절감
- 일반적인 개선 제안과 의료기관 및 교육기관에 대한 개선 제안

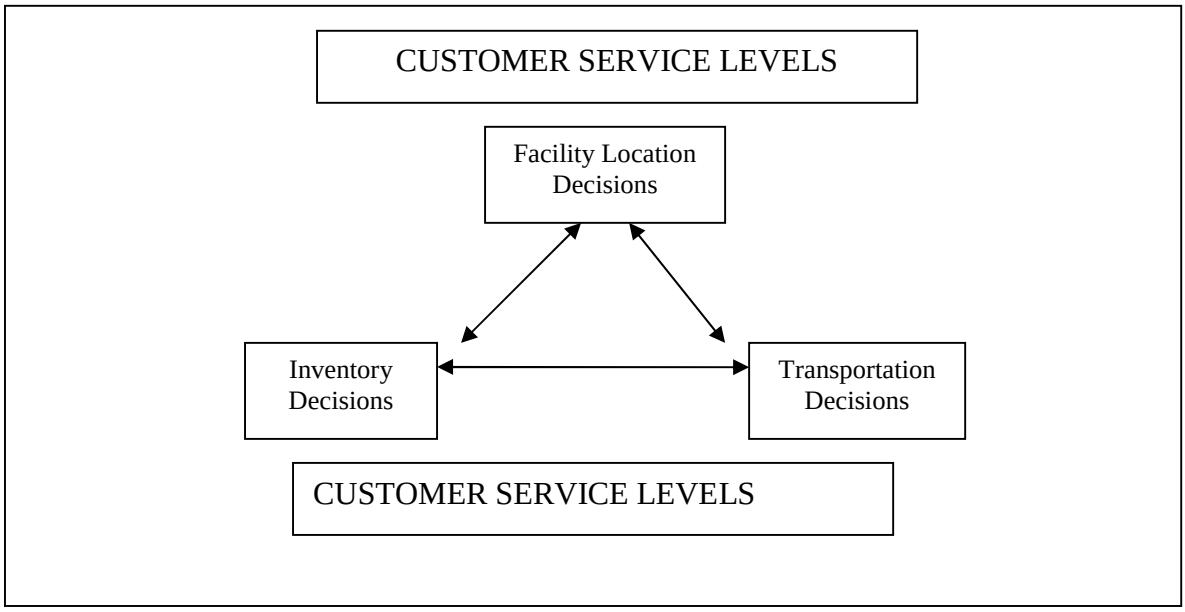
이 논문의 연구결과는 서비스 분야에 물류를 도입함으로써 얻는 유익하고 경제적인 이점들이 주목할 만하다는 것을 보여준다.

1. Introduction

1.1. Definition of Logistics

Logistics is about creating value, value for the customers and suppliers of a company. Value in logistics is expressed in terms of *time* and *place*, in other words when and where. Logistics Management see critically on each activity in the supply chain is it adding value or not. If little value is added, the question "Should the activity exist?" arise. Anyhow, value is added when customers are willing to pay more for a service than the cost to place it in their hands.

Logistics is all about planning, organizing and controlling to achieve the objectives. Planning refers to deciding the goals, organizing refers to actions needed to be taken to achieve the goals and controlling refers to measuring performance and taking corrective actions if needed, if goals are not achieved. Planning is usually seen as the most difficult task. For Logistics Management planning is concentrated around a primary decision triangle of location, inventory and transportation (see Figure 1.1.). The customer service level is the result of these decisions. It should be remembered that in the final end it is the customer, who drives all logistic decision making. This document will analyse logistics thinking within service sector, how the logistical functions introduced can add value to the supply chain in services.



Figur 1.1: The Primary Decision Triangle in Logistics Management Planning

1.2. Definition of Services

1.2.1. Nature and classification of Services

Service can be defined in many ways, one way is as Philip Kotler wrote; "A service is any act or performance that one party can offer to another that is essentially intangible and does not result in the ownership of anything. Its production may or may not be tied to a physical good."[1] The service component can be divided into different categories, depending on if the service is the major part of a total offer or a minor part. The five suggested categories are the following:

1. ***A pure tangible good***: The offer consists of a good e.g. salt. No services accompany the product.

[1] Marketing Management, Analysis, Planning, Implementation and Control, Eighth Edition by Philip Kotler (page 464)

2. ***A tangible good with accompanying service***: The offer consists of a tangible good accompanied by one or more services to enhance consumer appeal. For example a car manufacturer must sell more than the car.

3. ***A hybrid****:* The offer consists of equal parts of goods and services. A restaurant is a good example, they have food and service.

4***. A major service with accompanying minor goods and services***: The offer consists of a major service along with additional services or supporting goods. An airline passenger is buying a transportation service, but the trip includes for example food and drinks.

5***. A pure service***: The offer is primarily a service. Examples are psychotherapy and massages.
This document is going to include the three latter categories.
Services can also vary as to whether they are Equipment based (automated made by machines) or People based (accomplished by humans). Additionally Service Providers differ in their objectives (profit or non-profit) and ownership (private or public).

1.2.2. Characteristics of Services

There are some major characteristics that identify the differences between goods and services. These characteristics of services make the business more challengeable than pure manufacturing business. When identifying these we are generalizing and it may not apply equally to all services. The basic differences are:

- Customers do not obtain ownership of services
- Intangibility
- Inseparability
- There is greater involvement of customers in the production process

- Variability
- Many services are difficult to evaluate
- Perish ability
- The time factor is relatively more important
- Delivery systems may include different channels

The major difference is that services do not derive in any ownership of a tangible element. The output of the service may though be tied to a physical end product. As a customer you have your main interest in the final output, but the way in which you are treated during the service delivery is also of high importance to your satisfaction.

Services are Intangible; they cannot be seen or felt before purchase. To reduce the uncertainty, buyers look for signs of evidences of the service quality. According to Theodore Levitt, the key to good service business may be in trying to transform an intangible service into a tangible product.

Services are Inseparable, this means they are typically produced and consumed simultaneously.

Customers are often involved in helping to create a service product, they can serve themselves as in withdrawing cash from a bank automat or then they collaborate with service personnel as in hospitals, universities or hotels. It is important for service companies to educate customers to make them more competent and make them feel comfortable, if the service is about serving/helping themselves. In hospitals all routine controls such as weight, blood pressure measurements could be done by patients themselves while waiting.

Variability in services depends on who provides them and when and where they are provided. Service buyers are aware of this and the reputation of “good” service is important when selecting a particular service provider.

There are different categories of product characteristics. There are search attributes such as colour, taste, sound and price which are easy to evaluate. Experience attributes are such as vacations, restaurant and entertainment. These can also be evaluated. Credence attributes are such characteristics that are difficult to evaluate. A typical example is an evaluation of how well a doctor has performed some medical procedure. Services include a lot of credence attributes and are therefore difficult to evaluate.

The perish ability of services is not a problem if demand is steady, then it is easy to staff the services in advance. When demand fluctuates service companies have difficult problems, because services cannot be stored.

Services are usually delivered in real time. The customer has to be present to receive service and as we all know there are limits how long a customer is willing to wait, time is money! The customer of today is very time sensitive and speed is seen as a key element in good service.

Service businesses can use either physical or electronic distribution channels. The electronic distribution channel is becoming more and more popular due to the Worldwide web.

In this document we will find alternative logistics solutions to overcome the challenges with the service business.

1.3. History of Logistics

It is a historical fact that the concepts of logistics, transportation, and distribution were born long Before Christ, as aspects of military activities. The inefficient food and materiel supply for military troops led to the development of logistics, by this time we did not use the term yet.

More than a decade before the beginning interest of logistics within businesses, the service sector had carried out well organized logistics activities.

The military carried out the most complex, well-planned logistics operation in history. The French Military, headed by Napoleon already started to talk about the term Logistics. During World War II the military maintained high inventories, the U.S. troop's inventory were valued about one-third of those held by U.S. manufacturers. Soldiers were deployed smoothly. Food and right ammunition were provided to the soldiers at the right place at the right time. It was actually with this background the area of business logistics development started to grow.

In the beginning business logistics included only the field of transportation and distribution. Today transportation and distribution is only a part of the Supply Chain Management concept, which strive to integrate the internal and external business processes, create close relationship between partners involved and manage the products and information as they move across the organization and outside. I would rather talk about Supply Network Management than Supply Chain Management, because in today's Supply Management the parties involved also include Suppliers, vendors and sub suppliers as well as customers and the links between these forms a complex network instead of a simple chain.

1.4. The study task & Methodology

The service sector is very large and it is growing continuously. Traditionally we have seen the logistics thinking within the manufacturing industry, but the size and importance of the service sector forces us to think about the possibilities of applying logistics thinking to the service sector. Customers are more demanding nowadays, competition is growing, quality is of high importance and cost competitiveness is a crucial decision factor. The objective of this study is to investigate possible logistics solutions within services and finding the benefits and cost advantages of applying logistics principles and thinking to the service sector. The scope is to be quite general in nature about the topic

Logistics in Service Industries, but some focus is put on the Healthcare and Education sector.

The methodology consisted of three phases:

1. Literature Research
2. Contact with professionals in Logistics
3. Investigation of case studies

Literature about Logistics, Service Industries, Quality Management, Marketing Management and Cost Management where identified, to have a basis for the theories in the project. Professionals in Logistics where contacted to get hints, ideas and a wider view of the topic. Cases of logistics for Hospitals, Educational Institutes and other Service organizations were studied.

The study started with analysis of different Process Improvement Techniques that may be used within the service sector. Further it analysed different Logistics solutions that was able to be introduced to the service sector. Advantages, disadvantages as well as cost analysis of these were covered.

The goal of the study was to find recommendable improvement techniques and logistics solutions applicable in service industries. These may be introduced to hospitals, universities and departments in bigger companies concentrating on services.

2. The Service Sector

2.1. The growth of Service Sector

The service sector is large and it is growing all the time, especially for industrialized countries. The developed countries are also seeing the same pattern. Services make up the bulk of today's economy. The service sector is growing rapidly due to:

- Change in environment , life style etc
- Demand for new kind of services
- Advent of new technologies
- Fast development of information technology & computerization
- Lean manufacturing (contracting out most activities)

The service sector takes in a wide range of jobs, from personal and business services to tourism and hospitality. In late 1940's 40% of the workforce was working within the service sector. Today more than 70% of all jobs are in the service sector (U.S. & Europe) and also approximately the same percent stands for the GNP. Or CNN even talked about higher numbers the 4th of February 2004: "The service sector is the economy's biggest employer, and service activity -- including banking, tourism, entertainment and more -- makes up about 80 percent of the total economy".

The dominance of service sector is not limited to highly developed nations. World Bank statistics indicate that in many Latin-American countries the service sector accounts for more than half of the GNP (gross national product) and more than 50% of the work force (Lovelock and Wright, 1999). These countries also see the same steady growth.

2.2. Competition, customer satisfaction & Service quality

As service sector grows also the competition between the competitors within this sector grows. This leads to the fact that companies within the service sector have to understand the meaning of customer satisfaction and service quality. Even though customer satisfaction and service quality are closely related, they are not exactly the same. Customer satisfaction can be seen as a short-term emotional reaction to a specific service performance while service quality could be defined as customer's long-term, cognitive evaluations of a firm's service delivery[2].

The importance of quality in services cannot be underestimated. In Japan the notion of customer equals "honoured guest", this means that the customer is the judge of quality. This shows that service quality should be among a firm's first priorities. Many studies show that:

- The average company never hear from more than 90% of its unhappy customers.
- For every complaint it receives, the company has at least 25 customers with problems
- The average customer who has had a problem will tell 9 or 10 others about it
- It costs six times more to get a new customer than to keep a current customer

This shows that it is better to think about the quality before a problem comes to the customer, to investigate which attributes should be given most value. James W. Dean,

Jr. and James R.Evans define quality as:

[2]Definition found fromPrinciples of Service Marketing and Management by Christopher Lovelock and Lauren Wright

QUALITY IS MEETING OR EXCEEDING CUSTOMERS EXPECTATIONS.

It is noticed that one of the most common cause of service product failure is the inadequacy of specifications of the service, what should be expected. Important is to identify the key dimensions of service quality and set clear goals for these.

Customer surveys show that key dimensions for service quality include among others:

- Reliability
- Time: How much time must a customer wait?
- Timeliness: Is it on promised time?
- Consistency: Are service delivered in the same fashion for every customer and every time?
- Accessibility and convenience: Is the service easy to obtain?
- Accuracy: Is the service performed right the first time?
- Responsiveness: Can personnel react quickly?

In most surveys performed Reliability has proven to be the most important one in customer's judgement of service quality. All these key dimensions above could be improved by good customer driven logistics thinking.

Philip Kotler sees the quality of a customer driven logistics department as following:

- They set a high standard for service delivery time and they must meet this standard consistently
- They operate a knowledgeable and friendly customer service department that can answer questions, handle complaints, and resolve problems in a satisfactory and timely manner.

As a conclusion for this chapter it can be said that the rule of thumb for good service quality is to:

- set time standards and meet them
- QUICK RESPONSE

2.3. The eight components of Integrated Service Management

When marketing a good, there are usually four basic elements pinpointed, the 4P's which stand for product, price, place and promotion. The nature of a service product requires a little bit different approach for marketing than a traditional good. For services we can talk about the 8P's model. The 8P's stand for

- Product Elements
- Process
- Productivity and quality
- People
- Place and time
- Promotion and education
- Price and cost
- Physical Evidence

Product elements: include all parts of a service that add value in the viewpoint of the customer.

Process: A good process is important when delivering a service. The series of actions creating the process need to be clearly defined. The sequence of these actions should be logical and the process smooth and easy.

Productivity and quality: Improved productivity is of high importance to keep cost under control, which in turn makes the service cost competitive. Too high productivity may though have a negative effect on customer service level and should be considered carefully. Quality of a service can be defined as meeting or exceeding customer expectations. Productivity and quality often goes hand in hand.

People: people involved in a service can be the personnel providing the service or sometimes other customers.

Place and time: Decisions about when, where and how to deliver a service is important. Typically for services the decision about type of distribution channel has to be made as well, electronic, physical or both. Also if the service is provided directly to customer or via an intermediary has to be decided.

Promotion and education: includes all actions and activities carried out in order to attract customers and build customer preference for a specific service or a specific provider of service.

Price and cost: money, time, mental and physical effort needed when consuming a service. This is one crucial decision factor when picking a service or service provider.

Physical Evidence: Visible signs of high quality of a company can include vehicles, internal furnishing, equipment, signs, printed materials etc.

Integration and synergy between these 8P's are of critical importance for success to a service business. All these 8P's have to be taken into consideration while setting goals, planning processes and promoting the service.

3. Available Process Improvement methods within Service Sector

3.1. What is Process Improvement?

A process can be defined as a set of related tasks performed to achieve an outcome. The process in this document refers to providing a service.

Process improvement means identifying tasks that are limiting overall performance and develop strategies to improve them and improve overall output as well as revenues and profits.

3.2. Service as a system

When improving a service it is important to look at it as a whole system. The total service system includes three overlapping subsystems, service operations, service delivery and service marketing. In service operations an input is processed and the elements of a service product are created. Service delivery include final assembly of the element and delivery to customer and service marketing embraces all point of contact with the customers (billing, advertising etc.). As can be seen in figure 3.1[3], part of the system is visible to customers (front stage) and part of it is hidden, called backstage or technical core.

[3] Adapted from Christopher Lovelock and Lauren Wright

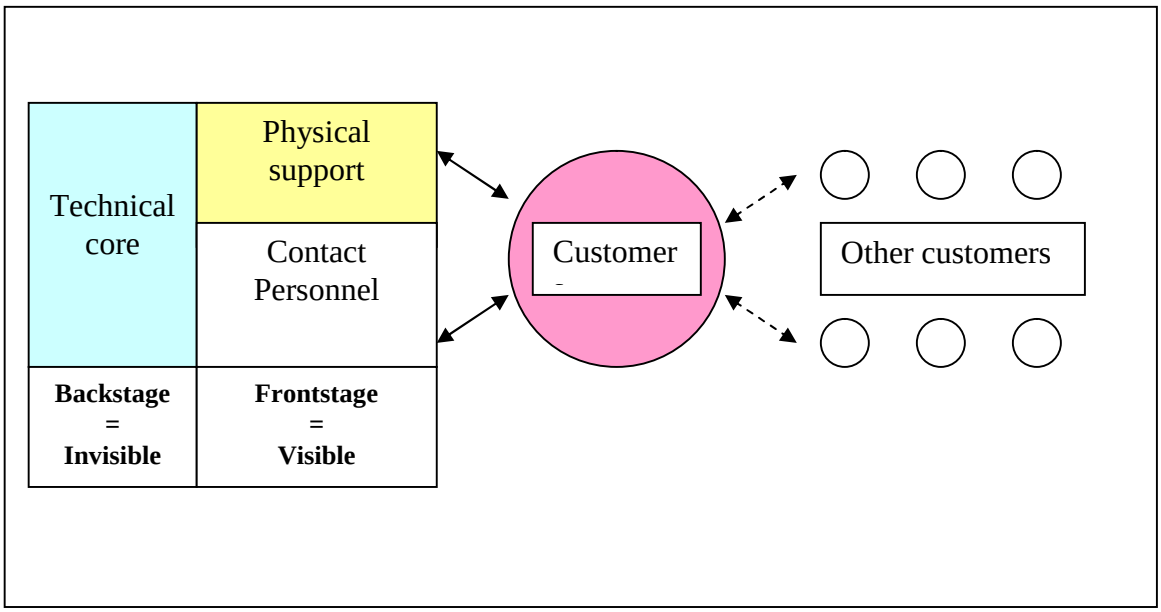


Figure 3.1: Service Business as a system

The arrows from one customer to other customers indicate that one customer's opinions and experiences have great impact on others. Even though the technical core activities are invisible to customers the outcome of them are noticeable. This means when trying to improve processes both backstage and front stage activities need to be analyzed. Backstage activities may be even more important than the front stage.

It is of high importance to eliminate variations in processes. There are a few famous Process Monitoring Techniques, helping to identify variations and defects and eliminate them. Variations can be caused by common causes or Special causes. It is estimated that 85% belong to the common area and the rest of 15% to the special causes (Michael E. Milakovich, 1995). Common variations results from the inability to be perfect, it is impossible to execute any process exactly as the previous one. Theses variations depend on many sources and elimination of these would cause a negligible result. The other category special causes result from some specific, unexpected problems, which may occur at any time. It is important for the staff working closest to the process to identify these and see if they are appearing frequently and what can be done to eliminate them. There are a lot of tools to be used to identify these variations. These process monitoring techniques include flow charts,

identifying each step in a process, which in turn can be analyzed to find possible problems.

A fishbone diagram, also called cause-effect diagram or Ishikawa Diagram from its father Dr. Kaoru Ishikawa is an analysis tool that provides a systematic way of looking at effects and the causes that create or contribute to those effects. Because of the function, it is also referred to as a cause-and-effect diagram. The design of the diagram looks much like the skeleton of a fish, therefore the name fishbone diagram. Pareto analysis again is used for the purpose of determining which of the many types of defects occur most frequently in order to concentrate one's efforts where potential for improvement is the greatest. Scatter diagrams can be used for validating "feelings" about a cause-and-effect relationship between types of variables. An example could be I wonder if students who spend more time watching TV have higher or lower average GPA's (Grade Point Average).

There are many more tools, and all these have one common goal, to reach higher service levels.

3.3. The Advantage & Challenge of the Service Sector

There is both advantage and challenge of the service sector. The advantage of the service sector is that the labour costs are pretty high compared to manufacturing sector. When labour costs are high an improvement in core process efficiency can have a significant impact. Improved core business processes mean improved customer satisfaction, improved employee satisfaction and increased profit.

There is also a challenge with the service sector. It differs a lot from the manufacturing sector. Service products are more complex to their nature. As already mentioned Production and consumption of services happen simultaneously, service cannot be store or inventoried and the product is intangible. All service products also involve close interaction with customers. Even though there is a challenge with the service sector we have well developed process improvement techniques that are adaptive to this. These techniques are identified in chapter 3.4.

3.4. Process Improvement Techniques applicable in Service Industries

Improved process usually means improved productivity which in turn leads to cost reductions. The techniques that can be used to improve the process are many and will be described in more detail in this chapter. The techniques described below are mostly initially introduced to manufacturing industries, but investigated during this project and resulting in findings that they are applicable to the service industries. TQS, Total Quality Service, is particularly developed for the service industries. One organisation is not forced to choose one of these and follow that route. It is possible to combine these various methods. As can be seen from Figure 3.2, there are some steps to be completed before the process improvement techniques can be used. When the mission and vision of an organisation is established and the organisational diagnosis is done usually the Critical Success factors and key business processes are decided and out of these the sub processes. For the different sub processes different improvement techniques can be used and combined.

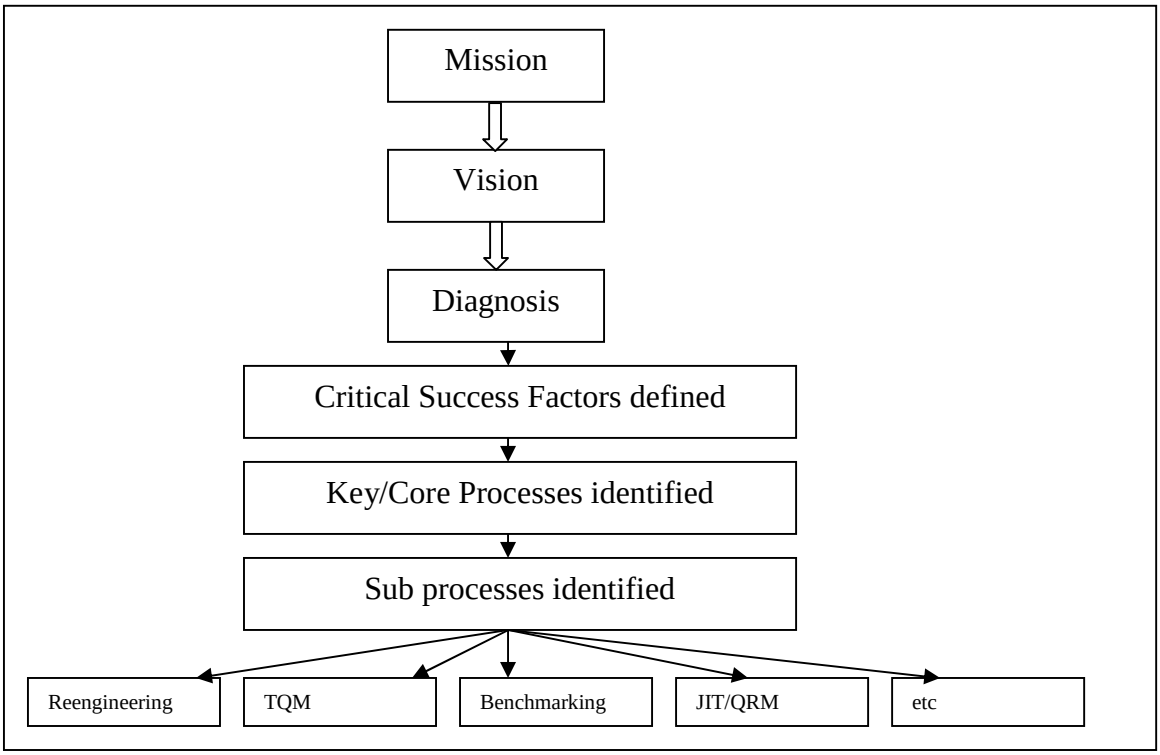


Figure 3.2: Steps needed to be identified before Improvement Techniques are utilized

3.4.1. Total Quality Management

TQM, Total Quality Management, is a management approach to success through customer satisfaction. TQM is all about understanding customers needs, both internal and external ones. The customer is the judge of quality. TQM focuses on improving business while reducing loss due to wasteful practices, operations. In other words it is maximizing productivity while minimizing costs. Earlier the biggest effort has been put in improving quality of the end product or service. Many analysis shows that usually a customer is happy with the basic product and service but is not so satisfied with the support service activities such as delivery, invoicing and customer contact. Involving everyone in quality improvement was seen as a possibility to achieve a competitive position.

The ideas behind TQM came from Edward Deming, J.M.Juran and Kauro Ishikawa.

Deming was a statistician and worked for Western Electric during 1920's and 1930's. During World War II he taught quality control courses as part of the national defence

effort. After the war Deming was invited to Japan to teach statistical control quality concepts to top managers. They embraced Deming's message and transformed their industries. Deming's philosophy is based on improving products and services by reducing uncertainty and variability in the design and manufacturing processes. Variation was seen as main culprit to poor quality. From service perspective this meant that inconsistencies in services frustrate customers and spoil a company's image.

Joseph M. Juran also joined Western Electric in 1920's. He spent much of his time as an industrial Engineer. Juran taught quality principles to the Japanese just after Deming. Juran's philosophy differed from Deming's in many aspects; Juran's programs were designed to fit into a company's current strategic business planning while Deming proposed sweeping cultural change. Juran meant that people in different levels of an organization speak different languages while Deming meant that statistics should be the common language. Jurans main message was that 1.) the mission of a firm is to achieve high product quality and 2.) the mission of each individual department is to achieve high production quality. There were also two other mentionable masters of Total Quality; Armand V. Feigenbaum and Philip Crosby. Feigenbaum was the one defining Total Quality Control in 1951, long before its application. Feigenbaum described TQC as follows:

"Composite product and service characteristics of marketing, engineering, manufacture, and maintenance though which the product and service in use will meet the expectations of the customer". Philip Crosby again, the youngest of all and the one that was not so much statistically driven as the other ones took a little bit different approach to Quality thinking. His approach explains that: "Quality is free. It is not a gift, but it is free. What costs money are the unquality things -all the actions that involve not doing the jobs right the first time."

The common line of most of existing quality philosophies is that managers need systematic approaches to drive continuous improvement programs within all business areas, market research, product development, design, manufacturing planning, purchasing, production process control, inspection and testing and then followed up by customer feedback.

The International Organization for Standardization (ISO), which developed the well-known ISO-9000 quality standards, defines TQM as "A management approach to an organization centred on quality, based on the participation of all its members, and aiming at long-term success through customer satisfaction and benefits to the members of the organization and to society." This is also a simple but quite all-encompassing model for TQM.

The Deming cycle also called the Control Circle is a methodology for improvement. The methodology was originally called the Shewhart cycle after its founder Walter Shewhart, but it was renamed for Deming by Japanese in 1950.
The Deming cycle consists of four stages, Plan, Do, Check, Act as can be viewed in figure 3.3.

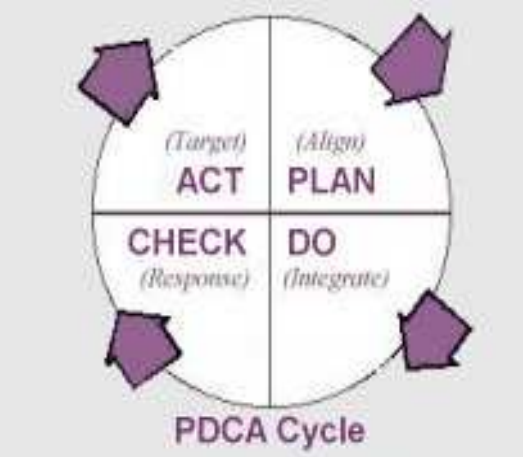


Figure 3.3: The Deming cycle

There are three fundamental questions to be considered:

1. What is tried to be accomplished?
2. What changes can be made that result in improvement?
3. How will we know that a change is an improvement?

The plan stage consists of studying the current situation, gathering data, and planning for improvement. The Do stage is pilot production process; the plan is implemented

and tested on a small group of customers. The check/study stage further evaluates if the plan is working correctly and find possible problems or further opportunities. In the last stage, the Act stage, the final plan is implemented to ensure improvements will be standardized and practiced. This leads back to the Plan stage for further diagnosis and improvement. This process is a never ending and focused on continuous improvement.

Kaoru Ishikawa has expanded Deming's four steps into six:

1. Determine goals and targets.
2. Determine methods of reaching goals.
3. Engage in education and training.
4. Implement work.
5. Check the effects of implementation.
6. Take appropriate action.

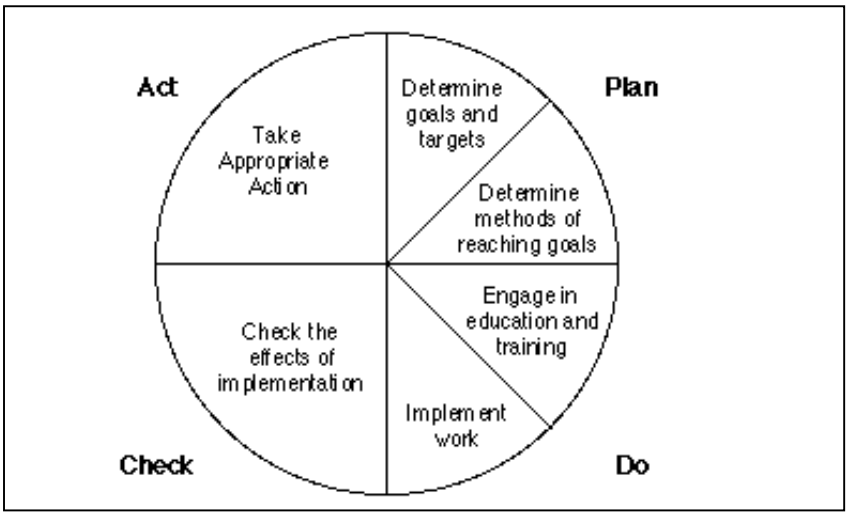


Figure 3.4: Kaoru Ishikawa's expanded Deming cycle.

The principle of it is anyhow the same and continuous improvement is behind it.
There are both advantages and disadvantages with TQM. The *advantage* of TQM is that everyone can be involved; it is a company wide issue. This in turn encourages individuals to take responsibility in improving their own job. TQM is therefore visible through the whole company and effects can be seen everywhere.

The *disadvantage* of TQM is that it is a long-term process and it takes time before improvement can be seen. This may lead to the fact that many people give up too early. Management need to be very active and keep people going by encouragement and keep them up-to date with results. TQM requires training and education of people involved which means it takes time and cost money.

3.4.2. Total Quality Service

Total Quality Service, TQS, has developed from a mix of the existing, various American and Japanese philosophies and strategies (see Appendix 3: Evolution of Total Quality Service). The immediate predecessor TQM was splitting into two models, one for manufacturing and one for services. TQS represents the latter one. TQS has a lot in common with TQM, but it is more tailored to fit the service industries. The major differences between TQM and TQS are closely related to the differences between a good and a service:

1. In services, measurement of quality does not deal with well-defined specifications, but with the perceptions of the customer. These do not only vary from customer-to-customer, but also within the same customer at various times.
2. In service determining customer expectations in advance of producing is more crucial than in manufacturing
3. Services cannot be stored, they are often produced, sold and consumed simultaneous with demand.

The TQS philosophy pinpoints importance of cross-functional management, flattening the hierarchy in organizations. Teamwork is essential and training of employees to respond to customers is given high value. Figure 3.5 shows an interactive model for TQS[4]. As can be seen interaction between teamwork, customer orientation, leadership is essential and the relationship between human resources and systems thinking (including statistical skills) is critical to reach an excellent, high-performance staff.

[4] Adapted from Improving Service Quality by Michael E. Milakovich

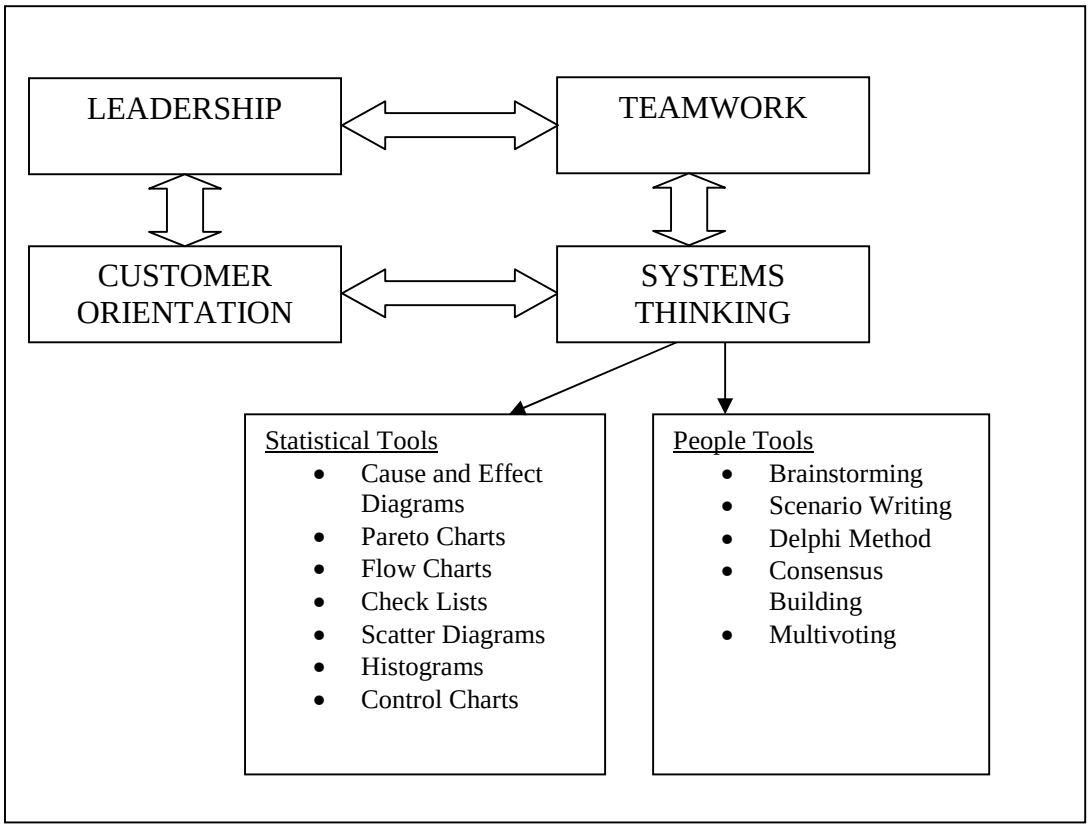


Figure 3.5: An Interactive Model for TQS.

The Customer-Supplier relationship needs to be tight. The main target of a service organization is to support and maintain a customer. Customer can be both internal and external ones. Close communication is important. The “voice” of a service process should be in line with the “voice” of the customer.

Empowerment of employees instead of setting tight rules and regulations is encouraged. Employees are encouraged to make decisions and act according to customer’s requests.

Customer feedback and satisfaction is of crucial interest and these results should be followed up closely. In TQM as well as in TQS continuous improvement is the slogan. In the TQS culture the cost of poor quality should be minimized.

3.4.3. Benchmarking

Benchmarking means evaluating and comparing the service with the performance of others.

Gaps in performance are identified and rectified in order to establish first-rate performance. There are three different types of benchmarking; *1. Internal benchmarking, 2. Competitive benchmarking and 3. Comparative Benchmarking.*

1. *Internal Benchmarking* usually happens “in-the-house”, a comparison between functions and departments within an organisation is done with the aim to optimise the process performance and remove errors.
2. *Competitive benchmarking* is a comparison of a company with its competitors. The product, service, function, department or company as a whole can be the basis of it. This is for example very common in hotel business.
3. *Comparative benchmarking* is a comparison of performance across industry sectors. In this type all areas of operation can be measured and improved.

The Processes for Benchmarking can be described as in the Figure 3.6, notice the difference between external benchmarking and internal.

The picture shows the steps in Internal versus external benchmarking. The 4 first steps are the same for both. The external one differs from the internal in that way that an external benchmarking partner is chosen and the standards are compared to the partner’s standards instead of evaluated internally.

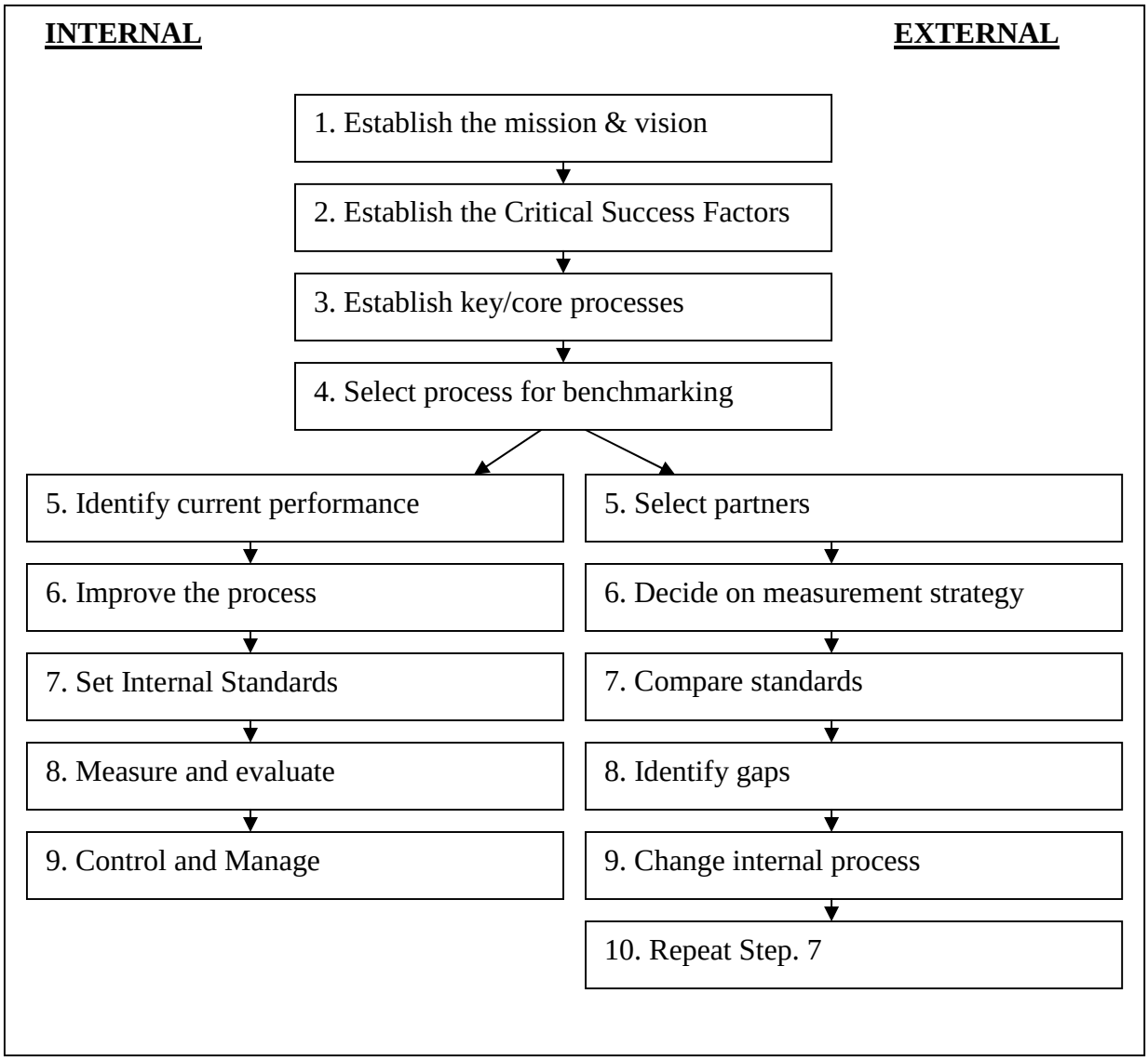


Figure 3.6: Internal and External Benchmarking process steps.

The advantage of benchmarking is that it instigates continuous learning and continuous improvement. The idea of measurement comes naturally with benchmarking. Disadvantages could be found if expectations are unreasonable and preparation if done badly.

3.4.4. The critical incident technique

The critical incident technique, CIT, is a methodology for collecting, categorizing and analyzing critical incidents that have occurred. Theses incidents can be satisfying or dissatisfying for both customers and service employees, in other words positive or negative experiences from both sides. This kind of analysis pinpoints what types of incidents during service delivery are likely to determine if a customer is satisfied or not. This in turn is helpful for future improvements in the service process.

It is also important to remember that customer-employee contact is a two way street. Analysing the employee's view of the situations, listening to their negative experiences helps improving their situations and encouraging which in turn keeps workers in their jobs.

3.4.5. JIT & Lean Manufacturing

Just In Time, JIT, and Lean Manufacturing has an intent to smooth out the manufacturing process by eliminating or reducing the traditional "stop and go" in a process. To be a Lean Thinker means to constantly strive to improve by focusing on driving out waste in all its forms.

The impacts of lean thinking have shown to be quality improvements, productivity improvements, smaller inventories and reduced lead-times.

It can be said that in all industries there are 7 types of waste that describe all activity that add costs but not necessarily value. These activities have to be recognized and tried to be eliminated.

The seven wastes originated in Japan, where waste is known as "muda." "The seven wastes" is a tool to further categorize "muda" and was originally developed by Toyota's Chief Engineer Taiichi Ohno as the core of the Toyota Production System, also known as Lean Manufacturing. To eliminate waste, it is important to understand exactly what waste is and where it exists.

The 7 Wastes – "Muda"	Definition
Overproduction	Producing more than needed
Transportation	Movement of product that does not add value
Waiting	Waiting time when material, people, equipment is not ready
Processing	Procedures not adding value from customer's point of view
Inventory	More materials, products on hand than needed
Motion	Movement of equipment, people that add no value
Defects	Work containing errors, mistakes etc.

Figure 3.7: The 7 "mudas" , wastes.

The 7 categories of wastes can be viewed in the picture above.

Overproduction means simply producing more than customer demand. Producing according to overoptimistic sales forecasts, batch production leading to excess output, "just in case" for breakdowns may be causes for this. In services this could be excess personnel at work shifts, unnecessary work done to accommodate people.

Transportation, movement of product that does not add value can be caused by bad functional layout, unplanned storage facilities, batch production etc. In services this includes typically too long movements for customers from one service point to another, bad sequences of process activities and bad lay out of service buildings. A

cure for this could be flow lines, continuous flow thinking and product design for service operations handled in chapter 4.

Waiting means time used when resources for use are not ready. Waiting for personnel, waiting for information and waiting for prints are some examples. There are many causes to waiting; in services typical causes are work imbalance, information entry delays (like computer problems), lack of priorities and lack of communications.

Processing or processes not adding value from customer's point of view. In services paperwork is often seen as waste. It is important to avoid excess paperwork and make the needs clear for customer.

Inventory means more material, products on hand than needed. In services inventory means work in process, like for example paperwork in process, tests waiting for analysis or distribution.

Motion, in other words movement of people, equipment adding no value. Looking for missing papers, samples, tests and sorting through storages to reach the right item are typical examples within services. Reason for these may be workplace disorganization and bad workstation layout.

Defects simply mean errors or mistakes. Often these can be of human kind but in some cases also avoidable. Wrong procedures may cause these and in that case the procedure should be changed.

3.4.6. Six Sigma

Six Sigma is a process improvement methodology that has its foundation in Total Quality Management philosophies.

It simply means a measure of quality that strives for near perfection. Six Sigma is a methodology for eliminating defects. Inside-out view of the business is often based on average or mean-based measures of the past. Customers don't judge on averages, they feel the variance in each transaction. Six Sigma focuses first on reducing process variation and then on improving the process capability. The key concepts[5] of Six Sigma are:

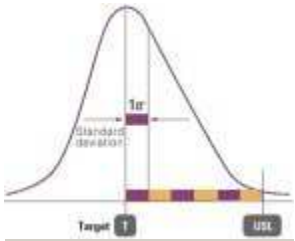
Critical to Quality:	Attributes most important to the customer
Defect:	Failing to deliver what the customer wants
Process Capability:	What your process can deliver
Variation:	What the customer sees and feels
Stable Operations:	Ensuring consistent, predictable processes to improve what the customer sees and feels
Design for Six Sigma:	Designing to meet customer needs and process capability

Figure 3.8: The key concepts of Six Sigma.

The term "sigma" is used in statistics as a measure of variation. Six Sigma indicates a 99.9997% defect free yield for a process. The goal is to reduce process output variation so that six standard deviations lie between the mean and the nearest specification limit. To achieve this almost perfect level in quality, Six Sigma focuses on reducing the variations that can occur in a process such as variations in materials, equipment, methods and conditions.

Six Sigma's methodology is very data intensive. It relies on accurate data collection and measurement to plan and track improvements. Sigma levels of performance are expressed as Defects per Million Opportunities (DPMO), how many errors would occur if an activity were repeated one million times. The goal is to approach 6 Sigma or 3.4 defects per million. In Figure 3.9 you can see how many defects per million 2 sigma, 3 sigma and so on allow.

[5] http://www.ge.com/sixsigma/sixsigstrategy.html



Sigma	DPMO
2	308,537
3	66,807
4	6,210
5	233
6	3.4

Figure 3.9: Sigma levels of Performance.

Six Sigma is a customer oriented technique and handles all improvements from the perspective of the customer. A gap between customer desires and the organization's current output is seen as an opportunity to create value. It starts with understanding the market. From that understanding, critical customer requirements (CCRs) are developed and process performance is measured against the CCRs.

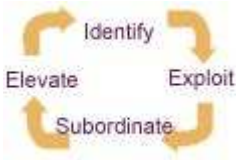
The guide for Six Sigma is the DMAIC cycle.There are five steps in the DMAIC cycle (Define, Measure, Analyze, Improve, and Control). As can be noticed it is taken from the older TQM model known as Deming cycle (plan-do-check/study-act).
The advantage from customer point of view is that six sigma listens to customer requirements and measures against that. For an organization within then service sector defects are attacked, cost thinned and customer satisfaction improved.
Being critical to the six sigma methodology, this approach may be seen a little bit theoretical and too mathematical in many eyes. People utilizing this approach should be familiar with its theories.

3.4.7. Constraint Management

The basic principle of Constraint Management (CM) is that every business has at least one constraint that limits the performance of the system. CM is a "whole system" methodology, meaning it views companies as an integrated whole composed of interdependent parts, rather than treating a complex organization as the sum of its independently managed parts.

The most common way used to visualize Constraints Management is to compare a business system (process) to a chain. This chain is composed of a series of links and one of them is the weakest (constraint). Resources (people, equipment, and facilities), the market, policies, knowledge, suppliers or materials can be constraints. As can be noticed constraints are not necessarily physical ones.

Constraint Management has 5 focusing steps for continuous improvement. Again we can see similarities with the Deming cycle. The steps are:



1. Identify the constraint
2. Exploit the constraint to minimize its impact
3. Subordinate everything else to exploit the constraint
4. Elevate the constraint-turn it into a non constraint
5. Return to step one

Drum Buffer Rope (DBR) is a scheduling technique and control mechanism used in Constraint Management. The schedule is designed to make all the workstations perform at the pace of the constrained resource or Drum. Non constrained resources are scheduled to serve the constrained resource. A buffer in front of the constrained resource allows for a continuous flow through the system.

Below is a comparison of CM to Lean Manufacturing.

System	Constraint Management	Lean Manufacturing
Pace	**Drum** (The constraint that is used to build the schedule.)	**Takt Time** (Maximum time allowed to produce a product in order to meet demand.)
Protection Mechanism	**Buffer** (A period of time built into schedules, to protect the drum from disruptions. This allows tasks to be released a predetermined amount of time earlier than they are strictly needed.)	**Eliminate Inventory** (Ideally achieve a one piece flow.)
Communication	**Rope** (A schedule that dictates the timing of the release of raw materials, or jobs, into the system.)	**Kanban** (Signals to indicate to production operators what products to produce and when to produce them.)

Figure 3.10: Comparison between CM and Lean Manufacturing.

The main difference between CM and Lean Manufacturing is the following: Lean manufacturing's just-in-time production requires the process to be balanced so each task has the same output level. On the other hand, DBR uses a buffer in front of the constrained resource to achieve an uninterrupted flow of products through the system.

3.4.8. Reengineering

Reengineering is the analysis and redesign of business processes to achieve faster and better performance while cutting costs. When talking about re-engineering it is not a question of a minor change, it is usually a massive one, affecting the whole organization. This radical technique is usually used when there is a real need for a change. Cases when re-engineering is used could be when a company is facing a disaster; it is a question of act and die. Also being the first within a new market niche or simple being the best requires some kind of re-engineering to reach.

Analysts identify each step of a process, measures how long it takes, look for opportunities to speed it up or maybe eliminate it and cut out dead time. Deep analyses of business processes may also lead to creation of alternative delivery forms that may constitute entirely new service concepts. All approaches done to reach these big goals need to be carefully analyzed and taken seriously. All the other techniques mentioned in this chapter can be seen as re-engineering processes, but they usually not as radical as when we are talking about traditional Re-engineering.

3.4.9. Time Based Competition & Quick Response Manufacturing

JIT, Just in Time, and Lean Manufacturing techniques were implemented already 30 years ago. High quality goods at low cost were the slogan. JIT and Lean Manufacturing also concentrate on mass production and homogeneity. The techniques are product and manufacturing driven, which ignores complexity and seasonality.
In late 1980's focus on time was more than simply a matter of efficiency. Speeding up processes meant serving more customers more efficiently. Time Based Competition, TBC, was the strategy's name, which point out that time means money, quality, productivity and even innovation. Georg Stalk.Jr means that being a Time Based Competitor requires three things to be accomplished:

- Your value-delivery system is two to three times as flexible and responsive as those of your competitors;
- You have determined how your customers value these capabilities and have priced accordingly; and
- You have a strategy for surprising your competitors with your time-based advantage.

Time is saved by eliminating delays and waiting time. These delays are usually caused by constraints in procedures, structural problems or quality problems.

Constraints in procedures could be eliminated by checking scheduling methods and eliminating staffing problems. Structural problems are caused by complex flow of material and information, location and facility inconvenience causing "extra" transportation time. Quality problems include extra time spent in rework due to insufficient design.

Time Based Competition started in manufacturing industries as most of the improvement techniques described. But many service organizations have also already in 1990's applied this thinking to their business. An example can be taken from Sweden[6]. The Karolinska sjukhuset (one of Sweden's most famous hospitals) was also a victim of the recession in Sweden in the early 1990. Higher costs and weakened economy forced the government to reduce healthcare expenditures. Karolinska decided to apply Time Based Competition thinking despite many suspicious reactions among medical people. It turned out to be a good choice. The poor coordination and scheduling were improved by redesign of operating procedures and staffing patterns. This in turn led to increased throughputs, lower costs and reductions of unnecessary delays and inconvenience for the customers and at the same time quality was kept or even improved to some extent.

TBC is a strategy to "GETTING TO THE CUSTOMER FASTER".

QR, Quick Response has developed from the Time Based Competition (TBC) concepts that were being developed around 1989. QR builds and extends upon the techniques developed in numerous other process improvement methodologies that have come before it such as Total Quality Management, Lean Manufacturing, Re-engineering, Constraint Management, and Six Sigma. Initially it was developed by and for the textile and apparel industries but today anybody serving the consuming public can apply this. This technique also fits smaller organizations.

As already said the earlier techniques JIT and Lean manufacturing concentrate on mass production, this means they do not take so much flexibility into consideration. QR again includes flexible productions systems. Its components include flexibility of:

[6] BCG Publications about time-based competition, www.bcg.com/publications (13.01.2004) by Thomas M.Hout and Georg Stalk.Jr.

- Products (e.g. customization of products and creation of additional features if needed)
- Product volumes (e.g. small batches)
- Product mix
- Product Delivery Schedules (e.g. frequent delivery)

The objective is to be able to tailor activities to trends and adapting to customer needs. There are a number of strategy components that clearly defines the QR thinking.

1. Activity according to Demand

The fundamental principal of QR is that the drivers are;

- The demand of the market and customer
- The volume and rate of consumer and market demand
- The variety of demand

In other words this means that the activities within a company are paced to the beat of the demand drum. Changes in demand are closely followed. Marketing, purchasing, product development and operations follow the market tempo and adopt accordingly.

2. Demand & Supply

Demand is always the target. For traditional Supply Chain Management improvement in supply has given a lot of attention. In QR the main point is to understand the demand and build the supply accordingly. QR put less reliance on forecasts. QR activities, resources and supply acts to real demand.

3. Time

The most important element in the time strategy of QR is fast and accurate adaptation to market change. Accuracy and flexibility will reduce time delays.

4. Information

Data and information is the only way to receive demand and link accurate and flexible supply to that. Timely and accurate flow of data will enable quick responses. The organization has to go through the internal and external data and information needs and find an Information System (IS) that supports these.

All these four works very well both in the manufacturing and service industries. Customer demand decides what type of service is provided. Demand equals supply, because in services supply cannot be stored. Time is an essential decision factor when choosing between service providers. Information is essential to understand the voice of the customer.

After reading many definitions of QR I did not really find any definition I really liked, but common for most of them were that QR is consumer driven, importance of flexibility, communication of information and reduction in time. I decided to define QR in my own way as following:

> Quick response is a technique that can be adapted to both large and small organizations serving the consumers. The driver of all activities and supply is the consumer demand. By being flexible in terms of manufacturing technology, product mix, volumes and schedules customer demand can be met and lead times minimized. Open and frank communication of information between trading partners are significant for success. The information systems help to make the internal and external flow of information quick and accurate.

3.4.10. ISO 9000

ISO 9000 is “a method for guaranteeing consistency of approach through the use of written procedures, system audits and review”. It is a system standard and document of what the company does, not what they produce.

Customer pressure and quality requirements of customers are reasons for ISO 9000. Also the notification that poor quality costs money (waste and rework) is a reason. It is also easier to have consistent approach throughout an organization with the aid of written instructions.

The advantages and disadvantages of ISO 9000 are stated below:

Advantages:

- ISO encourages consistency
- ISO gives aid in encouraging for improvement
- The written documents is a good guide for new employees
- When problems occur, the company have the standards for showing that they have not been nonchalant in their operations.

Disadvantages:

- The ISO 9000 can be bureaucratic and cause even more work
- Paper-heavy and difficult to manage
- Not many employees see the system as part of their normal job, lead to the fact that devotion to the system may be minimal

ISO 9000 is not a system for improvement, it is about consistency.

3.5. Importance of Performance Measurement

Without performance measurement it is impossible to know how well a process is executed. One may think that if there are no customer complaints, there are no problems. This is unfortunately usually not the case. If process improvement is tried to be done, measurement is the only way to plot the progress. Comparison of existing and improved process has to be measured in some kind of a unit.
The measurement in a process can be divided into three separate areas:

1. Input
2. Process itself
3. Output

The input measurements are there to ensure that input to process is correct. The area of process itself simply means measuring process performance by the aid of process success factors and the output enables to set process measures. Output should not be the only part to measure, this causes only reactive measures. The other parts enable reactive measures. The earlier in a process a problem can be recognized, the easier it is to solve it.
It is important that people working directly with the process are the ones involved in the measurements. They know the most about the operation and in the improvement stage they are the ones involved, so it is good they are involved in an early stage.
Irrelevant measurements should be avoided, because in the measurements are taken to improve quality and raise standards.

4. Alternative Logistics solutions introduced in Service Sector

After the tasks that are limiting the overall outcome of a process are identified, the analysis of possible solutions for improvement can take place. In this chapter different logistical solutions adaptable in service sector will be presented. The traditional definition of logistics is somewhat narrow to describe logistics processes in the service sector. Traditional Supply chain logistics is the physical flows and storage of materials and related information to the system. In goods industry this play the major role in logistics thinking. For the service industries this also exist, but it is not as important as Service response logistics, which is the process of co-ordinating nonmaterial activities and optimizing the service-providing infrastructure to coordinate and meet customers need. Below a comparison of Supply chain activities and Service Response activities can be viewed[7].

Supply Chain	**Service Response**
Sales Forecasting	Service Request Forecasting
Sourcing/Puchasing	Partnership development, staff hiring
Production Planning	Staff, equipment scheduling, distribution channel selection, capacity planning
Inbound Transportation	Data collection, customer pick-up
Inventory Management	Capacity Management, database mgmt customer record mgmt, personnel training
Warehousing	Data/information storage, retrieval and mgmt
Customer Service	Quality measurement and mgmt, expediting
Order Processing	Interfacing, negotiating, committing to the customer, monitoring delivery process
Distribution systems	Network layout, network planning, systems planning, channel planning
Field warehousing	Data/information storage, retrieval and control
Distribution control	Network control, communications control
Intra-company transportation	Personnel/customer movement, data/information movement
Distribution Administration	Network administration
Outbound transportation	Customer reporting, service engineering routing/scheduling

Figure 4.1: Comparison of Supply Chain Activities and Service Response Activities

[7] adapted from Logistics in Service Industries, prepared by Arthur D.Little and The Pennsylvania State University for Council of Logistics Management.

As mentioned traditional Logistics Management planning is concentrated around a primary decision triangle of location, inventory and transportation (see Figure 1.1.). The customer service level is the result of these decisions. Purchasing and customer service are also included in the traditional supply chain activities. Service response logistics focuses on the areas of minimizing wait times, managing capacity and providing delivery through distribution channels. This chapter will analyze the logistics thinking within both the area of traditional supply chain activities and service response activities, with concentration on the service industries.

4.1. Supply chain activities

4.1.1. Facility & Location

4.1.1.1. Location Analysis

Location analysis for service operations differs from location analysis for manufacturing operations. The fact that many services require the customer to come to the service delivery system, the service point, may require some facility location and space decisions. The problem of transportation costs and delivery time is not though essential to services. On the other hand it may be good that public transportation is available and location of the service point is easy to reach. The location of a service point depends a lot on the concentrations of demand and location of competition.

The Load-distance method or centre-of-gravity method is useful when measuring proximity of a facility to its customers and competitors. In this method the locations of customers, suppliers and others are known and make it possible to calculate the distance part of the load-distance method. The load may be assumed like amount of customers, suppliers and so on and this is the load part of the method. Grid coordinates on map can be used to measure distance.

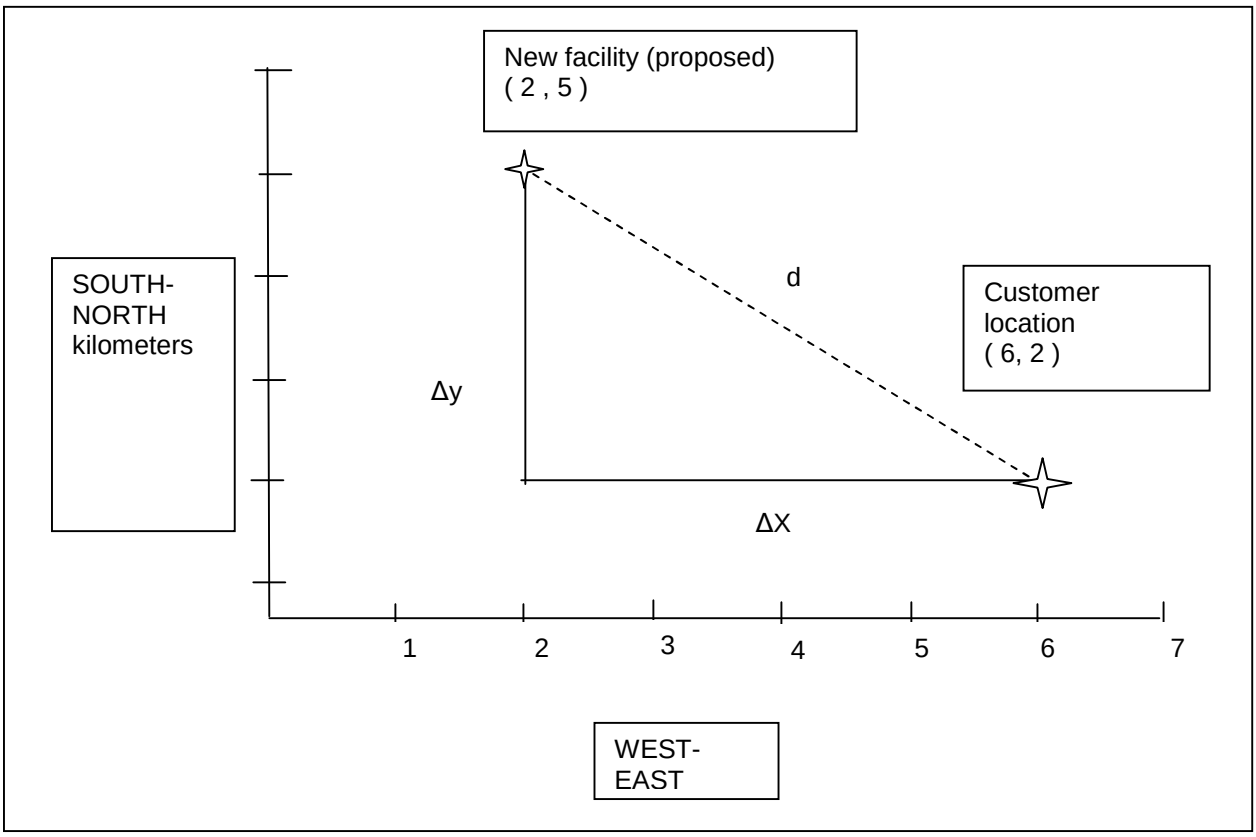


Figure 4.2: Example of calculations of Distance from Facility location to Customer location.

Pythagorean Theorem:

$$d^2 = \Delta x^2 + \Delta y^2$$

$$d = \sqrt{(6\text{km}-2\text{km})^2 + (5\text{km}-2\text{km})^2}$$

$$d = 5 \text{ kilometers}$$

The simple example above shows how a distance from a proposed facility location to a customer can be calculated with the aid of grid coordinates on a map. By applying Pythagorean Theorem distance d can be easily found. The activity load have to be estimated, for example the amount of possible customers around point (6 , 2). A new facility has many potential customers/customer locations, and each of these have a distance and a load. When looking at load and making decisions about possible customers attributes such as age, sex and income of population are also taken into account. When looking for the most appropriate location of a new facility the rule

would be to find a central location that is will minimize the distance travelled for all customers. This can be thought of as the centre of gravity.

The decisions about location may differ when talking about profit or non-profit service providers. Public institutions such as schools, healthcare offices do not have the profit-driven motivation to serve customers; they should be located most conveniently from the customer point of view. In profit-driven service organizations cost-benefit analysis is used when deciding on location.

Emergency unit's locations on the other hand are determined by minimizing response time.

4.1.1.2. Continuous flow

Traditionally continuous flow operations have been found in production. The reason for this is that many service operations do not have the "high volume" to support the large investments in facilities needed for continuous flow operations. Anyhow there are many services that can be seen as a continuous flow operation. Or then some related tasks within a process can be seen as a continuous flow and facilities can be built, organized to make the flow smoother. Once the sequence of operations is determined, the layout can be planned accordingly.

4.1.1.3. Manufacturing cells

When hearing the phrases "Manufacturing cells" and "Flexible Manufacturing systems" one may exclude these from service operations. These can though be applied to Service industry as well. The basic idea of these is 1.) To group products into one or more families which have similar processing requirements and 2.) To arrange equipment in close proximity that can meet those processing requirements.[8]

The advantages of these are that they:

1. Reduce setup/changeover time and cost, because similar products requiring similar setups and procedures are grouped together.

[8] Operations Management, Concepts, Methods and Strategies by Mark A.Vonderembse and Gregory P. White

2. Reduce material handling and material movement by locating equipment for performing the entire job in close proximity.
3. Increase the effectiveness and efficiency of people by focusing their attention on the product and their needs instead of focusing on material movements through the facility.

When talking about products and equipment, it can also include intangible products like a service. A good example could be patient focused healthcare. The concept of manufacturing cells and flexible manufacturing systems are already used in hospitals. Patients with similar illnesses are grouped together in the same location. Nurses with special training in these illnesses and equipment and medicine used are kept close to these particular areas. This means patients do not need to spend much time in travelling throughout the hospital and services are likely to be provided when needed, which again lead to an increase in the quality of nursing care. In educational institutes we can think of the different faculties, different buildings/departments for students having the same major to be some kind of manufacturing cells. For chemical students laboratories and chemical samples are close to the department of chemical studies. All classes closely related to chemistry are taught in the same building/department or close. The offices of the Professors in Chemistry are also close so the movement of students and teachers are minimized.

4.1.2. Inventory

Inventory and Warehousing are not a specific expertise area for service-organizations and therefore these are often outsourced or handled by a third-party vendor. In most of services the output is tide to a physical good in a way or another; therefore inventories can be found in most of service organizations. In hospitals there are both off-site and in-site inventories for medical and surgical supplies and medicines. In hospitals it is very important that stocks are available when needed. A special drug or blood of right type have to always be available when needed, it can be a question of life or dead. This means in a logistics inventory point of view that complex materials management

is needed. Often the in-house stocks are replenished on daily basis. For hospitals it is possible to have off-site so called HUBs which then are replenishing the in-site stocks. JIT thinking is essential in hospital environments in order to minimize inventories. If a special item is not available in stocks, expensive transportation methods such as helicopter may be used in order to get the materials. It is important to have a good Information system supporting the inventory management and purchasing. EDI system seems to be pretty popular.

In education facilities and other office facilities inventories are kept of office materials and supplies, like paper and pens, books, teaching material, communication devices, such as phones and computers and furniture. The inventory management of these are not critical to the success of the institution, but it is of course important to keep the inventory costs down. Excess stock means lost money, especially books tend to be "old" pretty fast, as new publications and new technologies are developed all the time.

4.1.3. Transportation

Transportation involves inbound and outbound transportation. In service organizations there are inbound movement of goods/supplies needed for providing the service and the outbound transportation of these. The transportation of goods directly to customer is seldom found for the service industries, except for organizations only providing transportation services. In hospitals typical transportation activities include transportation of surgical, medical supplies and drugs to from the outside stocks to the inside warehouses and from inside warehouses to clinic departments and units. Also movement of medical records, tests and samples and food to patients and transfer of patients are typical activities under the category transportation. The transportation is handled differently depending on if hospital has outsourced their warehouse functions or not. If warehouse activities are outsourced, the third party vendors handled the outbound transportation. It is possible to have special errands to handle the inbound pick-up and delivery according to schedules. Other high-tech solutions could be pneumatic tube systems or conveyor systems to move the test samples, medical

records and x-rays. This system requires a functional lay-out and some equipment investments.

Typical transportation in education institutes are movement of students and teacher from one classroom to another, or one faculty to another. Also movement of technical devices for teaching purposes (computers, projectors etc.) is a typical transportation activity. As already mentioned the lay-out of an educational facility should be built in that way that movement of students and teachers are minimized. Also the transportation of devices needed for teaching purposes should be minimized. For a computer class for example it is good that there is a laboratory with computers available, for chemistry classes a chemistry lab and so on. Today it is very common to bring a portable computer and portable projector to the classrooms where classes are held. It is preferable that common areas like cafeteria, libraries etc. are place in a central areas so that the distance travelled by everyone is minimized.

4.1.4. Purchasing

Purchasing is maybe the most visible logistics function in service industries and also the one given most attention in order to reduce costs. As already mentioned hospitals for example buy a lot of surgical, medical supplies, drugs and other special supplies needed. Group-buying can be recommendable to keep the purchasing cost down. This means that many departments in a big hospital buys the whole amount of same supplies at the same time, they are grouped together. Many smaller hospitals can also go together and group their buying. Order duplication of drugs and medical supplies is quite common in hospitals due to the fact that the doctors ordering these are many. A clear, user-friendly system, for example a database system, keeping track of all the needs is recommendable. It is very important that the system used is user-friendly, because one has to remember that doctors are not computer engineers. Many doctors also mean many opinions about brands. It can be recommendable to sit down and agree on some brands, to that purchasing is done in volumes instead of from many vendors.

In educational institutions purchasing include buying of papers, pens, books, teaching devices etc. It is recommended to be done once before every semester start. This in order to order as much as possible at the same time and get volume discounts. In educational institutes there are often many professors and maybe different opinions about brands needed. In this case it is recommended that the purchasing is done centralized and the brand variations minimized in order to get volume discounts from one or two vendors providing some particular brands.

4.1.5. Customer Service

Service organization's goal is all about providing customer service. For service organizations the face-to-face contact with customers is very important. The basic ways customers should be treated can be defined by some adjectives:

- Friendly
- Responsive
- Courteous
- Efficient
- Pleasant
- Helpful
- Caring
- Prompt

For service organization's qualities such as time is more critical than for goods-producing industries. Here we talk about minutes and hours instead of days. It is important that the standards for a particular service is specified so that the customer exactly knows what to expect. The standards again are set according to customer requirements, what does customers find as quality criteria's of the particular service provided.

In hospitals the customer service are both including patients and doctors. Patients judge customer service according how easy it was to find the right place, admission procedures, friendliness of staff, wait-times, food quality, cleanliness and so on. Post-hospital services, such as follow-calls or letters often leave a positive effect on the

patient. The doctors again demand that test results, x-rays results and other procedures are on time so they can manage their schedules. It is also essential that right equipment, material and drugs are available at the time when needed.

In educational institutes the customers group include students and teachers. For both students and teachers it seems important that class starts on time and that breaks are kept when promised. Students also seem to put high quality standards on the lessons if the teaching material is up to date and closely related to the real world.

4.2. Service Response Logistics

Service response logistics means shortly the coordination of an organization's non-material activities in order to reduce cycle times, manage capacity and provide the service smoothly through distribution channels. The critical thing within the service industries is that the coordination happens while the service is performed, and if problems occur it often means unhappy customer or even lost customers. A critical quality factor is wait-time and therefore there are many techniques that can be used to avoid excessive wait-times. Wait-times in hospitals occur in emergency departments, time waiting for test labs, time in admission, time to schedule special tests etc. In an educational environment wait-times can occur when waiting for admission results, waiting for meetings, waiting for test results, waiting for information etc. There are many techniques used to avoid excessive waiting-times and some of these are already described in Chapter 3 as Quality improvement techniques and some of the rest will be covered in this chapter.

4.2.1. Capacity, scheduling strategies

Services are direct and cannot be inventoried. It is very difficult to estimate service demand due to many reasons. Maximum demand is difficult to estimate for some service providers. It is for example hard to predict how many serious accidents with injuries will happen in the same day and cause a peak demand at a particular hospital. Process time may vary a lot depending on customer or provider. The customer may have many "service requirements" at the same time and he/she may be good or bad in

communication his/her needs. This means that a process time may vary. Concerning capacity decisions a service organization should decide between the following:

- Have enough capacity to meet maximum demand
- Choose not to satisfy all the demand

These two mentioned above have both benefits and disadvantages. Building enough capacity to meet maximum demand is good from the customer point of view, the demand can be met at any time, but on the other hand it means that capacity is not used a great percentage of the time and it means high costs.
The second way of ignoring peak demand is not a good way of handling a peak situation, it means dissatisfied customers and loss of those both in short-term and long-term. There are some strategies to chase demand, adjust production rate to meet demand.
Manage demand so that people will use services at off-peak times can be handled in a better way than allowing long queues. It was mentioned that service can not be inventoried. Resource inventory is though the service industry's option. Extra people and facilities, capacity, can be maintained to handle unexpected demand. In this case a trade off the extra capacity costs against the cost of unsatisfied customers will happen. Sasser has described some additional strategies for producing a better match between demand and supply in the service industry:

On the Demand side:

1. Differential Pricing, will shift some demand from peak to off-peak periods
2. Non peak demand can be cultivated.
3. Complementary services can be developed during peak time to provide alternatives to waiting customers.
4. Reservation systems are a way to manage the demand level

The first example, Differential Pricing, will shift some demand from peak to off-peak periods, means there is a possibility to have discount prices for low-seasons. This is typically used for off-season holiday packages. In hospitals or educational institutions this is not relevant, because if you are ill the cost does not play a significant role and choosing of major subjects are not decided on the basis of price. Less attractive subjects are not probably less expensive. Or maybe that could be a way to attract more students? The question is though are the students motivated enough if the major is chosen on this basis?

A goof example of Non peak demand being cultivated is when hotels have developed their “mini-vacation” weekends.

Waiting does not make a customer happy, but there are some alternatives to add complementary services for a waiting customer, cocktail lounges to sit in while waiting for a dining table is a good example of this. In hospitals complimentary service could be providing magazines, internet access or maybe utilizing the time by taking general tests (easy to take yourself) needed for most of the visits like blood pressure tests, weight etc. There may be a room close to the admission where this can happen, the equipment needed is available, paper and pen and maybe one nurse drops in to check every now and then. It is though important that instructions are clear to the customers so they feel comfortable doing it. Within education wait-times can be accepted if for example exact date when admission results and test results are given out will be informed; even though they are postponed a new date is better than no news at all.

The reservation strategy is commonly used within tourism. Restaurants, hotels and airlines make reservations to determine coming demand and at the same time limit the access to that service. In hospitals reservation systems are utilized when booking time for special tests or treatments.

On the Supply side the cures could be:

1. Part time employees can be hired to serve peak demand
2. Peak-time efficiency routines can be introduced.

3. Increase consumer participation in the tasks can be encouraged.
4. Shared services can be developed
5. Facilities for future expansion can be developed.

Overtime is of course always an alternative and a must sometimes, but the negative part of this is that personnel often get exhausted and quality of service may suffer due to this phenomena. Fast-food restaurants have used the part-time employee strategy for a long time. The biggest advantage of this is that is cost less, the staff is paid for when it is needed. The disadvantage is that it requires a very flexible work force. It also requires the forecast of demand to be quite accurate. In hospitals it is very hard to predict peak-demand. One possible approach to adapt to actual demand is to have a team of nurses/doctors that are on-call duty, which means that they are called to work when needed. This is a very common procedure today. The possibilities can be found in the source the nurses come from. They may be hired by the hospital, but today there are also many companies concentrating on hiring out staff. There may be a possibility that a hospital is calling this source as well, especially in places where shortage of medical staff is common. Often these can be multi skilled and able to work for different institutions, but on thee other hand they are not immediately familiar with the special procedures and equipment of the particular hospital. In educational institutions peak-demand may occur during exam periods in the end of each semester, this cause a lot of work for the teachers. One possibility is to hire in extra personnel (qualified) to help with checking exams and so on. In this case the companies hiring out staff may be on possibility. In universities and other educational institutions there are often clever students who are willing to help and earn some money. These should be utilized in helping teaching and helping with other administrational activities.

Another good way to hire part-time employees is to hire a visiting lecturer from the Industry, a professional from a specific field. This gives extra time for professors to their things and the students get a real-life picture of the subject in question.

Introduction of peak-time efficiency routines means that employees perform only essential tasks during peak period. This is all about priority. In an emergency situation

hospitals usually treat the most urgent cases first and then the people with minor injuries. Also the less important routines are skipped if possible to serve the more important need. During exam periods, routine work such as keeping classes may be skipped. This is both positive for the students and the teachers. Students have more time to concentrate on the studying for the exams and teachers have more time to check the exams already kept. Many educational institutions have chosen the other alternative, not to have so called exam periods to avoid peak demand. Instead they are trying to schedule the exams so that students and teachers do not have more than one exam a week.

Increased consumer participation meaning costumers doing some part of the service themselves, as when they bag their own groceries or using self-service gas stations. This is difficult in many services for example in hospitals, where the patients are often completely dependent of the nurses and doctors. Some simple laboratory test can though be taken by themselves as the blood pressure tests and weight, mentioned earlier. In universities the beginning of a semester may be very busy, when subjects need to be chosen. A clear computer database system may be introduced to the student, so they can handle the procedure completely by themselves. This though requires an introduction to all students and clear instructions. In the long run this is a good solution, especially in these days of technology.

An example of shared services is when several hospitals share medical-equipment purchases.

The last one on the supply side is pretty clear. Land or facilities for future expansions can be bought or leased.

Other strategies could be Adjusting capacity, sharing capacity and Cross-training of people. All these three are similar. There could be an ability to only use only part of the facilities or available employees at any given time. One section of a service facility can be closed off when demand is low and employees of that can do other things during that time and return when demand rises again. If employees are trained to do more than one activity, they can be shifted from one activity to another when demand changes.

Sharing capacity means different organizations with different demand patterns can use the same facilities or even same employees. Airlines for example can share gates, check-in facilities and ground crew.

Within hospitals sharing resources often means saving some money. The specialists and doctors are often expensive and only needed part-time. They can be shared between different medical institutions and hospitals in order to reduce expenses. Teachers can also work for different teaching institutions.

Cross-training of personnel is a good alternative. Multi-skilled people are attractive to the labour-market. This can be used in most areas of services. In hospitals it is good that nurses are specialized in some area, but can help within other areas when needed.

4.2.2. Distribution channels and operating hours

Distribution channels are the channels an organization use to deliver the service. For service organizations this can be both physical and electronically. Medical service can be given through hospitals, walk-in clinics, home health care, emergency departments and phone calls. Educational service can be received both in educational institutions and through the internet, which is gaining increasing popularity. Many service organizations are pinpointing channel management and trying to find new distribution channels in order to be more attractive to the customers. The service time and convenience for consumers are increased. People are more occupied nowadays; they travel more and are not always able to reach the service point between 9 and 5. The new distribution channels have given an opportunity to expand hours of operation. Today a variety of home-based services are provided with the aid of telecommunications. Teleshopping (shopping at home), telecommuting (working from home), teleconferencing (keeping conferences via phones) are a couple of examples. All these may save money in form of time, travelling etc. In medical environments these may be utilized as well. Post-hospital instructions for example may be given via this form of distribution channels. On the internet there are many discussion groups for different diseases and symptoms, questions can be sent directly to doctors. The internet is also a popular educational distribution channel nowadays; complete

educational programs can be completed through the internet. The complete educations received via internet are not so highly appreciated yet as compared to the degrees received from universities. I though think that Internet is a good distribution channel for education. What is recommendable is that some courses are offered to be taken via internet and the final exam for example is written at the university. Similar departments at many different universities, offering the same courses could go together and develop this idea. They could share the resources in that way that they have one tutor for each subject, who is employed to answer the questions related to the courses, checking exercises and so on. This means that many universities could utilize one professor to "keep the course" and save money while sharing resources. There could also be open discussion forums related to the topic. The exams could anyhow be kept in the universities to check the knowledge of the students and avoid cheating. This would also be beneficial for the students, they could execute the course at the time that suites them the best.

4.2.3. Managing Productivity

As already mentioned service industry is highly labour intensive and costs of labour are high. This leads to a great pressure to increase productivity. There are different approaches to improve service productivity.

- Increase of quantity by surrendering some quality
- Industrialization of the service
- Offer customer incentives to substitute own labour for company labour

The first one is simply about trading off cost and quality. Important to remember is that sales are affected to some degree by the level of service provided. In general lower service level means fewer sales.

Industrialization of the service means companies need to adopt a "manufacturing attitude" toward producing service by adding equipment and standardizing production. Hospitals could utilize this one.

A good example of the third one is a restaurant having a self-service salad bar, which is replacing "waitering" work with customer work.[9]

4.2.4. Improved information & communication

Clear communication and instructions to the customer may reduce wait times. Co-ordination of the service delivery in advance may be beneficial. Within healthcare we can take following example; during a pregnancy, close to due date, it may be best to contact the doctor by phone and discuss and see if it is the right time to come to hospital for delivery or not. This may save time in travelling to the hospital and back for the patient or then it may save some space at the hospital. Another situation is when discharging patients. It is best to arrange with pick-up in the morning time so that patient can leave the hospital and room is available as early as possible for the next one. In educational environments clear instructions and information, for example about subjects, exam dates etc. often reduce unnecessary calls and waiting time. Information systems have also given the opportunity to reduce wait-time, clear information is received faster.

4.2.5. Product Design for SO/ Process Simplification or streamlining

Service design can be viewed as a series of actions. Logistics thinking in service design involves deciding the sequence of the actions, the best order of actions for the customer. Developing a flow chart of the tasks included in the service is a good start

[9]" Look to consumers to increase Productivity" by Christopher H.Lovelock and Robert F. Young

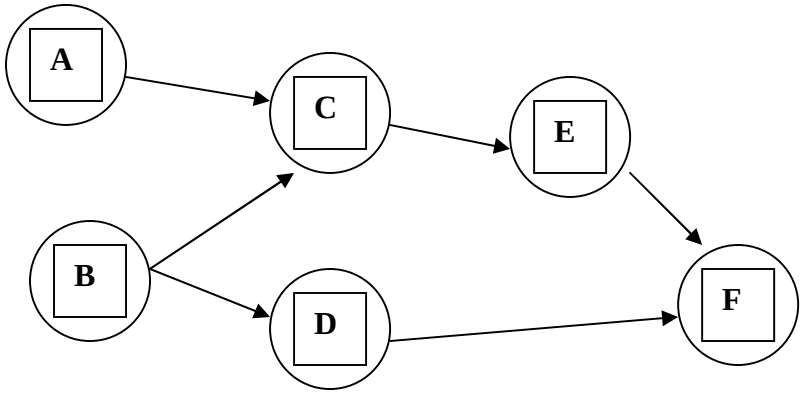
in designing a service operation. In this way it is easy to visually analyze what is happening and how activities relate to each other. The flow chart can be used as a tool when planning the layout of facility in which the service is provided in and the movement of people and information. It can also be used in capacity estimations. When designing a new service operation or analyzing and remodelling an old one there are some major things that should be taken into account:

1. The logical sequence of the steps
2. Are the capacities of the different operations in the sequence in balance with each other?
3. How much flexibility is available at each step?
4. Can steps be combined?
5. Can steps be done in parallel?
6. Can customers perform the transaction themselves?

Another way of determining the sequence of tasks of a service could be creation of a precedence diagram. A precedence diagram is a series of nodes representing activities and arcs and lines between these indicating sequences of tasks.

The example in Picture 4.1 represents a typical Class Registration Process at a State University in the United States[10]. First of all (A) the student prepare a tentative schedule and picks up the registration package in the college office (B). The diagram shows that these do not need to be done in any particular order. These can also be done simultaneously, a student can start doing A, prepare the schedule, do B, pick up the registration package and then continue with A again. Advisor approves the schedule when it is done, as can be seen from the picture A and B have to be finished before C can start. When schedule is approved it can be entered into the computer (E). According to procedure only task B has to be finished before obtaining financial voucher (D). Paying the fees (F) can be completed when both E and D are completed.

[10] Example adapted from Mark A.Vonderembse and Gregory P. White



TASK	Description	Immediate predecessor
A	Prepare tentative schedule	-
B	Pickup registration package	-
C	Get advisor approval	A,B
D	Obtain financial aid voucher	B
E	Enter schedule into computer	C
F	Pay fees	D,E

Figure 4.3: Typical class registration Process at a State University in the USA.

The advantage with the thinking of process simplification is that the change made does not be so radical and is anyhow showing some improved results. The small size of the change also makes it more acceptable.

The disadvantage with this is that it can be very time consuming, patience is also needed to notice results. Some experts also mean that process simplification may inhibit major improvements. Hospitals can use the so called streamlining procedures in admission procedures, drug order procedures and so on.

4.3. The Role of IT

Applications of information technology in service operations are important ways to achieve a competitive advantage. The e-business will require changes in global supply chain operations. Increased customer expectations and great opportunities for improvement will cause these changes. Companies want to connect thousands of customers, suppliers, distribution centres, transportation companies to improve:

- Customer's experience
- Cost
- End-to-end visibility
- Real time optimization
- Capacity for growth
- Performance measurement
- Reaction to correct operations breakdown, before they affect customer operations

For service industries this means probably also that more and more goes from physical delivery towards electronic delivery. The latest generation of supply chain management is Web-Centric. It is characterized by the marriage of the Internet and the supply chain and has resulted in the birth of electronic business (e-business) applications.

Supply chain management shifts the focus of analysis to the big picture, or the whole supply chain (NETWORK).The supply chain typically spans multiple companies and is very complex. E-business applications have evolved into the most intelligent and optimized tools with which to execute front-end and back-end operations in a supply chain, using the Internet. E-business applications effectively provide an information system that links multiple companies in the chain

The center of the e-business supply chain is an information hub (a node in a data network where multiple organizations interact in pursuit of supply chain integration), where incoming information is quickly processed and then sent out to other chain-members. The hub also has capabilities of data storage and push/pull publishing. These advanced tools enable true, real-time collaboration, connecting suppliers and customers to allow a greater sharing of information.

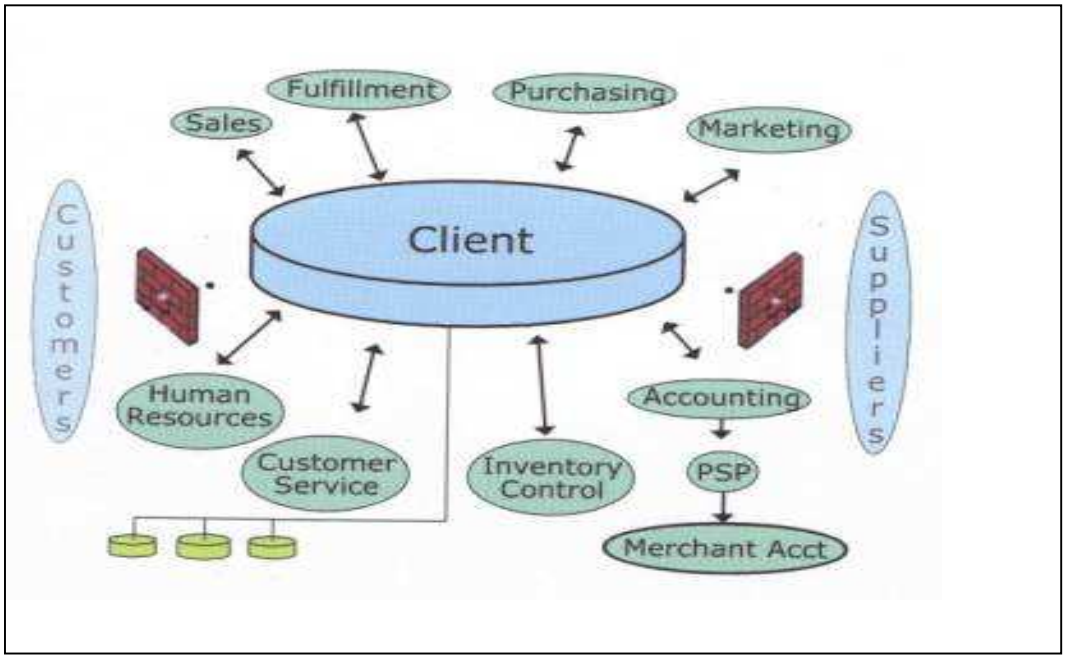


Figure 4.4: E-business Supply chain.

Logistics-focused e-business tools are designed to provide shippers, carriers, third-party management providers, forwarders and broker the capability to transact shipments with their customers, as well as manage internal workflows, control their financial management, improve customer service and sell services to other participating companies. Also planning services, enabling logistics providers to get the most out of their equipment and operations, are available.

This in turn can help to reduce the cost of finding new business, since they allow customers to actively seek out providers. These Internet-enabled tools allow customers to provide cost and delivery parameters for their shipments, and allow logistics providers to bid on only the jobs (or portions of jobs) they are interested in. According to Ian Lodge Business Develop mentor for i2, the best e-marketplaces can provide critical information regarding customer demands and delivery expectations up front, which is vital to achieving high standards of customer service, retaining customer loyalty and sustaining growth. Already there are many alliances of SW providers and ASPs (Applications Service Providers) developing complete supply

chain systems to suite e-business connectivity. Examples of these are i2, Manugistics and EXE.

Another example is the alliances of LSPs (Logistics Service Providers) and ASPs, for example SAP. It is becoming more and more popular for the customers (in this case companies within Service Industries) to buy these kind of services outside from one of the available providers. This phenomenon is called 4th Party Logistics (4PL).

5. Benefits and Cost Analysis

5.1. Benefits and Possibilities of Cost Savings

Applying logistics thinking into service industries means there will be many benefits both from the customer point of view and the organizations point of view. The customer will be more satisfied when services become more structured and organized, quality of services is improved; in other words the voice of the customer is heard, because quality in services is meeting or exceeding customer demands. Waiting time is reduced, distances to travel for customers are shortened and flow of service is smoother. More satisfied customers mean more potential monetary gain, for the company. A satisfied customer will purchase again.

From the service provider's point of view the internal customers, the staff, will most probably be more satisfied due to well organized processes and scheduling and coordination of staff. There will also be improved delivery effectiveness, time saving and possible reduction in costs for the organization.

The potential savings by introducing logistics thinking is high for service industries. It is estimated that over 75% of the operating costs involve logistics activities (Arthur D. Little, 1991). The Figure 5.1 shows a traditional cost structure. The Prime costs are the cost that are directly related to production of a good or service, the Direct Material cost (including raw materials, semi finished and finished products) and Direct Labour costs (Labour that is directly dealing with customers in services). Overhead costs are costs related to supporting functions. These include Indirect Materials, Indirect Labour and Fixed and miscellaneous expenses. Indirect Material cost include for example packaging supplies and communication costs, cost occurring in operations but they are not directly tied to the end-product. Indirect Labour costs include salaries of those not working directly with production or dealing with customers. Fixed and miscellaneous expenses consist of depreciation costs, taxes, rents, insurance etc.

Prime cost and Overhead cost all form the cost of goods produced. It is also within this are savings in quality costs can be made.

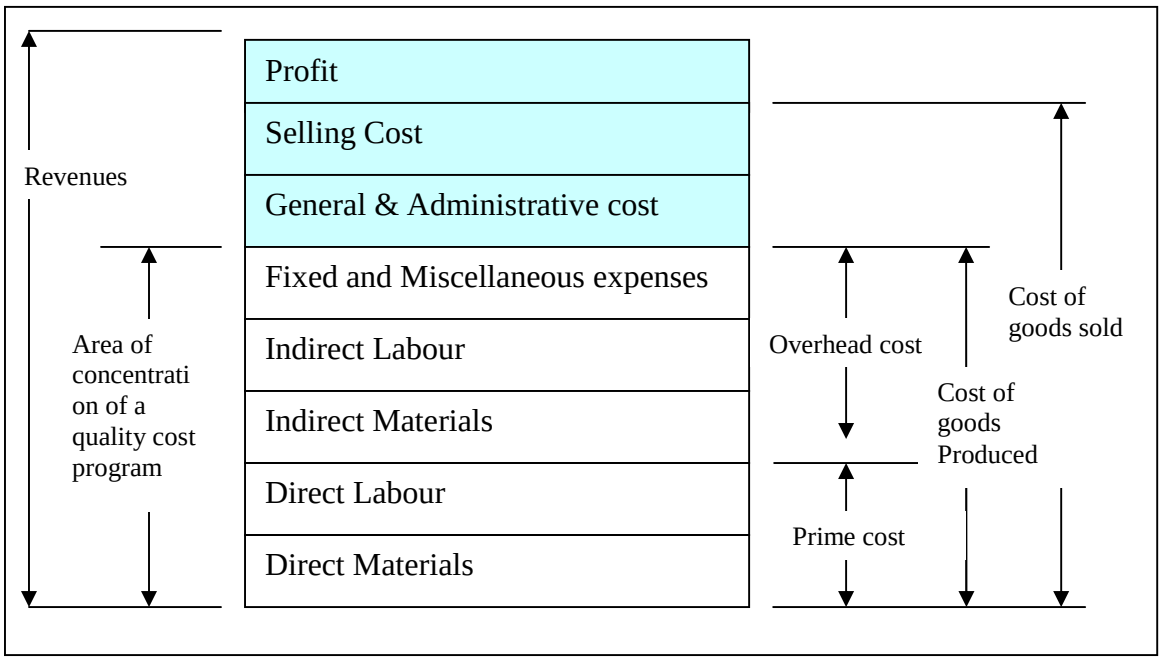


Figure 5.1: Traditional cost and Price structure[11]

The total Cost of goods sold includes Selling Costs (e.g. advertising, warehousing, and transportation) and General and Administrative costs (e.g. public relations, information systems). The Profit is finally the difference between the revenues and the cost of goods sold. The area for quality improvements is quite large and it is understandable that any reduction in the cost of quality would mean larger profit.

The labour cost range for services is estimated to be relatively high. Improvement in core process efficiency would mean savings in labour costs. Essential cost savings would be in the area of Quality or maybe it is better to say savings in the cost of poor quality. Poor quality can cost a lot for a company.

[11] Adapted from Principles of Quality Costs, Principles, Implementation and Use by Jack Campanella

In the picture below[12], the comparative cost of quality can be viewed.

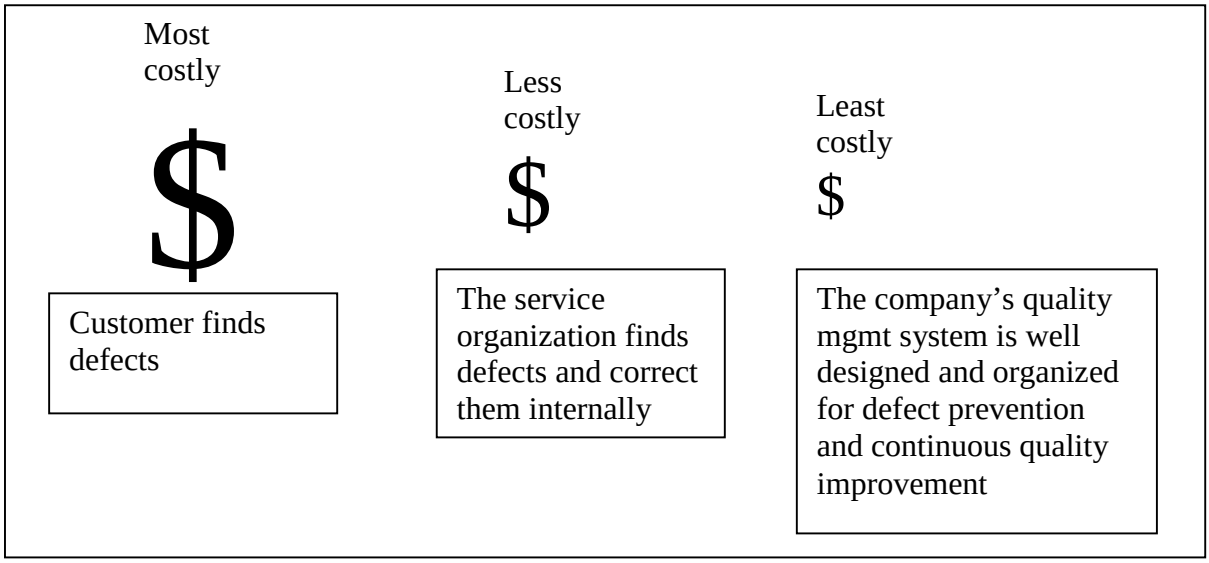


Figure 5.2: The comparative cost of Quality.

As illustrated the most costly is when the defect goes as far as to the customer. It would have been less costly if the service organization itself had found the defects through inspections and testing. The most desirable condition is to have quality programs that prevent defects to occur, like the techniques mentioned in chapter 3. The goal of the quality systems is to improve quality and reduce operating costs.

5.2. Definition of Quality Costs or Costs of Poor Quality

The quality costs can be defined as Jack Campanella wrote: "Quality costs represent the difference between the actual cost of a product or service and what the reduced cost would be if there were no possibilities of substandard service, failure of products, or defects in their manufacture".

In general the Quality costs can be divided into **Direct** and **Indirect** Costs. Direct costs can further be divided into **Controllable** costs and **Resultant** costs. Controllable quality costs are directly controlled by management and they include **Prevention** and **Appraisal** Costs. **Prevention costs** are costs of activities designed to prevent poor

[12] adapted from "Principles of Quality Costs" by Jack Campanella and Frank J.Corcoran,

quality, such as quality improvement projects, quality education and training and process capability evaluations. In the long run it is the most effective way to invest in prevention costs, even it is often seen as time consuming and expensive.

Appraisal costs are costs including activities like measuring and evaluating services to assure that they meet quality standards and performance requirements. Examples of these are; cost of normal test of service processes, service quality audits. Appraisal cost can also be of external type, like field performance evaluations. The service when the customer is helping themselves, for example by withdrawing money from a cash machine, field performance evaluations of these can be made.

Resultant costs include **Failure costs.** They are called resultant because they are directly related to management decisions made in the controllable category.

Failure costs can be of either internal or external type. Internal failure costs are costs occurring prior delivery to customer. Rework, re-inspections and retesting are examples of internal failure costs. External failure occurs after reaching customers. Examples of these are costs associated with processing customer complaints and returns and lost sales.

Controllable quality costs (Prevention costs + Appraisal costs**)**

+ Resultant Costs (Failure costs)

= Total Direct Quality Costs

While identifying quality costs there are a risk that only a portion of the costs are identified and then represented as a total. This is pretty normal for organizations, when some inefficiency is hidden and not measured they maintain an illusion of effective management. In the long-run they do themselves a disservice. Also when business is good there is a risk that there are fewer efforts to measure the costs of poor quality and to take actions to eliminate these causes. When making money you do not care how, instead you are just trying to make more. In the long run it may be

dangerous to ignore poor quality. In the picture below an iceberg of true failure costs is illustrated.

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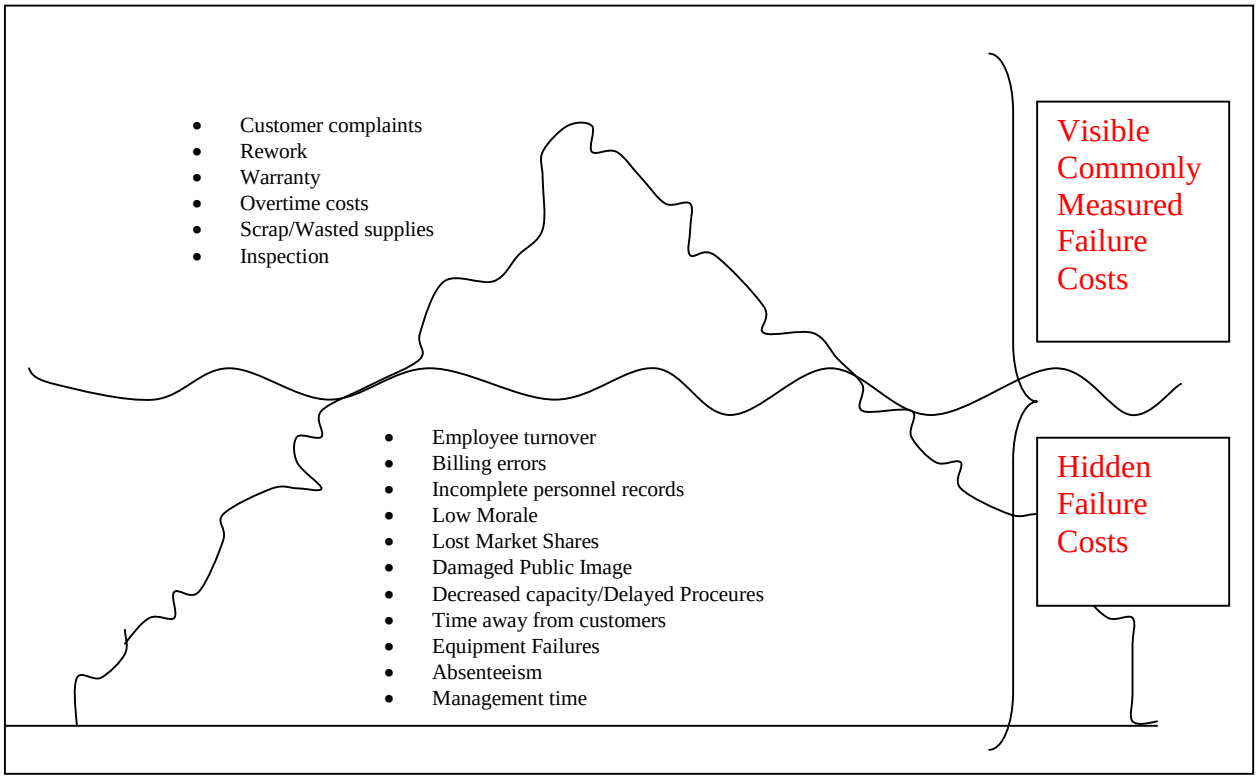

Figure 5.3: True Failure Costs

As can be viewed it is only the top of the iceberg that is visible, and these are the commonly measured failure costs, the Direct costs of poor quality. The major part of the failure costs are under the surface, hidden. These are the **Indirect Quality Costs** and are often ignored. What is important to remember is that is often these that are responsible for "sinking the ship".

It is difficult to put a value on the hidden costs but it is important to monitor them. Most of these are related to customer dissatisfaction with employee behaviour. The problem with this is that rumours are easily spread to other consumers. Dissatisfied customers tell others about their bad experiences, which can create a negative ripple effect. As already mentioned many studies show that if one customer has a bad experience, he/she will tell 9-10 people about it.

Even it is difficult to put an exact value on the hidden costs of poor quality Dr. Genichi Taguchi came up with a Quality Loss Function, QLF, for approximating hidden losses. The Quality Loss function can be used both internally, to provide motivation for own improvements, and externally, to motivate improvements to satisfy and keep customers. In the first case one has good knowledge of own “manufacturing” costs and can readily use the function. In the case of the benefit to an end user one can try to identify benefits from own knowledge of end use if this is sufficient or by asking the customer or by performing a bench marking to see where own competitors stand. The losses of concern are when a product’s/service’s quality characteristics deviates from its desired target value. The approach can be used for a product/service as well as for a process.

Quality is viewed as a step function as shown by the heavy line graph in the Figure 5.4.A product/service is either good or bad. This view assumes a product/service is good between LS, the lower specification and US, the upper specification. The vertical axis represents the degree of customer’s dissatisfaction of the product's/service’s performance. A and B stands for two different output distributions of two different providers during a certain time period. B has a higher fraction of "bad" performance (more variations) and therefore is less preferable than A.

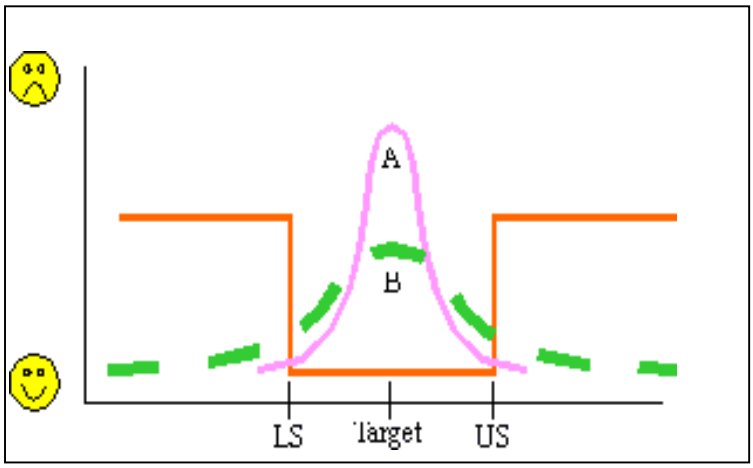

Figure 5.4: Variations of Customer Services A and B.

Taguchi means that the customer becomes **increasingly** dissatisfied as higher variations from the target occurs.

The QLF curve is quadratic, this means that loss increases by the square of the distance from the target value. The curve is centered on the target value, which provides the best performance in the eyes of the customer. Identifying the best value is not an easy task and targets are sometimes the designer's best guess.

LCT represents lower consumer tolerance and UCT represents upper consumer tolerance. Experts often define the consumer tolerance as the performance level where 50% of the consumers are dissatisfied.

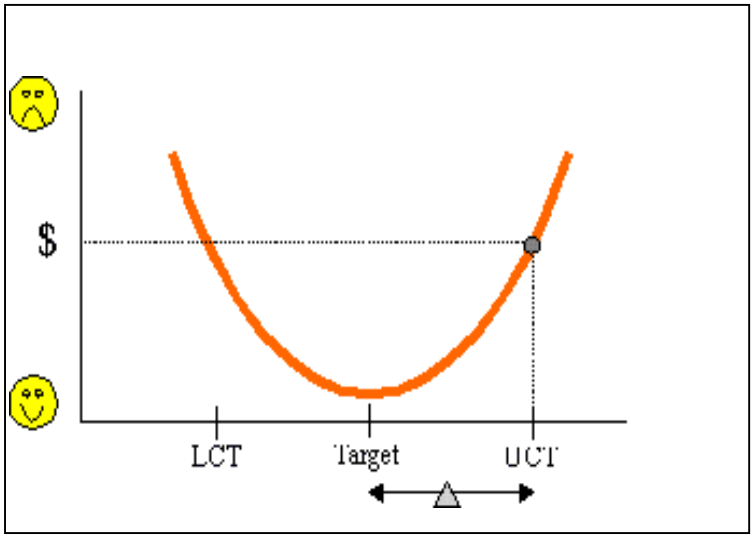

Figure 5.5: The Quadratic QLF curve.

The equation for average loss is:

$$L = k(y-T)^2$$

L = Loss in $

k = Cost coefficient = $/$\Delta^2$

y = value of quality characteristics

T = Target value

Most applications of the loss function in QFD can use a value of 1 for k since the constant would be the same for all competitors as it relates to the customer.

5.3. The Process-Cost Approach

Another quality cost approach is the **Process-cost Approach**. This looks mainly on costs for a process. The Process-cost approach divides the costs into *cost of conformance* and *costs of non-conformance*. Cost of conformance includes the cost associated with the activities to fulfil the needs of customers, without failure. Appraisal cost, Prevention cost and the normal costs associated with running a process, such as material, labour, Energy and overhead. Cost of non-conformance is the cost associated with failure of existing process, such as rework. When defining cost in this way more opportunities of reducing costs may happen within the conformance cost area than in the non-conformance. All the techniques mentioned in chapter 3, used for improving process may reduce cost of conformance activities. For example elimination of redundant tasks in a process, combination of process steps or finding process steps that may be done in parallel, introducing JIT can reduce Labour and overhead costs significantly. The process cost approach can be seen as not associated directly to quality, but by defining the costs in this way, many of the so called hidden quality costs can be found and eliminated. Complexity in processes and redundant steps can cause poor quality.

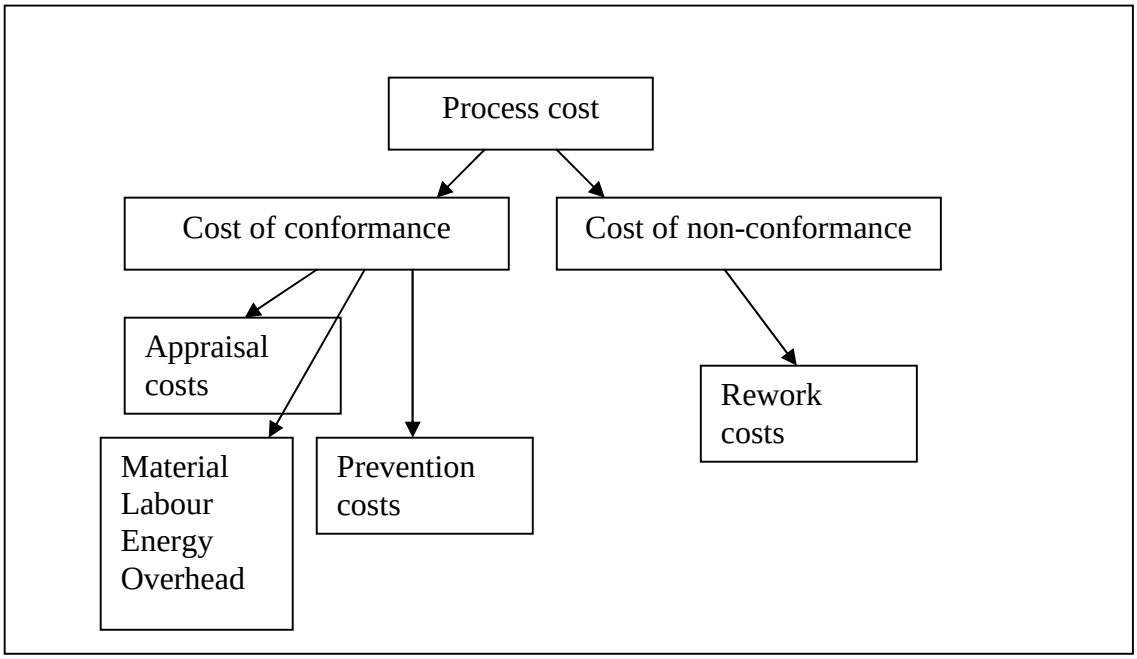

Figure 5.6: The Process Cost Approach.

5.4. Activity Based Costing

Traditional Costing systems allocate Overhead costs to products and use volume-related measures, resources are measured in proportion to number of units produced. In an organization there are anyhow many activities that are not related to the volume produced, like scheduling, inspection and purchasing. Traditional costing systems were designed for firms with a small range of products and low overhead costs. The limitations of the traditional cost system are that it tends to over-cost high-volume products and under-cost low-volume products. In 1998 Cooper and Kaplan started to talk about a more refined approach for assigning overhead to products and calculating product cost. This approach was called *ABC, Activity Based Costing* gives a better understanding of behaviour of overhead costs and what causes these and how they relate to products or services. This is also a tool for managing costs. ABC systems assume that activities cause costs and products demand activities. The following steps are included in the design of ABC:

1. Identify major steps that take place within an organization.
2. Create a cost centre (also called cost pool) for each activity.
3. Determine the cost driver for each major activity.
4. Assign the cost of activities to products according to the products demand for activities.

Below is a simple example of comparison of ABC with traditional costing systems.

Company SERVICE Ltd. Produces two services A and B. Same equipment and manpower are used for both, but volume of the service outputs differ. A is oflow volume and B of high volume.

	Direct Labour/output (hours)	Output	Total direct labour hours	No of set-ups	No of orders
Service A	0,25	10000	2500	40	1000
Service B	0,25	100000	25000	60	10000
			27500	100	11000

The **cost centre** costs are 900 000$ and divided between the cost centres as follows:

Output related	250000	
Purchasing related	300000	
Set-up related	350000	
	900000	

Traditional volume-based costing			
Cost-centre allocated costs		900000,00	
Overhead per direct Labour Hour		32,73	(900000/27500)
Cost per unit:	A	8,18	(0,25 direct labour hours X $32,73)
	B	8,18	
Total cost allocated to products:	A	81818,18	(10000x$8,18)
	B	818181,82	(100000x$8,18)

ABC system	Volume	**Activities related** Purchasing	Set-up
Cost traced to activities	250000	300000	350000
Consumption of activies	27500	11000	100
Cost per unit of consum.	9,09	27,27	3500,00
Cost traced to services:			
A	22727,27	27272,73	140000,00
B	227272,73	272727,27	210000,00

Cost per output:		
A	19	(22727,27+27272,73+140000,00)/10000outputs
B	7,1	(227272,73+272727,27+210000)/100000outputs

Figure 5.7: Comparison of ABC and traditional costing systems.

As can be viewed the cost per output is the same for A and B in the traditional system approach, while in ABC approach there is a significant difference between the high

volume B cost and low volume A. The quality cost methodology try to allocate quality related costs to specific activities, processes and departments, in order to reduce them. The use of ABC techniques is excellent for this purpose, because it is more detailed than traditional cost analysis. The advantages of using ABC in conjunction with quality cost analysis are the following:

- ABC enables to assign the overhead costs to responsible activity
- Many of the quality costs are within the overhead category. Especially the hidden ones. With ABC they can be assigned accurately
- When overhead costs are assigned properly, the calculation of poor quality changes and areas where quality improvement should occur are identified and can in turn impact investment decisions.
- Non-value added or redundant activities can be more easily identified and eliminated -> time and cost saving and improvement in quality.

D.W.Webster recommended a five-step process for using ABC to identify the costs of poor quality[13]:

1. Identify all activities (appraisal and prevention) and results(failures)
2. Determine the activity costs associated with these
3. Identify the benefits that benefit from prevention and appraisal activities and that cause the internal and external failures
4. Assign the Activity-Based Cost of quality as appropriate. Assign the cost of prevention and appraisal to the activities that benefit from these and assign the costs of failures to the activities identified as root causes.
5. Adjust the calculated costs of services to reflect these additional costs of quality

Using this approach helps to find the areas of improvement.

[13] adapted from Principles of Quality costs by Jack Campanella

6. Analysis and Recommendations

6.1. General

The service sector is the economy's biggest employer and makes up about 80 percent of the total economy. Investigations also show that it is growing all the time. Over 75% (Arthur D. Little, 1991) of the operational expenses seem to include logistics activities; this means that the potential of benefits and savings are enormous when having proper logistics management. Customer is the judge of quality and quality is the key to success for service companies. Reliability, timeliness, consistency, accuracy, convenience and responsiveness seem to be the adjectives a customer mostly relates with quality in the service sector.

The Process improvement techniques introduced are mostly aiming at quality improvements. All of them are good and an organization is not forced to chose one and follow that one slavishly. It is possible to combine these methods and adapt them to a particular service organization/department. For all services it is good to have some kind of a quality improvement program. The quality programs are good because they usually involve everybody within an organization. It is important that the improvements are measured and followed up. Incentives can be tied to quality and rewarded when quality is improved. This is especially recommendable in non-profit, public service organizations, where motivators sometimes are hard to find.

Benchmarking is good both in finding internal improvement areas and finding the competitive status of the company and areas of improvement in order to be more competitive.

Time is one of the most crucial decision factors in choosing service provider therefore time based competition and quick response thinking is important. ISO standards are good for showing consistency of an organization’s processes.

For the service industries the logistics functions can be divided into traditional Supply Chain Logistics and Service Response Logistics. While most of the services are tide to some kind of goods traditional Supply Chain Logistics exists, but it is not as important as Service Response Logistics. Service Response logistics involves coordination of non-material activities in order to reduce cycle times, manage capacity

and provide the service smoothly. IT plays an important role in the changing environment where customers are demanding more and more, quicker and quicker. IT enables quicker information flow and in services industries it also plays the role as an electronic distribution channel.

Applying logistics into Service Industries gives benefits for all parties involved, service providers and customers. Applying logistics means improved quality; more organized and coordinated process flows, reduced waiting times, closer distances to travel and savings in costs. While identifying costs of poor quality it is important to not only measure the visible costs. One has to dig under the surface to find the so called hidden costs of poor quality. Many of quality costs, especially the hidden ones are within the overhead costs. Activity Based Costing systems are good to understand behaviour of overhead costs and give an understanding what causes these. ABC means that activities cause costs. ABC assigns overhead cost to right activities and often identifies areas where quality improvement should occur. All in all we can say that applying logistics is beneficial and makes a happier customer and organization more profitable.

6.2. Healtcare

Hospitals are facing problems today due to many reasons. Biggest pressure lies in the area of increasing patient load, increasing operating costs, shortage of qualified healthcare staff and limitations in hospital facilities. Using some process improvement techniques and logistical thinking may relieve some of these pressures.

6.2.1. Useful Process Improvement Techniques

A suggestion is to use Constraint Management to identify and manage process constraints. As mentioned CM sees that every system has at least one constraint. When a patient is ill, any kind of waiting becomes a torture. By eliminating these kinds of delays, the patient can be discharged sooner and the customer satisfaction is increased. Also the throughput is increased which means some savings. By applying

Lean Healthcare to hospitals we mean to eliminate the mudas. In the graph below you can find examples of wastes, mudas, in health care.

The 7 Wastes – "Muda"	Examples in Healthcare
Overproduction	Unnecessary blood tests done to accomodate lab and personnel
Transportation	Too long travel distances required for patients to be tested/treated. Samples to be analyzed
Waiting	All kinds of waiting; Inpatients waiting in emergency department, waiting for testing and treatment, queing for discharge etc.
Processing	unnecessary paperwork, retesting, unnessecary moves of patients
Inventory	Lab samples waiting for analysis and lab results waiting for distribution
Motion	Looking for missing journals, sharing of equipment etc.
Defects	Retests, medication errors, wrong Procedure

Figure 6.1: The 7 "mudas", wastes of Hospitals.

These may seem quite obvious, but in most cases these obvious things have not been given a certain thought and when starting to analyze them, possibilities for improvement may be found. Some kind of quality improvement program is recommendable, TQM, TQS, as a continuous improvement program. It is important that clear measurements of these are performed and a good cure to keep up good quality is to have incentives tied to quality measurements. This motivates people to be involved.

External benchmarking, like competitive benchmarking, is beneficial when striving to be on the top among all the most competitive competitors within the field. Service forms, processes and costs can be analyzed and improved to be more competitive.

ISO standards can also be certified to hospitals. For example the ISO 14001, the environmental standards shows that a hospital has followed the standards for waste management, energy consumption and chemical management.

6.2.2. Supply Chain Logistics

For facility and location planning, a flow chart can be used as a tool to identify sequences of steps, combine steps if possible and then by analyzing these reduce the distance between steps. Manufacturing cells may be introduced in the form of patient focused healthcare. Same illnesses are treated in the same area, where special staff and equipment is available and unnecessary movements avoided.

For Inventories JIT thinking is the key to keep inventories down. Transportation in hospitals involves transportation of surgical, medical supplies between stocks and from stock to departments/units of hospitals, movement of medical records, x-rays, tests, food to patients and patient movement. A functional lay-out is essential for these to happen smoothly. High-tech solutions such as pneumatic tubes, conveyor belts can be invested in to ease the movement of x-rays, samples, tests, medical records etc. These demand though some investment capital.

Group purchasing keeps the purchasing down. Departments of hospital can go together or even many smaller hospitals can group together their purchases.

First impression is important from customer service point of view. In hospitals there should be enough parking spaces, the staff at admission should work in a friendly, efficient and pleasant way. Post-hospital services are seen as positive.

6.2.3. Service Response Logistics

Service Response Logistics should be applied to manage capacity, reduce cycle-times and provide the service smoothly. The recommendable cures for *managing capacity* include*:*

- Utilize time by letting patients take some simple tests (blood pressure, weight etc.) themselves while waiting
- Reservation systems should be utilized as much as possible

- Have nurses/doctors on on-call duty to meet peak demand
- Nurses can also be hired from companies hiring out staff
- Sharing of resources (doctors can be shared between hospitals) keeps cost down
- Cross-training of personnel enables people to help where most urgently needed

To reduce *cycle-times* and *provide the service smoothly* the distribution channels, how service is provided, and the operating hours have to be considered. Due to the fact that people are more occupied in recent days requires new forms of distribution channels and service availability. Service hours need to be expanded to 24 hour service and also the availability of walk-in clinics need to be considered. Telecommunication has offered a new electronic distribution channel for offering service. In healthcare this can be utilized by offering phone call service and internet services. Also post-hospital instructions etc. may be given via the electronically distribution channel.

Communication and clear flow of information should be pinpointed. This may in many cases reduce wait-times and make the service smoother.

Process simplification/Streamlining gives a good opportunity to reduce unnecessary steps combine steps or do them in parallel if possible, this in turn saves time.

IT should be utilized in order of speeding up registration/discharge processes, keeping track of patient records (medication, health history etc), keeping record of hospital inventories etc. Important is that the information systems used are user-friendly and courses are held so that staff can utilize it to the maximum.

If the logistics processes are not managed by high-level management it is recommendable that this is done and they are controlled by high level executives. This in order to be sure that the responsibility is clear and closely followed.

6.2.4. Cost Analysis & Saving Possibilities

When analysing the cost structure of European Hospitals (see Figure 6.2). It can be noticed that the hospitals have significant operating costs involving logistics processes and therefore the potential savings are big. For hospitals 57,5% involves Personnel costs, Overheads (taxes, rates, others) stands for 12,1% of the expenses. Materials Purchasing and handling (Medicines, Medical Durables and non-durables) represent 14,1%. This means that all theses expenses involving logistics accounts for more than 80% of the operating costs. Applying real figures of the economy of the service sector and seeing possibilities in savings in 80% of these costs will give us immense potential savings.

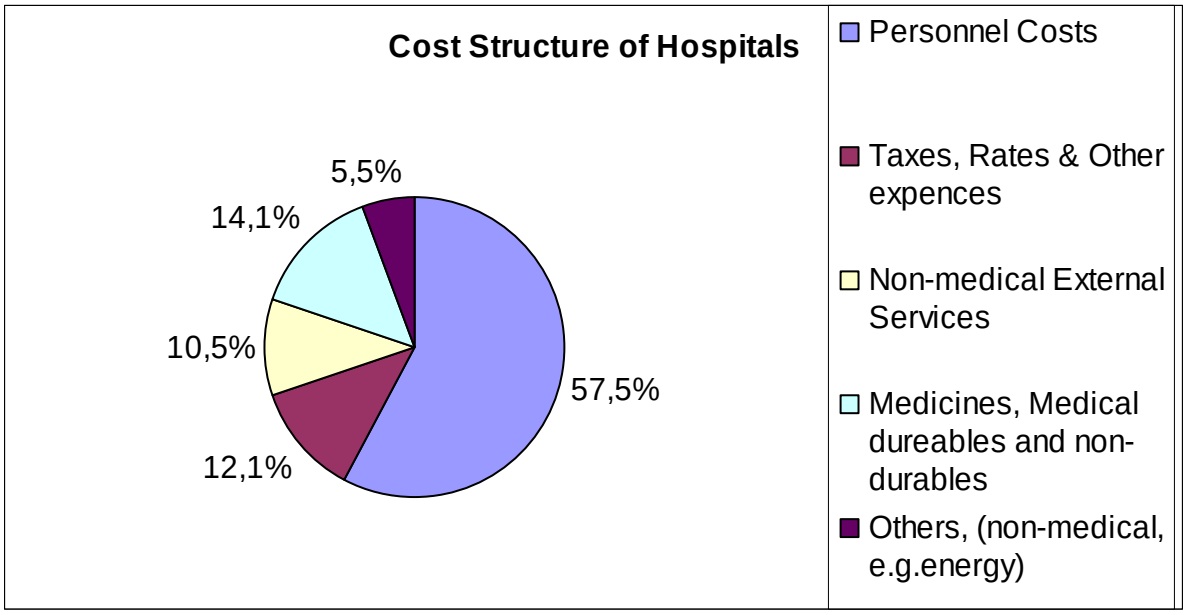

Figure 6.2: Cost Structures of European Hospitals (www.pharmig.or.at , 16.2.2004).

Activity Based Costing is more preferably than traditional Costing systems, in order to allocate the overhead costs to right activities and find areas of quality improvements. The so called hidden costs of poor quality are often among the overhead cost.

All in all it would be good for hospitals to have a small introduction course about logistics to all their staff and in the maybe have a brainstorming session where staff

can think about all the activities that can go under the category logistics. After that a small “improvement group” could be nominated and start working with it. This group should report to high-level executives about milestones and success. In many cases it is also good to have a “consultant” from outside to take a look at processes and help identifying bottlenecks and areas of possible improvement.

6.3. Education

Competition of educational institutes and especially universities is growing all the time. IT, and particularly the Internet has open new distribution channels for marketing and it is challengeable to keep up with the competition. The question is how to make our university the most attractive one. Regarding quality it is import for the educational institutes to be up to date with teaching material and relevant topics of today. Especially the universities should work closely together with the industry so that the graduating students are ready to fight with the hot topics in the real working life. Here we could talk about the logistics thinking of Quick Response. Universities should quickly adapt to the rapidly changing industry environments. In order to reach the quality, one quality improvement program could be introduced; one of the ones in Chapter 3 or a combination of some of them. Benchmarking is also good to keep a competitive place as an educational service provider. Improvements can be made in many areas involving logistics.

6.3.1. Supply Chain Logistics

When first taking a look at the traditional Supply Management functions we can see that location, lay-out and facility is important in the view point of convenience. The location of an educational institution can in some cases make the final decision of applying to one or another. The centre-of-gravity method can be useful when deciding on a location of the service point, location of a new one or moving of an old one in order to make it more attractive. Also the availability of public transportation to the

service point is important. In lay-out and facility logistics Manufacturing cells thinking can be applied so that every major have their own departments; Logistics department, chemical department, computer department etc. The lessons for a special major are all held closely to the particular department. If special equipment is needed, these are also closely available. In this way the travelling distance for the students and the professors teaching in the special topics are minimized. The common facilities should be located centrally to minimize distance for every one.

In purchasing and inventory issues group-purchasing should be made and vendors minimized to achieve volume discounts.

6.3.2. Service Response Logistics

From Service Response Logistics point of view peak demand can be handled effectively, distribution channels and operating hours can be expanded, processes simplified, information flow improved and of course cost saved by good logistics thinking. Peak demand can occur while there are ongoing exam periods. Professor may be busy in checking test, trying to teach at the same time and take care of all other working related issues. To handle this customers can do some work themselves, there are many clever students that could be hired as part-time teachers in some areas. A possibility is also to hire a visiting lecturer from the industry. In this way the students get a hot topic from the real life and the professor can concentrate on checking the test.

Many processes can most likely be simplified within education, like admission processes, graduation processes and other bureaucratic processes. Flow charts or precedence diagrams can be used to identify bottlenecks of processes. In many of these students can most probably take a more active role themselves. Admission processes and choosing of subject process can be simplified by letting students do as much “work” as possible themselves. This requires a user-friendly information system and clear instructions, but it will save time for the students and the possible administrator working with this.

Within educational institutions it is important that communication and information is clear and readily available to avoid unnecessary waist of time in spending on phone calls or extra visits to information points. The internet is a good tool to provide all necessary information. For example on the institutions homepage there could be all kind of information available, from general information, student's grades to dates of exams etc.

E-learning is gaining an edge and could be utilized by "normal" universities as well. This could also give them an image of a trendy university and make them more attractive.

E-learning actually gives opportunity to share resources and save money in that way. What is recommendable is that some courses are offered to be taken via internet and the final exam for example is written at the university. Similar departments at many different universities, offering the same courses could go together and develop this idea. They could share the resources in that way that they have one internet tutor for each subject, who is employed as responsible of answering questions, checking exercises etc. Many universities could utilize one professor to "keep the course". There could also be open discussion forums related to the topic. This would be beneficial for the students, they could execute the course at the time that suites them the best.

6.3.3. Cost Analysis & Saving Possibilities

Education is the one of the biggest employer within the service sector, in US for example it is the 6th biggest and a lot of money is involved (http://www.guidetobceconomy.org/ , 17.2.2004).

Studying the cost structure of Swedish School of Economics and Business Administration (Figure 6.3.) it can be noticed that approximately 65% goes to personnel expenses. The other costs that may include logistical processes are "Material Purchasing", standing for 3% and some costs within the category "Others", which represent 15%. Studies of other Scandinavian Universities cost structures give similar figures. With these numbers estimation can be made that 75-80% of

operational expenses may include logistical processes. Knowing that Education is one of the biggest employers within the service sector it means possibilities for some savings.

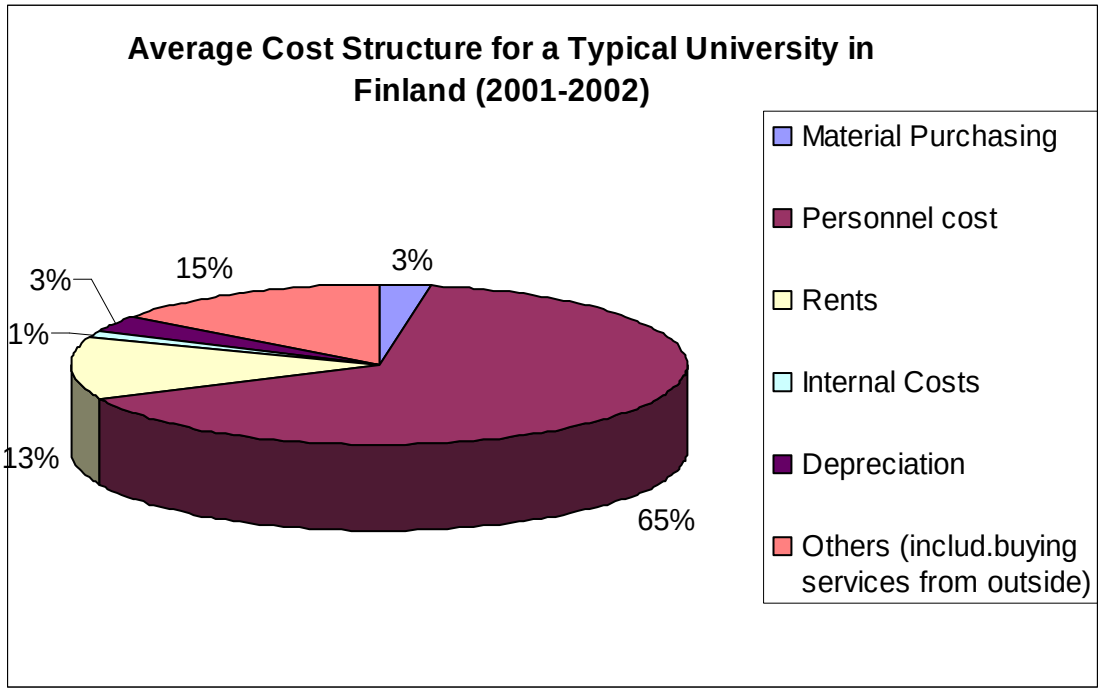

Figure 6.3: Cost Structure of a University in Finland.

Activity Based Costing could be used instead of the traditional costing system. In this way hidden quality costs can be found more easily.

As a conclusion I suggest a brainstorming sessions for students and staff, where possible areas of improvement can be found. An improvement team can be given responsibility to see that this is completed. E-learning is definite recommendable tool for marketing and educational distribution channel. Here the possibilities of savings in personnel costs can be found. Otherwise it can be quite hard to reduce the costs by introducing logistics thinking. But the comfort benefits for students and staff will be noticeable.

7. Conclusions

7.1. The method

I was really interested in this topic after Professor Ali suggested it to me and I decided that I wanted to go deeper into it. In the beginning there was a small frustration due to the difficulties in finding material directly related to the topic. It seems that this topic has not given too much investigation effort earlier or not many much are available. The fact that this dissertation is written in English and most of the literature at the libraries in Ulsan and Pusan are in Korean language, also limited the searching to some extent. After finding literature via Internet and ordering books it took quite a long time to receive them. I collected literature about Logistics Management, Service Marketing and Management and Quality Management and then started to investigate which of the Logistics functions related to Manufacturing are applicable to Services and how. The way of investigating this way was a little bit tough and time consuming but at the same times a learned a lot, especially about importance of Quality and the psychology behind customer service. The design of logistics solutions was not too difficult. After receiving ideas from books, professionals and having brainstorming sessions with friends working within different areas I think I ended up with pretty many solutions. After all you just need to go to yourself and think what you demand as customer in different situation. Human beings usually act the same ways. The Cost Analysis part was the most challengeable for me, when I have not much experience from this field.

7.2. My work

As a whole I think I gathered most of the Logistics techniques and solutions applicable in the service industries. The Process Improvement techniques introduced are all based on theories available. The Logistical solutions mentioned are both taken from literatures and developed as an outcome from brainstorming sessions with students and friends. Open brainstorming sessions are surprisingly good for coming up with different ideas and solutions and this especially helped me to think a little bit

broader than I did before. Without contribution of Professionals and inventive friends I would not have made this project. I would like to show my gratitude especially to the following Professionals:

- My Supervisor Professor Nam, for being helpful, being great support and giving feedback and inputs.
- Professor Ali, for being great support and giving ideas, especially in the beginning of the project.
- Anders Lindgren and Sirpa Möller at DNV for giving hints and contact names.
- Pekka Aaltonen at Logistiikan Koulutuskeskus in Finland and Professor Anita Lukka for providing me literature hints and the Research reports about Value added Logistical Support Service.
- Professor Aimo Inkiläinen for his inputs.
- Lic.tech.Henry Ericsson, Director of Industrial Management Programme at Arcada for his ideas.
- Researcher Johan Sandnäs for his help with the cost structures.
- And Council of Logistics Management (USA), European Logistics Association and Logistics Association of Australia for giving hint about literature findings, research findings and contacts.

The limitations of the project were as with many projects the time. The project started in the middle of November and a dead line for it was set to beginning of March. The cost analysis could have been made in more detail, with more investigations and real figures if the time would have allowed it.

It was also hard to find literature directly related to the topic. Theories about the Process Improvement Techniques were easy to find but getting literature related to the Logistical solutions were trickier. For further reading I would recommend the references at the end, especially Managing Quality in The Service Sector, Improving Service Quality, Principles of Service Marketing and Management, Principles of Quality Costs and Logistics in Service Industries (made for the Council of Logistics Management).

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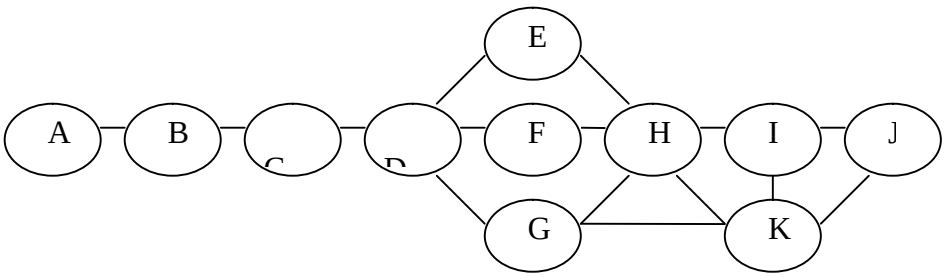
[14] Competing Through Supply Chain Management, page 78
[15] Principles of Quality Costs
[16] Logistics in Service Industries, page 54

Appendix 1: Work plan for my dissertation

In the table below the work breakdown structure, most likely durations and precedence relationships for my dissertation can be viewed.

	Activity	Most likely Duration (weeks)	Immediate Predecessors
A	Identification of Project	1	-
B	Document Study Task & Methodology	1	A
C	Gathering of Literature	2	A,B
D	Analysis of literature	3	C
E	Contact with Professionals	2	D
F	Investigation of Case Studies	2	D
G	Study of Different Process Improvement Techniques	2	D
H	Design of Alternative Logistics Solutions	2	D,E,F,G
I	Cost Analysis	2	H
J	Recommendations	1	I
K	Feed-back of Supervisor	1	J
L	Finishing Report	1	G,H,I,J,K

Predecence Diagram



Content of the different activities:

A. Identification of Project:
   - Professor Mohamed Ali came up with the idea of the project and after some investigations on data availability I decided I wanted to give it a try. My supervisor Professor Nam was also optimistic to the idea. Identification happened in the middle of November.

B. Document Study Task & Methodology
   - The study task to be documented and Methodology of study identified.

C. Gathering of Literature
   - Search for existing Literature of the topic. Gathering of Literature about Logistics, Service Industries in general, Quality Management, Marketing Management and Cost management to have as basis for the theories in the project. Order books if needed. Internet search.

D. Analysis of Literature
   - A quick analysis of the Literature has to be made to have some basic knowledge about the topic before contacting the Professionals. Especially topics mentioning the Service Industry in particular has to be studied. Analysis of Literature continues the whole way of the project as well as the internet search.

E. Contact with Professionals
   - Professionals within Logistics and Quality Management to be contacted to get new hints and ideas about the topic.
     Following organizations / persons contacts:
     - Aimo Inkiläinen, Professor in Logistics, Kauppakorkeakoulu Finland
     - Anders Lindgren, Det Norske Veritas (DNV)

- Anita Lukka, Professor at Lappeenrannan teknillinen yliopisto
- Council of Logistics Management (USA)
- European Logistics Association
- Logistics Association of Australia
- Lic.tech.Henry Ericsson, Director of Industrial Management Programme at Arcada (Swedish Institute of Technology, Espoo)
- Johan Sandnäs, Researcher at Svenska Handelshögskolan i Vasa (Swedish School of Economics and Business Administration).
- Pekka Aaltonen, Logistiikan koulutuskeskus, Finland
- Sirpa Möller, Det Norske Veritas (DNV)

F. Investigation of Case Studies

- Case studies of Logistics within Service Business to be investigated.

G. Study of Different Process Improvement Techniques

- Theories of Process Improvement Techniques to be studied in order to understand possibilities of improvements and finding suitable techniques for the Service Industries.

H. Design of Alternative Logistics Solutions

- Alternative Logistics Solutions to be found after studying Literature, discussing with Professionals, students and friends and investigating the case studies.

I. Cost Analysis

- After the Logistics Solutions are made an analysis of cost can follow.

J. Recommendations

- General conclusions and recommendations for hospitals, educational institutions and Service departments in general.

K. Feed-back from Supervisor

- Supervisor Professor Nam reads through the first version of the dissertation and gives feed-back so possible changes and improvements can be made.

L. Finishing Report

- Report can be finished when feed-back is received. Report can hopefully be completely finished before end of March 2004.

Appendix 2: Evolution of Supply Chain Management

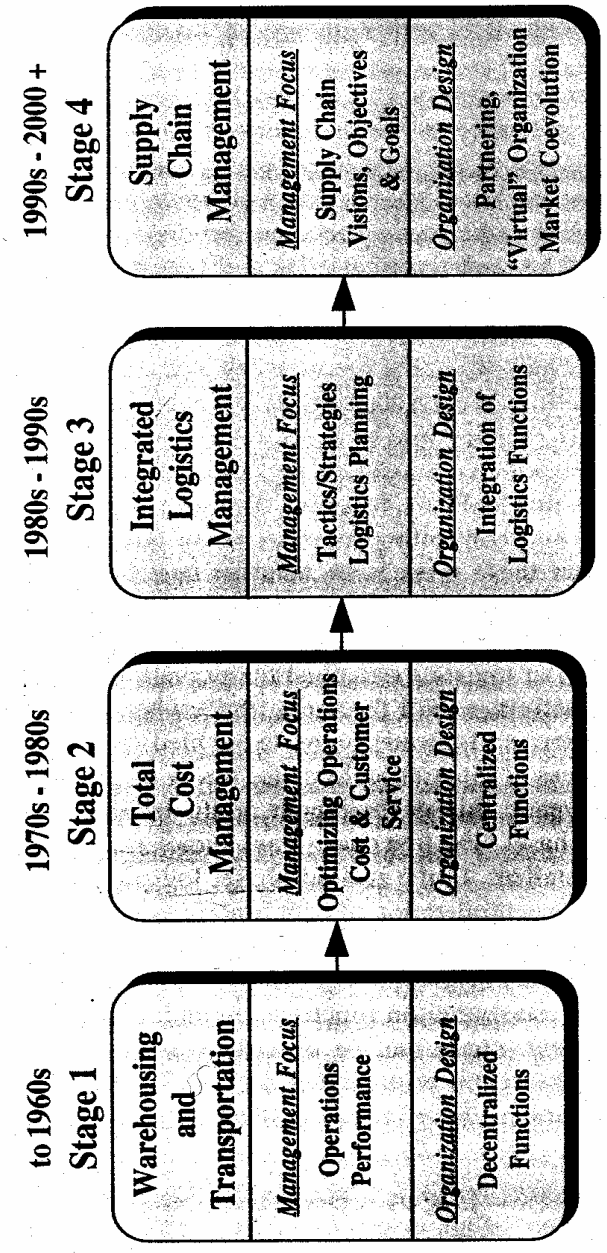


Figure 3.1. Four management stages.

Appendix 3: Evolution of Total Quality Service

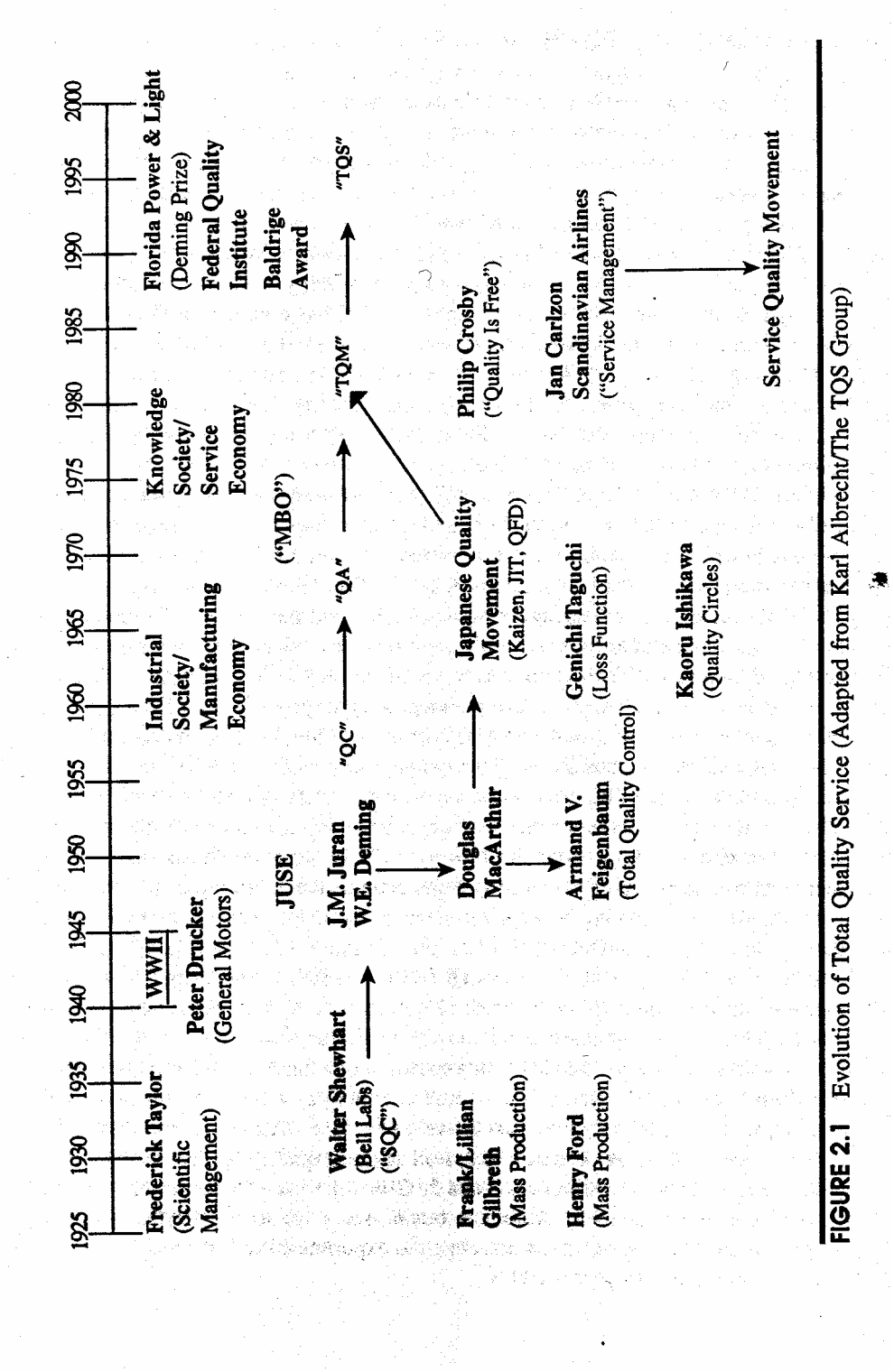


FIGURE 2.1 Evolution of Total Quality Service (Adapted from Karl Albrecht/The TQS Group)

Appendix 4: The Eternally Successful Organization Grid

THE ETERNALLY SUCCESSFUL ORGANIZATION GRID

	Comatose	Intensive care	Progressive care	Healing	Wellness
Quality	Nobody does anything right around here. *Price of Non-conformance = 33%*	We finally have a list of customer complaints. *Price of Non-conformance = 28%*	We are beginning a Quality Improvement Process. *Price of Non-conformance = 20%*	Customer complaints are practically gone. *Price of Non-conformance = 13%*	People do things right the first time routinely. *Price of Non-conformance = 3%*
Growth	Nothing ever changes. *Return after tax = nil*	We bought a turkey. *Return after tax = nil*	The new product isn't too bad. *Return after tax = 3%*	The new group is growing well. *Return after tax = 7%*	Growth is profitable and steady. *Return after tax = 12%*
Customers	Nobody ever orders twice. *Customer complaints on orders = 63%*	Customers don't know what they want. *Customer complaints on orders = 54%*	We are working with customers. *Customer complaints on orders = 26%*	We are making many defect-free deliveries. *Customer complaints on orders = 9%*	Customers' needs are anticipated. *Customer complaints on orders = 0%*

The Eternally Successful Organization Grid (continued)

	Comatose	Intensive care	Progressive care	Healing	Wellness
Change	Nothing ever changes. *Changes controlled by Systems Integrity = 0%*	Nobody ever tells anyone anything. *Changes controlled by Systems Integrity = 2%*	We need to know what is happening. *Changes controlled by Systems Integrity = 55%*	There is no reason for anyone to be surprised. *Changes controlled by Systems Integrity = 85%*	Change is planned and managed. *Changes controlled by Systems Integrity = 100%*
Employees	This place is a little better than not working. *Employee turnover = 65%*	Human Resources has been told to help employees. *Employee turnover = 45%*	Error Cause Removal programs have been started. *Employee turnover = 40%*	Career path evaluations are implemented now. *Employee turnover = 7%*	People are proud to work here. *Employee turnover = 2%*

Source: Philip B. Crosby, *Quality Is Free: The Art of Making Quality Certain,* New York: McGraw-Hill, 1979, p. 31.

Appendix 5: Detailed Quality Cost Element Summary

1.0	**PREVENTION COSTS**	2.0	**APPRAISAL COSTS**
1.1	Marketing/Customer/User	2.1	Purchasing Appraisal Costs
1.1.1	Marketing Research	2.1.1	Receiving or Incoming Inspections and Tests
1.1.2	Customer/User Perception Surveys/Clinics	2.1.2	Measurement Equipment
1.1.3	Contract/Document Review	2.1.3	Qualification of Supplier Product
1.2	Product/Service/Design Development	2.1.4	Source Inspection and Control Programs
1.2.1	Design Quality Progress Reviews	2.2	Operations (Manufacturing or Service) Appraisal Costs
1.2.2	Design Support Activities	2.2.1	Planned Operations Inspections, Tests, Audits
1.2.3	Product Design Qualification Test	2.2.1.1	Checking Labor
1.2.4	Service Design—Qualification	2.2.1.2	Product or Service Quality Audits
1.2.5	Field Trials	2.2.1.3	Inspection and Test Materials
1.3	Purchasing Prevention Costs	2.2.2	Set-Up Inspections and Tests
1.3.1	Supplier Reviews	2.2.3	Special Tests (Manufacturing)
1.3.2	Supplier Rating	2.2.4	Process Control Measurements
1.3.3	Purchase Order Tech Data Reviews	2.2.5	Laboratory Support
1.3.4	Supplier Quality Planning	2.2.6	Measurement (Inspection and Test) Equipment
1.4	Operations (Manufacturing or Service) Prevention Costs	2.2.6.1	Depreciation Allowances
1.4.1	Operations Process Validation	2.2.6.2	Measurement Equipment Expenses
1.4.2	Operations Quality Planning	2.2.6.3	Maintenance and Calibration Labor
1.4.2.1	Design and Development of Quality Measurement and Control Equipment	2.2.7	Outside Endorsements and Certifications
1.4.3	Operations Support Quality Planning	2.3	External Appraisal Costs
1.4.4	Operator Quality Education	2.3.1	Field Performance Evaluation
1.4.5	Operator SPC/Process Control	2.3.2	Special Product Evaluations
1.5	Quality Administration	2.3.3	Evaluation of Field Stock and Spare Parts
1.5.1	Administrative Salaries	2.4	Review of Test and Inspection Data
1.5.2	Administrative Expenses	2.5	Miscellaneous Quality Evaluations
1.5.3	Quality Program Planning		
1.5.4	Quality Performance Reporting		
1.5.5	Quality Education		
1.5.6	Quality Improvement		
1.5.7	Quality System Audits		
1.6	Other Prevention Costs		

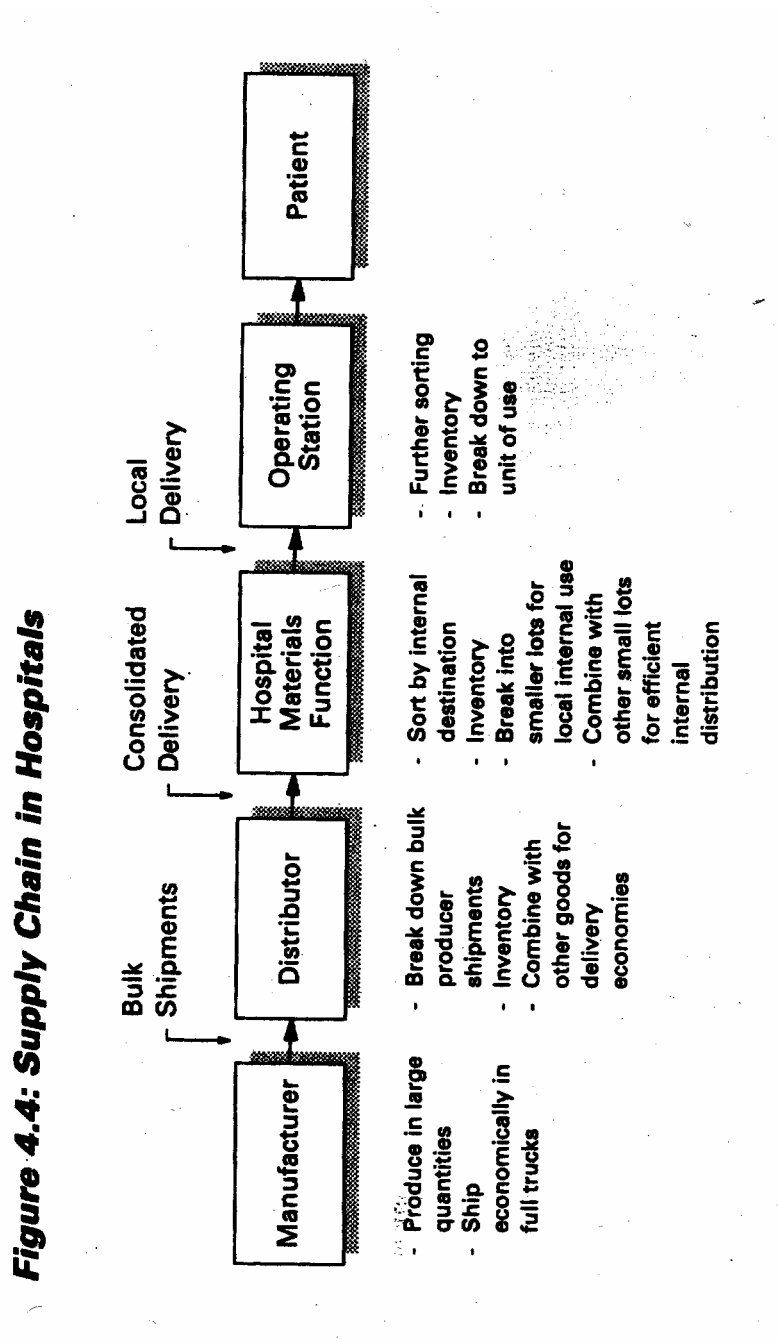
Figure B.1. Detailed quality cost element summary.

3.0	**INTERNAL FAILURE COSTS**
3.1	Product/Service Design Failure Costs (Internal)
3.1.1	Design Corrective Action
3.1.2	Rework Due to Design Changes
3.1.3	Scrap Due to Design Changes
3.1.4	Production Liaison Costs
3.2	Purchasing Failure Costs
3.2.1	Purchased Material Reject Disposition Costs
3.2.2	Purchased Material Replacement Costs
3.2.3	Supplier Corrective Action
3.2.4	Rework of Supplier Rejects
3.2.5	Uncontrolled Material Losses
3.3	Operations (Product or Service) Failure Costs
3.3.1	Material Review and Corrective Action Costs
3.3.1.1	Disposition Costs
3.3.1.2	Troubleshooting or Failure Analysis Costs (Operations)
3.3.1.3	Investigation Support Costs
3.3.1.4	Operations Corrective Action
3.3.2	Operations Rework and Repair Costs
3.3.2.1	Rework
3.3.2.2	Repair
3.3.3	Reinspection/Retest Costs
3.3.4	Extra Operations
3.3.5	Scrap Costs (Operations)
3.3.6	Downgraded End-Product or Service
3.3.7	Internal Failure Labor Losses
3.4	Other Internal Failure Costs

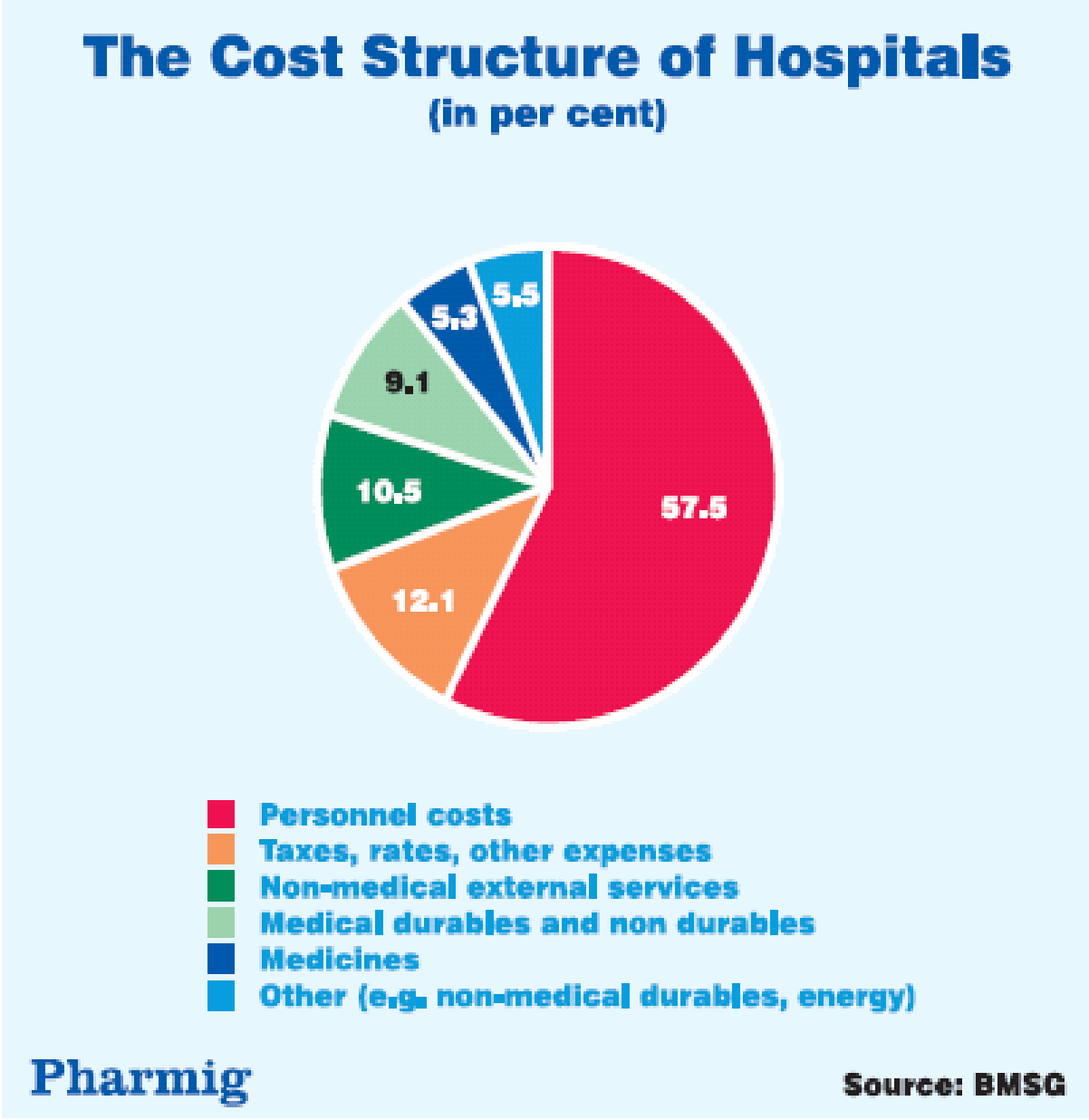
4.0	**EXTERNAL FAILURE COSTS**
4.1	Complaint Investigations/Customer or User Service
4.2	Returned Goods
4.3	Retrofit Costs
4.3.1	Recall Costs
4.4	Warranty Claims
4.5	Liability Costs
4.6	Penalties
4.7	Customer/User Goodwill
4.8	Lost Sales
4.9	Other External Failure Costs

Figure B.1. *(continued).*

Appendix 6: Supply Chain in Hospitals



Appendix 7: Cost Structure of Hospitals[17]



[17] www.pharmig.or.at (16.2.2004),

Appendix 8: Employment rate and GDP% of the Service Sector in Canada[18]

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Services sector (1999 data)	Employment	% of total employment	GDP ($1992 million)	% of total GDP
Retail & wholesale trade	347,9	18.2	11,518	12.5
Health & social services	197,6	10.4	6,284	6.8
Business services	170	8.9	5,438	5.9
Accommodation & food	153,9	8.1	3,54	3.8
Other services	152,6	8.0	4,295	4.7
Education	123,9	6.5	5,677	6.2
Finance, insurance, real estate	106,3	5.6	17,881	19.4
Government services	90,9	4.8	5,108	5.6
Transportation & storage	90,1	4.7	5,567	6.1
Communication	45,7	2.4	3,297	3.6
Total, services sector	**1,478,900**	**77.6**	**68,606**	**74.6**
Total, goods sector	427,5	22.4	23,359	25.4
Total, all industries	1,906,400	100.0	91,965	100.0

[18] http://www.guidetobceconomy.org/ (17.2.2004)

Appendix 9: Cost structure for Swedish School of Economics and Business Administration[19].

Kostnader för verksamheten

Material, förnödenheter och varor	-385 040,70	-389 645,88
Personalkostnader	-8 955 745,61	-8 989 795,96
Hyror	-1 763 807,41	-1 697 290,12
Inköp av tjänster	-1 337 021,63	-1 325 585,13
Övriga kostnader	-682 951,86	-720 710,38
Avskrivningar	-497 872.77	-415 517,56
Interna kostnader	-159 148,22	-177 401,32
Kostnader för verksamheten totalt	**-13 781 588.20**	**-13 715 946,35**

Handelshögskolan	**2002**	**2001**	**% of total** 2002	**% of total** 2001
Material	385041	389646	2,79%	2,84%
Personal	8955746	8989796	64,98%	65,54%
Hyror	1763807	1697290	12,80%	12,37%
Inköp av tjänster	1337022	1325585	9,70%	9,66%
övriga	682952	720710	4,96%	5,25%
Avskrivningar	497873	415518	3,61%	3,03%
Interna kostnader	159148	177401	1,15%	1,29%
	13781589	13715946		

Källa: www.hanken.fi

SUMMARY(Swedish School of Economics and Business Administration)	
Material Purchasing	3%
Personnel cost	65%
Rents	13%
Internal Costs	1%
Depreciation	3%
Others (includ.buying services from outside)	15%

[19] www.hanken.fi/hanken/documents/verksamhet-bokslut-2002b.pdf