# Analysis and Measurement of the hidden elements in the quality cost by using (AHP) approach and its effect on achieving the company's competitive advantage

## (Case study from Egypt)

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## Abstract

**The purpose of this study**: Analysis and measurement the hidden elements in the quality cost to control and decrease this hidden elements, to achieve the company's competitive advantage and applied it's on the case study from Egyptian firm.

**In order to achieve the study objectives:** We examined the quality cost elements (direct and hidden) in the October Pharma company for medicines and medical supplies - 6th of October City – Egypt , by using Analytic Hierarchy Process (AHP) approach, through Personal interviews with managers and employees and distribute questionnaires to them, to identify the quality cost elements ( direct and hidden) during the production phase and beyond, then analyze the hidden elements in the cost of quality according to its importance to measure the extent of its impact on the total cost of quality in order to achieve the company's competitive advantage.

**The results of the study :** the results in this study indicate that the hidden elements in this company represent a large percentage of the total cost of quality, which requires the company to control and manage it in a good way to reduce it, in order to reduce the cost of quality and then reduce the total cost of products and achieve the company's competitive advantage.

**Depending on this**: this study recommended the necessity of studying all the hidden elements of the quality cost in other Egypt firms with the aim of controlling it to reduce the total cost of quality and improve the company's competitive advantage in the market through reducing customer dissatisfaction and retain them and improve quality and reduce the cost of product.

**Keywords:** The hidden elements , The cost of quality, The company's competitive advantage , Analytic Hierarchy Process (AHP) approach .

# تحليل وقياس العناصر الخفية في تكلفة الجودة بأستخدام مدخل (AHP)

# وتأثيرها علي تحقيق الميزة التنافسية للشركة (دراسة حالة من مصر )

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## ملخص الدراسة

**الغرض من هذه الدراسة** : هو تحليل وقياس العناصر الخفية في تكلفة الجودة لضبط وتقليل هذه العناصر بهدف تحقيق الميزة التنافسية للشركة مع تحليل وقياس هذه العناصر في شركة مصرية .

**من أجل تحقيق أهداف الدراسة** ، قمنا بفحص وقياس عناصر تكلفة الجودة (المباشرة والخفية) في شركة أكتوبر فارما للأدوية والمستلزمات الطبية - مدينة السادس من أكتوبر - مصر ، باستخدام مدخل التسلسل الهرمي التحليلي (AHP) ، من خلال المقابلات الشخصية مع المديرين والموظفين وتوزيع الاستبيانات عليهم ، للتعرف على عناصر تكلفة الجودة (المباشرة والخفية) خلال مرحلة الإنتاج وما بعدها ، ثم تحليل العناصر الخفية في تكلفة الجودة حسب أهميتها لقياس مدى تأثيرها على التكلفة الإجمالية للجودة من أجل تحقيق الميزة التنافسية للشركة.

**نتائج الدراسة :** تشير نتائج هذه الدراسة إلى أن العناصر الخفية في هذه الشركة تمثل نسبة كبيرة من التكلفة الإجمالية للجودة الأمر الذي يتطلب من الشركة التحكم فيها وإدارتها بطريقة جيدة للحد منها ، وذلك بهدف تقليل تكلفة الجودة ومن ثم تقليل التكلفة الإجمالية للمنتجات وتحقيق الميزة التنافسية للشركة.

**وبناءً على ذلك**: أوصت هذه الدراسة بضرورة دراسة جميع العناصر الخفية لتكلفة الجودة في الشركات المصرية الأخرى بهدف السيطرة عليها لتخفيض تكلفة الجودة ومن ثم تخفيض التكلفة الأجمالية للمنتجات ،وبالتالي تحسين المركز التنافسي للشركات في السوق من خلال تقليل عدم رضاء العملاء و الاحتفاظ بهم وتحسين الجودة وتقليل تكلفة المنتج.


**الكلمات الأفتتاحية** : العناصرالخفية لتكلفة الجودة ، تكلفة الجودة ، الميزة التنافسية للشركة ، مدخل التسلسل الهرمي التحليلي (AHP).

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**Analysis and Measurement of the hidden elements in the quality cost**

**by using (AHP) approach and its effect on achieving the company's competitive advantage (Case study from Egypt)**

## 1-Theoretical Framework

### 1-1 : Introduction and research problem

The Quality has become the key strategy to survive in the highly competitive and customer-driven market which demands highest quality at lower price, and industrial experts are keen on exploring the possibilities of quality management with cost reduction opportunities. The need to improve an organization's financial position directly correlates with the process of making and measuring quality improvements (Zulnaidi, Y. ,2010).

Also, The quality costs represent a large part of total costs, taking about 30 % (Wu et al., 2011). where Reducing of quality costs allows reducing of total costs that would result in reducing of price of goods or services supplied and increase of customers' satisfaction and improved firm performance Thus achieving a competitive advantage for the company .

Over the last years , some studies about the understanding of quality cost concept has developed ( Omar, M. K., & Murgan, S., 2014), where Earlier models were having production oriented point of view, taking only costs of deviations from specification into account The area has become wider with the additional dimensions added to the term quality (Suthummanon, S., & Sirivongpaisal, N., 2011). Also, traditional quality was accepted cost models based on the Prevention-Appraisal-Failure cost categories (P-A-F) are widely accepted by the quality practitioners (Wang et al, 2010) even with their limitations that they are confined within the tangible and directly measurable costs only and are failed to address many of the cost areas (Luther R.2011) such as lost sales, loss of customer good-will, loss due to low morale of work force etc. (Snieska, V, 2013). Many of the cost elements were not identified, quantified or analyzed further in this approach (Jafari, A., & Rodchua, S., 2014) and do not adequately evaluate the invisible or hidden quality related activities.

Some studies shows that the analytical of quality cost elements methods are still limited to Apparent (direct) costs of the traditional Prevention-Appraisal-

Failure (PAF) model even though the strengths and capabilities of latest models in overcoming the limitations of ( PAF), where modern methods is well esteemed by academic community(Schiffaura- 2006).

Some studies (Rajeev Trehan et al., 2015) indicate to Cost of Quality analysis is emerged as an effective tool for the industrial managers for pinpointing the deficiencies in the system as well as for identifying the improvement areas by highlighting the cost reduction opportunities. However, this analysis will be fully effective only if it is further extended to identify the cost incurred in ensuring quality including the hidden costs and costs of missed out opportunities, where most of the hidden elements of quality costs are difficult to track and not getting accounted by the traditional accounting tools. .

Currently , companies are aiming at TQM status as an objective of continuous improvement of the quality of goods and services ,but there are no practical and comprehensive studies to identify and quantify the costs incurred in such quality improvement programs especially measuring the hidden elements in the quality cost.

The study of (Yathish Kumar, 2020 ) indicated that cost of quality management system acts as the most significant tool in measuring, controlling and decision making activities in a firm which aims on business excellence , also ,A big task for most companies today is to tackle the inadequacy of most cost accounting systems in addressing quality costs and in supplying appropriate data in a suitable format that considers total cost including the hidden cost of quality.

The research of (Wilson Vanderlei costa souse et al., 2018) demonstrates how proper management of intellectual capital can improve the management of hidden costs in public entities, providing the concept of intellectual capital and hidden costs and exploiting the existing intellectual capital measurement models.

The study of (Amar Murumkar et al., 2018), see that prevention, appraisal and failure are not the only quality costs, but there are other hidden costs must be identified.

Also ,the study of (A. Sailaja et al., 2015 ) handled the hidden elements of quality costs in manufacturing industry. Where the identified cost elements are classified into various groups for better analysis and, prioritized to identify the vital few among them, Analytic Hierarchy Process (AHP) approach which is one of the most popular Multi Criteria Decision Method (MCDM) and Pareto analysis were used in the study for prioritizing the hidden quality cost elements based on their degree of impact on overall cost of quality. By this analysis, the key cost

elements which are to be addressed to reduce the overall cost of quality ,where Hidden costs of quality represent a large percentage of the quality costs total (Shubhangan Modhiya et al., 2016), which makes it of great importance for companies to achieve a competitive advantage in the industrial field by producing high quality products at low cost and expanding their market share by increasing sales and achieving satisfaction of customer, Which is reflected in achieving the competitive advantage of the company.

The study of (Biswajit Mahanty, 2012) also indicated that cost of quality (COQ) analysis is an effective tool for the company for pinpointing the deficiencies in the cost system as well as for identifying the improvement areas by giving a clear insight to the cost reduction opportunities in terms of monitory benefits. The analysis will be effective only if the hidden costs, including opportunity losses, also are measured and quantified.

Due to the practical difficulties in measurement and analysis of hidden cost elements, most of the firms usually focus only on addressing the tangible and easily retrievable costs and hence achieving the intended result of quality improvements with less incurred cost, But this treatment did not take the total of quality costs due to the presence of hidden cost elements that were not measured and addressed(Amar Murumkar et al., 2018 ).

The study of (Shanshan, S. ,2013) indicated to analyzing and measurement of hidden quality costs is essential for a complete measure of losses due to poor performance and it would disappear entirely if every activity were performed without deficiency every time .

In spite of the academic interest of measuring and analyzing of hidden cost In developed countries , There are no Arab studies, especially in Egypt, that have dealt with this subject, which gives great importance to this research .

Hence, my research, will be an attempt to analyze cost of quality in a broader sense by tracing all the hidden elements of costs incurred in one of the Egyptian companies to ensuring the quality of each and every function associated with manufacturing process , Where become an analysis and measurement of the hidden cost elements is essential for a complete picture of quality costs.

Therefore ,the research problem is to show analyzing and measuring the hidden cost of quality can contribute to decreasing quality costs and achieving the competitive advantage of the company .

However, both of the accounting literature and firms' practice still are having questions of how to calculate all constituents of quality costs including hidden cost to maximal benefit from the system of accounting of quality costs.

Therefore , this study will discussion about the problems of calculating the hidden cost of quality , where there is a severe lack of accounting studies to calculate the hidden cost of quality( especially in Egypt) and its reflection on the total costs of the company to achieving the competitive advantage, besides a review of accounting literature on quality costs accounting models ,and discussed the studies performed by other authors as suggesting how to calculate hidden costs ,In case a study in Egyptian firm.

In light of the above ,the research problem can be presented in terms of the following questions :

1-What is the nature and importance of studying the hidden costs of quality for companies?

2- Does the hidden elements of the quality cost affect the total cost of quality?.

2-1:- Does the hidden cost elements influence on the prevention costs and reduce the firm's defective production cost?

2-2: Does the hidden cost elements influence on the internal failure cost and improve the quality of the firm's products?

2-3: Does the hidden cost elements affect the external failure cost an opportunity cost?

3-Does the reduction of the quality cost support the firm's competitive - advantage?

**1-2 : The research aims**

The research aims to achieve the following objectives :

- Analyzing and measuring the hidden elements of quality cost through a case study of an Egyptian company.

- Analysis of impact of hidden cost on total quality cost.

-Assisting firms in controlling the hidden cost elements in order to reduce them to face the strong competition facing the firm.

-Raising awareness of the firm's leaders with importance of analyzing and measuring the hidden elements of quality cost to reduce the production cost total and achieve firm's competitive advantage.

**1-3 : The research Objectives**

The objective of this study is to classify and measure all the hidden cost elements (direct, indirect and invisible elements) of quality costs in the firm under study, where the importance of such an analysis is ascertained by measure the impacts of hidden costs on the overall quality cost , where this study attempts to examine the impact of the hidden cost elements on reduction of the quality cost , an then increasing the competitive advantage of the company. The main objectives of this study are as follows :

-Comprehensive analysis of various hidden elements of Quality Costs and its classification.

-Ascertaining the degree of importance of each hidden cost element and identification of most significant elements in reducing the overall quality cost.

**1-4 :The research Methodology**

The research methodology adopted is as follows:

Personal interviews and discussions conducted with the managers and employees for analyzing the activities which controls and ensures quality of processes( product quality and delivery). the details on quality improvement activities, quality deviations and insufficiencies in procedures in meeting customer requirements and the costs associated with each of them are identified. Missed out opportunities in each process heading to losses were also identify and critically analyzed to find out all the associated quality cost elements. These cost elements are then grouped into direct and hidden quality cost category , and using the Analytic Hierarchy Process(AHP) techniques to ascertain the degree of importance of each hidden element and is prioritized based on their impact on controlling overall Cost of Quality, to identify the elements vital few among them.

## 1-5 : The research plan

The rest of this study is organized as follows**:**

2- Literature review and hypothesis development

3-Analyze and measure the hidden elements in the quality cost .

4-Case study from Egyptian company .

5- The Conclusions and Recommendations.

6- The References.

## 2- Literature review

There are some of previous studies that deal with the Analyze and measure of the hidden cost and its impact on total quality cost and the reflection on the competitive advantage of the company, the most important of which are:

The study of ((Yathish Kumar, et al., 2020 ) on titled (Quality Costs and its impact on competitive advantages in Manufacturing Industries ) focused on many industrial companies on quality costs ,Since it play an important and sensitive role among competitive companies .So, when these institutions control these costs more accurately, they may be able to stay in the competitive market for a longer period.

The results of the study show that there is no uniform definition of the costs of quality in the scientific literature .

Industrial organizations should separate quality costs from total costs to improve quality and thereby achieve better financial results.

Industrial organizations should consider the costs associated with quality especially hidden costs, being the only ones able to keep these organizations survival for a longer period of time under intense competition.

The study of (Wilson Vanderlei costa souse et al., 2018 ) titled (The contribution of intellectual capital management to minimize the hidden costs in public administration) showed this research demonstrates how proper management of intellectual capital can improve the management of hidden

costs in public entities, providing the concept of intellectual capital and hidden costs and exploiting the existing intellectual capital measurement models, especially the Queiroz model (2003).

This research presents a case study at the Fluminense Federal University Niterói (Brazil) with the application of a questionnaire based on the Queiroz model, in order to highlight the contribution that the management of intellectual capital can provide as an auxiliary tool in the detection, prevention and administration of the hidden costs.

The study of (Amar Murumkar et al., 2018 ) , the objective of this study is to give a survey of research literature and models on the topic of COQ and to provide a basic understanding of quality costs. This study addresses the need by first refining the traditional 'Prevention-Appraisal-Failure' (PAF) categories of quality costs and hidden costs. where this study proposed that prevention, appraisal and failure are not the only quality costs, therefore the company should identify such invisible quality costs to reduce customer dissatisfaction and retain them.

The study of (Shubhangan Modhiya et al., 2016) handle "A Review on Cost of Quality Methodology and Hidden Costs in Manufacturing Industries" where showed the inadequacy of most cost-accounting systems in addressing quality costs and in supplying appropriate data in a suitable format that considers total cost.

The study also addresses these needs by first refining the traditional 'Prevention–Appraisal–Failure' (PAF) categories of quality costs and hidden costs through the definition and addition of two new categories: 'extra resultant cost' and 'estimated hidden cost'. This study aims at discussing COQ as a great IE technique in modern day industrial scenario to improve quality and reduce the cost of product simultaneously .

Also, The study of ( P C Basak ,et al. ,2016 ) titled (Costs of Quality: Exploratory Analysis of Hidden Elements and Prioritization using Analytic Hierarchy Process ) showed the analysis of quality costs will be fully effective only if it is further extended to identify the cost incurred in ensuring quality in all areas of the supply chain including the hidden costs and costs of missed out opportunities ,where most of the hidden elements of quality costs are difficult to track and not getting accounted by the traditional accounting tools ,so the analysis is made in this research to identify the hidden elements of quality costs

The study of (A.Sailaja ,et al. ,2015) handle "HIDDEN COSTS OF QUALITY "where showed that the management accounting have an important role in the measurement and control of the components of manufacturing costs. where quality improvement programs for attaining continual improvements have become essential to any business organization

to thrive forward profitably with enhancement in its custom base. Cost of quality analysis is considered as one of the most effective management tool for gathering and analyzing the expenses in maintaining quality in a manufacturing process and also identifies the non-value added expenses.

The study of (Christian Bach et al., 2014) on titled (Quality As Competitive Advantage) showed that the quality has become a target for most organizations in the United States and most firms have spent millions of dollars on quality activities in order to reach defect-free productions , where this study aims also to discover how quality becomes a competitive advantage in different organizations.

The study of (Vytautas Snieska et al., 2014 ) on titled (Hidden Costs in the Evaluation of Quality Failure Costs ) showed the Reducing of quality costs allows reducing of total organizational costs that would result in reducing of price of goods manufactured or services supplied, increase of customers' satisfaction and improved organization performance Organizations that have prepared the programs of quality costs accounting adapted to their specific activity and paying more attention to implementation of quality programs, Also, optimization of quality costs is a condition necessary to survive in the market.

Both of the scientific literature and enterprises' practice still are having questions of how to calculate all constituents of categories of quality costs in details in striving for maximal benefit from the system of accounting of quality costs. .

From the previous studies, the researcher notes that there is no study dealing with the effect of measuring the hidden elements on reducing the costs of quality and its reflection on achieving competitive advantage, as all of these studies are in developed countries and there are no Arab studies on this subject , which gives this study great importance especially in the Egyptian environment.

## 3- Analyzing and measurement the hidden cost elements

## 3-1 : The quality and the hidden costs

Cost of quality or quality costs in a broader sense is the expenditures incurred by an firm in achieving and maintaining good quality as well as in handling poor quality throughout its line of operations with an aim to achieve highest level of customer satisfaction.

The cost of quality analysis causes changes and provide proof why changes should be made. The need to enhance the financial position of an firm directly correlates with the process of making quality enhancements. Also cost of poor quality will tend to zero, if every activities are performed well in time.

Some studies were pointed out the requirement of analyzing all elements of quality costs to make ideal decisions that leads to competitive advantages in the highly customer driven current market (Teli, S.N., et al., 2018). So, according to the American Society for Quality Control (ASQC), quality costs are a measure of costs specifically associated with the achievement or non-achievement of product or service quality, as defined by all product or service requirements established by the company and its contracts with customers and society(Ming-Tzong,et al., 2010).

If an organization does not consider to hidden quality cost they will face with direct and indirect cost resulting from remanufacturing or lost customer respectively, so organizations try to reduce these costs where cost reduction will be impossible if they are not Identify hidden costs causes , measured and managed properly. .

In order to improve quality an organization, it must take into account the costs associated with achieving quality including hidden cost , since the objective of continuous improvement programs is not only to meet customer requirements, but also to do it at the lowest cost. This can only happen by reducing the costs needed to achieve quality, and the reduction of these costs is only possible if they are identified and measured, therefore measuring and reporting the cost of quality including hidden cost should be considered an important issue for managers .

The measurement of COQ can trigger faster action on improvement because it shows the wastage in terms of monetary loss, This means that the

upper management will be more anxious to reduce this amount, so All types of organizations should immediately venture into measuring the COQ as it is directly linked to profitability .

Most organizations are confused about the costs figure of doing business.
It is time for them to realize that many hidden costs of quality are associated with the total costs . So, every organization must take the initiative to identify all the hidden costs and if it contributes to poor quality then actions should be taken to eliminate it (Haimanti Bhattacharya et al., 2020) .

Providing firm management with visible evidence of both obvious and hidden quality related costs can be valuable for improving performance. The idea of measuring is not always easy. This is because the culture of an organization itself can be a major obstacle. Standard costs systems usually institutionalize waste by relating it to a pre-established standard. A certain percentage of rejects may be considered necessary in a production process and as long these figures are not exceeded (Snieska , Vytautas et al., 2013 ).
Also,Measuring the quality cost in the industry is very important and useful, where It helps to identify the specific quality levels and ultimately improves the quality (Chopra and Garg, 2011).

The study of (Sailaja A et al., 2015) indicated the categorization of Quality , according the follow table :

Table(1) shows categorization of Quality

| The quality of costs | | | | |
|---|---|---|---|---|
| The tangible costs | | | | The intangible costs |
| The prevention costs, | The appraisal costs | The failure costs | | -Lost current sales<br>-Lost future sales<br>-Lost to society |
| E.G. | E.G. | Internal e.g. | External e.g. | |
| -Internal audit generation<br>–validations<br>-approvals education &training<br>-area line clearances | -retests<br>-MIS | -Rework<br>-Deviation<br>-Expired products | -rodent damage<br>-glass bottle breakages<br>-customer complaint | |

While the study of (Shubhangan Modhiya et al., 2016 ) classified the total cost of quality , according to the following table:

Table (2) The classified the total cost of quality

| Total Cost of Quality | | |
|---|---|---|
| 1- Cost of Conformance (COC) include | 2-Cost of Non- Conformance (CONC)- Include | 3-Opportunity Costs (OC) Include |
| A-Direct cost of (PC and AC)<br>B-Hidden cost of(PC and AC) | A-Direct cost of (IFC and EFC)<br>B-Hidden cost of (IFC and EFC | (A-Direct cost of (IFC and EFC<br>B-Hidden cost of (IFC and EFC |

Note : Prevention Costs(PC), Appraisal Costs(AC), Internal Failure Costs(IFC), External Failure Costs (EFC)

Also, the study of ( Ming-Tzong et al., , 2010) indicated to various approaches to measuring Cost of Quality(COQ ) , as follow:

Table( 3 ) Quality cost measurement models

| **Generic model** | **Cost/activity categories** |
|---|---|
| P-A-F models | Prevention + appraisal + failure |
| Crosby's model | Prevention + appraisal + failure + opportunity |
| Opportunity or intangible cost models | Conformance + non-conformance + opportunity Tangibles + intangibles P-A-F (failure cost includes opportunity cost) |
| Process cost models | Conformance + non-conformance |
| ABC models | Value-added + non-value-added |

## 3-2 :Hidden elements of the Quality Cost

The term 'hidden' cost (or 'invisible' cost) is used to indicate failure costs that are inadequately recorded in company accounts and/or failure costs that are never actually discovered. Such 'hidden' costs might be manifested as extra manufacturing costs as a result of defects or as additional costs for materials, machining time, and inventory space for scrapped and reworked parts (Snieska Vytautas et al. ,2013) used the term 'indirect PQC' (Poor Quality Costs) and stated that these had three components:

-Customer-incurred costs (costs due to the failure of the product to meet customers' expectations).

-Customer-dissatisfaction costs (which are difficult to quantify

-Loss of reputation costs (also difficult to quantify).

Such hidden quality costs can be significant. Indeed have asserted that they might amount to 10–15% of turnover, and suggested that they could constitute up to 10% of actual production costs. Some researchers also

estimated that the hidden quality costs are more than three times of the visible costs (Wilson Vanderlei et al., 2018).

Amar Murumkar et al.(2019) attributes the emergence of the hidden costs of a lack of accuracy of costing systems chosen by companies. Each method has its level of precision and detail that lead to the omission of various costs, hiding them.

In another work, Freiesleben et al (2007) address the hidden costs as a result of the complex interaction between two groups of variables that interact permanently: the company structures and human behavior.

The study of (Soo-Jin Cheah,2011 ) added the 'hidden' costs can be enormous, such as lower contribution margins from loss of customers and indirect labour costs go unrecognized because they are not measured or reported . Hidden costs of poor Quality times the visible costs. Unfortunately, many business decisions are still made only based on the information from the visible costs only.

Also , the study of (Suresh Kumer Kirshnan, 2019) indicate to the we should focus in on the hidden failure costs, It is clear that Profit = Revenue - Cost of doing Business but the issue that many people ignore is that the cost of doing business consist of the hidden failure costs besides the visible failure costs. This hidden failure costs is not usually added into the operational costs because of the difficulties in quantifying such costs. In a survey of Indian firms, it was found that 48% of respondents measured COQ manufacturing but only 41% of these used all four (Appraisal, Prevention, Internal and External Failure) cost categories (Arvind Chopra et al, 2012),where Arvind analyzed the reasons given by firms for not reporting COQ. He discovered that, problems with creating a parallel register for collecting quality costs from existing cost information system (46 %) was the major reason, followed by lack of support from management for collecting quality costs (22 %), manufacturing complexity (20 %) and finally the lack of awareness of the concept of quality costs (12 %),and the most significant result to come from his research was that hidden cost data was not exclusively used in calculation of COQ. He also found that firms relied heavily on estimates of apparent cost data in preparation of cost quality reports.

Although they cannot be easily measured of hidden cost , that it exist, , where include deterioration of the company's reputation, loss of customers,

project delays, increased overheads and liability payments.

It is concluded that a traditional accounting system is inadequate to meet the need of tracking quality costs, where Most researchers agree that the magnitude of the hidden quality costs is just too big to be ignored The importance of the manufacturing loss and design loss is made clear if we consider how large they are. They are more than three times the traditional quality costs, and they represent a figure around 30% of the company's throughput. If we take into account that the company concerned has already reached a very high level in quality costing, so Manufacturing loss and design loss are too large to ignore them (Snieska Vytautaset al., 2013), Also discuss ( Arman Sadreddin et.al .,2014) ) the value of customer loyalty and suggests that the loss of repeat sales from dissatisfied, customers or the inability to win new customers because of unfavorable word-of-mouth publicity is the most important yet least known aspect of quality costs. He further also thinks that companies must somehow understand their customer loyalty situation in order to make sound quality management decisions. A company that cares about its long-term performance and reputation must consider the hidden costs as if they were as tangible as the measurable costs (Amar Murumkar et al., 2019). A significant portion of hidden quality costs termed an(opportunity loss).

Gary Cockins (2006) has explained the trouble in measuring intangible costs( hidden costs), as Yang (2008) attempted to quantify lost sales as assessed hidden cost, Soo-Jin Chea (2011) presented an action research study of tracking hidden quality costs in a manufacturing process with a focus on the struggle of employees towards implementation of COQ system, also the significance of tracking and congregation hidden quality cost data were explained by Freiesleben and Suresh Krishna(2010).

Even though these studies were well esteemed by the quality practitioners, but not much practical studies found available in the literature with inclusive data collection and analysis of all costs including hidden costs experienced against all quality improvement activities in the firm, where this applied studies handle apparent costs of quality only (Soo-JinChea,(2011).

Also, Ashish J. Deshmukh et al., (2014)made an attempt to investigation to unveil all hidden quality costs including opportunity costs right from the customer obligation analysis to after delivery support.

To emphasize the importance of studying the hidden cost ,You've probably heard of the 80/20 principle. It says: Roughly 80% of the effects come from 20% of the causes. For instance, 80% of your sales come from 20% of your clients or 80% of the quality costs may come from 20% of the hidden cost.

Finally, these are the ideas that should be always remembered by anyone interested in quality improvement, according to Manuel E.et al., (2008),
-If we can define the hidden cost , we can measure it.
-If we can measure the hidden cost , we can analyze it.
-If we can analyze the hidden cost , we can control it.
-If we can control the hidden cost , we can lower it.

From the previous studies , the researcher conclude that studies handling the hidden costs of quality are limited and referred to the definition of hidden cost and its implications without addressing its measurement through actual data hidden costs in the industrial process , Also, there are a few studies are in place on opportunity costs also.

### 3-3 : Using the Analytical Hierarchy Process (AHP) of measurement the effects of hidden cost on the quality costs.

Analytical Hierarchy Process (AHP) is widely accepted technique (Brunnelli M., 2015) used for multi criteria decision-making, in which the relevant factors of a decision are arranged in a hierarchic structure and decisions are arrived based on paired comparison of expert's opinions on each criterion. It is very popular due to its simplicity, ease of use and flexibility (Munir R. et al., 2011) and a very reliable tool to facilitate systematic and logical decision-making process and determine the significance of a set of criteria and sub criteria(Bhatt, R. et al.,2010 ).

The study of (Brunnelli M., 2015) handled the Basic components of AHP are (1) breaking down a complex, unstructured situation into its component parts; (2) arranging these parts, or variables into a hierarchic order; (3) assigning numerical values to subjective judgments on the relative importance of each variable; and (4) synthesizing the judgments to determine which variables have the highest priority and should be acted upon to influence the outcome of the situation .

The AHP determines the preferences among the set of criteria in each level of a hierarchy by employing pair-wise comparisons of these criteria with respect to their impact to a criteria in the next higher level. Starting at the top of the hierarchy and working down, a number of square matrices called preference matrices are created in the process of comparing criteria at a given level. Judgments of preference are made on pairs of criteria in the structure using Saaty's scale of AHP (Saaty T. 2012 ).

In an industrial situation which focuses on result oriented objectives, elaborative and time consuming analysis of non-significant hidden cost elements is not practically advisable. Hence the most significant cost elements which are vital in controlling the overall costs of quality need to be identified so that the industrial managers can effectively focus on analysis of only these vital elements for further improvements in quality and cost reduction ( Sailaja A. et al., 2015) .

The Analytic Hierarchy Process (AHP), introduced by (Saaty T.,2012), which is one of the most popular MCDM techniques, is used for prioritization of hidden cost elements. Where the reason behind the selection of AHP lies in the fact that it can handle the objective as well as subjective factors and the criteria weights and alternative scores are elicited through the formation of pairwise comparison matrix. The advantages of AHP over other multi criteria methods are its flexibility, intuitive appeal to the decision makers, and its ability to check inconsistencies , While providing a useful mechanism for checking the consistency of the evaluation measures and alternatives, also (AHP) reduces bias in decision-making. .

When people do not measure the poor quality cost (PQC) relating to input, the ongoing process and also the output of an activity, they will assume that all the costs that occur is the costs of doing business. Unfortunately this is not true at all. In real life there are many things that happen without expectation. Such problems and interruptions should always be identified for immediate elimination. If it is left unattended, then it will form a culture that tolerates to waste. Of course this occurs in much traditional management. Many occurrences of failure events , It may lead to different types of hidden costs such as:

- Costs of redesign due to quality reasons.

-Potential lost sales.

- Costs of changing manufacturing processes due to inability to meet quality requirements.

- Costs of software changes due to quality reasons.

-Costs included in standard because history shows that a certain level of defects in inevitable and allowances should be included in standards .

-Extra manufacturing costs due to defects. This includes additional costs for space, inventory changes and overtime.

- Scrap not reported.

8-Excess process costs for acceptable product.

- Cost of errors made in support operations such as order filling, production control and etc.

The study of (Suresh Kumar Krishnan , 2006 ) indicate to that only the costs that are visible is always taken into consideration when talking about quality costs, but there are more hidden costs that can and should be identified, Also the Previous studies in this field are limited to a few dimensions of hidden quality costs in the manufacturing process (Cheah, S. J. et al .,2011) .

The study of (Brunnelli M., 2015) handled Significance of Prioritization of

Hidden Cost Elements in industrial situation which focuses on result oriented objectives, elaborative and time consuming analysis of non-significant cost elements is not practically advisable. Hence the most significant hidden cost elements which are vital in controlling the overall costs of quality need to be identified so that the industrial managers can effectively focus on analysis of only these vital elements for further improvements in quality and cost reduction( Aruldoss, M., et al 2013).

### 3-4 : The quality cost and the Comparative advantage

Many previous studies which investigated quality cost discussed the definition and classification of quality costs into categories, Some of them developed quality cost categories into models; each model had its features. Also, some studies investigated quality cost models and classified them in

groups (Castillo-Villar et al., 2012) .

However, the newly inventions in the industrial age impose many developments in management accounting (Obied-Allah et al., , 2016) , However in management accounting literature, there are very few studies investigating the relationship between quality costs and competitive advantage .

Even though the quality is now considered to be a critical success factor for achieving competitiveness, the cost of the quality approach is not fully appreciated by organizations ( Christian Bach et al., 2016). Therefore, the objective of any quality improvement program should be to find the level of quality that minimizes the total cost of quality (Vaxevanidis and Petropoulos, 2009).

According to (Obied-Allah et al., , 2016) , combination of three elements is key to product market success. They include the product costs, the product quality and the time required for its development. Therefore, any serious attempt to improve quality must consider all the costs associated with achieving quality. so, Quality hidden costing is an increasingly important issue in the debate over quality, where Quality costs can help to quantify specific quality levels and achieving competitiveness of the company.

Recently, many industrial companies have focused on quality costs

playing an important and sensitive role among competitive companies.

So, when these institutions control these costs more accurately, they may be able to stay in the competitive market for a longer period. So, Industrial organizations should consider the costs associated with quality, being the only ones able to keep these organizations survival for a longer period of time under intense competition(Mukhtar Che Ali, 2017) .

A firm's ability to produce a good or service more efficiently than its competitors, which leads to greater profit margins, creates a comparative

advantage, Also, reduction of cost and efficient internal systems, can also create a comparative advantage. Comparative advantage does not imply a better product or service, though. It only shows the firm can offer a product or service of the same value at a lower price.

Therefore, from the perspective of strategic management, it is recommended that the hidden costs are identified, sorted and evaluated individually and jointly, checking for effective management requirements on them(Suresh Kumar K.,2010 ) , where measure the hidden cost and control it, reduce the quality costs and hence lowers production costs and thus increases the firm's competitive advantage.

Also, competitive advantage refers to factors that allow a company to produce goods or services better or more cheaply than its rivals. These factors allow the productive entity to generate more sales or superior margins compared to its market rivals .

Competitive advantages are attributed to a variety of factors including cost structure, branding, the quality of product offerings, the distribution network, intellectual property, and customer service.

Competitive advantages can be broken down into comparative advantages and differential advantages ( Christian Bach et al., 2016) .
- Comparative advantage is a company's ability to produce product with cost lower and higher quality, which leads to greater profit margins.
-A differential advantage is when a company's products are seen as both unique and higher quality, relative to those of a competitor.

From previous discussions, the researcher considers that Quality costs have a direct impact on service costs and an indirect impact on profitability , where Industrial organizations should consider the costs associated with quality (Visible and hidden) , being the only ones able to keep these organizations survival for a longer period of time under intense competition , also the hidden cost is related to achieving the competitive advantage by measuring and controlling it's to reducing them ,this will lead to a reduction in quality costs and then reduce the total costs of products, and this achieves a competitive advantage for the company .

## 4- A case study of an Egyptian company

### 4.1. Methodology

The researcher chose October Pharma company for medicines and medical supplies - 6th of October City - Egypt, for the cooperation of its officials in providing the necessary data to achieve this research objectives ,

where the researcher used the following methodology to achieve the objectives of the study.

1- Identification of all processes and quality cost elements in all corresponding activities, Comprehensive data collection and quantification, Grouping in to direct and hidden Cost of Quality.
2- Analysis of impact of hidden COQ on total quality cost and also on organizational bottom line.

3- AHP techniques were used to ascertain the degree of importance of each element and were prioritized based on their impact on controlling overall Cost of Quality, to identify the vital few among them, where the AHP determines the preferences among the set of criteria in each level of a hierarchy by employing pair-wise comparisons of these criteria with respect to their impact to a criteria in the next higher level.

4- Eight experts were selected from key functions in the manufacturing firm under study as participants: two each from Quality Assurance, Manufacturing and Finance and one each from Marketing and Materials Management functions. Survey questionnaires using Saaty's scale were circulated among these experts to get feedback on priorities assigned by them against each cost category, subcategory and element.

5- Also, the researcher made personal interviews and discussions with the employees in each section were carried out to list out all processes, its input, output and control process as per the process cost model and all the activities in each process in the supply chain. Every activity were then analyzed critically to identify the quality lapses in each, which leads to an additional expense or loss to the organization.

6-The additional resources utilized in each of this instances were systematically identified and quantified using the records like log books, route cards, registers, time study, personal interviews etc. to get the cost incurred in each. Then these cost elements are classified into direct costs and hidden costs as per the follow categorization:

-Cost of conformance (COC) include the direct and hidden elements of prevention costs (PC) and appraisal costs (AC).

- Cost of non – conformance (CONC) include the direct and hidden elements of internal failure costs (IFC) and external failure costs (EFC).

- Opportunity costs (OC) including the direct and hidden elements of internal failure costs (IFC) and external failure costs (EFC).

It is also measured the impact of indirect and hidden quality cost elements on the overall quality cost and to the total cost of production .

**4.2- Data collection and categorization**

The research has been carried out in a October Pharma company for

medicines and medical supplies - 6th of October City – Egypt , where the PAF model of quality costing was already in practice in this firm with emphasis only on direct P-A-F elements of quality costs which are easily and directly measurable.

Also, each activity in the supply chain of this manufacturing firm is analyzed to identify the cost elements which are incurred in ensuring quality in each activity but not normally accounted in traditional quality cost analysis.

During this study, a comprehensive data collection strategy has been adopted for gathering information on various quality cost elements in each activity. For this, the Process Cost Model approach has been adopted, where in each functional area is treated as a set of processes with definite input, output and control processes. Each process is critically analyzed to gather maximum information on quality deviation against all the activities which make the process complete. Then the cost incurred including indirect and hidden against these quality deviations are quantified using the records of additional resource utilization in this regard. Lost opportunities in each process also identified and corresponding cost data captured and quantified .

The traditional (direct) elements of costs of conformance and non-conformance identified and analyzed in this firm as follow:

- Direct conformance costs (COC.D) include : prevention costs (PC.D) such as :(Cost on administration -Training cost on quality Standards, theories and practices of quality issues -Preventive maintenance cost of equipment's machineries - Cost on vendor quality assurance Preventive maintenance of test jigs & tools) and Appraisal costs (AC.D) such as:( In-Process inspection subassemblies and assemblies - Raw material inspection- Final tests after

integration of sub-assemblies and modules - Cost on internal as well as &customer audits).

- Direct non-conformance costs (CONC.D) include: internal failure costs (IFC.D) such as:( Rejection analysis- Excess material drawn against rejections, scraps etc.- Scrap\ wastages- Machine break down -Materials written off due to product design changes) and external failure costs (EFC.D) such as: (Repair of defective parts- Replacement of defective parts - Product recalls - Trouble shooting of field failures - Expenditure on customer service dept. for support calls from customers) .

Also, the hidden quality cost elements are identified by extensive information collection by interviews, log books, records and registers kept in various activity centers with entry of time study, time cards, machine logbooks, complaint log books, attendance cards, minutes of meetings etc. Where, the hidden cost elements were identified in this firm as follow :

-Hidden conformance costs (COC.H) including prevention costs(PC.H) such as ( Pharmaceutical design review- customer requirement review – process validation) and Appraisal costs (AC.D) such as ( customer audit- process audit at vendor premises).

-Hidden non-conformance costs (CONC.H) including internal failure costs (IFC.H) such as (Billing errors and rework on bills- Production Planning errors- Document procedures for raw material rejections, where Raw material planning errors lead to cost extra of raw material - Pharmaceutical design mistakes ) and external failure costs (EFC.H) Such as (Man power for field assistance on complaints – Emergency dispatches - Warranty claims) .

Similarly missed opportunities cost due to incapability of the system as well as inefficiencies are also listed out in each process and measurement techniques are devised by extensive data collection against each hidden element and identified its importance after rigorous discussions with the authorities concerned. where identified The hidden elements in the Opportunity Cost (OC) with its details as follow:

-Lost sales :

Poor performances in product and service leads to customer dissatisfaction which in turn results in reduction in market share.

-Under utilization of machine capacity

Utilization below the installed planned capacity of machines due to insufficient customer orders, balanced quantity of raw materials, consumables or work force as well as planning inefficiencies .

-Loss due to delayed payment

Delayed payments to the raw material vendors and loss of mutual trust

results in demand from vendors for advance payments instead of credit purchases. Loss on account of interest against the lost credit period .

-Customs clearance of materials

Customs demurrage charges on delayed customs clearance of materials. Also results in extra documentation , Follow up time etc .

-Excess Financial charges by Banks

Penalties imposed by banks against insufficiency of documents for financial clearances, Losses due to foreign exchange variations due to the absence of forward contracts etc.

-Emergency Dispatches

Extra shipping costs to meet customer urgency and to cop up with

delayed dispatches .

-Late delivery(LD)

Liquidate damages (LD)imposed by customer on late deliveries, part deliveries, delay in after sale support etc.

-Sundry Debtors

Payment realization delays results in accumulation of sundry debtors and loss of interest or availability of sufficient fund flow.

In light of the above, the hidden elements can be divided according to

each category, as shown in the following table : .

Table ( 4 ) classified the hidden elements into various groups

| Hidden prevention Cost | Hidden appraisal cost | Hidden Failure Cost | | Hidden Opportunity Cos | |
|---|---|---|---|---|---|
| | | Internal | External | Internal | External |
| -Customer requirement review (P.1.1)<br>-Pharmaceutical design changes(P.1.2)<br>- Process validation costs(P.1.3) | - Audits at vendor premises(P.2.1)<br>- Customer audits(P.2.2) | -Pharmaceutical design mistakes(P.3.1)<br>- Rejection Consequent costs(P 3.2)<br>(- Material Planning errors(P 3.3<br>-Production planning errors (P3 .4) | -Litigation cost on failed supplies(P4.1)<br>-Billing errors and rework on bills(P4.2)<br>-Extra field assistance(P4.3) | -Extra Shipping Costs(O1.1)<br>-Capacity Under utilization(O1.2)<br>-Delayed payments & Penalties(O1.3)<br>- Customs demurrage (charges(O1.4)<br>- Bank transaction losses(O1.5) | - Liquidate damages (O 2.1)<br>-Interest on Sundry debtors(O2.2)<br>-Lost sales(O2.3) |

## 4-3 : Arrangement the importance of Hidden Quality Cost Elements

Each hidden cost element in this study is having a distinct influence on the overall cost of quality and plays a vital role in improving the profit margin of the firm. But in a practical application, analysis of each and every cost element is not advisable since it is highly time consuming and unproductive. Hence the theory of "vital few" has to be applied to identify the most significant cost elements so that the insignificant elements can be avoided from further analysis of quality improvement programs. Hence an attempt is made in this study to prioritize hidden quality cost elements using Analytical Hierarchy Process (AHP) techniques.

Based on the hidden quality cost elements collected from the this firm, the hierarchical model with prioritization of quality costs as goal is developed, where the goal is broken down to cost categories and further to cost elements to form the AHP model for assessment .

where, Where the results of the analysis appear the AHP approach to arrange the importance of the hidden elements in influencing the total cost of quality through the following table:

Table ( 5 ) arrangement the importance of the hidden elements

| Level 1 | Relative weight% | Level 2 | Relative weight % | Level 3 | Relative weight% |
|---|---|---|---|---|---|
| **The indirect costs of quality** | 26.7% | The hidden Prevention costs (P1) | 7.8% | -Customer requirement review (P.1.1)<br>-Pharmaceutical design changes(P.1.2<br>-Process validation costs(P.1.3) | 11.2%<br>61.6%<br>27.2% |
| | | The hidden appraisal Costs(P2 ) | 10.2% | -Audits at vendor premises(P.2.1)<br>- Customer audits(P.2.2) | 28.7%<br>71.3% |
| | | The hidden internal failure costs(P3) | 49.4% | -Pharmaceutical design mistakes(P.3.1)<br>- Rejection Consequent costs(P 3.2)<br>- Material Planning errors(P 3.3)<br>-Production planning errors(P 3.4). | 60.7%<br>7.1%<br>12.2%<br>20.0% |
| | | The hidden external failure costs(P4) | 32.6% | -Litigation cost on failed supplies(P4.1)<br>-Billing errors and rework on bills(P4.2)<br>-Extra field assistance(P4.3) | 71.9%<br>8.4%<br>19.7% |
| **The opportunity costs** | 73.3% | The hidden internal opportunity costs (O 1) | 31.3% | -Extra Shipping Costs(O1.1)<br>-Capacity Under utilization(O1.2)<br>-Delayed payments & Penalties(O1.3)<br>- Customs demurrage charges(O1.4)<br>- Bank transaction losses(O1.5) | 6.2%<br>36.6%<br>25.8%<br>12.3%<br>19.1% |
| | | The hidden external opportunity costs ( O 2) | 68.7% | - Liquidate damages (O 2.1)<br>-Interest on Sundry debtors(O2.2)<br>-Lost sales(O2.3) | 6.3%<br>63.4%<br>30.3% |

The analysis revealed from above table , that in the first level, opportunity cost category is having more impact (73.3%) on cost of quality than the indirect (hidden) costs (26.7%), and In the second level, among the sub-categories of hidden cost category, internal failure costs are found more significant (49.4%)than the other sub-categories. Similarly, among the sub-categories of opportunity cost category, hidden external opportunity costs were found (68.7%) it is higher the hidden internal opportunity costs(31.3%)

Also, the relative weight level provide the prioritization of each cost element and their order of priority As per AHP analysis of prioritization of hidden cost of quality elements, where there are five hidden elements that most affect the costs of quality, namely :Litigation cost on failed supplies(P4.1 =71.9%) - Customer audits (P2.2 =71.3%)- Interest on Sundry debtors(O 2.2 =63.4%) -Pharmaceutical design changes(P1.2 = 61.6%) - Pharmaceutical design mistakes (P3.1 = 60.7%), therefore analysis of these priority cost elements will provide a clear focus on the areas where the quality improvement activities to be should strengthened, where the organization can improve its profit margin and increase its competitiveness.

Also ,the effect of measuring direct elements of quality according to the traditional model (PAF) can be compared with the effect of hidden elements and lost opportunity cost losses on the total cost of quality according to the following table :

Table ( 6 ) Measure the impact of direct and hidden elements on total costs of quality .

| | Cost of category | %to sales value | % to quality cost total | The Importance Of category |
|---|---|---|---|---|
| Direct costs | -The direct Prevention costs(PCD)<br>-The direct appraisal Costs(ACD )<br>-The direct internal failure costs( IFCD)<br>-The direct external failure costs(EFCD) | 1.64%<br>2.07%<br>5.03%<br>0.78% | 4.12%<br>5.95%<br>15.01%<br>2.03% | The second |
| Total of direct costs | | 9.52% | 27.11% | |
| Hidden costs | -The hidden Prevention costs(PCH)<br>-The hidden appraisal Costs(ACH )<br>-The hidden internal failure costs( IFCH)<br>-The hidden external failure costs(EFCH) | 0.11%<br>0.13%<br>2.89%<br>4.28% | 1.14%<br>1.16%<br>3.87%<br>7.43% | The third |
| Total of Hidden costs | | 7.41% | 13.60% | |
| opportunity costs | The hidden internal and external opportunity costs(OPH) | 17.73% | 59.29% | The first |
| Total of COQ | | 34.66% | 100% | |

The result shows that Cost of quality captured in the traditional systems in this year is 9.52 % of sales revenue whereas the same after adding hidden and opportunity costs included is 34.66%. The total hidden and opportunity costs amounts to 25.14% of sales revenue, which is around 3 times equal than the costs based on traditional P-A-F model, also the traditional quality cost amounts to 27.11% of total quality cost, where as total sum of hidden quality cost is 72.89% of total quality cost, out of which major portion is contributed by the opportunity costs (59.29%).

When we analyze the per category contributions to the total quality costs, opportunity costs shows the major category with Close to 60% contribution as represented in the table( 6 ).

This gives a clear picture of the quantum and impacts of hidden quality costs and opportunity losses to the organization.

This study reveals that the actual quality cost of the firm in this year(34.66%) is more than 34% of sales revenue , It is considered a large percentage ,this shows the inadequacy of traditional accounting system in analyze and measure the actual quality costs and also the importance of analyzing various hidden quality costs in a firm.

It is also found this study that the hidden COQ (25.14%) is higher than the net profit of the company, Where it was found that the net profit of the company during this year is equal to 24.19% from sales value . By analysis it is revealed that most of these hidden opportunity costs can be eliminated with awareness of the impact of the lost opportunities and proper planning to eliminate the root causes , It also ,this root cause analysis of opportunity costs gives an insight to the opportunities to improve the bottom line of the organization. Where these losses can be converted to opportunities for increasing profit margin of the firm. .

## 5-The conclusions and recommendations

At the end of this study, the researcher concluded several results, the most important of which are the following:

**First: the results of the case study**

1-In this study, a comprehensive analysis of all cost elements which contributes to the quality of products in the supply chain line of a October Pharma company for medicines and medical supplies - 6th of October City - Egypt has been conducted .

2-Apart from the normal prevention-appraisal-failure mode quality cost categories, more in depth analysis of all activities in the whole supply chain were done to track and measure the hidden elements of quality cost including the opportunity cost elements.

3-This study findings points out the fact that the hidden cost of quality is up to about 3 times than the direct quality cost elements in the October Pharma company for medicines and medical supplies - 6th of October City - Egypt and most of these hidden costs can be reduced or even eliminated by proper tracking and understanding the root causes .

4-This study highlights the inadequacy of traditional cost of quality system in tracking and assessing the overall costs of quality. In order to assess the overall cost of quality, the hidden costs also has to be identified, measured and analyzed. For tracing the hidden quality costs, it is necessary to move beyond the data produced by the traditional accounting system. This also gives an insight to the huge impact of hidden quality costs to the

organizational bottom line. Using this data the company can formulate survival strategies in the highly intensive competitive market scenario.

5- Also ,in this study, an attempt is made to identify the most significant hidden cost elements out of the whole set of hidden cost elements in the October Pharma company for medicines and medical supplies , based on their importance in controlling overall cost of quality by using AHP approaches . where detailed and systematic tracking of each functional element which is having significant contribution to the overall quality management of the October Pharma firm is done, , where An exploratory study were conducted to identify all possible hidden quality cost elements and categorized them into indirect quality costs and opportunity costs, ,Around 20 hidden cost elements which had impact on the overall quality cost are tracked in this study .Further the degrees of importance of each of these quality cost elements were ascertained using the AHP techniques. Thus, out of 20 hidden elements identified, only 5 found have significant importance.

6-The results of this case study helps the industrial managers to narrow down the complex problem of prioritization the hidden elements of quality cost and to address the top priority cost elements in their quality improvement programs for achieving quality with assured cost reduction.

7- This case study results and methodology are applicable to any similar Egyptian firm for classification and prioritization of the cost structure in the Egyptian industrial environment .

8-The difficulties that the researcher faced during this case study .

Like any other research work, this study had some obstacles too, as it is the issue of measuring hidden cost elements can be controversial to many people. Therefore the researcher faced several difficulties during this study, the most important of which were.

-Some executives who participated are also very afraid to disclose some important figures that are needed for quantifying the relevant hidden costs.

- Still there is misunderstanding the concept of COQ of some directors. They still assume that this is an activity to find out individual mistakes, so that later they can be blamed for it, this puts them away from the study.

-Lack of participation from some member of the organization, where - some people view it as an extra job to note down things going not right even though it is only taking few seconds of their time. This means data collection is disrupted were to some extent.

-Due to the confidentiality of the matter the researcher is not furnished with all the information. This make it difficult to quantify all the hidden costs .

**Second: The other results of the study**

1- Managing quality is critical in business and industrial today, where Quality in products, quality in services and even quality in the entire processes of an organization is so important, where It helps the organization in different aspects such as : satisfying and retain customers, maintaining a good reputation for the organization, reducing the risk of cost, and increases it's retain on investment and revenues , this achieves the competitive advantage of the company.

2- The analysis of Cost of quality is an effective tool for the managers for pinpointing the deficiencies in the quality cost system as well as for identifying the improvement areas by giving a clear insight to the cost reduction opportunities in terms of monitory benefits .The analysis will be effective only if the hidden costs including opportunity losses also are measured and quantified.

3-Due to the practical difficulties in measurement and analysis of cost elements, most of the firms usually focus only on addressing the tangible and easily retrievable costs and hence the intended result of quality improvements with less incurred cost are not fully met.

4- The accounting literature review suggests that although CoQ is considered to be the part of TQM process but finds a limited use in Egyptian industry. This case study prove that use of CoQ technique not only helps in measuring the various components of quality cost but also helps in reducing the failure costs .

5- Ignoring the hidden cost elements in COQ can make goods and services more expensive, where the hidden cost play a major role in increasing the total cost of products ,which affect competitiveness , therefore

Organizations should identified and measure the COQ total with focusing to eliminate the hidden cost , besides consider COQ as an integrated approach and long-term process .

6- The quality cost affects on the overall financial goal of a company, where a small reduction in COQ may boost the profitability of a company by a significant amount, also COQ technique resulted in cost cutting as well as quality improvement. Hence, efforts should be made to reduce the COQ as much as possible.

7- The prevention, appraisal and failure costs are not the only quality costs ,there were other hidden costs that are identified through this A case study of hidden quality cost ,where the company should identify such hidden quality costs to reduce customer dissatisfaction and retain them and improve quality and reduce the cost of product.

8- Further education on the practical level is needed for managers to understand better the COQ concept in order to appreciate fully the benefits of the approach, to increase their ability to implement a COQ measurement system include the hidden cost to achieving the company's competitive advantage .

9- The methods for COQ calculation vary as well, which causes an inconsistency in quality cost figures and makes it even more difficult to compare the results of the COQ programs among companies .

10-The task for most companies today is to tackle the inadequacy of most cost-accounting systems in addressing quality costs and in supplying appropriate data in a suitable format that considers total cost includes the hidden cost.

11-The cost of quality management system acts as the most significant tool in measuring, controlling and decision making activities in a firm which aims to achieving the company's competitive advantage.

**-The Study recommendations**

At the end of this study, the researcher recommends the following:

1-The companies should identify such hidden quality costs to reduce customer dissatisfaction and retain them and improve quality and reduce the cost of product.

2-Detailed studies are required to simplify the process of collection and measurement of hidden quality costs, where Sector wise other case studies should be undertaken to show the utility of the COQ technique in reducing the cost and improving productivity.

3-The hidden failure cost and the hidden elements of opportunity costs are effect on to lost part of the company's market share and loss of competitive advantage . Therefore it is very important that not only visible failure costs and visible or opportunity costs are to be decreased but hidden ones as well.

**" اللهم لا علم لنا إلا ما علمتنا "**

**اللهم : إن كنت قد أصبت فمنك التوفيق ولك المنة والحمد**

**وإن كنت قد قصرت فمن نفسى وحسبى أن الكمال لك وحدك**

**الباحثة**

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# Appendix

## The questionnaire list

-Note: The questionnaire list is used in comparison of the criteria for measuring the significance of the hidden cost elements, through the hierarchical levels (AHP)

-Please, mark your opinion on importance of cost category/ sub category/ cost elements in the pair wise comparison through the following tables :

1-The impact of indirect quality costs Vs opportunity costs on overall cost of quality

| the Cost Category | the more importance than | | | | | | | | Equal | the less importance than | | | | | | | | the Cost Category |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **the indirect quality costs- P** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **The opportunity cost - O** |
| | | | | | | | | | | | | | | | | | | |

2- The impact of sub categories on indirect cost of quality

| the cost sub category | the more importance than | | | | | | | | Equal | the less importance than | | | | | | | | the cost sub category |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | ٨ | **9** | |
| **The hidden prevention cost - P1** -Customer requirement review (P.1.1) | | | | | | | | | | | | | | | | | | **The hidden internal cost – P3** -Pharmaceutical design mistakes(P.3.1) |
| **The hidden prevention cost – P1** -Pharmaceutical design changes(P.1.2**)** | | | | | | | | | | | | | | | | | | **The hidden internal failure - P3** - Rejection Consequent costs(P 3.2) |
| **The hidden prevention cost – P1** -Process validation costs(P.1.3) | | | | | | | | | | | | | | | | | | **The hidden internal failure – P3** - Material Planning errors(P 3.3) |
| **The hidden appraisal cost – P2** -Audits at vendor premises(P.2.1) | | | | | | | | | | | | | | | | | | **The hidden external failure – P4** -Litigation cost on failed supplies(P4.1) |
| **The hidden appraisal cost – P2** - Customer audits(p2.2) | | | | | | | | | | | | | | | | | | **The hidden external failure – P4** -Billing errors and rework on bills(P4.2) |
| **The hidden internal failure - P3** -Production planning errors(P 3.4). | | | | | | | | | | | | | | | | | | **The hidden external failure – P4** -Extra field assistance (P4.3) |

3-The impact of sub categories on opportunity costs

| the Cost sub Category | the more importance than | | | | | | | | Equal | the less importance than | | | | | | | | the Cost sub Category |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **The internal opportunity cost - O1** | **9** | **8** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **The external opportunity cost – O2** |
| | | | | | | | | | | | | | | | | | | |