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Int. J Sup. Chain. Mgt   Vol. 8, No. 1, February 2019

The Effect of Hidden Quality Cost on Supply Chain Management of Sales and Market Share

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Abstract-**There have been difficulties in managing costs effectively which have led to reduction in both market and sales share. This study aimed to find remedies to the challenge of determining and measuring the hidden quality costs due to its negative effect on the customer satisfaction. This study engaged in the measurement and calculation of hidden quality costs in a sound and scientific manner in order to find solutions to the problem and achieve the research objectives. Increase in the sales and profits and market share of the economic unit and satisfaction of the customer are achieved through the effective the management of these costs. A deductive approach was employed in the study and a number of conclusions were made from the analysis of the results. First, the study conclude that lack of information as provided by the total quality costs is experienced due to failure to calculate the hidden quality costs. As the hidden quality costs provide indicators, they must be applied as required. Also, there is a task related to the risks surrounding the economic growth when it comes to the risk of losing market share. Similarly, the research found that these costs and disclosure, which affects the management of these costs effectively and objectively, are not measured and calculated by many of the industrial companies in Iraq.**

Keywords: Supply Chain, Pricing, Hidden Quality Cost, Strategic Planning, Price Control

1. Introduction

Over the years, most manufacturing units have focused on the efficiency and effectiveness of individual business functions. While as a new approach to business, the growing number of factories have recognized the strategic importance of planning, controlling and designing a single supply chain. Supply chains are processes that convert from primary to final products to the final customer of the flow They are connecting

organizations and companies active in the field. In general, the supply chain is a chain that includes all activities related to the flow of goods and the conversion of materials from the stage of provision of the raw material to the stage of delivery of the final product to the consumer. Supply chain management is the process of integrating supply chain activities and related information flows by improving and coordinating activities in the supply chain of production and supply. The main components of the supply chain are the program / source / fabrication / delivery / return.

The economy has become aspiring and becoming harder to meet the needs and desires of customers in the contemporary industrial environment due to the development of modern means of communication, rapid technological developments and increasing competition between economic units. Products of high quality and specifications must be produced as required to meet the desires and requirements of customers in order to achieve this. They are contained in the bulk of the costs of external failure in the economic unit as they happen due to the customer product delivery which is not in accordance with the specifications. Also it can be due to poor products delivery with negative impact that does not meet the wishes and expectations of the customers.

The unit does not work to achieve customer satisfaction being the cost of quality which does not add value to the product and rather a burden. Thus, the sales in the economic unit and the profit meant to be achieved will be reduced and the products in the resignation will be non-turnaround. At the same time, it leads to loss of competition in the market, loss of sales and loss of customers and affect the reputation and market share of the unit. Through the production of quality products and specifications required to meet the wishes and aspirations of customers, loss of competition in the market, and the

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management of economic units can reduce the hidden costs of quality. A high proportion of the total cost of quality belongs to the cost of hidden quality which makes it very paramount to the economic growth aiming at excellence in its aspect by manufacturing products with low cost and high quality. This thus led to increase in the sales and expansion of market share through the acquisition of new customers and customer satisfaction.

2. Literature Review

A quite number ofprevious studies have discussed the hidden quality costs as the main topic of the research.

According to [1], where the authors aimed to examine the application ways of the cost of quality in the industrial companies with a concentration on the hidden quality costs and the possible ways of adding the category of loss of opportunity to the existing four quality costs. The following are the main finding of the study:

1.   the hidden costs of quality tracking are not meant by the traditional cost accounting system
2.   It is necessary to bypass the data produced by the traditional accounting system in order to track hidden quality costs.
3.   The potential for quality improvement is highlighted by the identification of hidden quality costs.

In another vein, [2] in their study aimed to identify and measure all the direct, indirect and hidden elements of the cost of quality in all the functional activities in the economic unit. This study measured the effect of hidden quality on total quality costs in order to ensure the importance of this analysis. The study concluded that:

1.   Most hidden costs can be reduced by tracking them correctly and understanding the reasons behind their usage and hidden quality costs three times the costs of apparent quality.
2.   The traditional cost systems are not adequate to assess and track both the hidden quality costs and the total costs of quality.

2.1 The Nature and Concept of the Hidden Costs of Quality

There are two kinds of costs in the cost of external failure that does not add value to the customer and it is considered as one of the components of total quality costs: the first type is the observable quality cost while the second one is the hidden quality cost. The measurement and report of the phenomenon is often the fundamental information in the accounting records while the costs borne by the economic unit when the products are of poor quality are the hidden quality costs. This leads to the reduction of all the sales and market shares as it negatively affects the satisfaction of customers. The difficulty of calculation and measurement determines these costs [3].

The loss of sales, the salary costs paid to the employees who verify the customer's credibility from the product and the reputation of the customer's economic unit are used to measure costs of external failure borne by the seller, such as customer complaints. It is therefore not appropriate for a customer to refrain from buying in the future, and then goes on to inform everyone who knows about this product that it is not appropriate. The reputation of the product can be negatively affected and this will lead to loss of the unit in present and future customers. All of this will cause significant losses and negative sales. Evaluation of costs through good planning and design and focusing on prevention can make the cost to be reduced [4].

The costs of product failure are focused on by [8] added that to reduce the long-term costs of economic unit, the cost of intangible (hidden) quality is considered important. In terms of the hidden quality costs and the total quality costs, the economic units that estimate hidden quality costs can be obtained as they represent an important part of the costs of external failure [9]. Some researchers presented a range of views as follow:

1.   According to Anderson, poor quality of products shipped to customers can cause hidden quality costs and then leads to dissatisfaction in customers which is a crucial part of the external failure costs.
2.   In contrary, Juran and other scholars posit that costs of external failure constitute hidden quality costs for example: customer and sales losses due to lack of market share.
3.   Hidden quality costs are considered by Al-Masoudi to be part of the external failure costs. Thus, in determining and measuring the total quality costs and disclosing them in separate reports, these costs should be taken into account. Also, in calculating and measuring hidden costs and effectively managing them, many economic units face great difficulty.

4.   In another vein, Brekke mentioned that the costs of real (or total) external failure are divided into two: the result of the delivery of the customer defective goods and the bulk of which is often not installed in the records. In the case of delivery of goods without defects, these costs disappear. By introducing the iceberg model, the costs of a phenomenon can be identified and measured in the second part of the represent hidden costs that are difficult to calculate.

5.   The cost of an opportunity is represented by the hidden quality costs as stated by Guan et al. due to customers receiving poor quality of products. These are included in the costs of external failure and have led to customer's dissatisfaction.

One of the costs of external failure is the hidden quality costs as posited by the researcher.

According to the model of the iceberg, also known as the idea of an Iceberg pattern, 10% hidden costs are contained in the total costs of external failure while the remaining 90% of the hidden costs refers to the important part of the costs of the external failure which are used to reduce the costs by the concept called defrosting the iceberg. In [10] explained further that it is operated by reducing the costs of apparent external failure as it is necessary to start from the top and then hidden costs will gradually reduce with the melting of the iceberg.

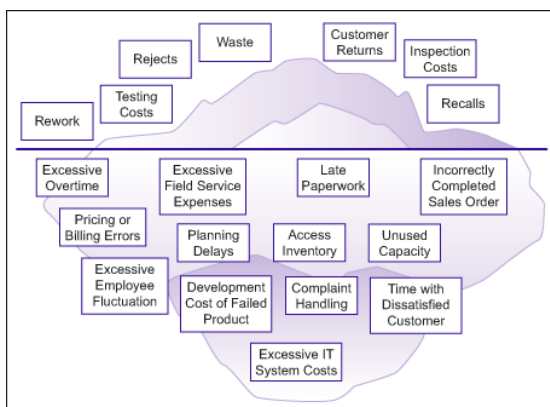Figure 1 illustrates the iceberg model

Figure 1: Iceberg model for hidden quality costs

In [11] stated that the higher the hidden quality costs, the more low-quality products and services as they are exposed to lower market share and affect the reputation of the economic unit.

In the short and long term, the expected profits of the economic unit are affected significantly by the hidden costs of quality. There are increases in the profit made due to reduction of these costs. The decrease in the price also has psychological effects on customers in addition with the potential of the economic growth to give stability to the market as they represent the costs of customer loss and dissatisfaction on both the market and sale shares. Therefore, in terms of disclosure, measurement and calculation, attention should be paid in order to effectively work to reduce and manage and to give the department a clear picture of them [12].

The following observations can be made based on the opinions of the researchers on hidden quality costs [9]:

1.   The costs of hidden quality are significant parts of the costs of external failure; the costs of external failure and the total quality costs are affected by a large percentage of them that can be up to 90%.

2.   In accounting records, these costs that are not observable need to be accounted for.

3.   This is due to poor quality result of the products given to the customers as it represents the lost income and the cost of opportunity as a result of loss of production and sales with low sales price.

4.   The customer satisfaction and sales and market share are negatively affected; the less those negative effects, the lower the hidden quality costs.

Thus, the accumulation of the costs of external failure incurred by the economic unit as a result of poor quality of the products delivered to the customers is defined as the hidden costs. Due to customers' dissatisfaction with these products, it leads to loss of market share and loss of customers and sales. Generally, they comprise up to 90% of the costs of external failure; as the defective products are shipped to the customers, this percentage decreases.

2.2 Measurement Models of Hidden Quality Costs

The proposed Measurement to estimate the Hidden Costs of Quality

Through the use of accounting records and hidden quality costs, quality costs are classified into observable quality which are the opportunity cost emanating from the low quality as there is usually no recognition for opportunity cost in the accounting records. In the same vein, In [13] stated that hidden

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costs of quality are high, are all the costs of external failure and should be estimated.

The multiplier method, market research method, and quality loss functionare the threemethods to measure hidden quality costs.

A. The Multiplier Model

Using the following equation, the total cost of external failure is measured under this method:

Costs of external failure = k (external measurable costs of failure)

The k represents the effect of external failure costs on hidden costs which is simply represented as multiplier effect. In [8] added that the estimates of experts in the economic unit are used to estimate the multiplier value.

As the costs of hidden quality are affected by the apparent costs of external failure, the methods depend on the multiplier effect while decreasing or increasing. This reveals the fact that the cost of external failure is presented in the hidden quality costs. To determine the value of the multiplier effect, the experts' estimates is needed although the method is simple. In [14] stated that the model is subjective as it is subjected to opinions of customers, sales representatives, personal judgments and estimates.

B. Supply Chain Management on Market Research Model

In this type of model, the impact of low quality in sales and market share are assessed with the use of systematic methods of market research by interviewing sales representatives and conducting customer identification. The size of the hidden quality costs is determined by providing substantial information to the economic unit where there exist important indicators used in estimating and identifying the hidden quality costs of the economic unit. Finally, In [5] stated that due to low quality, the results of this method can only be used to highlight the expected loss or profits.

Due to the opinions of sales representatives and customers, this method is more objective than the multiplier approach as the market research model requires more effort than the multiplier method. This model when placing the questionnaire for sales representatives and customers relies on personal estimates [8].

C. The Taguchi Quality Loss Function

The traditional point of view is entirely differed from the Taguchi point of view in an attempt to address the limitations of the traditional view. The method posits that any deviation from it represented a loss of economic unity and there was no loss at the target value [3]. Successful implementation of the Taguchi model is connected with the success in quality loss calculation that explains the costs of the hidden quality from low quality. Thus, the management of organization is required to be strictly determined although the estimates determine the level of the determination. Thus, according to [12], the deviation of the actual quality level limits the extent of the permitted result in increasing loss of the quality.

It is apparent from the above that measuring the costs of hidden quality requires three methods namely: the multiplier method, the method of the market research and the method of the loss function. From the three stated methods, the most objective one is the method of the loss function although the method is difficult to identify some elements of this function but it measures the loss mathematically.

2.3 Benefits of Measuring Hidden Quality Costs

In [3] mentioned that there are several benefits to measuring hidden quality costs. They are summarized as follow:

1 Financial Impact: the attitude of the workers is affected in the organization when calculating the costs of hidden quality critically. In that vein, anyone can understand the results of low quality as the quality is more realistic. When the results are turned into money, the employees can avoid failure and a clear picture is given to the management about the potential profits that can be achieved when low failure costs for low quality.

2. Quality Improvement Activities: By studying hidden quality costs, management can identify problems that can be resolved. Nevertheless, there is difficulty in identifying all the problems in all aspects but the cost awareness can be achieved in the process of improvement. This is preferable to idleness or ignorance on the idea of the problems that leads to higher costs in the organization.

3. Follow-up to quality improvement activities: The undesirable trends of low quality costs can be

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observedby looking at changes in low quality costs over a period of time. These are ways to get feedback from the work done as an alternative to quality improvement activities.

Invariably, the hidden quality costs are of high importance to an organization as it comprises a large proportion of the total cost of the total quality. The sales will be reduced, and then the profit too if they do not meet the needs and desires of the customers and if the economic units continue to ignore the recognition, measurement and disclosure in accounting records. In the long term market competition, it will result to the exit of these organizations.

The Effect of Using Hidden Quality Costs

According to the method of the quality loss function by Takoshi, the hidden quality costs will be calculated in this section for the solar panels product at Al-Mansour factory which belongs to one of the companies under the operation of Al-Zawraa Company. Also, in this section, the impact of hidden quality costs on sales and market share are calculated. In addition, the importance of eliminating these costs to meet the needs and desires of customers are highlighted with the calculation of hidden quality costs within the financial statements.

3. Calculation of Hidden Quality Costs in the Selected Company

The largest proportions of the costs of external failure are represented by the hidden costs which are incurred on the manufacturer through change in program, customer complaints and loss of market competition. There is result in the loss of part of the sales and market shareif the sample does not calculate hidden quality costs and recognition and disclosure in the financial statements. Therefore, the following steps are required in order to determine hidden quality costs:

1.   During the maintenance, the costs of the apparent external failure after searching for these costs in the factory records were discovered to bear the costs of the warranty as provided to the customers. As the rest of the products are all liquid and gas, the warranty is only provided on the solar panel products. From the cost of the apparent quality, the selected population of this study incurred one of the costs of external failure. During the warranty period in the maintenance workshop, the defective products attract maintenance and

repair costs as located at the plant site and represented by the costs of external failure phenomenon. The amount of these costs at the factory level for the years 2015and 2016 was found to be as followsafter reference to the reports of quality control and document:

Table 1: Guarantee costs for solar panel products for the year 2015 and 2016 (amounts in ID)

Details	2015	2016	Total
Warranty costs	140850	1653750	3062500

Table prepared by authors

2.   Using one of the methods mentioned above to calculate the hidden quality costs of the plant. Thus, the method of the quality loss function of Taguchi can be used to do the calculation as it is more objective than themethod of market research and the multiplier method. Using the following equation, the quality loss function (QLF) provided by Taguchi can be calculated in accordance with the mathematical loss without reliance on judgments or personal estimates:

Where L(x) is the total loss of hidden quality costs
K is the constant quality loss coefficient
X is the value of the real cost of quality and
T is the target value for quality characteristics

The following equation is used to calculate the quality loss coefficient:

C refers to the costs of the guarantee borne by the manufacturer also known as the costs of apparent external failure

D is the custom permits that can be accepted by the customers.

In the first step, after determining the costs of the external failure, which is represented by the value C in the equation for the constant quality loss coefficient, the tolerance represented by the value D is determined and after the director's interview for follow-up and planning. Value of D is 5% which is the value of custom allowances that can be accepted by customers in defective products. Also, the 5% is the target value for the quality characteristics (T value). The defective products percentage returned to the factory is within the permissible limits and with the following steps; the hidden quality cost is realized:

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1. The value of the constant quality loss factor (K value) is determined by dividing the apparent external failure costs (C) on the value of the D for the year 2016 using the following table:

Table 2: The constant quality loss coefficient of the solar panels product (amounts in ID)

Details Year	VALUE (C)1	VALUE (D²)2	VALUE K (1)÷(2)=(3)
2015	1408750	(0.05)²	563500000
2016	1653750	(0.05)²	661500000

Table prepared by authors

2. The value of the real cost of quality (value X) is determined. This value is observed through the percentage of defective products returned to the plant by customers and quality characteristicsduring the period of warranty to the number of unit product sold. The separate calculation of each product can be explained using the following equation:

3. The value of X is the number of defective units returned to the factory divided by the units sold

Table 3: Percentage of defective units returned to the number of units sold for solar panel products (amounts in ID)

Product	Year	defective units returned (1)	Sold units (2)	Percentage
Solar panel	**2015**	**180**	**1540**	**11.7%**
	2016	**211**	**1960**	**10.8%**

Table prepared by authors

Hence, the extract value (X – T) is determined from the deviation from the predefined specifications and then squared according to the equation of the quality loss function.

4. The value of the quality loss function L (X) is determined by multiplying the constant quality loss coefficient K value in the value of (2) X – T. This represents the hidden quality costs borne by the organization.

Focusing on the formal procedures, the hidden quality costs of the plant's solar panels can be determined for 2015 and 2016 as shown in the table below:

Table 4: the hidden quality costs through the Taguchi quality loss function of the solar panel product for theyears 2015 and 2016 (amounts in ID)

Detail Years	VALUE (K)1	VALUE (X)2	VALUE (T)3	VALUE (X-T)²4	VALUE L(X))5=(4)×(1)
2015	563500000	11.7%	5%	0.004489	2529551
2016	661500000	10.8%	5%	0.003364	2225286

Table prepared by authors

Therefore, the following table shows the percentage of hidden quality costs to the costs of external failure of the manufacturer of energy panels of the plant.

Table 5: The percentage of hidden quality costs to total external failure costs (amounts in ID)

Year	Costs of apparent external failure (1)	Hidden quality costs (2)	Total external failure costs(3)	Proportion of hidden quality costs to total external failure costs(2)/(3) =(4)
2015	1408750	2529551	3938301	64.2%
2016	1653750	2225286	3879036	57.3%

Table prepared by authors

Apparently, the financial statements contain cost bear by the factory that are not proven which are called the hidden quality costs. During the two years of the critical study, a high percentage of the cost of the external failure occurred which was higher than the apparent quality costs. For the years 2015 and 2016 and their respective total external failure costs, a clear picture of the plant will be given for the recognition of these costs in the financial statements in order to know the amount of costs incurred. They are not all shown in the statements to cover the financial statements. For the possibility of reducing these costs gradually, all costs and revenues for an organization are directed in order to achieve customer satisfaction and meet their needs and requirements. Also, there are contributions to the increase in sales to attract new customers. Thus, this improves the organizational performance among the competing economic units reputation.

The hidden quality costs must reduce the sales revenue of this product if the effect of hidden quality costs on the sales revenue of solar panels in the study sample must be shown due to the fact that the hidden quality costs of activities do not add value to the product. It has an adverse impact on the sales and on the possibility of the organization to achieve profits. Thus, the problem leads to loss of part of the market share of the organization.

Percentage of hidden quality costs to sales revenue = (hidden quality costs / sales revenue) * 100%

Year 2015= 2529551 / 70265305 * 100% = 3.6 %

Year 2016= 2225286 / 67432909 * 100%= 3.3 %

Table (6): Comparison between hidden quality costs and their ratio to sales revenues for 2015 and 2016 (amounts in ID)

Details	2015	2016	The difference
Hidden quality costs	2529551	2225276	304265
Percentage of hidden quality costs to sales revenue	3.6%	3.3%	0.3%

Table prepared by authors

From the above statements, it is noted that the ratio of hidden quality costs to sales revenue for the years 2015 and 2016 are 3.6% and 3.3% respectively which is considered as an inefficient indicator as the organization carries only the costs that would have been removed due change of programs and loss of competition in the market or loss of customers. In the above mentioned ratios, these costs led to a reduction in the sales revenues of the solar panel products although compared to 2015 by 0.3% the hidden quality costs in 2016 were reduced by JD (304265). The outcome is a good sign of the importance of an organization in minimizing the hidden quality cost in the second year.

On the other hand, and in terms of the annual sales volume, the presence of these costs is considered a loss to the organization and thus reducing the number of existing customers who operate with the deals of the organization. This affects the future potential to attract new customers; this leads to partial loss of the market share of the organization.

Meeting the needs and requirements of customers through the production of high quality products at reasonable prices is required for achieving the strategy of the organization in its dominance and survival in the competitive market. Reduction in the hidden quality costs because of its great importance in improving the reputation of an organization is one of the reasons that lead to the achievement of high quality. The higher the volume of sales and the market share, the lower the hidden quality costs and vice versa. One of the priorities of the management of the organization should be the achievement of customer satisfaction with focus on the maintenance of existing customers while trying to gain new customers. This allows better competition from the other organizations.

4. Conclusion

Pricing is an activity that needs to be repeated and is a continuous process. With the emergence of the concept of supply management, the views of industrial managers have evolved and turned into an intuitive insight into the cooperation between companies. This is an effective and useful occasion for managing the company in implementing an innovative pricing strategy and maximizing profits. A pricing model for expansion and development requires collaboration with different parts of the company. The three prerequisites for an appropriate pricing plan are the following factors in the organization: having the main goal and understanding the customers and the market process/holding a pragmatic management process for the development and implementation of the pricing plan / conducting an accurate pricing plan that has a willingness to commit to the pricing process. In a part of the supply chain that is used in certain circumstances or for certain commodities, there is no longer a discussion of price, but a discussion of time. In this case, the other paradigm differs, and we find that it is necessary to maintain a higher level in that particular commodity. Researchers believe that having a proper pricing plan for the company, there must be seven main steps: Step 1: Have a summary of pricing strategies / Step 2: Review the current pricing status of the company / Stage 3: Price-based pricing based on analysis of weaknesses Strengths, Threats, and Opportunities / Step Four: Determine the Pricing Strategy / Step Five: Determine the Pricing Goals / Step Six: Identify the Pricing Program / Step Seventh: Price Control and Review Pricing Types are: English Auction / Reverse Exhibit Online and Pricing / Auction Dutch style / auction Pricing Style With First Definitive Price / Group Purchase / Exchange Pricing / Pricing / eBay Discrimination

Style / Pricing Based on Discount Price / Bidding Pricing / Pricing / Price Discrimination Over Time / Crazy Pricing Resellers reviewing these effects on goods and services The world's most affordable ones can choose different strategies. Given the steady downward pressure on prices, it is clear that companies need to find ways to reduce their costs, consistent with price drops, in order to maintain their profitability. The business challenge is finding new opportunities to cut costs. Companies have already implemented many cost reduction programs. The argument is that the last remaining opportunity for a major reduction in costs is in the wider supply chain, not in the corporate operations. Not having a proper pricing strategy can lead to less sales, customer losing, lower market share, and lower profits. These strategies provide the right pricing for cost, customers and competitors and provide a reasonable margin for vendors. The following conclusions can be derived from the above results and findings:

1.   There is lack of information provided by the total quality costs due to failure to calculate hidden quality costs which means the methods are not being used as required because the hidden quality costs provide important indicatorsespecially the risk of losing market share as related to the risks surrounding the organization.

2.   Despite the importance of the cost of hidden quality, it is the main element of the cost of external failure. Thus the management of these costs are effectively and objectively affected as many industrial companies do not calculate and measure these costs and disclosure.

3.   The satisfaction of the customer is focused on by the loss method of Takushi. The lower the cost and the loss caused by the product, the more the product meets the needs and desires of the customers. In that manner, increase in sales and market share of the organization can be achieved. There could be increase in cost and loss with continuous failure to achieve customer satisfaction with the unit's products; thus, the volume of sales and market shares are reduced.

4.   Whether on the long or short-run of the debtors, there is a significant relationship between the hidden costs of quality and the profits to be achieved for the organization because the costs leads to increased profits. The effect also has psychological impacts on the customers and the organization potential to stabilize the market as they are the cost of dissatisfaction. Thus, both sales and market share can be lost by the customers.

5.   Calculating hidden quality costs using the quality loss function (Tajushi) is more objective and effective way of quality and planning control. The method is not subjected to personal judgments and estimates but rather focuses on the interest in product design from the scratch. Thus, by reducing the costs of the external failure, production of high quality products is achieved.

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