

The Cost of Quality—A Primer

Robert B. Austenfeld, Jr.

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1. Introduction

The purpose of this paper is to provide a brief overview of the cost of quality (COQ). When I first heard the term “cost of quality” it seemed strange as I had always thought of quality as saving money, not costing money. As we will learn the term “cost of quality” is really more about the cost of *poor* quality.

At the outset I would like to acknowledge the two main sources for the information in this paper:

- The American Society for Quality (ASQ) Quality Costs Committee’s book, *Principles of Quality Costs*, edited by Jack Campanella (3rd ed., 1999)
- “Quality and Costs” by Frank M. Gryna. This is Section 8 in J. M. Juran (Ed.), *Juran’s Quality Control Handbook* (5th ed., 1999)

This paper is organized as follows:

1. Introduction
2. The history of the cost of quality
3. The four categories
4. Setting up a COQ program—preliminary steps
5. Setting up a COQ program—follow-on actions
6. Using the COQ program for improvements
7. Other matters related to the COQ
8. Summary and conclusion

2. The History of the Cost of Quality

Apparently the COQ technique goes back at least as far as 1945 when, according to Gryna, “a pioneering effort proposed that quality-related costs be assigned to one of three categories...” (p. 8.3). According to Bottorff (1997) by 1960 “the technique was widely published in quality literature” (p. 33). In 1961, ASQ’s Quality Costs Committee was formally established to promote the technique as evidenced by the Campanella book and numerous other resources now available from that committee. In 1963 MIL-Q-9858A was published requiring many military contractors to measure their COQ.¹⁾ According to Campanella, “Today, more and more contracts, both government and commercial, are spelling out quality cost requirements...” (p. 2). Furthermore, the COQ has been incorporated into the bodies of knowledge of the certification programs of several professional organizations including, of course, ASQ (Bottorff, 1997, p. 34).

In summary, it is safe to say that the COQ is well embedded as a useful quality technique. In fact, as stated in Campanella, a COQ “system has the potential to become an excellent tool in the overall management of a business” (p. 17). This doesn’t mean it has always been implemented with success and an excellent article by Sower & Quarles (2003) deals with some of the reasons for this.²⁾ Let us now delve into exactly what we mean by COQ in terms of the categories that make up its structure.

3. The Four Categories

As mentioned the COQ technique goes back to at least to 1945 when it was

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- 1) MIL-Q-9858A Quality Program Requirements (Military Specification) was cancelled without replacement in 1996. Now other standards are used such as those in the ISO series (e.g., ISO 9001).
 - 2) Section 7 of this paper includes a summary of these reasons.

proposed that these costs be assigned to one of three categories. The three categories are: prevention, appraisal, and failure. When one thinks about it, this makes sense. Suppose you are the quality manager for some company. What costs does your company incur that are related to quality? Well, first and most obvious, especially to you, are the costs due to poor quality, for example scrap or rework. These are the “failure” costs. Thinking about it some more you would say, “What about all those inspections we have to carry out because our quality is not perfect?” Aha, those sorts of cost are “appraisal” costs. Finally, you would ask “What about the money we’re spending to try and improve our quality such as for training in the uses of statistical process control?” Aha again, those are the “prevention” costs. Perhaps the reason these categories have persisted so long is they represent a very logical and easily understood way to represent all COQ costs, some due to poor quality—the failure costs—and others due to actions taken to reduce that poor quality: appraisal and prevention costs. Sometimes this is referred to as the “PAF model.”

When we talk about the failure costs it soon becomes obvious that these costs logically breakdown into those incurred before delivery of the product or service and those incurred after delivery. There is an old maxim about quality that the sooner you catch the problem, the much less it’s impact. For example if we are able to find and correct a defect in our product or service before it reaches the customer, the damage to our company, both from a cost and reputation point of view, is much less. For this reason, the “failure” category is split into *internal* failure costs, which occur before delivery, and *external* failure costs, which occur after delivery.

Drawing on probably the most quoted source then, these are the formal definitions for these four categories from Campanella (pp. 32–33):

- *Prevention costs*: The costs of activities specifically designed to prevent poor quality in products or services.

- *Appraisal costs*: The costs associated with measuring, evaluating, or auditing products or services to assure conformance to quality standards and performance requirements.
- *Failure costs*: The costs resulting from products or services not conforming to requirements or customer/user needs—that is, the costs resulting from poor quality.
 - *Internal*: Failure costs that occur prior to delivery of the product or furnishing the service to the customer.
 - *External*: Failure costs that occur after delivery of the product or furnishing the service to the customer.

These are some examples of these costs:

- *Prevention costs*: Quality planning, quality training, quality improvement projects, supplier reviews, and design reviews.
- *Appraisal costs*: Inspections and tests (from incoming inspections and tests on supplies to final inspections and tests on the product); quality audits of the process, product or service; calibration and maintenance of the test and measuring equipment; and collection of process control data.
- *Internal failure costs*: Scrap, rework, reinspection, redesign, troubleshooting, and downgrading.
- *External failure costs*: Warranty costs, processing customer complaints, product recalls, lost customer goodwill, and lost sales.

To emphasize the basic differences between these costs the first two categories, prevention and appraisal, are often referred to as *conformance* costs and the last two, internal and external failure costs, as *nonconformance* costs.

In order to provide enough data to meaningfully track where these various costs exist it is necessary to develop a structure that breaks down each category into constituent elements. Such a structure should be tailored to the needs of each company. Appendix A, adapted from the Campanella book (Appendix B), shows

one such breakdown. These elements should serve as an excellent starting point for anyone just setting up their COQ program. Campanella also provides a detail description of each element (see Appendix B of the Campanella book). With an understanding of what is meant by COQ costs, let's now turn to how we would set up a COQ program. At this point, it might be well to emphasize a point made over and over again in the literature: the purpose of a COQ program is not to simply list all the COQ elements and the costs associated with each, but to use that information to identify the best opportunities for improvement and, once an improvement effort is undertaken, to monitor its effect on the company's COQ.

4. Setting Up a COQ Program—Preliminary Steps

For this section and section 5 I will, in general, follow the guidance by Campanella (pp. 45–70). That guidance can be broken down into two phases: Actions to be taken up to and including the management³⁾ presentation to “sell” the program (preliminary steps) and, once approved by management, the follow-on actions.

These are the steps to be taken up to and including the management briefing:

- Step 1: Get an estimate of the actual COQ costs.
- Step 2: Make a judgment call on whether management is likely to be receptive to the idea of a COQ program.
- Step 3: Develop a pilot project.
- Step 4: Develop an overall plan and schedule for the COQ program.
- Step 5: Make the management presentation.

Step 1: Get an estimate of the actual COQ costs. This is necessary to get management's attention when we brief them. At this point it will not be possible to get a complete picture of these costs nor is such necessary. Instead we are

3) When “management” is used it usually means “upper management” where the decision must be made for taking on a COQ program.

looking for examples of major COQ costs using available accounting information and estimates. It is at this point the quality manager will begin to work with the people in accounting to not only get their help but to be sure the costs developed have legitimacy in the eyes of management (vs. something the “quality” people came up with). Regarding these costs, Campanella says it is not surprising for even these rough estimates to show that the COQ is 20 percent of sales, something that should definitely get management’s attention since every dollar reduction of COQ costs goes directly to profit.

Step 2: Make a judgment call on whether management is likely to be receptive to the idea of a COQ program. Campanella doesn’t say how to go about this but I assume it would be based mainly on the quality manager’s understanding of how open upper management is to new ideas. Perhaps he or she could informally approach someone at that level with the idea to see what the reaction is.

Step 3: Develop a pilot project. Assuming management is judged to be receptive to the idea, the next step is developing a pilot project. A description of this project during the management presentation provides management a concrete example of how the COQ program would be used to reduce costs. Based on the work done to get an estimate of actual COQ costs, we would identify some limited area of operations that appears to have high costs due to quality problems. Perhaps that area is showing an exceptionally high scrap and/or rework rate (internal failure costs). Such a situation represents an opportunity for a high payoff, something in which management would surely be interested. Working with that area supervisor, a tentative plan should be developed for identifying the cause of the problem and fairly quickly resolving it. This will serve as an example of the value of a COQ program. More will be said about the pilot project shortly.

Step 4: Develop an overall plan and schedule for the COQ program. This will be necessary when making the management presentation so management can see

the whole picture and know the extent of everyone's involvement. Campanella suggest this plan include these "essential ingredients":

- The management presentation (to be discussed next)
- How the pilot project will be carried out
- How everyone in the company will be educated about the COQ program
- How the COQ cost accounting system will be developed
- How the data from the COQ quality cost accounting system will be collected and analyzed
- Once analyzed, how this data will be used to prioritize and carry out quality improvement activities
- Finally, a schedule for all these activities

Make the management presentation. The presentation team should probably consist of the quality manager, a representative of the accounting department (perhaps even the head), and the supervisor of the area chosen for the pilot project. The primary presenter will probably be the quality manager who we are assuming is championing the program. The purpose of this presentation is to sell management on the advantages of a COQ program. Showing the relatively large amount of costs associated with poor quality and how these costs can be reduced will best do this. Accordingly, probably the first thing to show would be the estimate of actual COQ costs developed in Step 1. As mentioned, the not unusual "20 percent of sales" should cause management to want to hear more. The accounting department representative can provide support to the quality manager as to the validity of the cost figures presented.

At this point it would make sense to describe the pilot project to give management a feel for how the COQ program would operate. This description should cover the full cycle of collecting, analyzing, and using the COQ data for identifying and eliminating the cause or causes of the high cost. To increase management's confidence in the pilot project the supervisor for that area should

probably participate in this part of the presentation. The description should be in enough detail to convince management there's a good chance for a relatively quick payoff from the project.

At this point there is a good chance that management will be convinced that a COQ program is a good thing. Now the primary presenter—the quality manager—can do some basic educating of the management team by covering some of the basic concepts such as the four categories of COQ costs. When talking about the external failure costs it would be well to emphasize such things as loss of customer goodwill and loss of sales, besides the more obvious costs such as handling complaints and warranty claims. Furthermore, with regard to internal failure costs, it is highly likely that there are a lot of hidden costs there too, such as scrap costs built in as a percentage of existing cost standards; and this should be pointed out also.

Next the plan and schedule should be covered to show management not only a complete picture of what's in store, but also to show that the quality manager has done his or her homework.

Finally, if at all possible, management approval should be obtained for the program and commencement of the pilot project and the complete COQ plan. This approval (or other decision⁴) should be recorded in the official minutes of the presentation meeting and distributed to all participants and other interested parties.

5. Setting Up a COQ Program—Follow-on Actions

Having won management's approval to proceed with the program, these are the follow-on actions:

- Carry out the pilot project.

4) Management may well say to proceed with the pilot project and then come back for approval of the complete program.

- Educate everyone in the company about the COQ program.
- Develop the internal COQ cost procedure.

*Carry out the pilot project.*⁵⁾ As Campanella says, the purpose of this project is prove a COQ system can save costs and, thus, sell management on its value, all with only limited investment. A pilot project will also allow debugging of the system.

Due to the project's importance, a full-time leader should be appointed. In a small company this might be the quality manager him or herself meaning he or she might have to cut back on some of the activities normally performed. Also someone from accounting should be assigned, at least on a part-time basis, to work hand-in-glove with the leader in finalizing the COQ elements that will be used.⁶⁾ Completing the pilot project team will be the supervisor whose area has been selected. It is probably best to start small choosing a single product line or facility that is not too complex. Also the area chosen should be as typical as possible of the company's entire operations.

Since the key to a successful COQ program is the system for collecting the quality costs, the next step is for the leader (quality manager or his/her representative) to begin working with the person from accounting to identify the COQ elements that will be used. Some of this work will have already been done in preparation for the management presentation. So the project will be representative of the final COQ program, elements in all four categories should be selected. As

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- 5) Gryna implies that this pilot project may take place before getting management's approval for the complete COQ program. This may well be since the decision at the end of the management presentation may be to proceed with the pilot project and then report back with those results for management's approval before proceeding with the complete program.
 - 6) Recall a lot of this work would probably have already been accomplished in preparation for the management presentation. Also approval for all necessary pilot project manpower resources should have been obtained at the same presentation.

will apply in general, it is important to use elements that represent the most major costs; time should not be wasted trying to come up with every possible element or, when controversial, into which category to place an element⁷⁾. As the elements are identified, the source of the cost data should be determined with priority going to existing accounting data and, that failing, a means for estimating the costs devised. Of course, the area supervisor should also be closely involved in setting up the COQ elements.

As Campanella says, from here on “it’s a matter of effort, patience, and perseverance.” Now the follow-on steps for collecting and using the COQ cost data are pursued including identifying the major costs and their drivers, conducting root cause analyses, devising and implementing the solution, and tracking progress in reducing the costs. In all likelihood, only a few of the major costs will be attacked, such as reducing scrap and rework, so that the project can show some fairly quick and significant results.

Assuming that management wants to see the results of the pilot project before giving the go-ahead for the full COQ program, another presentation will be scheduled with management once sufficient evidence of success has been obtained.

Educate everyone in the company about the COQ program. The degree to which this can be done will depend on whether management has given the full go-ahead or not. However, even if a full go-ahead is pending, the education can commence on a limited basis concurrent with the pilot project. In fact, the pilot project itself can be a vehicle for beginning this education effort by letting everyone know about it and its purpose. This could be done at little expense to the company and should start to raise interest in the COQ so that people will want to know more about it, especially if the initial information provided shows

7) When it is unclear or controversial which category to use simply pick one and stick with it since the important thing is consistency in collecting the data.

its benefits. After all, every functional manager should be interested in reducing his or her costs of operation. And, as they express interest, the quality manager can take advantage of that to tell them more about the program. The quality manager might even want to check with each functional manager to see if he or she would like to know more about the pilot project and the COQ in general.

Once management has given the full go-ahead a more formal education effort

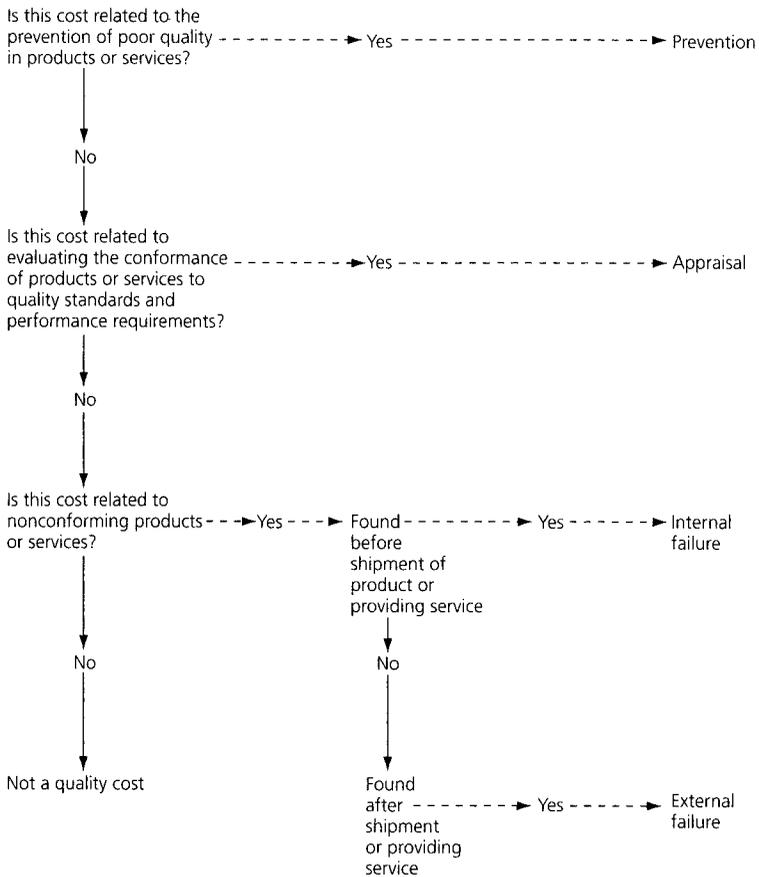


Figure 1. Decision chart for identifying COQ activities and assigning them to appropriate categories (from Campanella, p. 51)

should be undertaken. This would probably involve formal classes for at least the functional managers and possibly one or two levels below that depending on the size of the company. The emphasis in such classes should be on the benefits of the program and the need for the cooperation of all the functional managers to make it work. Again, the pilot project will provide an excellent example of how the COQ program will work; and, if the pilot project has begun to show results, of the benefits in terms of better quality and reduced costs.

As the other functional managers become educated about the COQ program, the quality manager can begin seeking their ideas for the program from their unique perspectives. In particular, these managers can be asked to identify activities of their department that might qualify as COQ costs elements. To do this they can be given a simple decision chart, such as shown in Figure 1 and the suggested elements shown in Appendix A⁸⁾ (both from Campanella). These actions of actively involving the other managers in developing the program will have the added benefit of them beginning to take ownership of it and remove it from the “Oh, that’s just something ‘Quality’ is doing” category or, worse yet, being perceived as just another “flavor of the month.”

In doing all this educating the primary underlying theme should be that the purpose of the COQ program is not to just collect and display the various costs associated with the four categories but to use that information for identifying the best opportunities for reducing costs and undertaking improvement activities accordingly. And as this happens, the functional managers will be expected to make whatever commitments are needed to ensure the success of these improvement activities.

Develop the internal COQ procedure. This step is perhaps the most important

8) As mentioned, these elements are from Appendix B of Campanella, which includes descriptions of each. These descriptions should help the functional managers better understand what an element is and what might be potential elements for their function.

since we are now going to put meat on the bones of the program for the entire company. Having undertaken a pilot program, we already know a great deal about what this procedure should be and can be guided by what we've learned from that project. The output from this procedure should be tables and/or charts that will (1) show us initially where our COQ costs exist and which are the biggest and, (2) as improvement efforts are undertaken, show us how those costs are changing. The steps leading to such an output are:

- Decide on the scope of the collection effort.
- Decide on and refine the COQ elements for each of the four categories.
- Identify the source(s) for the cost data for each COQ element.
- Assign responsibility for the collection and reporting of the cost data for each COQ element.
- Decide on which formats to use to summarize and present the COQ data and who is to receive these summary reports.

Decide on the scope of the collection effort. Now we must think about how we will approach this “entire company” data collection effort. Perhaps the most logical approach is to initially collect COQ costs for all functions across all COQ elements that apply to our company. To do this Campanella suggest a simple, albeit probably rather large, spreadsheet which shows the COQ elements along the left side and the functional areas along the top. Campanella’s example of this is reproduced at Appendix B. As such data is gathered and experience with the program is gained (e.g., via the pilot project), other ways to collect and display the COQ data will become evident. For example, Gryna shows an example of collecting the data for a bank’s installment loan process, which is reproduced at Figure 2. Note that in this example the COQ elements are not separated by category as they are with the Campanella example at Appendix B.

Other possibilities are accumulating the COQ cost data for each of the company’s profit centers—as suggested by Figure 3 taken from Campanella.

Operation	Prevention	Appraisal	Internal failure	External failure
Making a loan:				
Run credit check	0	0	26	0
Process GL tickets and I/L input sheets	0	0	248	0
Review documents	0	3014	8	0
Make document corrections	0	0	1014	0
Follow up on titles, etc.	0	157	0	0
Review all output	0	2244	0	0
Correct rejects and incorrect output	0	0	426	0
Correct incomplete collateral report	0	0	0	78
Work with dealer on problems	0	0	0	2482
I/L system downtime	0	0	520	0
Time spent training on I/L	1366	0	0	0
Loan payment:				
Receive and process payments	0	261	784	0
Respond to inquiries when no coupon is presented with payments	0	0	784	0
Loan payoff:				
Process payoff and release document	0	0	13	0
Research payoff problems	0	0	13	0
Total cost of quality (COQ)	1366	5676	3836	2560
COQ as % of total quality cost	10.2	42.2	28.5	19.1
COQ as % of reported salary expense (25.6%)	2.6	10.8	7.3	4.9

Source: Adapted from Aubrey (1988).

Figure 2. The COQ costs for a bank’s installment loan process (from Gryna, p. 8.9)

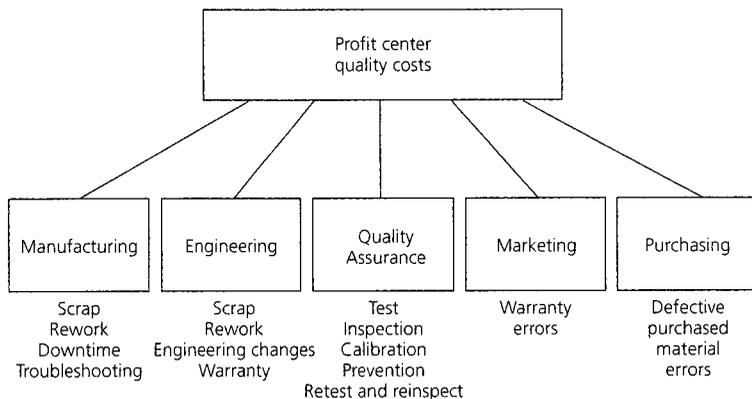


Figure 3. A profit center COQ example (from Campanella, p. 105)

These profit centers could be a factory or other operations facility, or even individual projects such as the pilot project. In any event, data should probably be collected for the entire company with the other areas/projects shown as subsets

of this complete picture.

Decide on and refine the COQ elements for each of the four categories. Once the scope of the COQ effort is determined, the full list of COQ elements can be decided upon and refined. Using all the experience and knowledge gained thus far, as complete a list of COQ elements as possible should be developed for the entire company. By this time this list should be fairly well defined since the quality manager will have been working with the functional managers refining whatever was used as a starting point (e.g., the elements shown in Appendix A [Appendix B in Campanella]).

Identify the source(s) for the cost data for each COQ element. Now the task is, for each COQ element, to identify the source(s) for its cost data. As with the pilot project the idea is to use as much data as is already available from existing accounting records. This means the quality manager must have a close working relationship with accounting and, as with the pilot project, even have a representative from accounting assigned to work with him or her,

As will already be realized from the pilot project, only some of the accounting data will be directly useful; for example accounts for scrap and rework, or an account that shows the costs of a department dedicated to inspections. More likely, it will be necessary to analyze the existing accounts and, where possible, breakout those parts that can be assigned to a specific COQ element. For example it is not uncommon for a cost standard for some product to include some set amount for defects—say ten percent. In this case we would want to break out this “hidden” cost and assign it to its proper failure cost element such as scrap or rework. In fact, it may become obvious that the existing accounting standard needs to be changed so as to no longer “hide” these important costs. In general, such tightening up of the accounts could well be a major side benefit of the COQ program.

Once we have exhausted all possible sources of cost data from the existing ac-

counts it will be necessary to devise means to estimate the remaining costs needed. According to Gryna, a good source of estimates is, of course, knowledgeable persons. Gryna (p. 8.13) also suggests other techniques such as keeping a temporary record of the time a production worker spends repairing defective product and then projecting that cost over the period of interest. Another technique mentioned is to estimate the cost to correct one common error or problem—for example correcting a billing error or handling a customer complaint—and multiply this “unit” cost by the number of similar error/problems during the period of interest. These “sampling” activities would have to be repeated from time to time to ensure they still provide a reasonably accurate basis for the total estimate.

Thus far we’ve been talking about direct costs associated with a product or service such as direct labor or direct material costs. However, to get more accurate cost the indirect costs must also be included. Traditionally, assigning an overhead cost based on some percentage of, say, direct labor is done. However, as both Gryna and Campanella point out this no longer provides a very accurate way to assign these costs since, due to improved manufacturing techniques, indirect costs are now a much larger percentage of the total cost. Therefore, to get a better estimate of the actual cost of a product or service we need to look at just what parts of the company’s general overhead costs are applicable to that product or service. In fact this is what Activity-Based Costing (ABC) does. For example, if one of the ABC cost drivers is machine setups, taking the total costs for all setups and dividing that by the number of setups would determine a per setup cost. Then each product would be assigned setup costs according to the number of machine setups it required. This sort of reasoning would be applied to all the cost drivers such as the cost of shipments, purchase orders, engineering changes, etc.

By assigning costs to a product or service in this way, a much more accurate estimate of its actual cost is obtained. In fact ABC is helpful not only in assign-

ing indirect costs but, in general, in allocating costs more accurately to specific cost elements. Accordingly, as we consider such things as the failure cost due to the scraping of some particular product we will have a much better picture of that COQ cost including its likely sources. Therefore, if a company is not already using ABC, as it implements its COQ program would be a good time to start.

Assign responsibility for the collection and reporting of the cost data for each COQ element. As we are developing the elements and identifying the sources for the cost data we should also be thinking about how the cost data will actually be collected and reported. It could be that some the elements will require input from more than one source. In any event, all sources and the person responsible should be identified and formally designated. Also a format and schedule for reporting the collected data should be promulgated. To keep the program from being viewed as “not really official” or “a ‘quality’ thing” the data should go to the accounting department for summarizing and final reporting. Having decided on the scope of the COQ program, the data will initially be collected on some sort of spreadsheet such as already discussed and shown in Appendix B.

Decide on which formats to use to summarize and present the COQ data and who is to receive these summary reports. Probably the primary recipient of the reports will be the quality manager who will then use them to brief management at periodic management reviews. However, once the COQ data is used to initiate improvement projects, summary reports for individual projects would probably be made available directly to those project leaders on an as-required basis. Although any reasonable format could be used, a typical one at the company-level, as suggested by Campanella, might look like that in Appendix C. Once the COQ program gets underway, trend charting should be used to show how the total COQ costs and those in each category are changing. Appendixes D and E are examples from Campanella of such charts. Note that the Appendix D chart is for a particular department/area/project and shows only total COQ costs whereas

the Appendix E chart—probably at the company-level—breaks out the costs by category (with the failure costs combined). Actual charts would be tailored to the needs of the organization.

In determining the reporting format one other thing must be decided: what base to use to compare the COQ costs against. As Campanella points out, actual dollar amounts are probably useful for deciding where to initiate quality improvement projects, however “unless the amount of work is constant, it will not provide a clear indication of the quality cost improvement trends” (p. 34). He further points out that: “For long-range analyses, net sales is the base most often used for presentation to top management” but such a measurement is not “practical and could be misleading for the day-to-day, week-to-week, month-to-month needs of the practitioners who are commissioned to make it happen” (p. 34). In other words, for short-range analyses a base that reflects actual conditions in terms of work performed is needed. Figure 4, from Gryna, lists some measurement bases and their advantages and disadvantages. Note that the table shown in

Base	Advantages	Disadvantages
Direct labor hours	Readily available and understood	Can be drastically influenced by automation
Direct labor dollars	Available and understood, tends to balance and inflation effect	Can be drastically influenced by automation
Standard manufacturing cost dollars	More stability than above	Includes overhead costs both fixed and variable
Value-added dollars	Useful when processing costs are important	Not useful for comparing different types of manufacturing departments
Sales dollars	Appeals to higher management	Sales dollars can be influenced by changes in prices, marketing costs, demand, etc.
Product units	Simplicity	Not appropriate when different products are made unless “equivalent” item can be defined

Figure 4. A comparison of some COQ measurement bases (reproduced from Gryna, p. 8.24)

Appendix C has columns for showing the COQ costs both in actual dollars and as a percent of bases (sales and “other”). Also the trend charts shown in Appendixes D and E are plotted against bases.⁹⁾

At this point we have done everything necessary to set us up for the real reason for the COQ program: reducing the COQ costs through improvement activities. This we will talk about next.

6. Using the COQ Program for Improvements

The following steps seem a logical way to use the COQ cost data to improve quality and, accordingly, reduce costs:

- Identify the largest contributors the COQ costs.
- Using Pareto analyses, identify the main reason(s) for those costs for each major contributor.
- Using techniques such as the “Five Whys,” determine the root cause of each main reason.
- Initiate and monitor corrective action.

Identify the largest contributors to the COQ costs. Having set up a numbering system such as in Appendix A, it is easy to break out the costs by category and then at any level. For example, all prevention costs start with 1, all appraisal costs with 2, etc. And then within each category the costs can be further broken out by element and sub-element. For example all prevention costs associated with getting customer feedback on our product/service start with 1.1. Accordingly, by summarizing the data in dollars and base percentages in tables (such as Appendix C) and trend charts (such as Appendixes D and E), it will soon become obvi-

9) Note that the Appendix D chart, for a department/area/project, uses direct labor as a base whereas the Appendix E chart uses sales. The Appendix D chart would probably be used for tracking some relatively short-range improvement activities and the Appendix E chart for briefing upper management on long-range trends.

ous where the largest costs are coming from.

Using Pareto analyses, identify the main reason(s) for those costs for each major contributor.

As an example, suppose sub-element 3.3.5—Scrap Costs (Operations)¹⁰—is found to be a large cost. Using a Pareto analysis you could find which products are causing you to incur the most costs due to scrap. Then another Pareto analysis could be used to identify the main reasons for each of these “major cost incurrens.” Let’s say the product identified is a housing the company produces and, again borrowing from Campanella, Figure 5 shows the results of the Pareto analysis of the reasons¹¹. It is obvious that a good place to begin would be to find out why so much damage is happening since this constitutes about half of the total costs. Figure 6 is another example from Gryna for “penalties” (cost element 4.6 in Appendix A). Note

that this combines two Pareto analyses by first identifying the three common reasons for the penalties (Cost Drivers) and then, causes for each reason (Root Causes)¹². A cursory examination of Figure 6 shows that we need to investigate the root causes(s) of “poor raw materials” which are accounting for 60% of the total penalties costs.

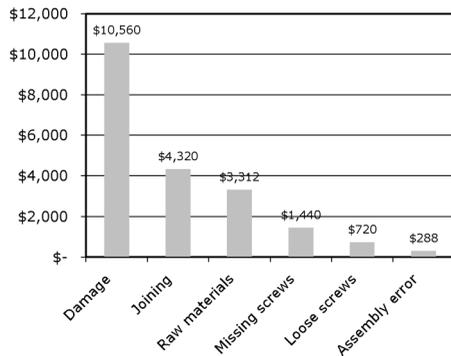


Figure 5. Example of Pareto analysis of causes of scrap for a housing product (adapted from Campanella, p. 68)

10) See page 5 of Appendix A.

11) The costs could be obtained by having the reason for each housing scraping recorded over some set period, say each month.

12) However I would question his use of the term Root Causes since it seems these are really intermediate causes.

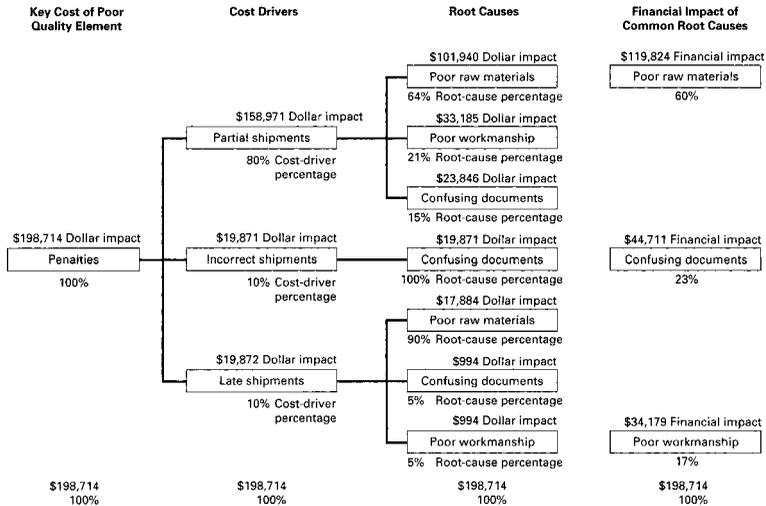


Figure 6. Example of Pareto analyses for penalties (from Gryna, p. 8.21 [in turn adapted from Atkinson, Hamburg, and Ittner, 1994, p. 142])

Using techniques such as the “Five Whys,” determine the root cause of each main reason. At some point a team¹³⁾ would probably be established to bring together the necessary expertise and functional representation—depending on the specific COQ problem—to do a root cause analysis and develop solutions. This team may be constituted even before we get to this root cause stage to do the preliminary work of identifying the major cost contributors and the main reasons for those costs. In any event, now the task is to ask why do these reasons exist; for example, for our scrap example in Figure 5 we would begin asking why is the damage occurring. If one answer is because of rough handling in transport, then why is that happening, etc. until we finally gain enough information to be working on the solution.

Initiate and monitor corrective action. At this point, the team should have

13) Or multiple teams depending on how many quality problems the company wishes to work on at the same time.

enough information to take corrective action to eliminate the root cause. For example for “damage” (causing about half of the scrap) a solution might be to change the way the housings are transported. This might entail developing a better transporter or training the material mover.

Once the corrective action has been implemented, then the team (or maybe just the quality manager since the team’s work is essentially done) should continue to monitor the COQ element in question to verify that the corrective action is working and has caused scrap and associated costs to decrease.

The examples we’ve used in this section are, of course, only a small part of the total COQ picture and it is conceivable that once the program is fully up and running there would be several teams operating at all times attacking various COQ problems throughout the organization. And behind all this effort is the well-structured COQ system into which COQ cost data is regularly being fed and from which COQ reports are being produced when needed and for whoever needs them. This is not to suggest that a good COQ program is meant to begin generating a mass of paperwork but only that it has the potential to report what’s needed, when it’s needed.

7. Other Matters Related to the COQ

In this section we will discuss the follow miscellaneous related matters:

- How ISO 9001 relates to the COQ
- Linking the COQ to an organization’s strategic goals
- COQ and Lean Enterprise/Six Sigma
- Why organizations often fail to use COQ effectively
- Hidden costs

How ISO 9001 relates to the COQ. ISO 9001 is an international standard for quality management systems. Once an organization has been certified as meeting

this standard it may advertise that fact.¹⁴⁾ Since this standard is so popular and almost a requirement in today's highly competitive environment, I thought it would be useful to see how its requirements align with a set of generic COQ elements, namely those shown in Appendix A (from Campanella). Appendix F attempts to do this. Appendix F lists each ISO 9001 requirement. For each requirement I tried to show which COQ category (P, A, IF, or EF) and COQ element it was related to. The information in Appendix F is not considered perfect and probably fails to completely match all COQ elements with an ISO 9001 requirement, but it does show there is a close relationship between the two programs as well there should be. It is noteworthy that almost all of the requirements of ISO 9001 are related to either a prevention or appraisal cost element. This makes sense since we are talking about the requirements for a quality management system that, by definition, is meant to prevent or detect nonconformities before they become failure costs.

It should be noted that ISO 9001 has two companion documents: ISO 9000, *Fundamentals and Vocabulary*, and ISO 9004, *Guidelines for Performance Improvement* (see references). ISO 9004 provides anyone really serious about having a good quality management system a lot of guidance for doing this. Austenfeld (2002) provides more information about these ISO 9000 standards—issued in 2000—and how they differ from the previous set, which was issued in 1994.

Linking the COQ to an organization's strategic goals. Campanella briefly discusses how a COQ program can support a company's strategic planning process (pp. 73 & 74). Schottmiller (2001) has developed a model for linking quality costs to an organization's strategic goals. His model is built around a COQ database that is fed by information from both the formal reporting system (such

14) It should be noted that being ISO 9001 certified doesn't necessarily mean the organization will provide quality products or service, only that *at the time of certification*, its quality management system had that capability.

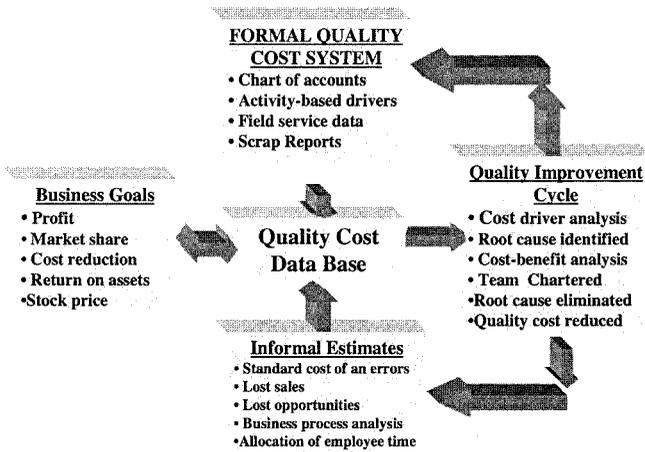


Figure 7. A model linking the COQ with an organization's strategic business goals. (from Schottmiller, 2001)

as established accounts and ABC “drivers”) and informal estimates. Out of this database comes the information needed to effect quality improvements. The database also feeds into the organization's strategic business goals helping to shape them. And, these goals also help shape the database by dictating what new or additional information is needed to meet those goals. Figure 7 shows this model. The bottom line here is that a robust COQ program can provide valuable information for helping an organization develop strategic goals and monitor their accomplishment.

COQ and Lean Enterprise/Six Sigma. As should be evident from what has been written above the COQ program is focused on developing a way to view all COQ costs in a company and then homing in on those areas where the costs are largest and setting up improvement projects to find fixes to reduce those particular costs. In looking for solutions to specific quality problems there are two quality methodologies that have become popular over the last ten or so years: Lean Enterprise and Six Sigma. Lean Enterprise is finding ways to eliminate sources

of waste in the company such as excessive (or really any) scrap or rework. Austenfeld (2003) provides an introduction to Lean Enterprise and Austenfeld (2004) provides examples of Lean Enterprise techniques. There are many good references on Lean Enterprise such as Levinson & Rerick (2002), Liker (1998), and Womack & Jones (1996).

Six Sigma is a methodology pioneered by Motorola that has as its objective to reduce variation. In fact, the goal of Six Sigma is to reduce variation so much in a single-step process that the number of defects is only 3.4 parts per million (ppm). This compares with a defect level of about 60,000 ppm using what has been a traditional “three sigma” standard for quality (Pyzdek, 1999, Appendix Table 18). Given that many of today’s processes are actually multiple steps and the yield percentages for each step are multiplied for a total process yield, the need for Six Sigma is obvious. In fact as Pyzdek says “Considering that the complexity of modern processes is usually far greater than ten steps, it is easy to see that Six Sigma quality isn’t optional; it’s required if the organization is to remain viable” (p. 142). In fact, the advantages of Six Sigma in terms of reducing defects and producing high quality products are enormous and many companies—notably General Electric when under Jack Welch—have adopted it. Austenfeld (2000) offers a brief overview of Six Sigma and, like Lean Enterprise, there are many good references such as Pyzdek (1999), Breyfogle (1999), and Pande, et al. (2000).

Although both the Lean Enterprise and Six Sigma offer excellent methodologies for solving specific problems detected by the COQ data, they are also worthwhile components of an ongoing general quality improvement effort. However it probably makes sense to let the information gained from analyses of the COQ data guide where these methods can be applied most cost-effectively.

Why Organizations often fail to use COQ effectively. The excellent article by Sower & Quarles (2003) reports the results of a survey of U.S. businesses about

whether they use COQ and, if not, why not. They found that “only about one third of organizations in the sample systematically track quality costs.” The reasons most often cited for this were:

- Lack of management interest/support
- Company economic condition or status
- Lack of knowledge (both in general about the principles of the COQ and more specifically about which items to include in the COQ program, and if they had the requisite experience to properly execute the program)
- Lack of adequate accounting and computer systems
- Do not see the benefit of COQ

Sower & Quarles make suggestions for overcoming these obstacles, which are summarized in their conclusions:

Key aspects of these suggestions include the need for education in quality principles throughout the organization, knowledge of change management processes by quality professionals, the need to translate the language of quality into the language of business, and recognition of the power of modern information systems—particularly ERP¹⁵⁾ and ABC systems—in facilitating tracking of COQ. Perhaps most important is the recognition that better results result when better information is available. Even approximately accurate COQ data can facilitate better decisions, so the fact that some quality costs (e.g., external failure costs) can only be estimated should not deter an organization from implementing a COQ system.

If anyone is experiencing difficulty in implementing a COQ program they should realize they are not alone and could probably benefit from a perusal of the Sower and Quarles’ article.

15) Enterprise resource planning systems are company-wide, real-time computer systems that integrate all the company’s functions. The two most famous ERP companies are Oracle in the U.S. and SAP in Germany.

Hidden costs. We've already mentioned the hidden costs that might exist in a standard that, say, allows ten percent of the costs to be allocated to scrap. Of course this cost needs to be separated from the standard so it can begin to be accurately accounted for and reduced. However there are many other examples of "hidden" costs. For example engineering time that is used for preventive or corrective action work but, again, not broken out as such. Another example is what's been called the "hidden factory"; e.g., a production worker who spends a lot of time correcting some defect so he or she can be sure to pass a "good" part on downstream. Besides a lot of extra labor being used due to poor quality, the problem is compounded by the fact that the *cause* of the nonconformance never gets attended to. Another example is excessive inventory or unnecessary movement of parts and material due to a poor plant layout. Many of these "waste" problems can be solved with an aggressive Lean Enterprise program.

A special class of hidden costs—associated with external failure—is business lost due to customers being unsatisfied with the product or service. If the customer complains at least the company can account for the cost of handling the complaint¹⁶⁾, but what about the customers who don't complain but simply take their business elsewhere. Also there is the ripple effect of a dissatisfied customer telling others about their bad experience with the product or service. Campanella says that it may not be possible to estimate such costs but, in any event, "...at least identify the areas of customer dissatisfaction" (p. 85) so you can take improvement actions. A rigorously run customer complaint program will help identify such areas.

The bottom line here is to be aware of the many possible places where hidden costs might be lurking and try to devise ways to account for them in the COQ database, even if it is necessary to make rough but educated estimates.

16) And gain valuable information about customer dissatisfaction.

8. Summary and Conclusion

The purpose of this paper has been to provide an overview of the COQ. Accordingly I've briefly discussed the history of the COQ, the four categories of the COQ, the preliminary steps and follow-on actions when setting up a COQ program, the use of the COQ program for improvements, and various matters related to the COQ. Regarding the last thing these are the areas that were covered:

- How ISO 9001 relates to the COQ
- Linking the COQ to an organization's strategic goals
- COQ and Lean Enterprise/Six Sigma
- Why organizations often fail to use COQ effectively
- Hidden costs

In concluding I would suggest that the main points about the COQ are these¹⁷⁾:

- If a company is not tracking its COQ, these costs are probably much greater than management realizes.
- The reason a COQ program can be very effective in getting management's attention is it uses "the language of management"; i.e., dollars. Not only does this get management's attention initially, it is the key for management's all-important continued support of the program.
- Every dollar saved by reducing internal or external failure costs means another dollar of profit or another dollar that can be used for improvements.
- The ultimate purpose of a COQ program is not to simply display all the costs in the four categories but to use that data for deciding what improvements to do next and then carrying out and monitoring those improvements.
- Money wisely spent on improvements usually has a large pay off. Another

17) There are probably others but these are the ones that seemed most important to me.

way of saying this is that prevention costs are usually very cost-effective.

- As your failure costs decrease you can usually decrease your appraisal costs as there should be less need for tests and inspections.
- Everyone in the organization should be educated in the COQ and ad hoc teams formed and trained as necessary to tackle specific improvements. Often multiple functional areas will be involved.

Finally I would recommend anyone thinking about setting up a COQ program take advantage of the ASQ Quality Costs Committee's resources. Shepherd (2003) describes a number of useful resources including a CD that had just been released for "simple, self-paced" learning. Other resources include Application Notes—short two-sided single sheets—on various COQ subjects¹⁸⁾ and a "number of other publications." These resources are available to ASQ members through its website. The Committee also provides on-site training on the COQ. Appendix G is a description of a two-day course. Additionally I would recommend the two references I've drawn on heavily for this paper, the Committee's *Principles of Quality Costs* edited by Campanella and Section 8 in *Juran's Quality Control Handbook* by Gryna titled "Quality and Costs." I would also recommend Chapter 7 of Feigenbaum (1991): "Quality Costs—Foundation of Quality-Systems Economics."

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18) For example "Quality Costs—How and Where to Start," "Integrating Cost of Quality with the Balanced Scorecard," and "Quality Costs—Implementation in a Service Organization."

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Appendix A (page 1 of 6)

Campanella's Suggested Breakdown of the COQ Elements

(Adapted from Campanella, 1999, Appendix B)

On the next page is a first and second tier breakdown of the COQ elements as suggested by Appendix B of the Campanella book *Principles of Quality Costs*.

As Campanella states:

This list is not meant to contain every element of quality cost applicable to every business. It is intended to give the reader a general idea of what type of elements are contained within each cost category to help in deciding individual classifications for actual use. (p. 187)

He also states: "A quality cost program need not identify all elements [as listed here]; rather, it should concentrated on the quality cost elements most significantly affecting your company" (p. 19).

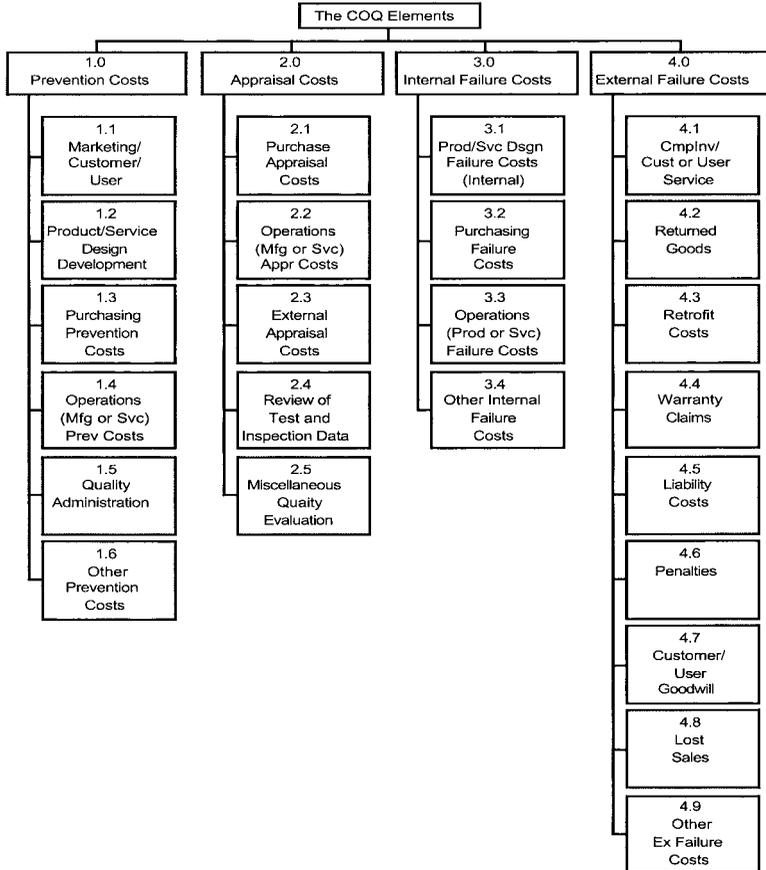
The full breakdown of each category is shown respectively on the four pages following the next page.

Appendix A (page 2 of 6)

Campanella's Suggested Breakdown of the COQ Elements

(continued)

(Adapted from Campanella, 1999, Appendix B)



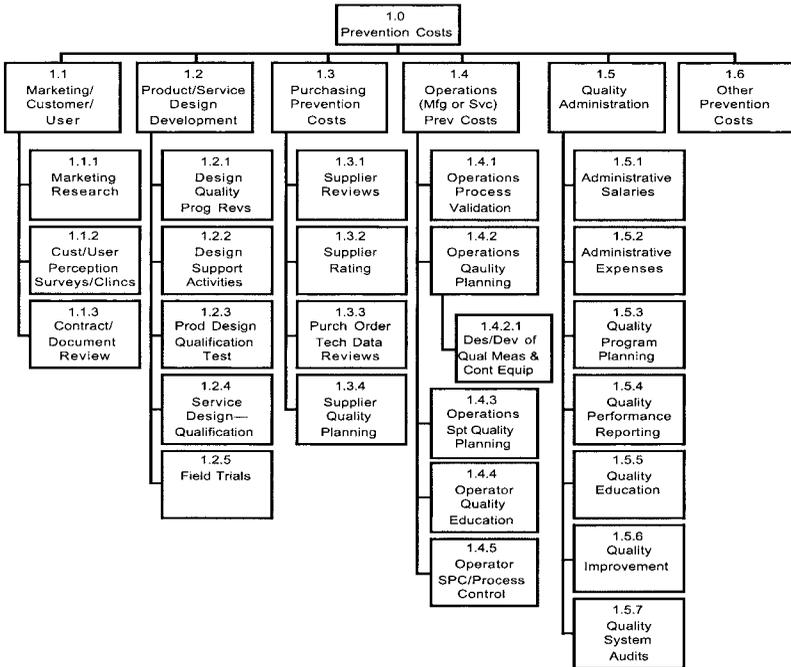
Appendix A (page 3 of 6)

Campanella's Suggested Breakdown of the COQ Elements

(continued)

(Adapted from Campanella, 1999, Appendix B)

A Breakdown of the Prevention Cost Elements



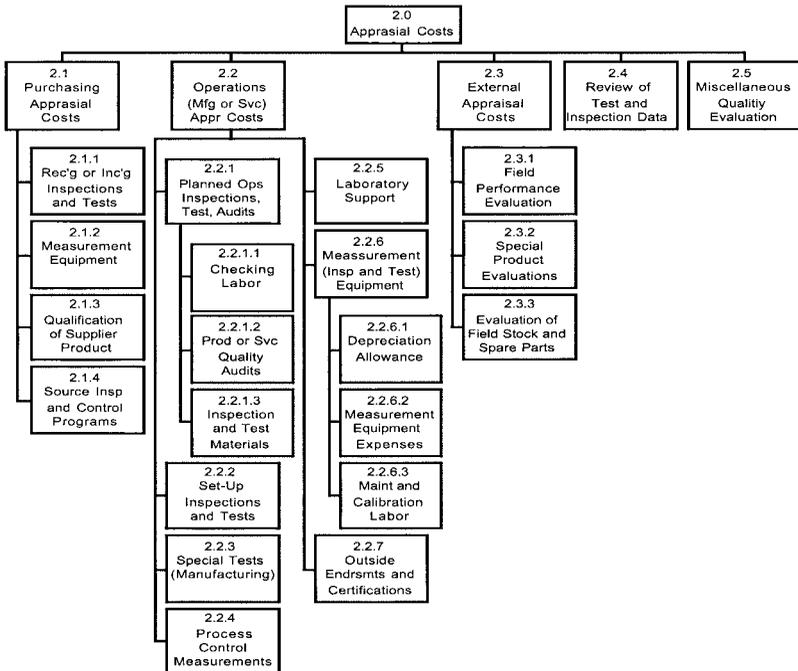
Appendix A (page 4 of 6)

Campanella's Suggested Breakdown of the COQ Elements

(continued)

(Adapted from Campanella, 1999, Appendix B)

A Breakdown of the Appraisal Cost Elements



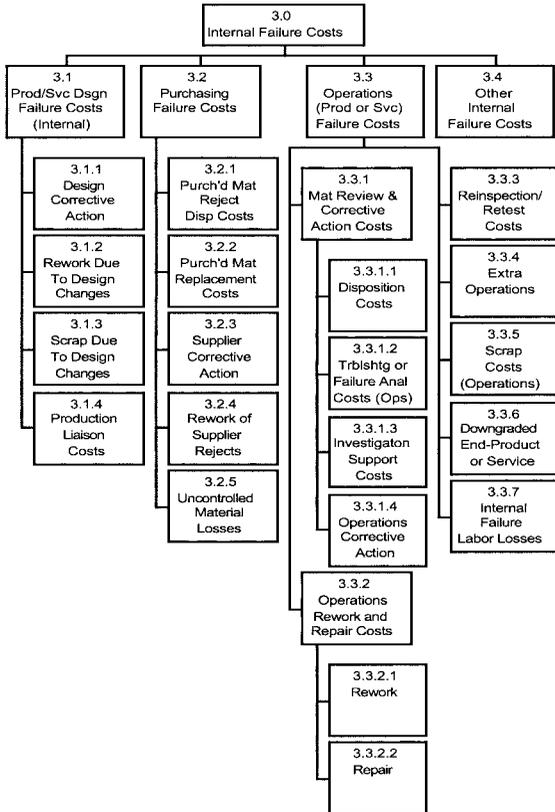
Appendix A (page 5 of 6)

Campanella's Suggested Breakdown of the COQ Elements

(continued)

(Adapted from Campanella, 1999, Appendix B)

A Breakdown of the Internal Failure Cost Elements



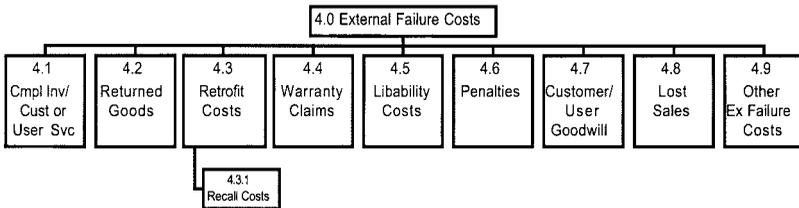
Appendix A (page 6 of 6)

Campanella's Suggested Breakdown of the COQ Elements

(continued)

(Adapted from Campanella, 1999, Appendix B)

A Breakdown of External Failure Cost Elements



Appendix B

A Suggested Spreadsheet for Collecting COQ Data

(from Campanella, 1999, p. 56)

Department															
Element	Description	Accounting	Administration	Engineering	Estimating	Field services	Manufacturing engineering	Marketing	Procurement	Production	Production control	Quality	Receiving	Shipping	Totals
Code															
1.1.1	Marketing research														
1.1.2	Customer/user perception surveys/clinics														
1.1.3	Contract/document review														
1.2.1	Design quality progress reviews														
1.2.2	Design support activities														
1.2.3	Product design qualification test														
1.2.4	Service design — qualification														
1.2.5	Field trials														
1.3.1	Supplier reviews														
1.3.2	Supplier rating														
1.3.3	Purchase order tech data reviews														
1.3.4	Supplier quality planning														

Appendix C

A Suggested Format for Summarizing and Presenting the COQ Data

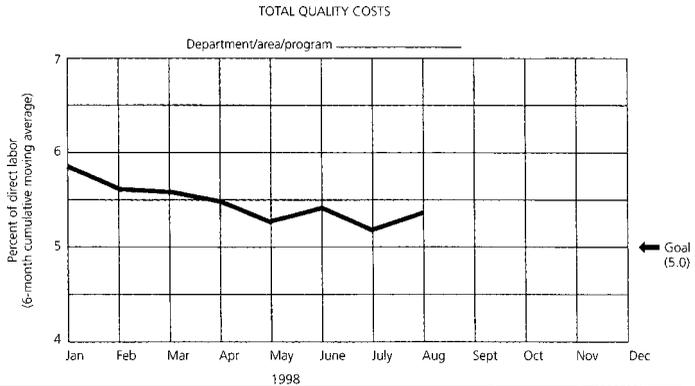
(from Campanella, 1999, p. 57)

QUALITY COST SUMMARY REPORT FOR THE MONTH ENDING _____ (In thousands of U.S. dollars)						
Description	Current month			Year to date		
	Quality costs	As a percent of		Quality costs	As a percent of	
		Sales	Other		Sales	Other
1.0 Prevention costs						
1.1 Marketing/customer/user						
1.2 Product/service/design development						
1.3 Purchasing prevention costs						
1.4 Operations prevention costs						
1.5 Quality administration						
1.6 Other prevention costs						
Total prevention costs						
Prevention targets						
2.0 Appraisal costs						
2.1 Purchasing appraisal costs						
2.2 Operations appraisal costs						
2.3 External appraisal costs						
2.4 Review of test and inspection data						
2.5 Misc. quality evaluations						
Total appraisal costs						
Appraisal targets						
3.0 Internal failure costs						
3.1 Product/service design failure costs						
3.2 Purchasing failure costs						
3.3 Operations failure costs						
3.4 Other internal failure costs						
4.0 External failure costs						
Total failure costs						
Failure targets						
Total quality costs						
Total quality targets						
Base data	Current month		Year to date		Full year	
	Budget	Actual	Budget	Actual	Budget	Actual
Net sales						
_____ Other base (specify)						

Appendix D

An Example of a “Short-Range” Trend Chart for a Department/ Area/Program Using Direct Labor as a Base

(from Campanella, 1999, p. 59)

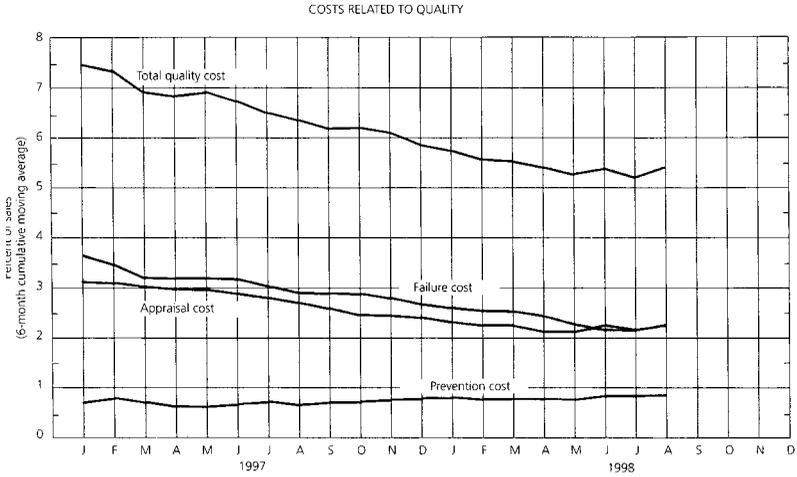


Total quality cost*	937.9	921.8	1380.5	1217.2	888.9	1385.5	1157.5	1290.7				
Direct labor*	16,429	18,984	25,028	21,051	18,562	25,363	24,546	20,943				
% of direct labor	5.7	4.9	5.5	5.8	4.8	5.5	4.7	6.2				
6-month moving average	5.8	5.6	5.6	5.5	5.3	5.4	5.2	5.4				

*In thousands

Appendix E

An Example of a “Long-Range” Trend Chart Using Sales as a Base (from Campanella, 1999, p. 60)



Appendix F (page 1 of 6)

Matching the ISO 9001 Requirements With the COQ Elements

The following pages list the requirements of the ISO 9001 (reference ANSI/ISO/ASQ Q9001-2000). For each requirement, an attempt has been made to show which COQ category it relates to—prevention, appraisal, internal failure, or external failure—and which Appendix A COQ element it relates to. The following abbreviations are used:

P	Prevention Costs
A	Appraisal Costs
IF	Internal Failure Costs
EF	External Failure Costs
COQ	Cost of Quality
QMS	Quality Management System
ABC	Activity-Based Costing

It should be noted that the list on the following pages starts with clause 4 of the ISO 9001 standard. This is because the first three clauses deal with “administrative” matters such as the scope of the standard and terms and definitions. The requirements are set forth under these five clause headings:

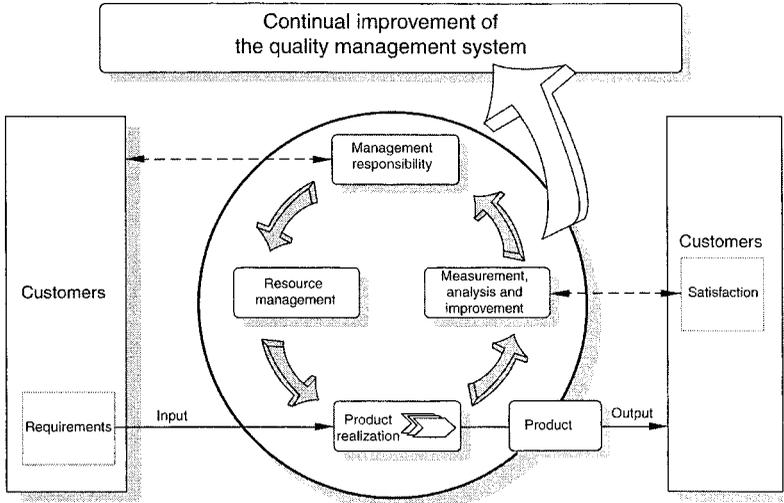
4. Quality Management System
5. Management Responsibility
6. Resource Management
7. Product Realization
8. Measurement, Analysis and Improvement

The requirements are grouped this way to show that together they make up a model of a “process-based” quality management system as shown on the next page.

Appendix F (page 2 of 6)

Matching the ISO 9001 Requirements With the COQ Elements

(continued)



Key

- ▶ Value-adding activities
- - -▶ Information flow

Note: This model is from ANSI/ISO/ASQ Q9001-2000, p.x.

Appendix F (page 3 of 6)

Matching the ISO 9001 Requirements With the COQ Elements

(continued)

ISO 9001 Requirement	P, A, IF or EF related	Comment on requirement(s)	Related Appendix, A COQ element(s)
4 Quality Management System			
4.1 General Requirements	P	Concerned with establishing and maintaining the QMS.	1.5 Quality Administration
4.2 Documentation Requirements			
4.2.1 General	P	Sets forth documentation and records required, mostly 1.5.3 (Quality Program Planning) and 1.5.4 (Quality Performance Reporting).	1.5 Quality Administration
4.2.2 Quality Manual	P	Quality program planning.	1.5.3 Quality Program Planning
4.2.3 Control of Documents		Concerned with the control of documents and records. Most COQ costs would probably come under Administrative	1.5 Quality Administration
4.2.4 Control of Records	P	Salaries/Expenses (1.5.1/1.5.2)	
5 Management Responsibility			
5.1 Management Commitment			
5.2 Customer Focus			
5.3 Quality Policy			
5.4 Planning			
5.4.1 Quality Objectives			
5.4.2 Quality Management System Planning	P	These are actions top management must take, such as ensuring the establishment of a good QMS. It is not clear (to me) whether these "management" costs would fall under a specific COQ element or be chalked up to overhead. If an organization were to charge it to a COQ element it would probably be 1.6 Other Administrative Costs.	1.6 Other Prevention Costs?
5.5 Respons. Auth. and Comm			
5.5.1 Respons and Auth			
5.5.2 Management Rep			
5.5.3 Internal Comm			
5.6 Management Review			
5.6.1 General			
5.6.2 Review Input	P	This review is to ensure the QMS is doing what it's suppose to be doing. In a sense, it represents the ultimate "prevention" activity since it is here management get the results of audits, customer feedback, corrective actions, etc. and decisions are made about future improvement actions.	1.6 Other Prevention Costs?
5.6.3 Review Output			
6 Resource Management			
6.1 Provision of Resources	P	"...to enhance customer satisfaction by meeting customer requirements." This ISO 9001 requirement is too general to assign a COQ element.	n/a

Appendix F (page 4 of 6)

Matching the ISO 9001 Requirements With the COQ Elements

(continued)

ISO 9001 Requirement	P, A, IF or EF related	Comment on requirement(s)	Related Appendix A COQ element(s)
6 Resource Management (continued)			
6.2.1 General	P	Concerned with ensuring those performing work affecting quality are competent based on education, training, and experience.	1.4.4 Operator Quality Education 1.5.5 Quality Education
6.2.2 Competence, Awareness and Training			
6.3 Infrastructure	P	Concerned with the buildings, utilities, equipment, supporting services, and "work environment" needed for product conformity. These costs would probably be considered overhead and charged to specific COQ elements according to some allocation scheme or using an ABC system.	n/a
6.4 Work Environment			
7 Product Realization			
7.1 Planning of Prod Realization	P	Concerned with actions to ensure attention to quality matters during the design and development stage.	1.2 Product/Service/Design Development
7.2 Customer-related Processes	P	Concerned with all requirements, both customer-specified and those known by the organization to be necessary (e.g., regulatory). COQ element 1.1 focuses on the quality-related requirements.	1.1 Marketing/Customer/User Development
7.2.1 Determination of Rqmts Related to the Product			
7.2.2 Review of Rqmts Related to the Product			
7.2.3 Customer Communication	P, EF	Concerned with customer communications in connection with: the product, inquires, the contract, and customer complaints.	1.1 Marketing/Customer/User 4.1 Complaint Investigations/Customer or User Service (<i>partially</i>)
7.3 Design and Development	P, IF	All actions taken to plan and carry out an effective design and development effort. This effort should result in a final design that meets all "design and development inputs" such as functional and performance requirements and applicable statutory and regulatory requirements. Although some of these actions are pure design and development matters, there is probably a close relation with COQ element 1.2 (Product/Service/Design Development) cited at 7.1 above. By implication would include COQ element 3.1, costs related to problems with the design (IF costs).	1.2 Product/Service/Design Development (<i>partially</i>) 3.1 Product/Service Design Failure Costs (Internal)
7.3.1 D&D Planning			
7.3.2 D&D Outputs			
7.3.3 D&D Review			
7.3.4 D&D Verification			
7.3.5 D&D Validation			
7.3.6 Cntrl of D&D Changes			

Appendix F (page 5 of 6)

Matching the ISO 9001 Requirements With the COQ Elements

(continued)

ISO 9001 Requirement	P, A, IF or EF related	Comment on requirement(s)	Related Appendix A COQ element(s)
7 Product Realization (continued)			
7.4 Purchasing			
7.4.1 Purchasing Process	P, A, IF	Concerned with ensuring (1) the supplier is capable of providing the desired product or service (P costs) and (2) the conformity of the product or service (A costs). By implication would include COQ element 3.2, costs related to problems with purchased material.(IF costs).	1.3 Purchasing Prevention Costs 2.1 Purchasing Appraisal Costs 3.2 Purchasing Failure Costs
7.4.2 Purchasing Information			
7.4.3 Verification of Purchased Product			
7.5 Production and Service Provision			
7.5.1 Control of Production and Service Provision	P	Concerned with all activities needed to ensure control of the provision of the product/service.	1.4 Operations (Manufacturing or Service) Prevention Costs
7.5.2 Validation of Processes for Production and Service Provision	P	Concerned with validation of any processes where the output can't be verified by monitoring or measurement.	1.4.1 Operations Process Validation
7.5.3 Identification and Traceability			
7.5.4 Customer Property	P	Concerned with identification/traceability of the product, control of customer property, and preservation/packaging. The COQ costs associated with these three requirements would seem to fall under operations support.	1.4.3 Operations Support Quality Planning
7.5.5 Preservation of Product			
7.6 Cntrl of Mtr'g & Mstr'g Devices	A	Concerned with determining monitoring and measuring requirements and the provision and control of equipment therefor. COQ element 2.1.2 is under purchasing and 2.2.6 is under operations.	2.1.2 Measurement Equipment 2.2.6 Measurement (Inspection and Test) Equipment
8 Measurement, Analysis and Improvement			
8.1 General	P, A	A very general requirement that the organization will plan and implement the processes needed to check conformity of the product and the QMS and to improve the QMS. Accordingly, all of COQ element 2.0 would seem to apply as would element 1.5.6 under prevention costs.	2.0 Appraisal Costs 1.5.6 Quality Improvement
8.2 Monitoring and Measurement			
8.2.1 Customer Satisfaction	P	Concerned with measuring customer perceptions of the quality of the product/service.	1.1.2 Customer/User Perception Surveys/Clinics
8.2.2 Internal Audit			
8.2.3 Monitoring and Measurement of Processes	P	Concerned with determining (1) if the QMS conforms to all requirements and is effectively implemented/maintained and (2) that the QMS is effective (and corrected when found wanting). (Note: Costs related to <i>correcting</i> QMS deficiencies would probably come under element 1.5.6.)	1.5.7 Quality System Audits 1.5.6 Quality Improvement

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Matching the ISO 9001 Requirements With the COQ Elements

(continued)

ISO 9001 Requirement	P, A, IF or EF related	Comment on requirement(s)	Related Appendix A COQ element(s)
8 Measurement, Analysis and Improvement (continued)			
8.2.4 Monitoring and Measurement of Product	P, A	Concerned with verifying that the product requirements have been met at each stage (design and production).	1.2 Product/Service/Design Development 2.2 Operations (Manufacturing or Service) Appraisal Costs (less 2.2.6 Measurement [Inspection and Test] Equipment)
8.3 Ctrl of Nonconforming Prod	IF, EF	Concerned with action taken on nonconforming product identified either before or after delivery to the customer.	3.3 Operations (Product or Service) Failure Costs 4.9 External Failure Costs
8.4 Analysis of Data	P	Concerned with the collection and analysis of data on the suitability and effectiveness of the QMS to include where improvement can be made. Similar to requirements 8.2.2 and 8.2.3.	1.5.7 Quality System Audits 1.5.6 Quality Improvement
8.5 Improvement			
8.5.1 Continual Improvement	P	Concerned with continually improving the QMS.	1.5.3 Quality Management Planning 1.5.4 Quality Performance Reporting 1.5.6 Quality Improvement 1.5.7 Quality System Audits
8.5.2 Corrective Action	IF	Concerned with taking corrective action in general.	3.1.1 Design Corrective Action 3.2.3 Supplier Corrective Action 3.3.1.4 Operations Corrective Action
8.5.3 Preventive Action	P	A very general requirement that the organization will determine (and take?) action to eliminate the causes of potential nonconformities. It seems this would be related to all COQ prevention cost elements.	1.0 Prevention Costs

Appendix G (page 1 of 3)

Description of ASQ's Two-day On-site Course on Quality Costs Principles

(<http://www.asq.org/on-site-training/topics/qcostprinciples.html>,
as of October 2005)

Quality Cost Principles

Improve customer satisfaction and financial performance using this powerful tool. Surveys show a vast majority of companies either overlook or are unaware of the concept of Cost of Quality (CoQ). Successful use of CoQ shifts the focus from a quality cost system to using CoQ as an effective tool in the selection and management of improvement efforts. (Two day course)

Who Should Attend

Managers, supervisors, quality leaders, and facilitators responsible for and involved in continuous improvement will benefit from this course, as will representatives from accounting and finance.

Learning Outcomes

- Know how to conduct CoQ assessments
- Use CoQ to manage improvement projects to increase customer satisfaction and financial performance for your company
- Be able to identify CoQ cost-drivers within your organization
- Understand how to make a quality cost study

Course Agenda

- I. Introduction
- II. Linkage of Quality Improvement and Profits
 - A. Background of Quality Costs
 - B. Evolution of Quality

Appendix G (page 2 of 3)

**Description of ASQ's Two-day On-site Course on Quality Costs
Principles** (continued)

1. Definition of Quality
2. Quality - A Competitive Weapon
- C. Traditional vs. Value-Driven Quality Strategy
- D. Video - Quality Costs for Continuous Improvement
- III. Cost of Quality Definitions and Types
- IV. Successful COQ Initiatives
 - A. Integrate COQ with Strategic Management Initiatives
 - B. Assess COQ
 - C. Estimate Cost of Lost Sales Opportunities
 - D. Use COQ in Management Decision Making and Problem Solving
 - E. Workshop - Determining COQ for Quality Failure
 - F. Understanding Cause and Effect in Quality Cost Measurement
 - G. Linking Strategy, Quality, Productivity, Competitiveness and Customer Satisfaction
- V. Establishing COQ Baseline
 - A. Two Approaches
 - B. Advantages and Disadvantages of a Formal COQ System
 - C. Improvement Project Approach
- VI. Using COQ to Manage Continuous Improvement
 - A. COQ Improvement Model
 - B. Project Selection
 - C. Team Selection
 1. Team Membership
 2. Effective Improvement Teams

Appendix G (page 3 of 3)

**Description of ASQ's Two-day On-site Course on Quality Costs
Principles** (continued)

- D. Cost Driver Analysis
 - 1. Methodology
 - 2. Root Cause Analysis
 - 3. Percent Allocation and Cost
 - 4. Add Common Root Cause Costs
- E. Cost-Benefit Analysis
- F. Workshop - Cost Driver Analysis
- VII. Other COQ Applications
- VIII. Summary and Evaluations