COST OF QUALITY

Quality Problems And Their Real Costs

by **Johannes Freiesleben**

It is well known that poor quality adds to the regular cost of production. The more obvious of the costs of poor quality are associated with the establishment of inspection systems and with waste of resources. These costs can be considerable, and their existence alone often justifies a large improvement effort.[1]

However, direct production costs are only one part of the total cost incurred by poor quality. Not so obvious costs can be equally substantial, if not more important. A seldom discussed dimension of quality costs that I'll call transaction costs is part of these hidden costs. They are associated with the involvement of management.

Two kinds of managerial transactions can be distinguished when discussing quality: those that cover up the problem and the far less costly ones that eliminate it. So, if an organization is in doubt whether to improve its quality fast, it should also think about the transaction costs involved.

In 50 Words Or Less

- **Transaction costs are an important part of the hidden costs of poor quality.**
- **These are associated with management's involvement in dealing with a problem.**
- **Quality aware companies prevent most of these transactions by focusing on solving problems and improving quality.**

How It Happens

When production runs as scheduled, management rarely becomes involved in daily operations. The well-oiled production engine runs smoothly as flawless products leave the production lines and are packed and shipped.

Management can then perhaps use its time to shape winning strategies, such as how to outwit the most pressing competitor. But as soon as quality

problems surface, management has to take action on the production side of things.

Every quality problem requires management activities because it calls for additional procedures that are different from scheduled production procedures. These management activities correspond to what Ronald Coase terms managerial "coordination" (see "Transaction Cost Theory—the Fundamentals," p. 54). They require resources in the form of management compensation or, if management is distracted from its normal tasks, opportunity costs.

TABLE 1 Managerial Transactions Associated With Quality Problems

Stage	Managerial transactions	
	Strategic level	Operational level
1. Problem firefight	—	Coordinating the firefight
2. Inspection	Planning the inspection system	Coordinating operations
3. Defect treatment	Planning the defect treatment system	Coordinating operations
4. Quality improvement	Planning the improvement effort	Coordinating the improvement

What are these transactions? And which management level—operational or strategic—is involved? The strategic level is the planning level, a role traditionally assumed by top management, and the operational level is the coordination level, assumed by the division or department heads directly involved in production.

Transaction Classification

To develop a classification for quality induced transactions, let's assume an average company goes through certain stages in dealing with a quality problem. At the first stage, the existence of the problem is detected—for instance, because of a rapidly rising number of visible defects. Because the company has no information on the problem's causes at this time, operational management has to coordinate a problem firefight.

At the second stage, an inspection system is established to deal with the quality problem in a more systematic way. This inspection system requires strategic management involvement to plan the system and operational management to coordinate the system's activities.

At the third stage, the operation of the inspection system yields a growing number of sorted out products that do not meet quality standards. The sorted out products require additional procedures in the form of rework, recycling or disposal. Each of these defect treatments involves both strategic and operational management, like the inspection system. Inspecting out faulty products thus induces additional transactions for defect treatments.

At the fourth and last stage, the organization may decide the inspection approach is inappropriate to solving the quality problem because defects are not being prevented but only detected. The company may start a quality improvement program. Improvement activities require the involvement of both strategic and operational management.

Table 1 depicts these four stages and the associated managerial transactions.

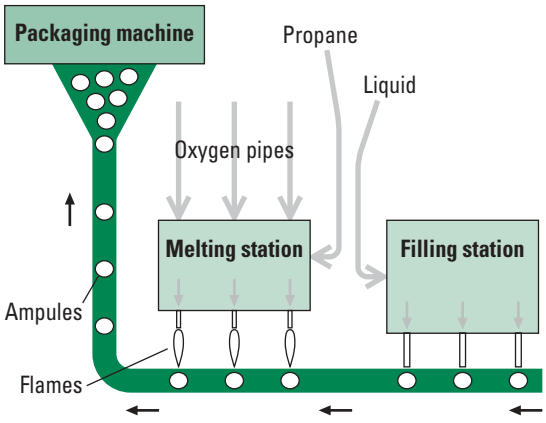
A Practical Example

Consider an example from the pharmaceutical industry. In a production process for liquid pharmaceuticals, glass ampules are filled and then sealed with a flame. A machine processes several ampules at a time (see Figure 1). The ampules then proceed to a packaging machine, where hundreds break each day when the machine grabs them for insertion into packages.

This quality problem induces high costs because of wasted glass and liquid, a slowdown in the production flow and cleaning activities at the packaging machine.

Initially, operational management decides to correct the problem by having operators pack the ampules by hand, thereby bypassing the packaging machine. For this task, operators have to be assigned to these new activities, and existing work schedules have to be rearranged. Operational management also has to train operators in their

FIGURE 1 Filling Machine For Pharmaceutical Ampules



new tasks and control their performance.

Although this firefighting temporarily relieves the situation, after some time the company starts again receiving customer complaints about broken ampules. An analysis of the returned ampules reveals in all cases the breakage is caused by glass instabilities.

The supplier of the ampules can credibly prove its ampules were flawless when delivered. Strategic management now decides to place an inspection machine that controls whether the ampules are good or defective between the filling and packaging machines.

A plan and budget are outlined for this inspection activity, and a suitable supplier for the machine is selected. After the purchase contract is negotiated and the machine is delivered, the managerial tasks are passed on to operational management. The machine has to be installed, and personnel have to be instructed on how to operate and maintain it.

After the inspection process is initiated, the system has to be operated on a permanent basis that involves managerial coordination and control transactions.

Because the inspection activities immediately produce a high number of sorted out ampules, strategic management has to decide what to do with them. Again, all alternatives have to be evaluated, and a decision has to be made. It is decided to recycle the ampules because glass and liquid can easily be separated in a recycling machine and reused in the production process.

Again, a plan and budget for the recycling activities have to be developed and a supplier for the recycling machine found. As in the inspection process, operational management later takes over the coordination and control of the recycling process.

After some time, both the inspection and recycling processes are firmly established and yield acceptable results. The number of customer complaints drops significantly, which strategic management interprets as a sign of the effectiveness of the solution.

But it is not until a new production executive reassesses the setup that management gets an impression of the enormous costs of the inspection system. The two additional processes of inspection and recycling require machines, space, workers, variable inputs and management transactions.

Excluding transaction costs from cost calculations results in a systematic underestimation of the total costs of poor quality.

They also cause a considerable slowdown of the process flow. Yet they still do not prevent defects from being produced in the first place.

The new production executive therefore persuades the company's board to investigate the quality problem. An improvement plan and budget are developed, and a team of process engineers

and external consultants is formed. Operational management coordinates the team activities.

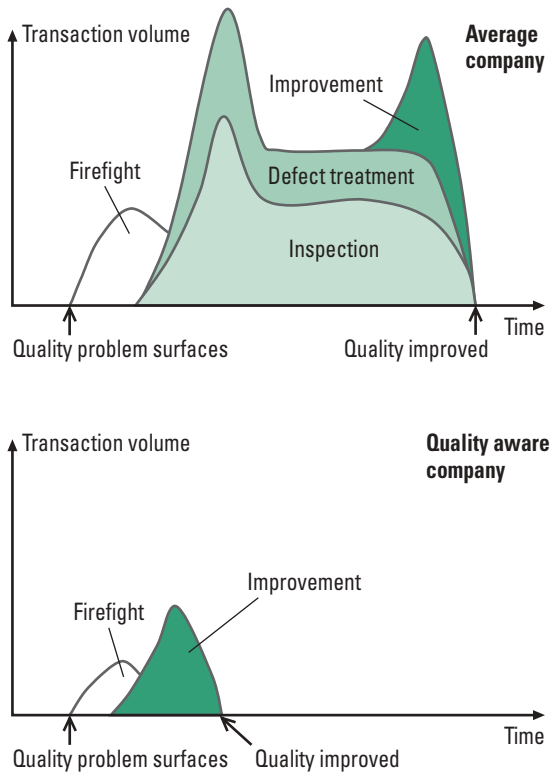
After a team member comes up with the idea of numbering the ampules that leave the filling machine, it is learned only those sealed in a certain flame are defective. The root cause is discovered as a leak of the oxygen supply pipe. The undersupplied flame has a temperature that's too low causing an uneven melting of the glass. After the oxygen supply pipe is changed, the quality problem is eliminated.

To safeguard this improvement, the production executive, being familiar with monitoring technologies, suggests inserting a heat sensor in each of the flames. Its purpose is to automatically check whether all flames have the right temperature and prevent the same problem from recurring.

Although new quality problems might surface over time, the company can now be sure it is able to detect flame related problems before they start to produce a high number of defects.

With this improvement and maintenance effort, the recycling process is obsolete and the inspection process can be greatly reduced to sporadic inspection. As a result, the elimination of the quality problem has saved the company a significant amount of money, which includes money spent on managerial transactions of the inspection and recycling process.

FIGURE 2 Transactions in an Average And Quality Aware Company



How To Reduce Transaction Costs

Not all companies have to pass through such a lengthy process to eliminate a quality problem. Quality aware companies have long recognized they cannot eliminate a quality problem by inspection. Inspection separates, more or less effectively, good from bad products. It is only a superficial solution because it does not improve the process performance.

A quality aware company can eliminate most of the transactions caused by a quality problem by directly and immediately focusing on quality improvement.

To be fair, we have to admit even organizations with the highest quality reputation might be taken off guard by the emergence of a new quality problem and might initially also engage in firefights. But we can presuppose they will soon begin to search for the cause of the defects instead of setting up an extensive inspection system.

As they directly proceed from firefighting to quality improvement, they avoid the establishment of the inspection and defect treatment processes, which are accountable for most transaction volume and costs.

Figure 2 depicts the development of transaction costs for an average company, which runs both inspection and defect treatment processes for a certain time (some companies run them forever), and a quality aware company, which directly proceeds to quality improvement.

After the initial firefighting, which brings in operational management, the development for

the average company shows high peaks in both inspection and defect treatment transactions due to the involvement of strategic management. These peaks are followed by plateaus of transactions, signifying the subsequent continuous involvement of operational management.

At the end of this phase, a final peak shows the involvement of strategic management in the improvement activities. The rapid decline in transaction volume is then due to the progress of the improvement project and the decline in tasks for operational management. At the end of the quality improvement, the transaction volume is zero because the quality problem has been eliminated.

The quality aware company can avoid the middle two sections of inspection and defect treatment transactions. In Figure 2, the quality improvement transactions are highlighted to show their magnitude in relation to the other transactions.

Companies spend much less for transactions involved with quality improvement than for transactions involved within inspection and defect treatment. The reason is that quality improvements are usually conducted in a well-defined timeframe, whereas inspection and defect treatment processes often continue for a long period after they are established. They therefore require operational management transactions on a permanent basis.

Furthermore, the usually expensive budgeting and planning activities of top management[2] can be kept low for improvement projects.

There is a simple measure to determine the financial impact and hence the justified budget of improvement projects. A company might spend as much on quality improvement as can be saved in costs of poor quality over the lifetime of the investment. Investments benefit the company for multiple periods. They result in saved costs of poor quality and increased revenues as long as the process is in operation. Therefore, they are cost effective per period only with their depreciation rates.[3]

Hence, we have to compare the costs of poor quality to the investment's depreciation rate. If, for instance, the saved cost of poor quality is $100,000 and the investment is depreciated over 10 periods, we might use an investment sum of up to $1 million to eliminate the quality problem.

Although the cost of poor quality is sometimes difficult to calculate, we need only a rough estimate to get an idea of the advantages of an improvement investment. The strategic management involvement can thereby be reduced substantially.

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Improvement Transactions

Another effect, which makes a quality improvement less costly in terms of transaction costs, is repetition and learning. Quality improvements follow a sequence that can be applied universally to all quality problems, no matter what root cause they might have. I call these improvement transactions. Consider the problem solving sequence described by J.M. Juran:[4]

1. Analyze the symptoms.
2. Theorize as to causes.
3. Test the theories.
4. Establish the cause(s).
5. Simulate a remedy.
6. Test the remedy under operating conditions.
7. Establish control points to hold the gain.

Similar problem solving sequences have been applied by most quality management profession-

als.[5] The important point is that although quality problems are variable in nature, the way to solve them is not. Once the problem solving sequence is learned, it can be applied at lower costs when the next quality problem surfaces.

Learning basically yields economies of scale, and the more quality problems a company successfully eliminates, the fewer management transactions are necessary to plan and coordinate the improvement process the next time. The standardized process thereby requires less and less strategic and operational management.

Contrary to improvement transactions, transactions associated with inspection and defect treatments are not subject to economies of scale because they directly depend on the specific quality problem, which necessitates a distinctive, permanent response.

The effectiveness of an inspection system depends on how well the quality dimension in

Transaction Cost Theory—the Fundamentals

Ronald Coase, the founding father of transaction cost theory, showed that to use markets for the exchange of goods, participants have to get involved in communication, the search for information, price negotiations, negotiations of legal terms and other time consuming activities.[1]

Coase called the costs involved in these activities "transaction costs." In formal organizations, transaction costs are to a large degree reflected in organizational costs of planning and control—also called "coordination costs." Because the hierarchical command now replaces lengthy negotiations, transactions can be reduced and efficiency gained.

Coase found this to be the explanation for the existence of companies: To carry out a certain value adding process inside a company instead of buying it in the market, the coordination costs must be lower than the market transaction costs.

With this perspective on transactions, Coase essentially forced economists to think about the costs involved in human interaction. Transaction cost theory is therefore a key to understanding the value of managerial planning and coordination activities.

The volume of managerial transactions inside companies is also affected by the degree to which the production sector runs as planned. O.E. Williamson, one of the most influential exponents of transaction cost theory, thought of transactions as representing "the economic equivalent of friction in physical systems."[2]

Using this definition, transactions represent deviations from the ideal, efficient state of a system. For quality problems, these are deviations from the planned production schedule. These production disruptions require management involvement. The transaction volume increases, and with it the transaction costs.

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question can be inspected, which is highly situation dependent. The way to deal with the defective products also depends on this specificity.

Learning effects can, if at all, be appropriated only on the operational management side of a single quality incident. Long-term experience might optimize either the inspection or defect treatment process because it is repeated over and over again. Yet there cannot be positive spillover effects for the handling of other quality problems.

Comparing the two types of transactions, we find the one being directed at permanently soothing the impact of the quality problem (inspection and defect treatment) and the other being directed at eliminating the quality problem (improvement).

The latter is subject to learning effects and thus economies of scale because it applies a universal logic, and its total transaction volume is small, since the quality problem is quickly eliminated.

The former is connected to individual solutions, thereby limiting learning effects, and its total transaction volume is high, because inspection and defect treatment processes are sometimes in place forever if companies are unaware of the costs involved.

Easily Neglected

Because managerial transactions are invisible and often difficult to determine, they are easy to neglect in cost calculations. As Coase points out, the factors that determine the cost of coordination by management within the firm are difficult to discover.[6] Such factors include quality problems.

Excluding transaction costs from cost calculations results in a systematic underestimation of the total costs of poor quality. Although a generally accepted way of accounting for transaction costs has yet to be found, a rough estimate for transaction costs would be an additional 30% to the cost of poor quality price tag. This high number might at first be surprising, but thinking of the high costs involved in human interaction, it becomes clear we indeed deal with an important cost factor.

The two types of transactions connected to quality problems require different amounts of resources. Given high management compensation, quality problems create high transaction costs. On the other hand, quickly improving the process performance spares inspection and defect treatment transactions. Furthermore, learning effects make im-provement transactions cheaper over time since management involvement is reduced.

Thus, we can add one more argument to the collection of sound economic reasons for quality improvement. Quality aware companies are the winners, also from a transaction cost perspective.

ACKNOWLEDGMENT

The author thanks the Swiss National Science Foundation for its financial support of this research.

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