

Quality Control Paradigm

2004 July 19

by Anthony Glenn
File: Quality Control.sxw

At intervals, there is discussion on the subject of administrative accountability. It seems that most previous papers have rather missed the point of accountability. What accountability is all about is controlling the quality of decision making.

Quality Control

In any well-run factory, there is always a "production" section and a completely separate "quality control" section. Production actually makes the product and quality control checks that the product is of satisfactory quality. Errors due to haste, incompetence, criminality or complacency are an ever-present danger in any human activity. Every step of the production process must be checked for quality, sooner or later. Neglecting quality control results in unreliability of the product and failure of the product to perform adequately in the hands of the customer (known as field failures). Failures in the field are normally vastly more expensive to the customer than higher product price due to any adequate quality control scheme at the factory. The classical example is from the military. If a soldier's rifle fails in the field of battle, that soldier dies. A dead soldier costs society enormously more than the cost of any rifle.

The basic principle of quality control is this: The quality of a product is assessed, and the assessor has the ability to impose a penalty against the producer if the quality is poor. In response to this penalty, the producer makes changes in production and quality improves.

Thus, quality control is a **negative feedback** mechanism. Negative feedback is well understood in electronic amplifiers; it allows amplifiers built from practical components to perform with insignificantly small errors in output, which would be prohibitively expensive without the use of negative feedback. There are many similarities between quality control and negative feedback in an amplifier. The assessor's idea of the desired product corresponds to the input signal. The assessor's ability to correctly decide a suitable penalty corresponds to the error comparator. The penalty corresponds to the error voltage. The responsiveness of the producer to the penalty corresponds to main amplifier gain.

Amplifiers with negative feedback can suffer from a tendency to oscillate, if not correctly designed. Quality control is subject to the same danger and has the same remedies; reduce delays, control gain, add nested feedback paths.

Quality control can itself fail if: (1) The assessor is unable to judge quality. (2) The assessor cannot impose a penalty. (3) The producer cannot respond to the penalty such that quality improves. All these things correspond to zero gain at some point in the feedback loop.

Inability to Judge Quality

There is sometimes bad feeling between producers and quality control assessors. This is an attempt by the producers to intimidate the assessors into making excessively favourable assessments, thereby subjecting the producers to a lesser level of penalties. This is an immature human reaction and can occur in any case where there is any attempt at quality control. Of course, many producers recognise their own interest in higher quality, and adopt an adult attitude towards quality control. These producers are cooperative towards quality control, and are neither too friendly nor hostile to the assessors. The assessors thus have the best possible chance to do their jobs properly.

Complex tasks often need a complex assessment process to decide if the task has been completed correctly. If the assessor does not have the resources or ability to assess quality, then a wrong or no penalty will be produced.

Auditors assess the financial performance of organisations. If the auditor is overloaded (that is, under-funded), proper investigations cannot be conducted and performance defects will not be found. Note that persons performing defectively often know that they are doing it, and take care to conceal the facts from the auditor. Only a well-funded and determined auditor can discover things which have been concealed.

Many banks around the world have lost vast sums of money by failing to correctly assess the claims of speculators wishing to borrow. (In this paper, the term "bank" is used to mean any lending body, regardless of whether it calls itself a bank or not.) The banks had plenty of resources for the assessment, but little inclination to perform the assessment correctly, due to social factors. Bankers admire speculators before the speculators crash, and are willing to bend over backwards to accommodate the wishes of their heroes.

Criminals have further advantages: fear and greed. If an assessor can be induced to do the bidding of the criminal, then the assessment will be corrupted, to the financial disadvantage of others. Some people admire wealthy criminals, they covet the wealth, ignore the criminality, and are nice to the criminals in the hope that they might share a little of the wealth. Such hopes are usually futile, unless the guilt is also shared. Criminals normally threaten violence if crossed; it takes a brave auditor or loans officer to stand up to them. Criminals frequently offer clandestine payments in return for compliance. This amounts to a conspiracy to defraud. Such conspiracies are very difficult to prosecute, and may be presumed to be widespread.

No Penalty

The quality control section in a factory normally has the ability to stop shipment of product unless passed for quality. The product goes back to the producers for "rework", or is discarded. The rework or discarding costs the factory money, that cost is the penalty. Factory management enforces the rules in order to ship a high quality product. If the producers were allowed to ignore adverse quality control assessments and ship defective product, then that would be equivalent to having no quality control section at all. Clearly, shipped quality would fall. In a competitive market, customers would then impose an even higher penalty by making their own adverse quality assessments, then failing to buy the product.

Auditors face a difficulty imposing penalties. A private auditor gets hired by the company being audited; it is difficult to punish your own customer. An auditor can only produce an unfavourable report. A potential customer can choose a "friendly" auditor. Investors, and others, wishing to find out which companies have high quality financial performance, need to remember this always. Ideally, the auditor should be paid by the investor, not the company, to avoid conflict of interest.

Public auditors produce a report for parliament. Departments adversely reported on, may refuse to correct deficiencies pointed out by the report, thus attempting to escape any penalty. As mentioned above, no penalty means no quality control. It is the responsibility of parliament to impose a suitable penalty. For example, personnel changes, budget cuts, reorganisation, reduction in powers, etc. Departments can often be noted disliking being audited. This should be taken as prima facie evidence that there is something nasty going on and such departments should be audited with increased vigour.

Some people appear to feel that the only supervisors are capable of making quality control assessments and imposing penalties. This is quite incorrect. Quality control sections in factories do not supervise production sections. Both have their own hierarchies. Auditors do not supervise those audited. A free market is itself a quality control mechanism; customers make quality assessments and impose a penalty on low quality producers by failing to buy. This is the discipline of the market.

Some producers try to escape the discipline of the market by establishing a monopoly. If a producer is the only seller of something then customers cannot impose the penalty of failing to buy.

The producer can then afford to neglect quality control internally. This is why socialism does not work, and also why many government departments are so inefficient. There is no quality control imperative bearing down on the top decision makers and so they focus on other matters.

Producer Unresponsiveness

If a producer is unable to respond to a penalty by improving quality, then quality control fails. The producer may have every desire to improve quality, agree that product quality is low, and be trying to do better. Alas, if the circumstances facing the producer are such that the producer cannot see how to improve quality, then quality will remain low.

Increasing the penalty is of no use. The producer may genuinely be doing as well as can be done with the available resources. In that case, the only way to get higher quality is by increasing the resources available to the producer. Many producers feel that increasing their monetary resources is the way; they are often mistaken. Resources include knowledge. A better way of doing things can be invented. It is almost always possible to improve efficiency, possibly by the use of a little lateral thinking. Those charged with doing the thinking may or may not have the ability.

Education of producer personnel may help. Calling in outside consultants may help. A complete change of methods may help. People who have been in the same job for a long time tend to get fixed in their ideas. Sacking a few individuals, especially those at the top of the hierarchy, may help.

Instability

The first time instability in a negative feedback loop came to the notice of human beings was on a steam engine. James Watt invented the centrifugal governor, a device which controls the speed of a steam engine by spinning weights around on a shaft connected to the engine. The centrifugal force on the weights is opposed by a spring. The deflection of the spring controls the steam valve. Higher speed closes the valve, lower speed opens the valve. Right speed means the valve is open just enough to keep the speed of the engine constant. The "penalty" for the engine running too fast is lack of steam. The "penalty" for the engine running too slow is lots of steam, thus forcing the engine to speed up.

It was found that some engines would "hunt". That is, the speed would be, say, too low, the valve would open, the engine would speed up to the right speed but the response of the governor was too slow and the valve would stay open long enough for the engine to over-speed. The governor would then catch up, close the steam valve and the engine would begin to slow. The same thing would happen when the speed was going down and the engine would under-speed. After a delay, the valve would be opened again and the engine would be once again speeding up. This hunting would go on indefinitely. Since the object of the governor was to make the engine run at a constant speed, hunting was undesired behaviour.

The solution was to reduce total loop delay and loop gain. The centrifugal mechanism had to respond quickly, with a rapid movement in the steam valve position closely following changes in engine speed. The steam valve had to be designed such that a movement in it would rapidly and proportionally affect the engine torque. Increasing the rotational inertia of the flywheel would allow the governor to react in a short time compared to the time for significant changes in the speed of the engine.

The nineteenth century steam engine builders probably got stability (that is, freedom from hunting) by trial and error. Now, we have more precise methods. Negative feedback loop stability was analysed by Nyquist to give the **Nyquist stability criterion**. Loop gain versus phase shift is plotted for all frequencies starting from zero. The Nyquist criterion says that the locus of this plot must not go outside the point where loop gain is one and loop phase shift is 180 degrees.

All the steam engine characteristics have corresponding characteristics in electronic amplifiers. Research in negative feedback continues to this day, particularly in high quality audio amplifiers. Anything about feedback which is discovered in amplifiers is applicable to any feedback mechanism, electronic or otherwise. Getting an insight about amplifiers applied to running the economy or administering an organisation, may not be obvious, but in principle it can be done.

The most well-known example of instability in economics is the occurrence of periodic booms and busts in the economy. The economy fails to grow to the satisfaction of the government and the government takes some action to expand the economy. The economy does so, but keeps going into a boom. The government takes contractionary action. The economy contracts obediently and goes into a bust. The cycle continues.

Positive Feedback

Positive feedback occurs when instead of there being a penalty for deviation from a desired standard for something, there is a reward. Speculators often have a positive feedback effect on each other. If the price of a class of assets (for example, real estate, art, shares, etc.) starts to move (either up or down), a herd mentality takes over in the speculators and they either bid the price up (accompanied by ever larger borrowings) or dump the assets, losing money in the process. Ultimately, reality intrudes (that is, the banks come to their senses and stop lending; or the speculators have disposed of all their holdings to canny long-term investors), then the speculators realise that these assets they have been bidding up (or down) are overvalued (or undervalued).

Speculators who have lost money by selling too cheap may then go bankrupt. One or more banks typically lose money when that happens.

Some speculators find themselves in possession of overvalued assets, which they have paid too much money for and which they have borrowed large sums of money to buy. These speculators are "the patsies". Their situation is grim. The party is over. There will be no buyer to take the assets off their hands for an even higher price. Interest charges are mounting. They are expected to run the assets at a profit big enough to cover interest, and they cannot. The banks are applying ever greater pressure. Their reputations as smart business operators are gone. Bankruptcy looms. The banks are about to lose a huge amount of money.

The Standard Method of Robbing a Bank

The overwhelmingly most popular way of robbing a bank does not involve a sawn off rifle or a balaclava. Nor does it involve anything so crude as dynamite on any kind of safe. No, it is much better, (1) the bankers willingly hand over the money in large quantities, and (2) it is all perfectly legal. Banks throughout the world have lost trillions of dollars with this method. Losses from armed robbers or safe blowers are a mere trivial inconvenience by comparison.

Here is how it works. (1) Find a patsy. (2) Buy assets, the bigger the better. (3) Make the price of the assets go up by a series of sales between the conspirators. This is how the conspirators get their profit. (4) The patsy borrows a large amount of money from the banks, based on his/her/its previous good record. (5) Sell the assets, for a vastly inflated price, to the patsy. (6) Cut off all communication with the patsy. Make sure none of the conspirators are liable for any of the patsy's debts.

The patsy goes bankrupt, taking the banks with him/her/it. The former owners of the assets can adopt a very haughty attitude: "The assets were profitable when they were in my hands. Patsy must be lacking in business acumen. That is not my problem." It might even be possible for the conspirators to buy the assets back from the now desperate patsy, at a deep discount. They are ready to do it all again, at an opportune time.

The major problem facing the conspirators is finding a patsy with sufficiently large borrowing capacity. Often the patsy is some individual, subject to flattery, who actually volunteers for the role

(without knowing what trouble will follow). Astonishingly, banks and governments sometimes willingly play the part of patsy. If the conspirators can get control of a formerly reputable limited liability company, cheaply, then the company will be the patsy, provided the company can get sufficient borrowing capacity. Banker stupidity helps to increase the patsy's capacity to borrow.

Is parliament going to do something about this? Money talks, rapid reform cannot be expected. Will the banks wake up? Yes, for a while, then a new young set of bankers will take over. The young bankers will ignore the warnings from those old fashioned bankers ("Poor old guys, living in the past, what would they know?"), and do it all again. The standard period for banks to engage in this institutionalised forgetting is 50 years. There were major speculative crashes in the 1840s, 1890s, 1930s and the 1980s.

An example of this process was what happened with the now failed entrepreneurs of the 1980's. The banks have assured the public that their losses on the big operators are a mere minor part of their total losses. Presumably, there were lots of little entrepreneurs doing the same thing as the big end of town. The "Savings and Loan Scandal" in the USA is another example. Total losses from the S&L scandal are conservatively estimated at \$US500 billion (Yes, that's a five with eleven zeros after it). The US government foolishly gave the S&Ls unlimited financial guarantees and unlimited freedom to lend for any purpose. The government became a perfect patsy. The government now holds vast assets, worth far less than the sum paid out, plus gigantic debts.

The solution to the problem of forgetfulness amongst bankers must include education. This is how it is done with engineers. All engineering courses are designed to prevent engineers from making the same mistakes that have been made before. Engineering courses usually include a discussion of famous engineering disasters. Likewise, there must be university courses for bankers, with a recognised banking qualification for those who pass. Loans officers should be required to hold the banking qualification. Lending institutions who appoint unqualified loans officers should suffer the most severe possible penalties which can be imposed by government. Banks should face the loss of their banking license. Company directors should be held personally liable.

Education is not the full answer, there must also be relentless public disclosure. If loans can be negotiated in secret, then criminality will continue to occur. Anybody wanting to borrow money must expect that the negotiations for the loan will be fully recorded and subject to public disclosure. Borrowers who do not wish to be subject to public disclosure are free to borrow in a foreign currency, with the negotiation done outside the local jurisdiction. That will insulate the local banks from the inevitable losses when the speculative crash occurs. There must be a properly functioning whistle blower protection scheme. There must be a banking ombudsman. Banking auditors should be paid for by the government. There must be freedom-of-information legislation for banks.

Need for Quality Control at All Levels

It sometimes happens that supervisors feel that the performance of their underlings is something that should be subject to quality control, but they themselves are so important that any suggestion that their own performance may be deficient would be an impertinence. This attitude can be seen in all third-world dictators.

Dictators are intolerant of criticism, in other words, they try to avoid even verbal penalties from those who may assess their production of government decisions as defective. Naturally, the quality of those decisions is poor as a consequence. Poor quality government is the primary reason for poverty and misery amongst the unfortunate ordinary residents of third world countries. Democracy is a quality control mechanism for governments. The electorate does the assessing, the penalty is losing power. The consequent higher quality of government decision making is the reason why democracies are so prosperous.

Any group of people who cannot impose the penalty of voting against the government will normally be ignored or treated badly by the government. A typical case was that of the opponents of

white racism in South Africa, the white racist government served only their white electorate (which was mostly in favour of white racism), and exploited the blacks. The opponents of white racism had to think of some way of imposing a penalty on the white racists, other than voting them out. Violence and international sanctions were the result.

Multiple Levels of Quality Control

In a factory, there is quality control at every step. The component producers have their own quality control to make sure they make good components. Sub-assembly producers check that the process of assembling components into sub-assemblies is done correctly. Product assemblers control the quality with which sub-assemblies are assembled into products. So it goes for every little section of the factory.

But this compartmentalised method of quality control is not enough. Suppose there is a component defect which causes the final product not to work but is not tested for at any earlier stage. The component producers and the sub-assembly producers are all firmly convinced that they are producing satisfactorily, but the product assembler is making defective product and it is not that assembler's fault. There must be some method whereby the product assembler (that is, a component consumer) can penalise the component producer for producing bad components. In a single factory, it is simple, overall factory management forms a trouble-shooting team with representatives from the component producer, product assembly and usually product design; and the team sorts out the problem.

Thus, the local quality controls, in all the little sections of the factory, constitute **inner** feedback loops. The overall product quality control constitutes an **outer** feedback loop. There are multiple levels of quality control, all essential. The better all these levels work, the better the overall performance of the factory. Enlightened factory management knows all this and so their factory can prosper.

Now, for "factory" substitute "economy", for "factory management" substitute "government", for "producer" substitute "company or department", and so forth.

In the economy, things are not quite so simple when it comes to getting messages about unsatisfactory product quality back to producers. Often the consumers are faced with a producer (that is, company or government department) which considers that it knows best. In a competitive market, the consumers can then buy elsewhere. Alas, there are many barriers to free competition: product differentiation, copyrights, patents, trade secrets, imperfect information, etc. Government departments are normally running a monopoly. Of course, consumers can always vote the government out, but that is a rather crude all-or-nothing approach. On balance, the unhappy consumers may feel that the opposition is no better than the government, so they may not wish to vote the government out.

The electoral system can be regarded as an outermost feedback loop. The internal quality control in a department can be seen as an inner feedback loop. To make the system more responsive, what is needed is some form of intermediate level feedback. That is the purpose of things like ombudsmen, consumer councils, external review panels, outside auditors, appeals tribunals, etc. All these bodies give better, more precise correction to producers and actually reduce the probability of consumers deciding to vote out the government.

Some producers, particularly government departments, do not like to be told that their performance is unsatisfactory. This is the immature, but natural, human rejection of unpalatable messages. It is a method of ego defence. Parliament must be on guard against such tendencies in the upper levels of departments.

Whistle Blowers and Retaliators

Decent people often want to get rid of some situation which would not be tolerated if publicly known. Whistle blowers are people who, despairing of making progress any other way, make publicly known the situation. They constitute a form of quality control on the organisation they blow the whistle on. The organisation is not making correct decisions. The whistle blower forms an unfavourable assessment and whistles. The penalty is public exposure followed by some form of action from outside the organisation. Provided the action is effective, the quality of decisions then improves.

The retaliators are those individuals who wish to perpetuate the situation. Retaliators may be easily identified by their lack of outrage about the poor decision quality, but their strong interest in knowing the identity of the whistle blower. It is the aim of a retaliator to punish the whistle blower and so injure him/her that no more whistle blowing happens. Retaliators know this, so do whistle blowers.

If governments wish to prevent corruption, inefficiency, injustice, etc. within organisations, then a very good start is to protect whistle blowers and sack retaliators. Whistle blowers are often the only way for some scandal to be revealed and the quality of decisions in an organisation to get improved. Auditors should produce an adverse report, if there is something obviously wrong with the accounts, but if something is outside the audit process, auditors cannot help.

Whistle blowers can exist anywhere. A police informer within a criminal organisation is a whistle blower. The Mafia retaliators kill unhesitatingly should they find an informer. Sensible anti-crime authorities run absolutely watertight witness protection schemes. Australia might catch up eventually.

Responses

The author welcomes responses to this paper. It is all part of quality control on papers. Please reply by e-mail to Anthony Glenn <aglenn@pcug.org.au>.

Copyright Notice

Unlimited reproduction rights to this paper are granted provided no editing is performed and the author's name is included. All other rights under copyright law are reserved.