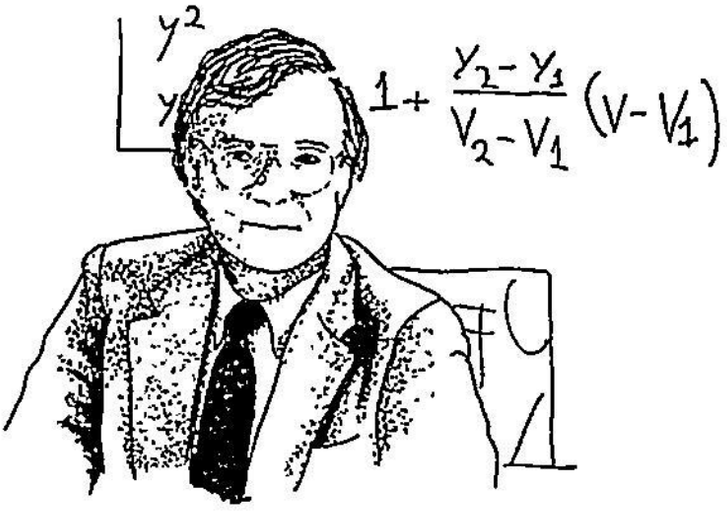
You Pay Your Money and You Take Your Chance

by Gordon Young



Quality control is the name given to practices in manufacturing industries that establish and maintain standards of quality in manufactured goods. Random chance affects manufacturing quality so statistics is part of quality control. The computer manufacturing industry, like most others, practices quality control.

Quality control matters when you buy a new PC computer system. IBM clone systems are built with components from different manufacturers. Motherboards, modems, monitors, printers, keyboards, drives, chips: all the many components can come from different manufacturers before they're put together to form the whole computer. Often buyers find component-based PC systems are the lowest priced. Vancouver has many retail dealers building and selling component-based PC systems.

Computer component manufacturers vary in their policies on quality control. Some impose high standards in manufacture that ensure components are almost all good and very unlikely to fail. Some have looser standards of manufacture, maintaining standards of quality in the marketplace by promptly repairing or replacing defective components returned under warranty. A few rotten-apple manufacturers produce poor-quality items, sell them cheap, ruin their own reputations and go broke, leaving a legacy of bad components failing on their owners with no manufacturer to honor the warranty.

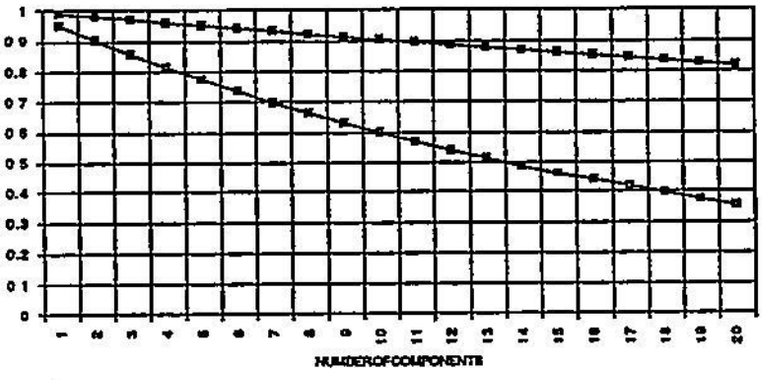
What are the odds of buying a brand new component PC system that has something wrong with it? New buyers can make the mistake of thinking that because their new computer cost them thousands of dollars and is very high-tech that it must be infallible. This is false. Statistics of quality control give the odds on defects appearing in a new component PC system. The odds are surprisingly high.

The Last Shall be First

Defects in a new computer system are likely to crop up anywhere. This is important for first-time buyers of complete systems to know. They are often computer novices who are gradually learning. The range of use of their system expands as they learn. From basic low-end functions they progress into specialized and advanced high-end functions.

Defects are just as likely in high-end functions as in low-end functions. But it takes time for the learning novice to get into these high-end function and discover the malfunctions that defects cause. This can be time enough for the warranty on the defective component to expire. This leaves owners stuck with the bill for repair or replacement if they want to use the high-end function that they bought and paid for but never received.

Quality Control Level of a Component PC System
(Probability of No Defects)



A False Faith

The idea that computers and computer components should be infallible because they are high-tech puts misguided faith in technology. Computers are complex and complicated. They are made up of enough parts, any of which may fail, that what is loosely called the law of averages or more accurately the long-run argument applies. Computer components can be trusted to behave as statistical entities with a probability of failure and a complementary probability of success.

"Failure" is when something goes wrong. Hard discs crash, files don't copy, printer heads break, modems don't connect, and on and on and on. Experienced computer users know bugs are part of using these computer systems.

"Success" is when things go right. The computer runs smoothly doing what it is supposed to, lulling the user into a treacherous sense of security. Things will go right some of the time, even most of the time, but not all of the time. Over a long-enough run the law of averages will catch up and high-tech computers and computer components will fail.

Setting the Standard

Manufacturers generally produce to a set standard of quality control. This standard is measured by the proportion of defective units produced out of the total units produced. It is expressed as a percentage or a decimal fraction between 0.00 and 1.00. It is also the probability of any given unit being defective, for example the unit you get as part of your brand-new computer.

Consider a fictitious hard drive manufacturer. The standard of quality control they set for themselves might be that one drive in twenty is defective. That is, one drive in twenty will fail while within warranty. Items that fail outside of warranty are not considered defective by most manufacturers.

The defective rate is 1/20, which equals 0.05; 5 % of the hard drives are defective, 95% are non-defective. In quality control these values are expressed as statistical probabilities. The probability of a "failure", a defective drive, is P(failure)=0.05. The probability of a "success", a non-defective drive, is P(success)=0.95.

A P(failure) expressed as a percentage is called a failure index. Failure indexes of 5% or 1% are the most common quality control standards in industry. Sampling and testing procedures enforcing quality control standards are usually based on tables, charts and protocols that assume a 5% or 1% failure index.

"You like Statistics? YECH!!"

That's what one charming young lady said when I told her I wanted to study statistics. I was escorting her on a walk around the seawall on our first date. I didn't get a second.

I did go on to study statistics. At the risk of ruining my chances for a vibrant

love life forever, I'm now going to tell the whole world about it.

Here comes some math. Readers who recoil in horror can skip to the graph which summarizes the math. But some readers will see the logic, get an aha! experience and be strongly impressed.

Start by thinking of a single computer component manufactured to a lower quality control standard with a failure index of 5%. It has a 95% probability of being free of defects (success!)

Now let's add to it another computer component with a failure index of 5% as we begin to build our whole computer system. For the whole system to be free from defects both components must be free from defects. In statistics we calculate the probability of this success by multiplying the probabilities of the two separate successes.

So the probability of the system being defect-free is 95% * 95%, or 0.95*0.95=0.9025. Our two-component system has a 90% probability of being defect-free, and a 10% failure index.

Let's add a third component with a high standard of quality control. It has a failure index of 1%, and a 99% probability of being defect-free. The probability of our three-component system being defect-free is:

(95%)*(95%)*(99%)
=0.95*0.95*0.99
=0.89=89%

There is an 89% probability of no defects and an 11% failure index.

Some readers will have noticed the pattern. As components are added, the probability of defects is increasing. The overall standard of quality control is slipping as the system gets more complex. Even when the components are of high quality the overall quality control standard will slip as component after component is added.

The Best of Times, The Worst of Times

Now we can construct best- and worst-case scenarios for quality control standards in component PC computer systems. The quality control standard of a given system depends on the number of components in the system, falling between the best-case and worst-case scenarios.

The best-case scenario is that all the components are manufactured to a high-quality control standard with a failure index of 1%. If we say the variable n is the number of components, the failure index for the whole system follows the formula 1-(0.99**n). This is the lower line on the "Failure Index" graph.

The worst-case scenario is that the components are all manufactured to a lower quality control standard with a failure index of 5%. The failure index for the whole system follows the formula 1-(0.95**n). This is the upper line on the "Failure Index" graph.

For those who know what it means, these are exponential decay formulae. The quality control standard decays exponentially as the number of components in a PC computer system goes up. This decay process is represented in the "Quality Control of a PC System graph."

Look at a best-case scenario of a system with a high quality control standard of 1% failure index on all components. The quality control standard drops below an adequate level of 5% failure index if there are more than five components. A short list of motherboard, monitor, keyboard, printer and one floppy drive makes up a computer system that barely passes in a best-case scenario. Any system more complicated is sure to have an unacceptably low quality control standard.

A fully loaded PC computer system can have twenty or more components. A best-case scenario gives a failure index of 18%, more than one chance in six of a defect in the system. A worst-case scenario give a failure index of 64%, a bit less than two chances out of three. These are pretty long odds to face when gambling with thousands and thousands of dollars of your hard-earned money.

The Cure

The components themselves have components. They follow the same logic of quality control standards. But the unit has passed the manufacturer's quality control standards before going to the dealer. By themselves the components have an adequate quality control standard.

It's when the dealer puts all the components together to make the whole computer system that the quality control standard slips. The whole system, sold as a single unit ends up being manufactured to a poor quality control standard. The cure for this is another level of quality control. Dealers can re-establish a good quality control standard if they test and burn-in the total system before they let the buyer take it out the door.

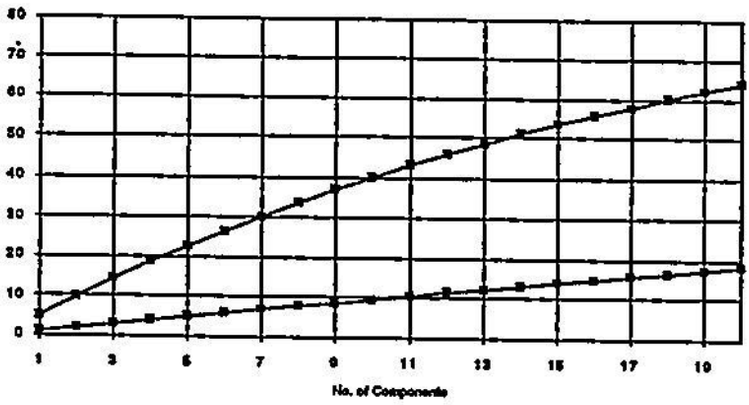
Thorough testing by the dealer runs special testing software. These programs run and check all functions, high-end and low-end. A conscientious dealer checks test results, returning defective components to the manufacturer and replacing them with components that do pass the test. This drastically reduces the chances of a buyer getting a system with a defect.

Electronic components like motherboards and expansion cards are likely to be fine indefinitely if they pass their initial testing and burn-in. With proper power surge protection they can long outlive both you and I.

Components with moving parts (hard and soft drives, printer heads, keys, etc.) will gradually wear out and eventually fail. They will probably fail outside of warranty but hopefully after a long lifetime of stalwart service. Initial testing should move all the moving parts and move them enough that initial breakdown problems are unlikely and a long working lifetime can be expected.

Dealers who test equipment thoroughly before passing it on to a buyer are not going to be the cheapest.

Failure Index



Testing requires extra person-hours and resources and the cost must be passed on to the buyer.

Testing may not be as important to experienced computer users or to those buying only one component at a time to add to an existing system. Individual components from different manufacturers are usually produced to a good quality control standard. Experienced users are likely to spot the odd defective unit if they get one. For these buyers, mail order or large-volume discount dealers may provide best value for the dollar.

Complete systems from a single manufacturer form a single production unit. For example, a portable computer from a major manufacturer (Sharp, Toshiba, etc.) will be manufactured and tested to that company's good quality control standard. Though it doesn't hurt, dealer testing is not as necessary for these items.

Novice computer users buying a new component PC system are at the other extreme. They may lack the experience to recognize poor performance, or may put it down to their own lack of expertise. If they do find a defect they can have an obstacle explaining it to the dealer to get it serviced under warranty.

For these buyers it is more valuable to choose a dealer who tests the equipment for them. It costs more in retail markup but is likely to save money and problems in the long run. Remember that the individual components were manufactured to an adequate quality control standard. The math showed that it is when they are all put together into a PC that the quality control standard drops past the point where the chance of getting a defect in a system is too high.

Dealer testing and burn-in, repairing or replacing of components reestablishes a good quality control standard for component PC computer systems. In the unregulated PC clone market it is the dealers who provide the quality control standard the buyers receive.

Buyer Beware

These are good reasons for new buyers to choose a dealer who thoroughly tests and burns-in a new component PC computer system before the buyer takes it out the door. Remember the way the probabilities worked out. In a multi-component system there will be between one chance in ten and two chances in three that there is something wrong with it somewhere.

Summary

Today's PC computer systems are made up of different components from different manufacturers. Each component is probably made to an adequate quality control standard by its manufacturer. But the statistical effect of putting many different components together into one computer system causes the quality control to slip surprisingly far below an acceptable standard.

Dealer testing and burn-in establishes a good standard of quality control for component PC computer systems.

A reference for the information in the article is:

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