Statistical process control

Too often, finance professionals manifest a smug sense of superiority towards their peers in manufacturing. In this third column in a series, David Rowe argues that when it comes to operational risk management, the manufacturing sector has much to teach financial institutions. Statistical process control is a good case in point

For much of the modern industrial era, business professionals have tended to set themselves apart from 'intellectuals'. They viewed themselves as men (and more recently women) of action who didn't have time for academic hair-splitting. A well-known example occurred in 1908 when William Gosset discovered what we now know as the Student's *t*-distribution. The name derives from the fact that his employer, Guinness Brewery, would not allow him to publish his findings under his own name. As a result he published under the pseudonym 'Student'.

Obviously much has changed since then. Certainly, financial engineering offers a very different picture wherein quants from the business world joust regularly in print with academics on the finer points of diffusion processes and solution algorithms. Firms generally view such contributions as very favourable publicity that enhances their standing in the market. Nevertheless, the old 'man of action' syndrome remains alive and well in many areas. I fear that operational risk management in financial institutions is one such example.

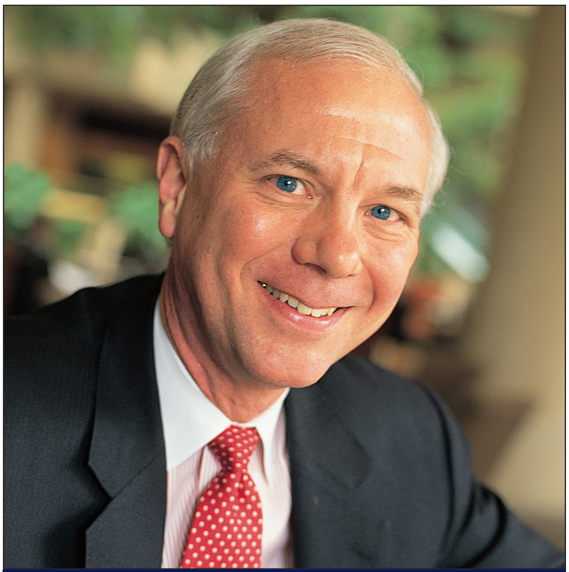
It is commonly said that what cannot be measured cannot be controlled. It is further argued that quality cannot be measured so it cannot be controlled. The second statement was soundly refuted by the total quality management movement that started in Japan in the middle of the twentieth century and then spread to the US manufacturing sector starting in the late 1970s. The problem is that there is no single measure of quality. Rather, it is reflected in consistent performance on a variety of eclectic measures. This is best exemplified by statistical process control (SPC) as pioneered by Walter Shewart and described in his 1931 book, entitled *Economic Control of Quality of Manufactured Product.*

The essence of SPC is structured and disciplined sampling of the results of a process. Every process is subject to some variation due to common causes outside the control of those managing the process itself. It is management's role to eliminate as many of these common causes of variation as possible. Still, some minimum variation will remain. If a process is 'in statistical control', it will exhibit results that fluctuate around a mean performance level (perhaps with some predictable trend in this mean). While these fluctuations may not be normally distributed, sampling based on the average of several results, often with samples as small as four or five, will produce a nearly normal distribution. SPC practitioners monitor such sample results consistently over time in the form of process control charts. They examine these charts for evidence of non-normal behaviour. The idea is to use such evidence as an early warning of something new within the process itself that needs to be addressed, or possibly a new external cause that requires senior management attention. SPC practitioners have developed several rules of thumb relative to process control charts that are deemed to be signals worthy of investigation. Some of these are obvious by inspection, but others are more subtle and are best screened by computers. One obvious signal is:

- *A single outlier beyond three standard deviations.* If the process results are normally distributed, such events only occur once in 370 trials, so they are worthy of investigation in their own right.

Less obvious signals include:

- *Two out of three consecutive points beyond two standard deviations in one direction.*
- *Four out of five points beyond one standard deviation in one direction.*
- *Eight or more points on one side of the mean (regardless of how far removed).*
- *Six or more points with a common trend (that is, five or more consecutive first differences of the same sign).*
- *Fourteen or more points that oscillate up and down.* This may be related to change of shift or rotation of equipment. Often, sampling must be done carefully or this effect may be masked in the data.
- *Eight or more points beyond one standard deviation in either direction.* Avoiding the centre of the distribution may indicate a new and previously unrecognised source of volatility.
- *Fifteen or more points within one standard deviation.* Signals are not always bad news. An unexpected string of results within one standard deviation may indicate some favourable improvement in the control process that can be isolated and replicated elsewhere.



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Application to financial services

SPC has been shaped largely in the context of product manufacturing. As such, its practices need to be adapted to the somewhat different circumstances of the financial services industry. In some ways, however, its application may well be easier in finance. For example, the daily number of failed trades or unmatched confirms is already a sample of a significant number of individual transactions. As such, these are likely to be normally distributed.

In any case, financial executives should look to their peers in manufacturing for important lessons in the analysis and control of operational risk. ■