If It Ain't Broke…

Problems with narrowly defined projects

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The objective of all improvement projects should be to improve the effectiveness, or the efficiency, of the core processes. Everything else should be secondary to this objective. If you improve the efficiency of a support process, or even a portion of the core process, but at the same time lower the overall efficiency of the core process, what have you gained?

At one time a Compounding Department, known as Department 13, had material costs which amounted to 75 percent of their production costs. During what we shall call Year One, a project team was formed and given the job of reducing the material costs in Department 13. During August of Year One, a process change was made which was designed to reduce the material utilization. Following this change the average material cost per 100 pounds of material dropped from $215.22 to $208.20. During March of Year Two, another process modification was implemented. During the next four months the material cost dropped to an average of $205.37 per 100 pounds produced. In July of Year Two a change was made in the formulation of the material used in Department 13. This change resulted in an average material cost of $201.22 per 100 pounds produced. One month later the project team and Department 13 got an award for these successful cost reductions. Finally, in January of Year Three, Department 13 changed suppliers for some of their raw materials. This resulted in an average material cost of $198.46 per 100 pounds produced.

Against this background, the monthly report for July of Year Three, given in Figure 1, shows the following values for Department 13: Production volumes were down four percent from the monthly target. They were also down two percent from last year. The year-to-date value was pretty much in line with the yearly plan value, but it was eight percent below the previous year.

Monthly Report for July

	Dept	July Actual Value	Monthly Plan Value	% Diff	% Diff from July Last Yr	Year-to-Date Values Total or Average	Plan	% Diff	This YTD as % Diff. of Last YTD
Production Vol. (1000 lbs)	13	34.5	36.	– 4.2	– 2.0	251.5	252	– 0.2	– 8.0
Material Costs ($/100 lbs)	13	198.29	201.22	– 1.5	– 1.9	198.46	201.22	– 1.4	– 3.6
Manhours per 100 lbs	13	4.45	4.16	+ 7.0	+ 4.5	4.46	4.16	+ 7.2	+ 9.3
Energy Costs / 100 lbs	13	11.34	11.27	+ 0.6	+ 11.3	11.02	11.27	– 2.2	+ 9.2
Total Prod. Costs/100 lbs	13	280.83	278.82	+ 0.7	+ 0.9	280.82	278.82	+ 0.7	+ 0.4

Figure 1: Monthly Report for July of Year Three for Department 13

Year-to-date material costs were down almost four percent from a year ago, which was good. For Year Three as a whole, man-hours were up nine percent from last year, which was bad. Energy costs were up, which surprised no one. Total production costs were essentially unchanged from last year, which was good, especially in light of the *increases* in manhours and energy costs.

In all, it was a rather mixed bag of results—some good news, some bad news, some neutral results. Each of the five categories used in the management report will be considered as a separate time series below. Of course, the complete story is a composite of all of these time series, but we have to assemble the big picture one piece at a time.

We shall begin with the material cost values. The material costs are shown in Figure 2. The gaps in the record correspond to the changes made by the project team. The effectiveness of these changes can clearly and easily be seen on this graph. Each of the changes made by the project team did result in definite and real reductions in the material costs.

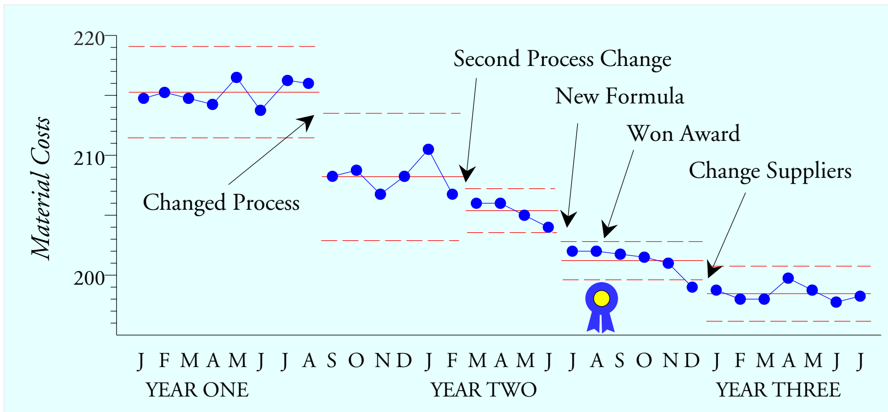

Figure 2 ***X* Charts for Material Costs in Department 13**

The man-hours per 100 pounds of product are shown in Figure 3. The gaps in the record correspond to the changes made by the project team. Clearly there have been increases in the number of man-hours per 100 pounds of product. *Each and every change made by the project team had the effect of increasing the actual labor content of the product.*

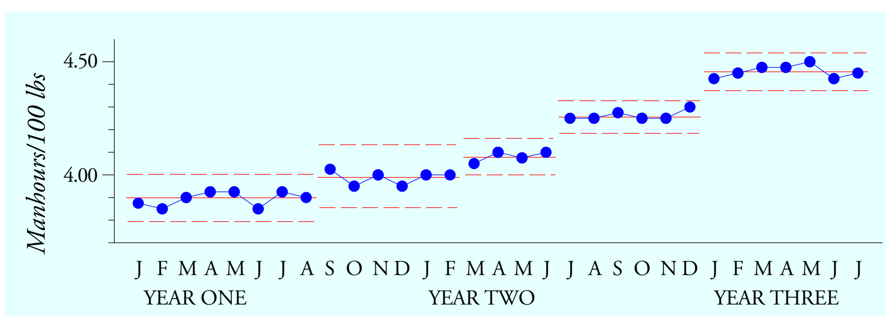

Figure 3 ***X* Charts for Man-hours per 100 Pounds Produced in Department 13**

The production volumes are shown in Figure 4. The gaps in the record correspond to the changes made by the project team. The limits were computed from the first eight values and their moving ranges. (I did not compute limits for each of the five segments here simply because the original limits were sufficient to tell the story contained in these data.)

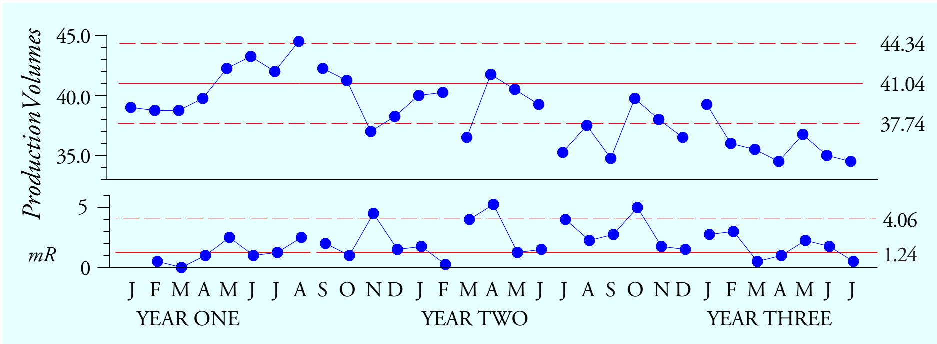

Figure 4 ***X mR*** **Chart for Production Volumnes in Department 13**

The first eight values in Figure 4 suggest an upward trend for the production volumes. However, following the first process change, and continuing through the subsequent changes, there is a downward trend in the production volumes. In addition to the two large transition ranges, the moving range chart shows three other points above the limit. These three values suggest three additional changes in the level of production in Department 13. If these were deliberate changes made by management, then there is no need to look for Assignable Causes. If these changes were surprises, then there is something to be gained by looking for the Assignable Causes behind these shifts.

Thus, the production volumes are down while the man-hours per 100 pounds are up—*a classic description of declining productivity—totally buried in the figures in the Monthly Report.*

The energy costs are shown in Figure 5. They have risen as expected. In fact, the running record shows a fairly straight line sloping upward. (The trend line for these 31 values was found by computing the averages for the first 15 values and the last 15 values. These two averages were plotted at the 8th and 24th time periods respectively and connected with a straight line. The limits were placed on either side of this trend line at the usual distance of 2.66 times the average moving range.)

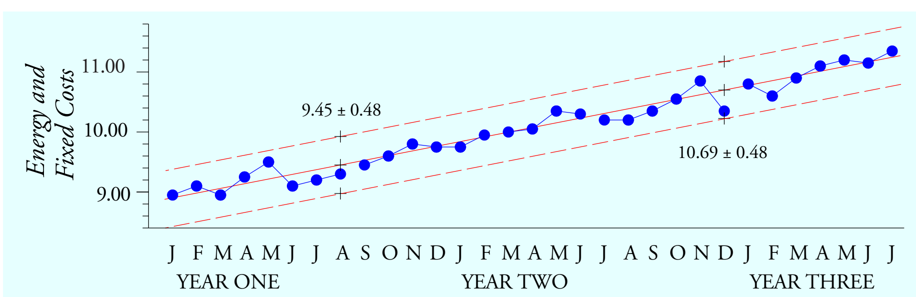

Figure 5: ***X*** **Chart for Energy Costs in Department 13**

The total production costs are shown in Figure 6. The gaps in the record correspond to the changes made by the project team. (The limits shown were based upon each segment, and were computed by ignoring the four moving ranges shown by white dots in Figure 6. These are the first moving ranges following each of the four known changes.)

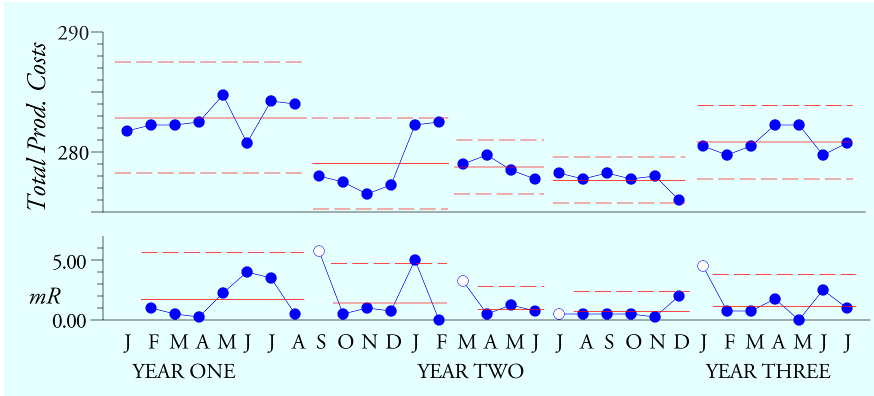

Figure 6: *X* Chart for Total Production Costs per 100 Pounds in Department 13

The first process change resulted in a definite drop in the total production cost, although inflation of other costs had eroded these gains by the first two months of Year Two. The second process change caused a slight drop in the total production cost. Finally, even though the final change at the beginning of Year Three did reduce the material cost, the increases in the other costs have more than offset this gain. Still, all in all, they are doing better than they were at the beginning of Year One, or at least it would appear that way from these data.

While the total cost data and the material cost data look good, and the energy costs look pretty much like they should, there are some indications of trouble in the time series for man-hours and production volumes. Unfortunately, Department 13 does not use its own stuff, and therefore it has no way of assessing the quality of its product.

The figures developed from the records in Department 13 cannot take the quality of the product into account. This makes all of the cost figures suspect, because they are based on pounds shipped, not pounds converted into usable product in Department 14.

Department 14, on the other hand, keeps careful track of their successful conversion rate. Among all of the problems that can occur in Department 14 the major cause of scrap is "will not mould." The category has been shown to be most directly affected by the quality of the component supplied by Department 13. The percentages of scrap (by weight) due to "will not mould" are shown in Figure 7.

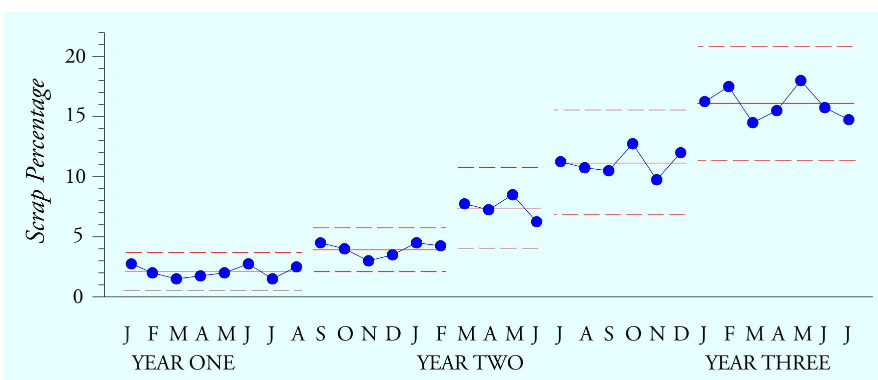

Figure 7: *X* Charts for "Will Not Mould" Scrap Percentages in Department 14

While each segment in Figure 7 stays within its own set of limits, each segment, beginning with September of Year One, has points that fall outside the preceding set of limits. This means that each and every signal in these data correspond to one of the changes made by the project team in Department 13. While Department 13 got an award for their improvements, Department 14 suffered the consequences of each of their improvements. While Department 13 celebrated, the motto in Department 14 was "The beatings will continue until the quality improves."

This negative impact of the project team's efforts was not seen because of the artificial boundary created by the "departments" and the subsequent partitioning of the management data. While everyone was minding their own department, no one was minding the store.

If we delete the pounds of scrap produced in Department 14 from the total amount of product produced in Department 13, then the data for Department 13 will tell a different story. We begin by taking the total production costs and scaling them to reflect the scrap rate due to "will not mould."

Figure 8 shows the net value to the company of the changes made by the project team in Department 13. Any way you look at Figure 8, Department 13 effectively increased the total cost of the finished product every time they made a change, and they got an award for doing it! One cannot help but recall Dr. Deming's first theorem:

"No one gives a hoot about profits—
if they did they would be interested
in learning better ways to make them."

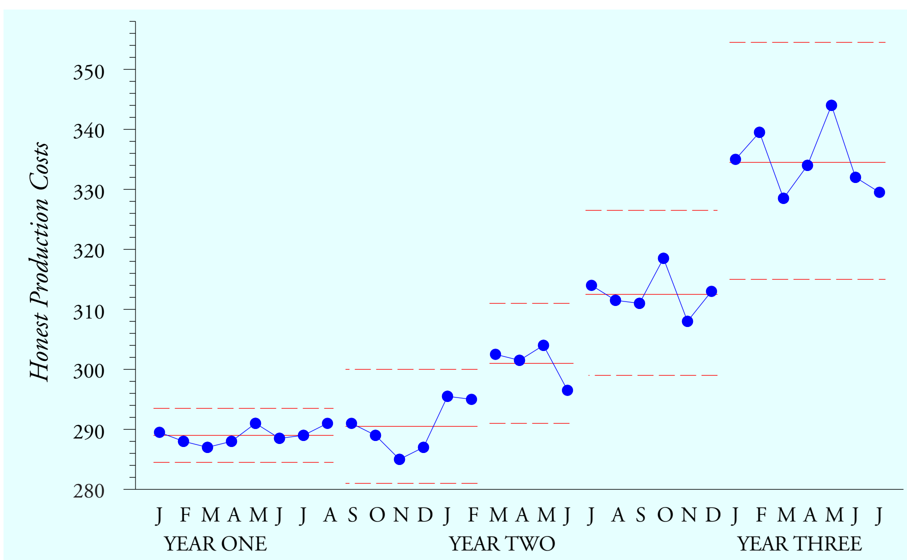

Figure 8: *X* Charts for the Honest Production Costs in Department 13

What if the changes had not been made? What if Department 13 had done nothing? The total cost per 100 pounds of usable product may be estimated as follows. Assume that Department 13 continued to use the same process, with the same supplier, and without the modifications in material usage or formulation. Assume material costs go up five percent each year. Allow for the increases in wages and the increases in energy costs which are known to have occurred. Assume that the scrap rate in Department 14 averages the 2.1 percent shown by the first eight months of Year One, and assume that the labor content of the product stays the same as it was at the beginning of Year One. These conditions will result in the estimated total production costs shown in Figure 9.

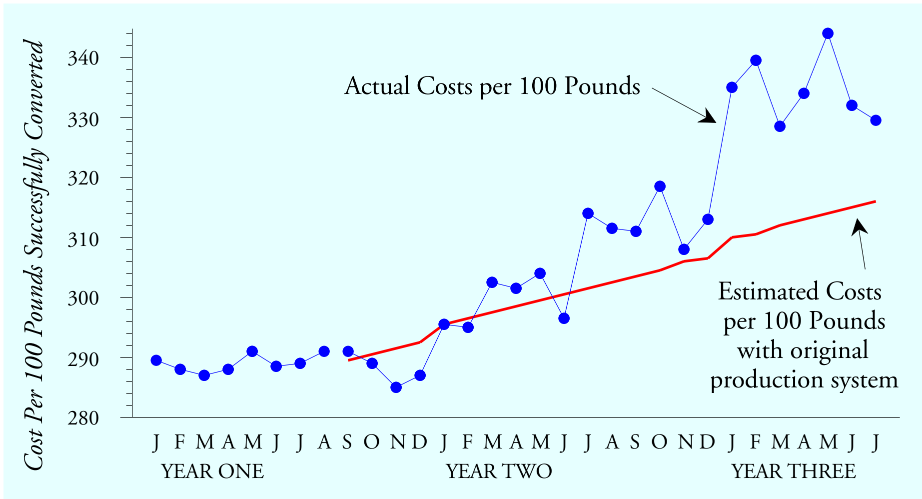

Figure 9: Actual Costs versus Estimated Costs

The company would have come out ahead if they had kept the production system which was in place at the beginning of Year One and sent the project team for a three-year, all-expense-paid vacation someplace cheap, like Cuba.

The second tragedy of this story is that the managers had too much invested in the "improvement" effort to admit that it had been a failure. Therefore, the messenger (from Department 14) who revealed the effect of all these "process improvements" soon took a job at another company. (The data for this example are contained in Chapter Five of my book ***Understanding Variation, Second Edition***.)

This is a classic example of the optimization of a subprocess that resulted in a decrease in efficiency for the core process as a whole. Managers must look at the whole picture, not just the narrow slices provided by the departmental figures. The artificial boundaries created by departments can distort both the data and the system.

The optimization of each department
will always result in a plant which is suboptimal.

The optimization of the whole system
will require that some departments be operated suboptimally.

However, by encouraging competition between managers, most organizations make it impossible for departments to cooperate for the good of the company.

In addition, this is an example of a project that had the wrong objective. Rather than being given the job of identifying ways of increasing productivity, this team was told to implement a specific solution—"Reduce material costs in Department 13." Implementing solutions before we identify the problems is a guaranteed shortcut to chaos. Moreover, the managers here confused change with improvement. By changing things without respect to the consequences of those changes they created chaos. Improvement often consists of doing the same things with greater consistency, rather than finding new things to do.

The objective of data analysis is understanding and insight. And the best analysis is the simplest analysis that provides that insight and allows you to communicate it to others. While many different techniques exist, the primary technique of data analysis is still the process behavior chart. With its simplicity and clarity, it is unsurpassed at providing the maximum insight with the least effort.