Lagging vs. Leading Safety Indicators

How to turn historical accident data into leading KPI's

By Thomas A. Smith

Introduction

Many managers and safety consultants tend to excuse data for recordable injuries, lost workdays and first aid cases as having little value. They describe them as 'lagging' indicators and 'traditional safety metrics' that merely summarize how many accidents have happened. They dismiss them as irrelevant and not what *they* would use to measure the success of a safety program. But that's irrelevant because the definition of good safety management is to meet the needs and expectations of its customers and employees are *the* customers of safety management. Therefore if the expectations and needs of the employees are not met then safety management is a failure no matter what the experts think. The most important expectation employees have about safety is they will not be harmed while doing their jobs. Preventing employee injuries, minor to major, is one of the most difficult and perplexing problems of management. Not paying full attention to accidents would be equivalent to ignoring quality defects of products and services.

SPC – using historical data for prediction

> There is story about a drunk looking for his keys under a street light. A passerby asks him what he is doing and he says he is looking for his lost keys. The person asks him where he thinks he lost them and the drunk replies "in the driveway." The person asks, then why aren't you looking for them in the driveway? And the drunk replies, because this is where the light is.

The first rule of data collection is, if you are not going to use it don't collect it. But when management consciously chooses to ignore or not learn how to better analyze mandated safety data, it is making an egregious mistake by missing an important opportunity to improve how safety is managed. At the very least historical accident data measures the gap between what should be going on and what is actually happening. Unfortunately most managers do not realize the safety data they describe as *lagging* indicators can be analyzed and transformed into leading indicators to provide a statistically valid prediction of future safety performance. Forsaking pertinent accident data for irrelevant information is abdication of safety leadership. You are making the same error as the drunk above who is looking in a place that's easier to work but is a futile effort for solving the problem.

Walter A. Shewhart created statistical control charts in the 1920's while working at Bell Labs, as the tools for analytic studies. His definition of statistical control is: "*A phenomenon will be said to be controlled when, through the use of past experience, we can predict, at least within some limits, how the phenomenon may be expected to behave in the future."* Control charts are a proven method to extrapolate the past to the future. They examine the data for internal consistency. They are concerned with taking appropriate action in the future based upon analysis of data from the past. They also give empirical evidence that a change in a procedure has worked. The real world problems of safety require prediction and prediction always requires extrapolation. SPC charts are the best and proven tool for analyzing data of a constant-cause system to predict future outcomes. The intent is to improve outcomes of the future by understanding and correcting problems in the system that cause trouble; be it quality, safety or productivity.

To use SPC effectively requires knowledge about systems. A system is defined as a network of interdependent components that work together to accomplish its aim. Without an aim there is no system. A system exists to serve something other than itself. Work systems cannot manage themselves. A system is not the sum of its parts but the product of the force of the interactions between the parts. How components of a system react and respond to each other determine the outcomes of the system. Therefore no single component can have an independent effect

on the system. A safety department working by itself cannot improve safety. If departments, suppliers and customers don't work together safety outcomes will suffer.

Understanding how to prevent accidents starts by knowing the system and analyzing it using the theory, thinking and tools of statistical process control (SPC). Many people believe SPC only works in manufacturing involving measurements on the shop floor. This is a mistake. SPC charts work well for a wide range of conditions. Their most important contribution is when they are used to analyze the impact of the system on the people who work in it. They are extremely appropriate for analyzing safety. SPC charts are the system talking to you. They are the voice of your safety system. They help determine:

- if the variation of accidents in the system is *stable*
- if any *special* causes exist
- if the safety objective of preventing accidents in operations is *off target* and by how much

SPC charts provide a common language for management and workers to study, understand and deal with the complexity of safety for which both have a mutual concern. SPC provides the theory and tools to predict with confidence the production of future accidents based on past results. They prescribe the appropriate reaction to trouble. When an SPC chart shows a stable state the next step is to fix the causes in the system. Unlike variable data where a process may not be making defects, when you are counting accidents you are in trouble. The value of SPC charts is they will tell what kind of trouble you are in and how to react to it.

No work system whatever the effort put into it will be free of accidents. In the world of SPC there are two kinds of accidents. The difference between the two are the type of cause.

> Type 1 accidents are when the outcome (an unfortunate or extra pleasing event) results from *common causes* of variation.
>
> Type 2 accidents are when the outcome is a result of a *special cause*, something outside the system.

It's important to differentiate between the two types of accidents of constant-cause work systems. Why? Because if you don't the action aimed at reducing accidents in the future will be disappointing. SPC employs systems thinking which helps us understand why accidents are outcomes of the force of numerous interactions between factors of the work system i.e. *common causes*. It is estimated common causes are responsible for over 90% of all accidents in operations!

You cannot understand a system using non-systems thinking which views the actions of the parts of the system taken separately. This includes the actions of an employee. When you separate the parts of a system they lose their essential characteristics. Non-systems thinking defaults to seeking immediate causality when anything goes wrong. A person's performance is attributed strictly to their effort and ability with no attention paid to the constraints and invisible factors outside of their control that play a role in the accident. Consequently when accidents happen someone, usually the person closest to the problem, is blamed. Non-systems thinking also leads people to mistake symptoms for causes. The corrective actions developed from this perspective only makes matters worse. It results in workarounds or patches with no attention paid to systemic issues or the underlying causal factors of accidents. Management ends up *satisficing*, settling for solutions that are 'good enough', instead of working to dissolve the safety problem so it will never return.

When the run chart in Figure 1 below was presented to a management team their reaction was "*What went wrong in August, November and December*?" The supervisors in the meeting told them nothing had changed in those months or any of the other months. Every safety requirement was met, all safety rules were followed and every injury was investigated with corrective action taken! This is the typical knee jerk non-system thinking response by managers. They react to every single data point as though something special was going on. In their way of thinking safety was "good" April and "bad" in August, November and December.

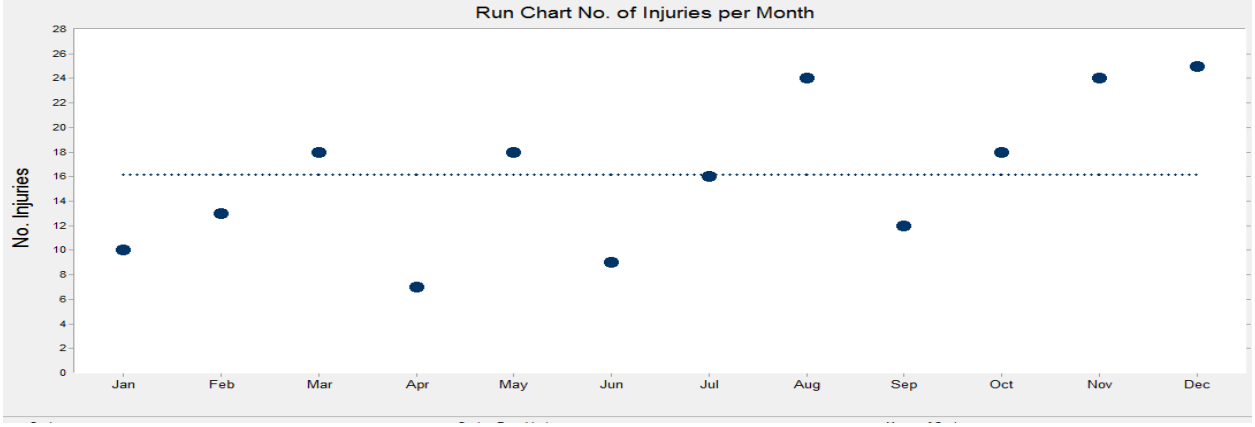

Figure 1 Safety data in a "Run" Chart

The effective application of SPC to safety will prevent people from reacting improperly to safety problems. What if these managers were knowledgeable about SPC? If the data in Figure 1 was presented to them in the 'C' Chart in Figure 2 they would have reacted differently. The managers would have said, '*We can see the safety performance is stable and in control. The SPC chart is telling us that. There are no unusual runs or points above or below the control limits. We need to correct this system! '*

The C chart reveals the number of injuries was the result of random *common cause* variation. Common causes are factors continually present in the system whose impact varies from hour to hour, day to day, month to month. Factors that disrupt the usual flow of the system are called *special causes*. The enlightened managers would realize there was no difference in the safety performance that occurred in April vs. December. It was just normal random common cause variation. The system that produced 6 accidents in April is the same one that produced 25 in December and averages 16 injuries per month. Nothing had changed in terms of how safety was managed in that time. The accidents will continue with varying numbers each month until the system is correct.

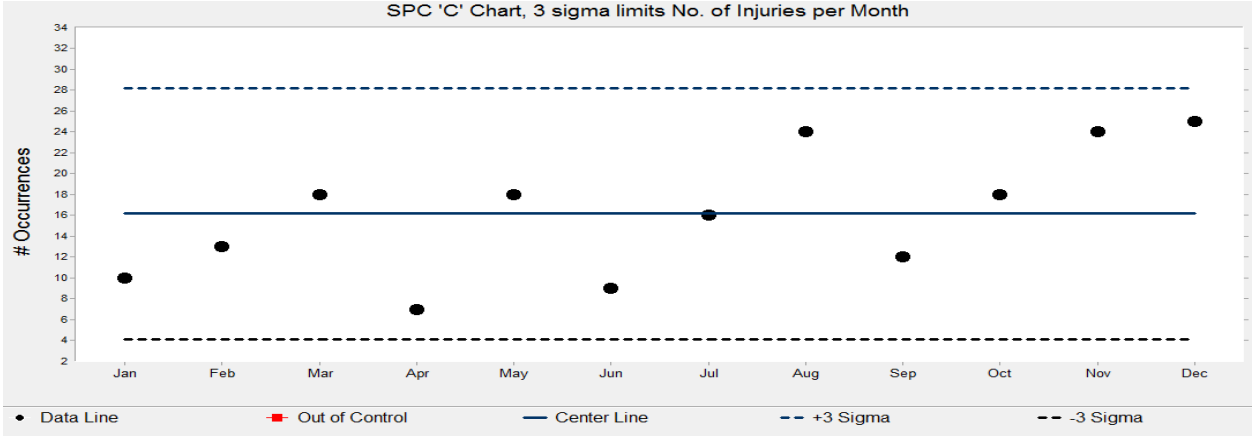

Figure 2 Safety data in a "C" Chart

The plant safety objective is zero accidents so the managers know it is off target. They would also understand it wouldn't make any sense to focus on or blame the individual workers. They work in the system that management designed and controls. They know the system cannot produce better safety than what it was designed for. They realize the individual workers are doing their best but they cannot overcome fundamental faults, the common causes of the system. They also know that systems, even simple ones, are too complex for a manager working on their own to understand. Studying and fixing a systemic safety problem is better done by people working together as a team.

Absent this knowledge, non-system, single-event thinking manager's normal reaction is to treat each and every data point and accident as though it is the result of a special cause. They will demand something be done immediately to correct the problem. Which means someone, not themselves, is going to be blamed for the problem.

Some of the typical management reactions in this situation are:

- Supervisors will be told to work more diligently when they investigate every injury and find the *root cause*. They may even be sent to "Root Cause" training classes.
- Additional urgent safety meetings will be held with employees to show them the accident data and tell them to work harder to pay more attention to safety.
- Safety observation audits of workers may be conducted, or their frequency increased if they are already being performed, and the results fed back to them in the form of positive re-enforcement. The expectation being employees will see the errors of their ways and be motivated to worker safer.
- A safety incentive program will be implemented to motivate the employees to be safer.
- Management puts the screws on for safety.

In this world there is no hope of changing management's problem solving paradigm of fixing the parts of the system. These managers do not realize their reactions will only make matters worse. They are *tampering* with the system. Tampering is when you treat outcomes driven by common causes as special causes. They do not understand in a common cause situation there is no such thing as THE CAUSE. (Tampering has been described as taking a trip off to the Milky Way or a fool's errand since you are searching for something that truly doesn't exist.) They are holding workers accountable for common causes, factors over which workers have no control. They are misinterpreting workers' unsafe behaviors as causes not understanding they are only symptoms associated with accidents. They are basically noise in the system. Trying to fix the workers when the system is the problem is a serious mistake. The fact is the accidents will continue randomly at the present level until the system is correct. And the manager's reactions will result in losing the respect of the workers. They are doing the wrong things right and in the process they are making things wronger.

When knowledge about SPC is applied to safety, managers will know how to react to trouble. If common causes are in play they will plan to study the system. Enlightened by the data presented in the SPC chart they will recognize the need to take a deep dive to synthesize a solution to the trouble. They realize common causes and accidents they create stem from complexity in the system. Since there are many variables involved learning how to dissolve the problem will require a team of people trained how to complete the Plan, Do, Study and Act cycle.

Management is a choice

When people are asked, "What is the first rule for managing a business?" the most frequent response is, "*To make a profit*." But this simply isn't so. Profit *is* a requirement. But profit is to a business as health is to a person. You need it and the more you have of it the better off you are. But it's not the reason you exist. Other answers to the question include; "*To satisfy customers*." or "*To make high quality products*." Or "*Take care of its employees*." All are important but not correct.

The first rule for managing a business is: "THE ARE NO RULES." This means you can *manage* your business anyway you like. (This is not to say you can lie, cheat and steal. Management must be ethical in all transactions.) Think of the contrast of management styles of Wal Mart vs. Costco. Both are successful retailers and compete with each other but are managed quite differently.

The point is there is no law a company use command control to manage its operations. Nor is it mandatory management treat employees with respect and dignity and use the theory of continual improvement. There is no requirement of managers to be a systems thinkers. Nor is there a mandate to force managers to use short-term thinking and manage by the numbers. How a business is managed is always optional.

Having said that there are some rules that should be followed to ensure tools of managing will be effective. SPC will not be effective in a company whose main objective is making profit by meeting specifications through management methods of command and control. SPC effectiveness requires the enlightened philosophical guiding principles of managing for continual improvement. The two approaches have nothing in common and contradict each other.

Managing for continual improvement requires constructive thinking, profound knowledge, teamwork and cooperation between managers, workers and suppliers to satisfy the needs of customers. Managing to meet specifications does not. It uses command and control with the aim to control people and the parts of the system taken separately. In this world managers think short term. They see workers as 'human capital' and bionic machines easily dispensable to reduce costs. For them workers and their actions are the primary causes of trouble. These managers will have no use or time for SPC.

Conclusion

American companies have used SPC successfully and abandoned it twice in the last 75 years. The first time was during WWII when they used SPC to run defense factories to improve quality and reduce waste in operations. After the war private industry abandoned SPC for the methods of mass production. Quality and waste reduction were not valued in this environment.

The second time was in the 1970's and 80's. By then Japanese firms were taking markets from American businesses. Ford Motor and a handful of other companies under the guidance of quality gurus Dr. W. Edwards Deming and Dr. Joseph M. Juran, made good use of SPC to save their business. But at the same time many companies tried SPC and gained little or nothing because they retained command and control management and culture. Management did not understand what was required to make SPC effective. By the 1990's they treated SPC as passé and sought other problem solving tools.

That does not diminish the power and need for SPC to manage for continual reduction and elimination of accidents. SPC is the only Key Performance Indicator (KPI) capable of predicting future safety performance. But for SPC to be effective the aim of safety management must be changed. Working for the aims of compliance with safety rules and regulations, fixing the parts of the system separately and behaviors of employees is no longer *good enough*. The aim of safety must be to fix the common causes responsible for the vast majority of accidents. In this world SPC will thrive as a valuable tool/language to get the Voice of the Safety Customers into the Voice of the System.

To learn more about how your company can use the theory and methods of Statistical Process Control and Profound Knowledge to manage your safety program for continual improvement contact *Thomas A. Smith* (Smitty) at Mocal, Inc. Mr. Smith works with management and hourly employees to help them learn about new theory of management to obtain team skills and work on culture change. His book; *System Accidents: Why Americans Are Injured At Work And What Can Be Done About It* has received high praise and can be obtained at Amazon.com. He can be reached at tsmith@mocalinc.com or his company website at www.mocalinc.com or (248) 391-1818.