Software that swims upstream

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The goal: Track the early indicators of accidents

Software is no newcomer to safety. We have been compiling our OSHA and MSHA logs, tracking our training, and categorizing accident data for years. Much of the bookkeeping function of safety is now available as a software application. But safety software is missing out on its greatest opportunities - to measure upstream indicators of accidents and to correlate these with accident data in a predictive and prescriptive way.

Safety software programs, like safety programs, tend to be stand-alone units: specific applications to perform one specific task. Safety thinking tends to be likewise one-dimensional. Many managers and safety professionals continue to look for a simple solution to a complex problem. Many such programs have improved safety, but none has really solved the whole organizational problem of accidents. The search for the program of the month or the magic bullet has distracted us from the "systems approach" that will most likely yield the desired results.

Heinrich pointed out that accidents and near-misses are preceded by and immediately caused by unsafe acts and/or unsafe conditions. Software is only crudely used at present for physical audits and is slightly more sophisticated at tracking behaviors because of the recent popularity of behavior-based safety (BBS). None of the existing programs combine the physical and behavioral audit information, much less correlate them with downstream accident data. The safety profession is still lacking a comprehensive software solution.

What's available?

- Risk-management companies have several database programs that compile and score site safety factors related to workplace conditions and systems issues. These are generally stand-alone programs designed to improve conditions and reduce insurance rates.

- Several companies have developed their own audit software and perform regular walk-throughs of their work areas looking for potential safety issues. None of these programs currently interfaces with other software and many assume that safety issues discovered can be resolved with a one-step solution.

- Behavior-based safety software is designed to track data generated in safety observations of targeted behaviors. It generally calculates a ratio of compliance called "percent safe," which is simply the number of compliant or safe behaviors divided by the total number of behaviors observed.

Several of these software programs have rather sophisticated variables, which allow for tracking of behaviors by location, time, date, and other factors. At least two of these programs also allow for written explanations by observers or those observed about the rationale for certain behavioral choices or to identify organizational barriers to safety.

BBS software has taught us that upstream measurement is not difficult. Unlike accident data that is usually reported to safety professionals, upstream data must be audited and observed. But the input and reporting of this data is basically a database function with linking to variables that allows for more sophisticated interpretation. Safety professionals could easily modify and use BBS software for both behavioral and conditional audits. In fact, at least one of the BBS products allows for multiple checklists and would be quickly adaptable with minimal effort.

Managing metrics

But what Deming would have called "profound knowledge" of safety is neither the upstream audit data of conditions and behaviors nor the downstream reporting of accident data. It is the relationship between the two and the resulting ability to predict accidents based on past history and current status.

The first step in developing such a program might be to perform a Pareto analysis of the behaviors and conditions that have been the immediate causes of past accidents. Audits and observations would begin to provide upstream metrics on the existence of these factors in the current workplace and culture. Downstream metrics of accident and near-miss data could continue to be gathered but linked to conditional and behavioral causal factors in an ongoing Pareto chart, which would begin to predict ratios of risks to accidents.

Heinrich acknowledged that not all at-risk conditions and behaviors turned into accidents. This means that all such risk factors have an accident ratio, an average number of times performed per accident. If the audits and observations were performed in compliance with good practices for sampling, the data could be extrapolated into approximate number of times performed during time periods and compared to actual accident occurrence. These comparative ratios could be used to create algorithms that could predict accidents with an increasing degree of accuracy.

Testing relationships

Software could also verify the links between causal factors (conditions and behaviors) and accidents. If a work site suspected a link between certain behaviors and accidents, the software could either prove or disprove the link. Likewise, if certain conditions were suspected of causing accidents, these relationships could be investigated.

Similar testing was done in the late 1960s with weather predicting software. Programmers naively hoped that a few algorithms could produce accurate forecasting

but discovered that weather variables (humidity, barometric pressure, winds, competing weather systems, etc.) were so numerous that predictions were almost impossible. However, if Heinrich's original hypothesis that all accidents are immediately caused by either conditions and/or behaviors is correct, the formula for predicting accidents could be much simpler than the weather.

If software could predict accident probability of behaviors and conditions, safety professionals and managers could better prioritize the use of limited resources toward the problems that would yield the highest returns. The study of immediate causes could also enhance the understanding of underlying causes and root causes of behaviors and conditions in the complex physical and social conditions of the workplace. Such understanding of systems could yield some very simple, yet powerful solutions to reduce accidents. Once the workplace solutions were implemented, the technology could be focused on highway and home accidents as well.

Such research and custom software development is a very expensive proposition for single companies. But more and more companies are developing sophisticated software solutions to common business problems by banding together to share ideas and costs. The cost of accidents to companies around the world is a potential incentive for such cooperation and development.

Safety software has only just begun to swim upstream and help us to track the early indicators of accidents. Such tracking and the ultimate correlation of upstream and downstream safety indicators have tremendous potential to help us understand the process that produces accidents and find optimal solutions for the future.