D55 "Historical Hangover:" Backlogs as Hysteresis

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After attending this presentation, attendees will have knowledge of how cumulative inefficiencies in a system (such as a forensic laboratory) can lead to backlogs (unworked cases older than 30 days) and the conceptualizing backlogs as a type of hysteresis.

This presentation will impact the forensic science community by providing a basis for understanding the true source of backlogs, policy implications, and a new way of solving this persistent problem for forensic laboratories.

Hysteresis is the dependence on a system not only on its current environment but also on its past environment. If a given input alternately increases and decreases, the output tends to form a loop. Loops may also occur because of a dynamic lag between input and output.

Rate-dependent hysteresis is where an input variable X cycles from X_0 to X_1 and back, the output $Y(X)$ may be Y_0 initially and a different value Y_2 on the return. The values of $Y(X)$ depend on the values that X passes through, but not on the rate of change of X. That is, backlog is backlog, regardless of how slowly (inefficiency) or quickly (disaster) it builds.

History matters in that predictable amplifications of small differences are a disproportionate cause of later circumstances; in the long run, this historical hang-over is inefficient. Inferior standards can persist simply because of the legacy they have built up. A more technical definition is when a path-dependent stochastic process has an asymptotic distribution that emerges as a consequential function of the process' history (a.k.a., a non-ergodic stochastic process); a fuller explanation follows.

A system will ratchet toward a state that is, to one degree or another, dependent, reversible, and inefficient. Because the system is asymptotic (history-dependent), it moves toward one or more attractors governed largely by externalities. Unless the system can control the allocation of internal resources, it will hit a less-than-efficient lock-state which will be costly to recover from. Exit and opportunity costs become barriers.

Forensically, this asymptotic state results in a backlog. The backlog is more than a simple inefficiency, but rather is the cumulative historical result of uncontrolled resource allocations and process change based on misperceptions and misinformation. If a productivity indicator is defined as Submissions — Reports (S — R), this creates a form of rate-dependent hysteresis demonstrating the rate of work that is being done under the current environment and backlog (unworked submissions over 30 days old) as a rate-independent hysteresis (because it has memory — the 30 days) indicating process efficiency. Some relation of the two should be an indicator of capacity — what could be achieved if the inefficiencies of the backlog were removed.

In the old phrase, "If you give a person a fish, they can eat for a day; if you teach them to fish, they can eat for a lifetime," where the reality is, if S — R does not equal backlog as measured by cases unworked after 30 days, then you may never reduce your backlog by working "harder" or "smarter." The laboratory will have achieved a hysteretic state that may not be reversible due not only to internal processes but also externalities. The laboratory needs to be able to learn how to fish — just being given fish doesn't solve the systemic problem.

Viewing backlog as hysteresis provides a change in perspective, allowing for a systems approach to policy, methods, process improvement, and, eventually, backlog reduction.

Laboratories, Backlogs, Hysteresis

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