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Systems Thinking:
It's more than you think.SM

Continuous Improvement Associates

Exponential Improvement

Too many fires to fight? Long-term improvement doesn't get priority?

Here's how to escape the cycle!

What is systems thinking?
Seeking to understand system behavior by examining "the whole" … instead of by analyzing the parts.

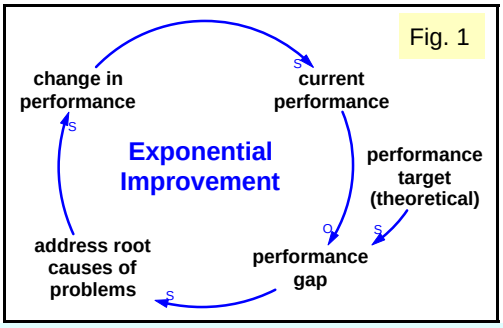
What about TQM?

Let's not take anything away from TQM. It's powerful. Exponential improvement (**EI**) is based on the same principle: Look for root causes of process problems, correct them, continue to monitor the process and continue making corrections. That's balancing feedback (Fig. 1).

What is Exponential Improvement?

EI goes beyond continuous improvement to allow teams to not just improve a process, but to agree on targets for *how much* improvement to expect and *how long* it will take. It sets up a tracking system that allows the team and management to *monitor that improvement is on schedule*. This tells us when most of the potential improvement has been achieved and *when it's time to focus our efforts on another process*. It also gives management a logical rationale for creating appropriate team rewards.

Fig. 1



This feedback loop works just like a thermostat-controlled heating system. Only it reinforces process improvement toward the performance target. Addressing root causes is like turning on the furnace.

If EI is so great, why isn't every organization doing it?

Good question. Evidently organizations don't know about it. There aren't many "sure things" in this world … but *this* is one of them. And it works for all processes, production and development.

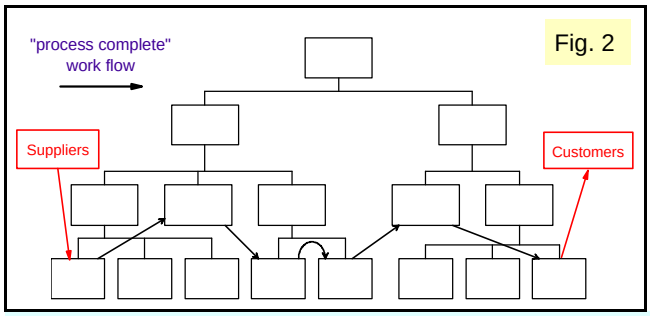
Prerequisites

EI builds on a base of continuous improvement. Full-fledged TQM isn't necessary, but some aspects of TQM are essential. They include process mapping, problem tracking, and maintaining Pareto diagrams.

The major barrier to improvement:
We've never learned to reward people for the disasters that never happened … that is, the disasters they prevented!
Bob Powell, 1994

Process mapping. It's best to map "process complete" activities (Fig. 2) for all processes, not just production processes Organizations learn just from mapping. Everyone may *think* they know how a process works, but they don't *really* know until it's mapped. Additionally, it gives organizations the visibility necessary to take out "no activity" or "no value-added" steps … the essence of what's known as "lean."

Fig. 2



Instead of focusing on functional performance improvement, this approach looks at the "process complete flow across functional boundaries from suppliers to customers.

Problem tracking. It's OK to fix problems one-at-a-time, but it's more efficient to focus on classes of problems. Because each person's experience of a process is different, everyone involved in supporting and affected by the process (it helps to include suppliers and customers) needs to keep a "glitch list." The risk in learning only from our personal experience is that too often we draw conclusions from too little data. It's not that we don't learn, it's that *we learn too much from too little*. This leads us to be unaware of the highest priorities. Truly, we need others to make good decisions.

Pareto diagrams provide a common understanding of the relative frequency of problems. After tracking glitches for an agreed-upon period, we cluster them and plot the counts in descending order (Fig. 3). Generally we want to work on preventing the problems in the largest category … but not always. Sometimes top categories are too difficult; they may

require too many resources or be too formidable technically.

How much improvement?

For the mapped process, estimate the current requirement for the measure (such as cost or time) most important to the organization. Then estimate what the measure would be if *everything* went perfectly … that's the theoretical minimum, the target. The gap (target - actual) between the two values can be halved every "half-life" (Fig. 4).

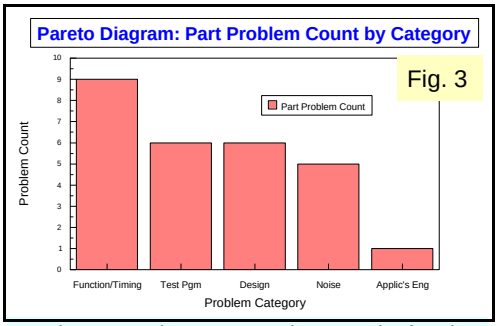


Fig. 3

It's important that everyone keep track of problems. Otherwise there's not a comprehensive understanding of what's happening. If each of us bases action solely on our own experience, we "learn too much from too little."

How long will it take?

It's called the half life because (and this is kind of technical) the stock & flow diagram (Fig. 5) represents an integral equation for a feedback loop. "Performance" is the accumulation of "chg in perf" … just as a lake is the accumulation of the flow of a stream.

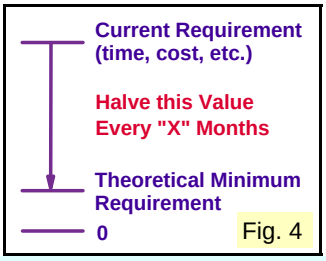


Fig. 4

A feedback process cuts the gap, the improvement potential, in half every "half-life."

The solution to an integral (or differential) equation for a feedback loop is an exponential function … the only function that can maintain its form around a feedback loop. As with radioactive decay, the behavior is exponential. Figure 6 shows half-lives that can be expected depending on process complexity.

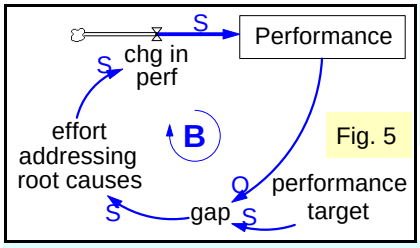


Fig. 5

This is the "stock & flow" representation of the improvement feedback process. The form of the "solution" must be exponential.

Tracking improvement

Because the behavior is exponential, we get a straight line on a semi-log plot (Fig. 7 shows real data for ASICs). This gives the team, and management, a way to confirm progress.

Fig. 6

Matrix: Half-Life (months)

Technical Complexity	Organizational Complexity: Low	Med	High
Low	1	7	14
Med	3	9	18
High	5	11	22

The half-life depends on the organizational and technical complexity of the process.

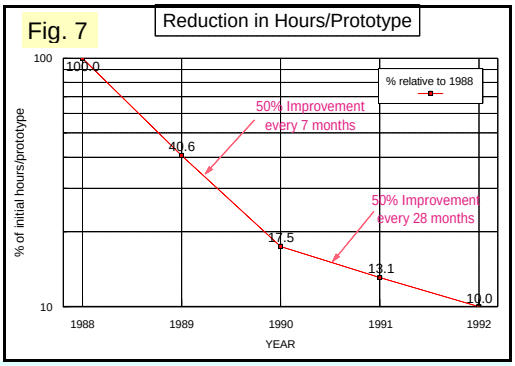


Fig. 7

This is real data from an ASIC prototyping process. Over the first 3 years, product engineering time to take designs from design tape to prototype shipment and production approval was halved every 7 months. All other measures (on-time delivery, designs meeting proto and production spec w/o intervention, design speed increase of 43%) improved similarly.

Summary

This really works … really it does.

A typical half-life is 3 - 6 mo's, but that seems a long time in a fast-paced organization; progress, though substantial, is imperceptible without this kind of tracking. Such improvement usually doesn't happen without faith, team participation and team rewards … which we seldom have.

Exponential Improvement works for the same reason Moore's Law for semiconductors has held true: learning is a feedback process. For integrated circuits it means that state-of-the-art semiconductor density doubles every 18 - 24 months.

Industries learn exponentially. Organizations can, too.

Feedback is Power - Tap It

Exponential improvement gives organizations a way to realistically set improvement targets and to reward people and teams for disaster prevention, rather than for disaster recovery. There is a sound theoretical foundation for why this works. It can save time, dollars, and even lives. It can help keep organizations out of crisis.
And besides, staying out of crisis is the only decent way to live.

Workshop Benefits

If an organization has its process mapped, tracks problems (process glitches or yield loss mechanisms), and maintains Paretos, then a group can reach group consensus on targets, half-life, and measures to track in a one-day workshop. Otherwise, together we can design a series of half-day workshops to build capabilities in stages.
This methodology builds capability that assures perpetual progress.

Looking for a "silver bullet"? Don't.

It's better to improve one hundred things by 1%, than to improve one thing by 100%.

W. Edwards Deming

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