

IT METRICS STRATEGIES

Helping Management Measure Software and Processes and their Business Value



What Makes Your Organization Fast? Metrics and Organizational Learning — Part I

by Michael Mah

Alan Webber is one of the founding editors of *Fast Company* magazine. I recently had the pleasure of meeting Webber after hearing him address the Massachusetts Software and Internet Council, where he spoke about the paradoxes of work and life in the new economy.

According to Webber's bio, the idea for *Fast Company* supposedly came to him one night when he tripped on a discarded shoe box and hit his head on an open desk drawer. On the desk were copies of *Rolling Stone*, *Harvard Business Review*, and *US News & World Report*. The rest, as they say, is history.

During his speech, he referred to old economy versus new economy formulas — in particular, the contrasts between them. In the old economy, size mattered. Bigger was better: history, brand, tangible assets (factories and other hard assets), and sheer numbers of employees mattered. When things got tight, success strategies included cutting costs, maximizing margins, consolidating resources, and outsourcing in order to downsize.

In contrast, new economy formulas say that speed replaces size, imagination replaces brand, and intangible assets replace tangible ones. Smarter is better. The new economy enables you to create your own way of doing

Continued on page 2.

Defect Metrics, Inspections, and Testing: Pay Me Now, or Pay Me Later

by Michael Mah

A Story of Baptism by Defects

As I described in last month's *ITMS*, in a past life I was once "baptized" into the world of software by a mentor who put me in charge of integrated test planning on a critical leg of a US \$750-million project. It was a hapless job. Scope growth and project complexity started out at a manageable level, but, as the months went by, things got ugly. This crunched the project against an immovable deadline. Sound familiar?

I had accepted the position long before hell started breaking loose. Boy, was I dumb. Because I was young and full of optimism, I got my kicks by being at work until 11 pm with the other obsessive-compulsives. I wondered why the more experienced and senior engineers wouldn't touch the position with a 10-foot pole. After

Continued on page 6.

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executive summary

Happy New Year! 2001 is truly an exciting time to be in the field of technology. Although HAL 9000 may not be running your IT Space Odyssey, there's no doubt we're at the cusp of an era of revolutionary progress in technology as compared to even a few years ago.

Many *ITMS* readers have asked for more information on organizational learning, so the first article in this issue takes an in-depth look at this topic. Cisco Systems Chairman John Chambers once said that Cisco's secret weapon is not time to market — it's "time to learning." Metrics play a key role at Cisco. To me, organizational learning is truly where companies either succeed or fail. When metrics emerge, companies can act in a productive, learning way and improve. Of course, if they don't like the numbers, they can kill the messenger or the message with cover-ups, denials, and antilearning defense mechanisms. Some companies choose the latter, but I make clear in my article that you don't have to.

In "Defect Metrics, Inspections, and Testing," I look at applying organizational learning to reduce software defects. Many firms think about quality in terms of testing out bugs toward the end of a project. But if you implement inspection processes earlier, IT reliability can be improved by not injecting defects in the first place. I also discuss how you can measure benefits.

These two articles fit together well; the first articulates fundamental management principles, and the second is about taking the theory into practice from a defect management perspective.

We hope that *ITMS* has shed new light on managing IT "by the numbers." Many dedicated people work hard to produce the content — thanks to my guest authors, whose practical wisdom is invaluable, and to the readers, without whom none of this would be possible. Finally, thanks to the folks at Cutter who make it all come together! Happy holidays!

Michael Mah, Editor

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Continued from page 1.

business. In the words of the late musician Jerry Garcia when asked about the success of his band the Grateful Dead: "We make the music only we can make." In short, in the new economy, it's all about being faithful to your own style and way of working. This applies to companies as well as teams and individuals.

What also struck me about Webber's comments was a phrase that he attributed to John Chambers, chairman of Cisco Systems, one of today's hottest, most successful companies. Chambers said, "It's really not about time to market — it's time to learning."

It's Not Just Time to Market — It's Time to Learning

According to Webber, Chambers says that Cisco learns faster than its competitors. The rate of speed for sharing ideas and information within the organization is what's important; time to market emerges from that. This is what Chambers claims is one of Cisco's advantages. Moreover, what gets measured is still what gets done, with metrics playing a crucial role in decisionmaking.

Furthermore, talent wins. The team with the best people wins. Talent is the scarcest asset in the world, and Cisco aggressively recruits for it. The company is also about reinventing leadership. Although people generally want less management, they want *more* leadership — and genuine leadership at that.

What does this have to do with metrics? A lot, apparently.

If we believe in the concept of organizations as collectivities, then leadership of that collectivity serves a crucial role in *getting the right information* to learn effectively. Leadership has to probe and ask for metrics information (inquiry). It has to properly interpret facts and manage unexpected findings (element of surprise). It needs to

understand and learn from mistakes, rather than engage in cover-ups and dysfunctional responses (antilearning defense mechanisms). It has to act and adapt in a way that accelerates the discovery of solutions, continuously reexamine its espoused values, and align its actions with these values to maximize its creative and productive capacity.

It also should appreciate that leadership may not necessarily come from the top of the hierarchy. Tapping into knowledge may involve being creative enough to draw out talent at all levels of the organization. This is the mission of genuine leadership.

None of Us Is As Smart As All of Us

I am about to make the case for metrics being a vehicle not only for individual learning but also for organizational learning. In *Organizational Learning II: Theory, Method, and Practice* (Addison-Wesley, 1996), authors Chris Argyris and Donald Schon say that in the early 1970s, social scientists felt that organizational learning "seemed to smell of some quasi-mystical, Hegelian personification of the collectivity. Surely, they felt, it is individuals who may be said to learn, just as to think, reason, or hold opinions. To them, it seemed paradoxical, if not perverse, to attribute learning to organizations." They continue, "Yet in everyday conversation, as well as in scholarly discourse, it is increasingly common to find people attributing to teams, departments, or whole organizations, such activities as thinking, reasoning, remembering, or learning."

This was also a theme in John Perry Barlow's keynote address at *Pop!Tech 2000* (www.camcon.org), recently held in Camden, Maine, USA. At this conference on "Being Human in the Digital Age," Barlow said, "What we're doing now with technology is the most important thing we've ever done — a fundamental metamorphic shift. We are wiring the collective human nervous system

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and creating a new layer of evolution, one that is aware of itself. Why that's important is not clear ... it just feels that way."

When an organization adopts a probing stance of inquiry to uncover benchmark metrics about its performance, engages in a discovery process, identifies causal factors, and embarks on a comprehensive training to change its behavior for the better (and in the process, lowering defects, reducing effort, and accelerating time to market), who is doing the learning? Is it just a few individuals, or is it the "meta mind" of the organization?

I say that it's both. It is indeed the individuals, but it is also the organization as an entity. Moreover, the metrics that enable this process are organizational metrics, not individual programmer metrics. The organization becomes an evolving, growing, progressive entity. Through this process, it prospers and becomes stronger than it was before, creating an environment within which its individual members can thrive and prosper.

And isn't that what working in organizations is all about?

Company Metrics and IT Baselines As Organizational Knowledge

IT metrics play a crucial role in the process of organizational inquiry. IT metrics repositories (whether paper or electronic) serve as the corporate memory, a storehouse of organizational knowledge on IT projects. Company intranets act as central nervous systems along which information and actions flow. The interdependence of these two — memory and communication — creates a synergy for the parts of the company to operate effectively and in unison. Think of a symphony orchestra or the interdependent actions of the human body skiing down a mountain trail with all parts operating in sync (most of the time, anyway).

At *Pop!Tech*, Barlow went on to say that technology is not really invented by individuals. Nothing is. Everything is a collective experience. He asks, "How can you write a song if you've never heard one before?" Indeed, how can an IT organization design and build a major software application if it has never done so before?

On an organizational level, when technology enables an organization to wire itself together, the meta mind that emerges within its internal communities has the ability to operate in new ways. In the words of Cutter Consortium Senior Consultants and *Peopleware* authors Tom DeMarco and Tim Lister, teams "gel." If communications break down, an organization is, in a sense, crippled.

But when things operate the way they should, good (if not extraordinary) outcomes are possible. Many organizations experience remarkable discoveries if they have structurally sound metrics programs combined with a mindset or psychological stance that is receptive to learning. In one organization where I consulted, an IT productivity benchmark assessment revealed patterns that opened the way to reducing defects early in the development process through the use of inspections. The team found areas in its process that it could surgically target to reduce rework. This involved the use of inspection processes earlier in the design process to make sure things were done right (or "more right") the first time. When these discoveries were made through examining the company's history, the team was able to set actions in motion and solve the problems at hand by focusing on a process solution.

A critical person in making things like this happen is the chief memory officer (CMO) I described in the September 2000 issue of *ITMS*. The CMO, as advocated by Professor Eric Abrahamson of Columbia University's School of Business, has a special purpose: "Only by remembering the past ... can we avoid making the same old mistakes — and take advantage of valuable opportunities. By contrast, companies that forget the past are condemned to relive it."

In this manner, metrics databases provide the corporate knowledge needed to allow a company to learn about its processes and product cycles, helping teams make better-informed decisions in the future.

Organizing a Metrics Function

However, there's a challenge involved with gathering organizational metrics: it can't be done by a single individual. It requires the concerted effort of a group — a metrics

group, with components of the IT organization itself as the “constituency.”

Argyris and Schon posit that “Organizational action cannot be reduced to the actions of individuals. When, then, does it make sense to say that a collection of individuals constitutes an organization that acts?” They continue, “Consider the mob of students who are holding a spontaneous protest against their university’s financial aid policy. At what point do they cease to become a mob and begin to be an organization? The mob is a collectivity, a collection of people who may run, shout, and mill about together. But it is a collectivity that cannot make a decision or take an action in its own name, and its boundaries are vague and diffuse. The mob begins to resemble an organization as it begins to meet three conditions. The individual members of the mob must:

1. Devise agreed-upon procedures for making decisions in the name of the collectivity
2. Delegate to individuals the authority to act for the collectivity
3. Set boundaries between the collectivity and the rest of the world

As these conditions are met, members of the collectivity begin to become a recognizable ‘we’ that can make decisions and translate their decisions into action.”

This outlines a critical concept for organizing an IT metrics function. When I’ve spoken with organizations about why their metrics initiatives failed, it’s often been because the above three group conditions were not met. Management might espouse the value of IT metrics, but it never provided the leadership or the resources to translate these values into effective, demonstrated actions.

Problems also arise because metrics programs compete for resources with other IT projects. Cutter Consortium Senior Consultant Chris Pickering articulates this nicely in the Business-IT Strategies Advisory Service *Executive Update*, “Metrics and Other Priorities” (July 2000). Pickering says that this decision comes down to executives who often judge allocation of resources

based on return on investment (ROI). But how do you run an ROI calculation on learning? It’s true that most ad hoc organizations carry static inertia against change that predisposes them to staying ad hoc. Ironically, what decisionmakers are saying with ROI demands for metrics initiatives is that they want the metrics on why they should bother gathering metrics.

In many cases, organizations can be successful without metrics programs by making decisions purely on a qualitative basis. However, I believe that “ad hoc success” is more often the random result of heroes acting under duress, and that this is not sustainable in the long term.

When a metrics group is successful, it’s often because it has become organized, using proven frameworks and methods that satisfy the above criteria. These frameworks can be acquired and imitated, rather than created from scratch. Companies that provide metrics solutions make this available, saving valuable time and effort, and standard definitions for metrics are available from the Carnegie Mellon Software Engineering Institute (SEI). A metrics group is then enabled to concentrate its energy in a coherent way, rather than reinventing the wheel and struggling from disharmony of purpose.

Overcoming Fear of a Metrics Inquisition

Acquiring organizational IT metrics knowledge requires engaging in a process of inquiry. People must ask, seek, and probe for answers. Herein lies a problem. Most IT projects miss deadlines, overrun budgets, and deliver less-than-promised functionality. I would not call this failure, arguing that the statistics might actually demonstrate bad promises, poor or nonexistent estimation practices, and ineffective project control. But people may feel that they’ve failed on a personal level. Teams often suffer from damaged self-esteem as a result of these intense pressures. Ironically, these are several of the very things that a successful metrics program solves.

However, to achieve this situation, organizations must pull off a remarkable feat. They must:

1. Gather information about the projects and processes that are leading to these outcomes.
2. Do this in an environment where people are afraid of being evaluated, judged harshly, and subsequently punished or even fired (when the bullets are flying, keep your head down).
3. Overcome organizational inquiry possibly being perceived as an “inquisition.”
4. Deal with the unspoken fears of being punished.
5. Learn about the “whys” behind the successes as well as the failures.
6. Act on this newfound knowledge.

These factors, if overcome by genuine leadership, can result in the accelerated learning that results from effective inquiry. Genuine leadership will do so by answering these often unspoken questions and concerns, “What is it that you are asking for? Why do you want this information on me? Who is asking for it? What are you going to do with this? If I take time to get this information, I take away from time working on my project. This project is already behind schedule, for which I am already being punished. Please, go away.”

(By the way, these fears are legitimate in a high-pressure new economy environment. They are so relevant that they will be the subject of a future *ITMS* article series, tentatively titled, “Why People Hate Metrics.”)

For a moment though, let’s set this aside and address the critical concept of organizational inquiry, which is a vital end game that needs to be reached for organizations to accelerate time to learning.

Argyris and Schon describe inquiry not as an inquisition, but instead draw on philosopher John Dewey’s definition. In their book they write that Dewey believed that “inquiry begins with an indeterminate, problematic situation, a situation whose inherent conflict, obscurity, or conflict blocks action. The ‘inquirer’ seeks to make that situation determinate, thereby restoring the flow of activity.” In short, getting the metrics sparks *action*.

This also describes the steps to emerge from SEI Level 1 (Initial). It comes as no surprise therefore that 75% of the key process areas for SEI Level 2 and Level 3 have to do with metrics (which come from inquiry).

Argyris and Schon continue, “The Deweyan inquirer is not a spectator, but an actor who stands within the situation of action, seeking actively to understand and change it. When inquiry results in a learning outcome, it yields both thought and action, at least in some degree new to the inquirer.”

Inquiry does not become organizational unless it is undertaken by metrics practitioners who function as agents of the organization doing the learning. When these agents engage in this discovery process that leads to learning, the results are manifested in knowledge that is new to the organization, leading to different and (hopefully) improved actions. For IT organizations, the actions may be designed to improve time to market, lower cost, improve system reliability, and deliver IT applications and functionality that enable the corporation to thrive in its market.

Stay Tuned

Next month’s *ITMS* will include the second part of this series on organizational learning. Among the issues I’ll address are dealing with organizational resistance, handling metrics surprises, entry points for a metrics program, crisis interventions using metrics, and learning dynamics.

Resources and References

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Defect Metrics, Inspections, and Testing

Continued from page 1.

some time on the job, I found out. Boy, were they smart.

As the project got into the latter stages of design and coding, the milestones for code drops began to slip. The programming department began delivering incomplete software releases to the system test labs. Test plans and procedures could only be partially run, and workarounds were the norm rather than the exception.

Gradually, we began to watch the bars on our fancy project management charts creep toward the right during weekly executive meetings with the head honcho. My mentor taught me how to ride the hot seat and explain these yellow- and red-light situations to the vice presidents and department heads. It was like the walls collapsing in *Indiana Jones and the Temple of Doom*.

However, I learned valuable lessons about “good, fast, cheap: pick two.” Having been trained in electrical engineering and physics, I delved into early papers of researchers like Robert Tauseworthe (Jet Propulsion Laboratory), Larry Putnam (Quantitative Software Management), and Fred Brooks, C.E. Watson, C.P. Felix, and Peter Norden (IBM) to understand the dynamics and inherent behavior patterns of research and development projects (like software and IT). There were explanations about nonlinear interrelationships between project attributes like scope/size, deadlines, effort, and defects that had answers to the problems I faced. When I found them, it was as though I’d found a priceless talisman.

Managers in today’s fast-paced software development arena are faced with the same dilemmas my team faced in trying to balance scope, speed, and reliability. Some are naïve, as I was, wanting to satisfy customers’ demands of fast schedules, high quality, *and* low cost. But most development managers will give you this typical response: “Yeah, right!” It seems that the norm is speed rules, effort is constrained by team size, and defects are left to run out of control.

Looking at Defect Curves

IT organizations that capture defect metrics on their projects will discover that these metrics rise to a peak, level off, and then taper down over time. The characteristic shape these projects exhibit is known as a Rayleigh curve, named after the British mathematician. The peak of the curve is the point in time where the defect rates are highest. Teams test out the defects, driving the defect rates down. When the curve is at an acceptably low point, the system is ready to be placed into service. (This idea was described in detail in “Charting Defects Metrics — Knowing When Good Is Good Enough,” *ITMS*, December 2000.)

The notion of defects rising to a peak and then tapering off is shown in Curve A in Figure 1. This curve is a function of several causal factors that drive the height and length of the curve. One obvious driver is project size. Generally speaking, projects that are small in scope have small curves. Projects that are large in scope have large curves.

Other drivers include the skill of the team, the team size and deadline pressure (see sidebar, “Why Defects Grow Geometrically Under Deadline Pressure” on page 8), the amount of scope change, and the maturity of the IT process. All of these combine to produce a characteristic curve for an IT project. (This will also be the subject of a future *ITMS* article.)

It is well known that catching defects late in the process is more expensive and painful than catching them early on. This is exhibited in Curve B in Figure 1. When early design phases don’t catch defects that make their way into the code, the peak of the curve shifts to the right. Then, instead of the team needing to find and fix x number of bugs under Curve A, they need to find and fix $x + y$ bugs, which is the combined area between the start and end of system testing under Curve B.

This path “backloads” the defect find-and-fix rate against the back wall of the project — an aggressive deadline. If your IT project is riding Curve B, you’re in trouble. It’s likely

that you'll be pressured to deploy the system when the defect rates are high compared to Curve A. It's not unusual for teams in this situation to release applications with twice or even three times the number of defects. When those defects make it into the field, it's felt by both you and your customers. At least half are likely to be serious or critical defects that can bring down the system. With the deadline looming and bug rates high, it may feel as though the walls are closing in — walls with nasty metal spikes on them.

Ways to Tackle Defects Earlier

Some organizations have found a way to shift onto Curve A (and even reduce its peak), using an inspection process early in the development lifecycle to prevent the insertion of defects. This finds any that are there sooner rather than later.

Metrics tell us if an organization is hitting pay dirt. In one case that involved a systems software division, the numbers showed clear results. After implementing an inspection process, code defect rates were reduced by more than 50%, with defects per 1,000 lines

of code falling from the 30s to the teens. Production jobs with abnormal ends fell 57%, while the number of jobs ran increased 10%. They installed more than 1.5 times the number of "large" projects in a given year. These are the kinds of numbers that you need to sustain real IT process improvement in the eyes of your senior management. As the adage goes, without metrics, you're just another guy (or gal) with an opinion. You need hard proof.

In process-driven environments, small improvements in operational processes can translate into significant dollars saved and costs avoided. Some companies start instituting inspection processes by implementing quality training as the first step. Consider quality management leader Philip B. Crosby's four absolutes of quality:

1. The definition of quality is conformance to requirements.
2. The system of quality is prevention.
3. The performance standard is zero defects.
4. The measurement of quality is the price of nonconformance.

