Benchmarking IC Development Capability–Why?

White Paper

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INTRODUCTION

In the past few years, the business landscape for semiconductors has changed dramatically. In the face of narrower market windows and growing design complexity, competitive pressure has not only increased greatly, it's become truly global. Fabless semiconductor companies face even greater competition as vertically integrated device manufacturers (IDMs) move strongly into the market for application-specific standard products (ASSPs), the domain where fabless chip makers have held sway. In addition, systems companies have been spinning off their semiconductor operations, swelling the ranks of the IDMs and bringing with them extensive systems knowledge.

At the same time, leading-edge process technologies are widely available from both independent and IDM foundries, so that manufacturing is no longer a key differentiator for most IDMs. Instead, they are emphasizing design capability, long a fabless stronghold—at least ostensibly. Indeed, design capability is now the key differentiator and a competitive advantage for chip makers across the board.

To make matters worse, experienced design engineers are in short supply, forcing chip makers to do more with less.

In this fiercely competitive environment, only the fittest will thrive or possibly even survive. Today, being the fittest means being at the top of the heap in design capability, and design productivity is the linchpin of design capability. Indeed, world-class design productivity equates with a world class time-to-market capability.

The question thus becomes, "How can a company reasonably know what its design productivity is?" The answer, obviously, is to measure (or benchmark) it. Indeed, measurement of the engineering organization is an integral element of a balanced scorecard.*

Benchmarking when a project is finished and at regular milestones throughout the product development lifecycle gives a company much more than just a measure of its competitiveness. Overall, it enhances decision-making, enabling a company to manage risk better, and therefore, maximize its return on investment in product development.

More specifically, benchmarking gives a company essential capabilities to:

- Assess its competitiveness
- Accelerate change
- Set performance goals for cycle time, productivity and the like
- Diagnose root causes of bottlenecks
- Improve predictability of cycle time, schedule and staffing requirements.

*Footnote: *The balanced scorecard is an approach to strategic business management developed in the early 1990s by Dr. Robert Kaplan, a professor at the Harvard Business School, and Dr. David Norton. It clearly prescribes what companies should measure to balance their financial perspective. For more information, go to the Balanced Scorecard Institute's Web site, www.balancedscorecard.org/.*

ASSESSING COMPETITIVENESS AND ACCELERATING CHANGE

Obviously, a company can't operate without financial performance and market data, or without comparing its performance in those areas to others in its industry. Today, assessing and monitoring the competitiveness of the engineering organization is just as necessary. With design capability, and therefore design productivity, central to success, benchmarking engineering performance is essential. How else can a company be sure how its design productivity compares with the competition's?

Equally important, how else can it be sure that it's improving at least as fast as its competitors? As a company improves, a lack of company data may be giving it a false sense of security. It may be increasing productivity (or cutting cycle time, or improving whatever metric is seen as key) at what it believes is a healthy rate, but that may not be the case. For instance, if a company is improving productivity by 20%, it needs to know whether the competition is improving by 30% or even more. If its improvement is lower than the industry average, it's falling behind and that spells financial peril. There is no faster way to accelerate change in an organization than by showing that the competition is "eating one's lunch."

SETTING PERFORMANCE GOALS

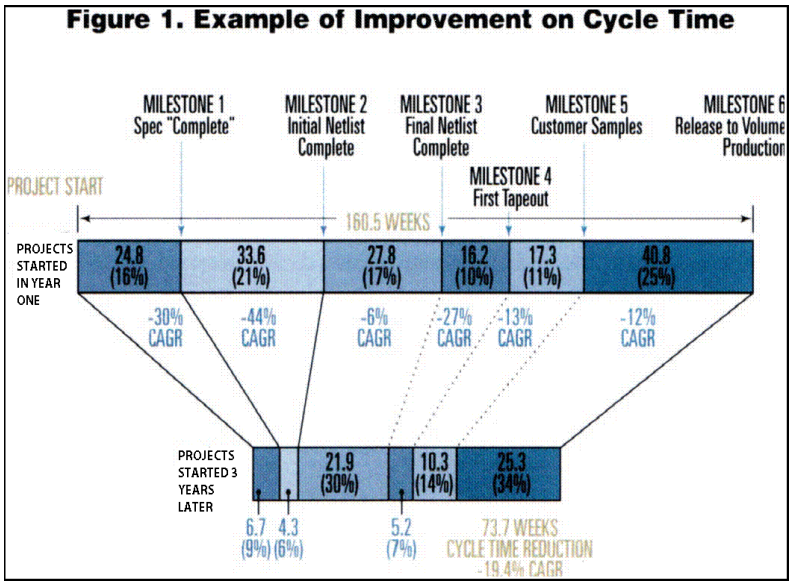
Benchmarking throughout the product development lifecycle enables managers to set performance goals based on solid knowledge, not just for productivity, but also for such essential parameters as overall cycle time, duration of key development phases, schedule slip, spin count and development cost. No matter where a company stands in terms of the competition, managers will be able to stretch their staff with realistic performance targets instead of engaging in wishful thinking—something very common in the semiconductor industry today. If, for example, a company's average cycle time is 80 weeks, cutting it to 50 weeks in one year would be a fantasy.

Realistic performance goals are much more likely to be achieved than goals set capriciously. Moreover, unrealistic goals discourage the staff, creating either unnecessary—and pointless—stress or shakes of the head and a why-bother attitude. Furthermore, if a company can see that even with improved productivity a product still will be a year late in getting to the market, significantly reducing its profitability, management will be able to decide whether it's worth adding more staff to help cut cycle time and thus time-to-market.

DIAGNOSING THE ROOT CAUSES OF BOTTLENECKS AND DELAYS

The essential elements needed to diagnose the root cause of bottlenecks and delays are a standard set of project milestones—when the spec is frozen, an initial netlist and so on—and two simple metrics, time and effort. Managers can then see where a development team is spending more time than planned—for instance, developing the initial spec or physical design. In other words, dissecting the design cycle into time intervals defined by a standard set of milestones is the first step toward conducting root cause diagnostics.

Figure 1. Example of Improvement on Cycle Time

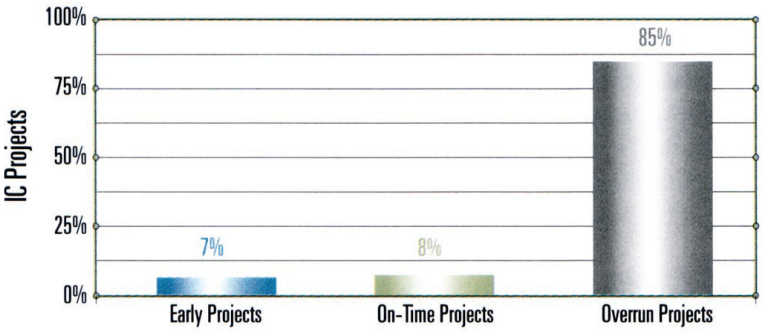


Shown is the cycle time improvement of a business line of a particular company within the semiconductor industry. Establishing a standard set of milestones not only enables measurement of internal improvement, but it is also a prerequisite to benchmarking against industry competitors. A minimum set of milestones must include unambiguous definitions of project start, project end and several key interim milestones.

IMPROVING PREDICTABILITY

Schedule performance is a serious problem in the semiconductor industry. Some 85% of IC projects miss their schedule, with an average overrun of more than 50% (Figure 2). And those are the successful ones, those that reach volume production; the figures don't include projects that were canceled because of excessive slips in the schedule. Obviously, missed schedules can have a profound impact on a product's profitability, and that naturally extends to the company's bottom line.

Figure 2. IC Development Schedule Performance



Source: Numetrics Management Systems

Eighty-five percent of IC projects (ASIC and ASSP) in the semiconductor and systems industries miss their target schedule. The average overrun is 53%. A primary reason for schedule misses is due to underestimating the complexity of the design (hardware and software) and over-estimating the productivity of the development team. The combination leads to the setting of unrealistic schedule goals.

Benchmarking productivity and other key performance indicators (KPIs) provides a powerful foundation for improving predictability, which yields substantial leverage during product planning. These metrics result in reliable estimates of design cycle times and staffing requirements. In turn, having reliable estimates minimizes both the risk of approving projects that *can't be done in time to achieve the required return on investment (ROI), or even to be profitable. Good estimates also reduce the risk of establishing initial schedule targets that aren't achievable with the resources assigned.*

Likewise, with reliable estimates of design cycle times and staffing requirements at each phase of the development lifecycle, companies will have visibility to decide whether to add resources (if that's a possibility) to achieve the cycle times necessary to meet narrow market windows. Alternatively, if adding resources isn't an option, managers will have objective grounds for insisting on removing nonessential product features from the spec (features that could likely be incorporated in a subsequent version of the chip!).

Helping to ensure that those project plans that cannot achieve the cycle time needed to produce acceptable profits are killed has a direct impact on financial performance. Likewise, maximizing the probability that those projects that are approved hit their target market entry date is finally becoming a serious focus among semiconductor companies. Portfolio decisions of this nature are possible only if there are reliable estimates of cycle time and staffing requirements.

The payback for sound portfolio management will be big for those that can execute, because they will be the ones that manage risk better and, therefore, achieve maximum ROI.

IMPLEMENTING CONTINUOUS IMPROVEMENT PROCESSES

Continuous improvement is essential for a company's health. No company can afford to stand still while the competition moves ahead. To paraphrase the Balanced Scorecard Institute, "You can't improve what you don't measure."

In other words, benchmarking on an ongoing basis throughout the product development lifecycle, as well as at the end, is the means to ensure that a company is making the necessary improvements to remain competitive, and it will be able to know how its improvement rate compares with the industry's. It's no surprise, therefore, that leading-edge semiconductor manufacturers have begun benchmarking themselves aggressively. (Of course some claim to be benchmarking by holding "benchmarking meetings" with their competitors, but this is often no more than industrial tourism.)

Benchmarking also enables a company to objectively determine the best-performing projects and teams to identify or verify its best practices. It can then extract them and leverage them across the entire engineering organization. Capturing such institutional knowledge means that it is not lost when people leave the company. What's more, benchmarking enables a company to compare its design performance and use the benchmarking metrics to develop or maintain industry best-in-class status.

Benchmarking delivers other benefits, as well. Having objective data and a repository of best practices, new managers can quickly be brought up to the level of experienced ones. In addition, reliable estimates of cycle times and staffing requirements eliminate or reduce the need to cut corners during development to meet the target schedule; which translates into higher-quality products. Realistic schedules and staffing also eliminate or reduce burnout, reducing staff turnover.

In sum, benchmarking enables a company to assess its competitiveness. It enables managers to set goals for KPIs and to identify low productivity, as well. It gives them the data to diagnose the root cause of bottlenecks and delays. Most importantly, having objective data, managers can reliably estimate cycle time, schedule and required resources, thus improving predictability. Benchmarking is thus a critical element of any continuous improvement process.

INSTITUTING BENCHMARKING

Like anything worthwhile, benchmarking is not simple. To institute benchmarking across the enterprise, or at least within a business line, a company must identify appropriate metrics and KPIs and establish a methodology. It must create standard milestones and definitions for the product development cycle. In addition, databases must be set up and continuously fed with data. Finally, a method is needed to make "apples to-apples" comparisons; otherwise the data is essentially meaningless.

Beyond the technical requirements, a commitment must be made at every level of the development organization. Without a doubt, measurement is intrusive, and numerous obstacles, such as resistance to change and fear of being measured, must be overcome. Therefore instituting benchmarking requires a carefully considered approach, including education. Once a company has established benchmarking as an ongoing process, it will want to use the metrics to develop or maintain industry best-in-class status.