

Technology Due Diligence

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Due diligence is generally thought of as an assignment for accountants and lawyers at times of significant change—a merger or acquisition, a stock offering, a joint venture. But like so much else in business today, the familiar definition lags behind the times. As Hamscher writes, “Every acquisition today can be considered a technology acquisition.” When companies that make and sell technology change hands or recapitalize, they need to be reviewed by a technology due diligence team—but so, too, do financial institutions, manufacturers, and service organizations that use technology to do business. We are all riding now on waves of new technology. How well we accomplish the feat is a critical competitive factor. What investment may be needed to compete effectively is a critical financial reality.

The concepts, practices, and team structure that make technology due diligence effective offer a genuinely fascinating, broadly relevant topic. A doctoral graduate of MIT in Electrical Engineering and Computer Science, Hamscher has developed a technology due diligence practice for Price Waterhouse. He reports here from the heart of the matter.

Every acquisition today can be considered a technology acquisition. Corporate purpose and operations are now permeated by technology, both at companies that create technology (e.g., software developers) and at the many companies that use technology to execute strategy. For this reason, the uses and management of technology by a target company merit close scrutiny during due diligence. After all, the acquirer is buying an infrastructure of computer systems and skilled technical staff that may or may not serve its purposes well.

As currently practiced, due diligence rarely focuses on technology use and management, and retains its traditional concern for a company’s past and current status as depicted in financial statements, contracts, and litigation. Those findings are useful but shed little light on the *future* value of a company’s products and operations, although the target’s future is actually at issue. If due diligence considers technology at all, this typically occurs when the acquirer assesses a patent portfolio or verifies that the computer systems used by the target company to prepare financial information are secure and operate correctly.

Prudent management must look beyond the concerns of traditional due diligence to investigate a company’s technology assets. To that end, this article proposes a distinct technique: technology due diligence, or TDD. This approach seeks to identify areas of technical risk and opportunity, and, secondly, areas in which an acquirer must make new investments in technology to sustain or enhance the target company’s performance. In the

course of the article, we will look carefully at how and why management turns to TDD and will also consider:

- The four critical areas of technology evaluated by TDD
- Traits and skills needed by a TDD team, and the constraints it is likely to face
- Methods and tools of TDD
- The role of TDD in business transformations other than acquisitions.

The illustrative examples cited along the way refer primarily to deals involving technology companies—an especially lively field for M&A these days. But TDD techniques definitely apply to operational users of technology such as financial institutions, consumer products manufacturers, entertainment producers, and energy suppliers: they all depend on technology to create goods and services and manage their businesses.

The need for clear perspective

When one company decides to buy another, the potential impact on both organizations is, of course, immense. The financial and human stakes are high, the time pressure extreme, expenses heavy, financing uncertain, employees anxious, vendors and competitors watchful. With their company's strategy and resources committed to the project, executives of the acquirer want the most accurate understanding and valuation of the target.

An enormous number of acquisitions now involve information technology companies. One study counted 1,884 IT mergers and acquisitions in North America and Europe in the first half of 1997, up from 1,599 in the first half of 1996.¹ The value of the 1997 activity was \$94.9 billion. Another study reported that 75 percent of North American IT companies plan to pursue mergers and acquisitions.²

As companies race to expand and to amass technological tools, they benefit when they step back to evaluate what, exactly, they are buying. That is the role of technology due diligence, a role often best played by a third party with no stake in the outcome of the deal. Third-party TDD provides the unbiased perspective that executives may lack in the heat of the chase. Consider the conflicting perspectives likely to be present when a technology company producing software, hardware, or other electronics invests in or acquires a company with *similar* technology. This type of deal usually has the objective of consolidating market share. The technical leadership of the acquirer (e.g., the Chief Technology Officer or Director of R&D) cannot delegate due diligence to managers and staff whose jobs may be threatened by the acquisition. Some key executives on the acquirer's side may see the deal as a means of eliminating a competitor, extending their own power and control, or pursuing agendas not aligned with corporate goals. As a result, their evaluations can be skewed or myopic. Their focus on corporate and personal benefits may blind them, for example, to the hard integration issues sure to follow the honeymoon.

Other scenarios equally suggest the need for TDD. For example, a technology company is acquired by a company from a completely different industry that is eager to diversify into a promising market. Such acquisitions are often justified by the belief that ownership grants control that will enhance the acquisition's performance. Unfortunately,

that control can easily prove to be counterproductive: market forces press upon the new subsidiary as before—only now the new parent constrains the subsidiary’s ability to respond. The track record of such deals is poor; the acquired company is often hampered and ultimately smothered by its new owner.

When an acquirer lacks the target’s technical background, the acquirer needs realistic expectations about the strengths, weaknesses, and market prospects of its target. If it focuses solely on the merits of diversification, acquiring management may overlook the technical challenges. Given the dissimilarities, how would the target company further the acquirer’s strategy? Will management cultures collide and produce wreckage rather than benefits? Could the purchase disrupt the target company’s most valued and longstanding customer relationships?

Under these and comparable scenarios, it makes sense for a third party to step in to assess as fairly as possible the target company’s technical infrastructure and management. A TDD team can provide acquiring management with insights into how the target company uses and manages technology and, more important, whether significant investment is needed to upgrade lagging technology. Guided but not controlled by the client, a skilled TDD team presents facts and analysis vital to making an informed judgment about the technological aspects of a target.

Management can use the information to estimate the future cash flows associated with technology. These cash flows may take such forms as capital expenditures to repair infrastructure suffering from earlier under-investment, cash benefits associated with consolidating technical operations, and so forth. Cash-flow estimates based on TDD reports can figure into future-oriented valuation methods such as net present value and shareholder value analysis.

The four levels of TDD

A TDD team tailors its work—typically executed in less than a week—to the interests and concerns of the executives championing the investigation. Based on input from the chief executive and his or her technology advisors, a TDD team will concentrate on four critical aspects of a target company’s technology:

- **The general technical environment**—factors such as the age, fitness, and flexibility of the company’s technology, and how well the company handles technology across divisions
- **Unique technologies**—the potential of proprietary technology to serve the company in the future, as well as methods used to create, preserve, and exploit intellectual property
- **Research, development, and operations**—support and maintenance, technology development and integration, and product evolution
- **Management and staff**—understanding staff incentives, career paths, and leadership.

These four focal points typically allow the team to map key features of the target’s technology position. However, to succeed the TDD team needs clear but not restrictive guidance from investors on what aspects of the target are of greatest interest. Executives

should be straightforward about their intentions. That is, do they intend to treat a company as a strategic asset—or as a cash cow with no plans for long-term development? Does a strong R&D portfolio motivate the deal—or does a dominant market position? Experienced TDD teams use accurately drawn context to go beyond generic criteria, ensuring that no key points are missed.

Level one: technical environment

A company's technical environment consists of hardware, software, and networks, and the way in which those elements are installed and run. The TDD team will be encouraged, not fazed, if the environment seems to be in a state of flux. Ferment can signal that innovation is under way. The TDD will concentrate on the history of and plans for continual, orderly change amidst the flux. Key indications include timely upgrades to vendors' latest releases, awareness of emerging technology, realistic and multiyear budgets for improvements, and controls over rollouts and support.

The team will also note infrastructure problems that often result from fuzzy boundaries of responsibility, such as oversight of e-mail systems and Internet accounts across divisions. Do messages move quickly, or do they vanish? Can staff with a compelling need for Internet access get that access? Technology managers balance centralized control of technology against the particular needs of business units. Every TDD assigns titles and technical management responsibilities to people—an exercise that rapidly reveals organizational fault lines.

In companies that create and market technology products (as opposed to companies that use technology for, say, billing and internal communications), the environment is more complex and extends to the tools used to create products. TDD studies whether a company has the right tools to execute its service and product strategies. For example, one semiconductor company failed to invest in costly—but necessary—hardware and software to design and simulate the performance of chips. As a result, its engineers had great difficulty making required design changes, and this in turn caused time-to-market delays. Potential acquirers had to be savvy enough to factor into their valuation of the company this critically required investment.

Level two: unique technology

“Unique” refers, in one sense, to technology created by a company either to sell or to use in R&D efforts. As they develop such proprietary assets, technology managers wrestle with the tradeoffs inventoried in the standard engineering maxim: “Good, fast, cheap: pick any two.” The choices made by managers reveal much about a company's philosophy. Technology evaluation often comes down to determining which one of the three factors has been sacrificed to achieve the other two, how those choices compare to those of competitors, and whether the tradeoff can—or should—be sustained in the future.

In this domain, TDD also scrutinizes how companies protect and exploit unique technology assets in their patent portfolios. The team reviews intellectual property for hidden value. For example, a target company may have failed to use intellectual property in its own products or to license it to others. There are other important variables: for example, some companies may wield a keen sword in pursuit of patent infringers, while

others may be poorly shielded from potential liability in patent infringement suits filed against them.

Finally, “unique” technology may be licensed to and used by a target company, with a high degree of customization to meet the company’s needs. Such unusual choices require strong justifications. There is nothing wrong with custom hardware and software—veering from the mainstream may indicate that managers think independently when sourcing products rather than opt for the safety of the leading brand. However, unusual technical choices require strong justifications. Technology that seems inappropriate for a given task must have clear supporting arguments. Without such support, the technology is probably a bad choice that will require investment to correct.

Level three: research, development and operations

Research, development and operations are tightly interrelated in technology companies. TDD looks at specific issues for each activity:

- **Research.** Innovation results from interaction, not isolation. A company suffers when its research group never visits customer sites, hires “clones” of its existing staff, and avoids diversity of ideas. If management does not energize its researchers, then an acquirer can at best expect the group to provide incremental improvements, not breakthroughs. The group will also fail to notice threats from competing technologies; one organization spent millions of dollars annually on prototypes that were easily outperformed by inexpensive products already on the market.
- **Development.** Much of the cost and all of the revenue of a software program, for example, occur after its first release. Evolution is a “must” after version 1.0 debuts. An organization that ignores bug reports and new-feature requests will find its customer base slipping away. The initial product development ultimately matters less than a solid procedure to ensure that the program evolves to meet customer needs. For this reason, the presence or absence of an upgrade procedure has major implications when TDD reviews operating plans and financial projections.
- **Operations.** Acquirers often look to layoffs and reengineering to achieve operational efficiencies and cost reductions. However, after an acquisition executives are typically too optimistic about the scale and pace of benefits when they install new systems and train users and operators. In one TDD engagement, we examined a target that itself had resulted from an earlier merger. However, the target’s two business units had failed to combine thoroughly their desktop systems, e-mail, and applications programs. This legacy greatly complicated the integration task for the acquirer.

Level four: management and staff

We have left to last the most important focus of TDD: people. Good engineers are notoriously hard to find and difficult to replace when they leave. And they do leave; in today’s robust economy, many technicians change companies every two or three years. TDD seeks to determine exactly who was responsible for technically successful products, whether they remain on staff, and how likely they are to stay after the acquisition. Executives should keep these TDD issues in mind:

- Make no personnel decisions until staff incentives are understood. Investors should appreciate who the technical staff are, what they do, and why they continue to work at

a company. Judgments about the pace or quality of innovation and staff turnover hinge on the financial and psychological incentives (and punishments) offered by an organization. Be aware that things may not be what they seem. For example, one company awarded bonuses to its software developers when they finished projects ahead of schedule. In any given year, 70 percent of the developers got bonuses. Yet despite this seemingly fine performance, the company's glacial product release cycle put it far behind competitors with better speed-to-market. Why? As rational beings, the developers responded to the schedule-based incentive by wildly inflating their time and effort estimates and setting easy goals. They won their bonuses—but the company was losing its market position.

- How does a company manage the difficult issue of career paths for its talented researchers? Do talented staff move among research, development, and operations by default or by choice? Do assignments align with the aspirations and skills of technical staff? TDD will consider how executives at a target company create and use career models to retain and motivate employees. In one typical company, the most skilled technical staff could not advance their careers unless they moved into engineering management—whether they displayed aptitude for it or not.

Skills and constraints of a TDD team

TDD is a complex endeavor with high stakes. The complexity arises from two sources: first, the need for extremely specific knowledge and staff resources, and, second, process constraints. The two are, in a sense, mirror images. The constraints imply the skills needed by the TDD team.

- **Confidentiality:** There are dire legal and professional consequences for the disclosure of internal financial and technical information. Sometimes the target company's management may even refuse to disclose their most sensitive information to the investor directly and reveal it only to a third party with tight restrictions on what can be conveyed to the investor before the deal closes. Thus, a TDD team must have the highest standards of discretion regarding such information. The TDD team must be totally separate from any corporate finance or consulting services within the same organization. Explicit rules will ban the sharing of facts discovered during a TDD engagement.
- **Responsiveness:** Once acquisition negotiations reach the due diligence stage, all parties desperately want the deal completed as soon as possible. The risk of a deal's collapse is increased both by the number of people involved and by the amount of elapsed time. If negotiations drag on, competing bids may surface and competitors may reach out to restless technical staff. The success of a TDD depends on immediate response, as if the team is a fire station crew: the alarm bell rings, the fire trucks roll.

Knowledge requirements: Team members will bring skills in semiconductors, communications, systems architectures, software engineering, and systems integration—each a vast and dynamic subject. People who already understand the substance of the target company's technology are difficult to place in a TDD team on short notice. And they are almost impossible to find when the acquisition involves technology unique to the

target. Such technical knowledge is just the start of a TDD team’s skill set. Requisitioning somebody—however brilliant—with no grasp of TDD methods and constraints endangers confidentiality. As a result of these constraints, the TDD organization must maintain unequivocal access to a pool of talent with exceptional understanding of technology, management, and due diligence procedures. The TDD leadership needs to be honest enough to *decline* an engagement if it cannot assemble a team with the necessary base of knowledge.

- **Objectivity and enthusiasm:** For natural reasons of self-interest, a target company wants to present its technology in the best possible light. Given that bias, TDD team members strive to balance skepticism about unproven and unfamiliar technologies against an uncritical belief that new technologies are necessarily better than old. Successful TDD requires mature, unflappable professionals who maintain a passion for continuous learning—an enthusiasm they take to every assignment. To protect the team’s objectivity, its fee must remain completely independent from any consequences of its work. That is, due diligence can only be expected from a team with no financial stake in its results, via either a contingency fee or a promise of additional work based on the deal’s outcome.

The TDD process: reading, listening, testing

At the start of a TDD engagement, the team consults with the acquiring executives to plan the direction of inquiry. In pursuit of answers, a TDD team collects and analyzes a great deal of research from public and private sources, with the goal of assembling a solid understanding of the company’s products, markets, and management. Exhibit 1 shows some of the sources TDD commonly examines.

Exhibit 1

TDD Information Sources

	Public Information	Private Information
Business	Annual reports Analyst reports	Business plan Contracts
Products	Marketing materials Analyst reviews Demonstrations	Hands-on demonstrations Product histories
Management and staff	Industry surveys Executive titles	Organization charts Process maps Management resumes
Research, development and operations	Product analysis Job postings Internet newsgroup discussions	R&D pipeline status Development methodology Maintenance logs
Unique technology	Academic publications Technical white papers Patents assigned	Architecture documents Program interface definitions Patent applications

	Public Information	Private Information
Technical environment	Press reports Liens and leases	Standards and guidelines Systems topology

The top two levels (business and products) provide overall context, while the bottom four levels refer to the earlier discussion of technology.

TDD teams extract insight from the raw materials through analytic models that examine, for example, product features, value chains, revenue cycles, and research portfolios. A feature grid is a table comparing a company's current products against its future products and the similar products of competitors. Such a comparison sheds light on a company's evolution strategy. Where is it now? Where is it going?

TDD teams also sketch the value-chain process that transforms raw materials into finished products. A discussion of value chains with target company management spotlights areas of risk and opportunity.

Vintage charts, depicting revenue cycles, help investors grasp the impact of short product cycles on a company's prospects. Revenues from new technologies decline rapidly and diminish to zero in a few years, due to competition and obsolescence. By pushing wave after wave of new technologies to market, companies avoid decline and build revenue momentum. Each wave quickly generates large revenues, which drop as a company aggressively cuts the prices of aging products every quarter. Exhibits 2 and 3 show an attractive and, by way of contrast, an ominous vintage chart.

Exhibit Two

Vintage chart of an idealized technology company. New products quickly hit peak revenue in year 2 followed by decline and a maximum lifetime of 5 years. Revenue growth comes only from the annual release of new products.

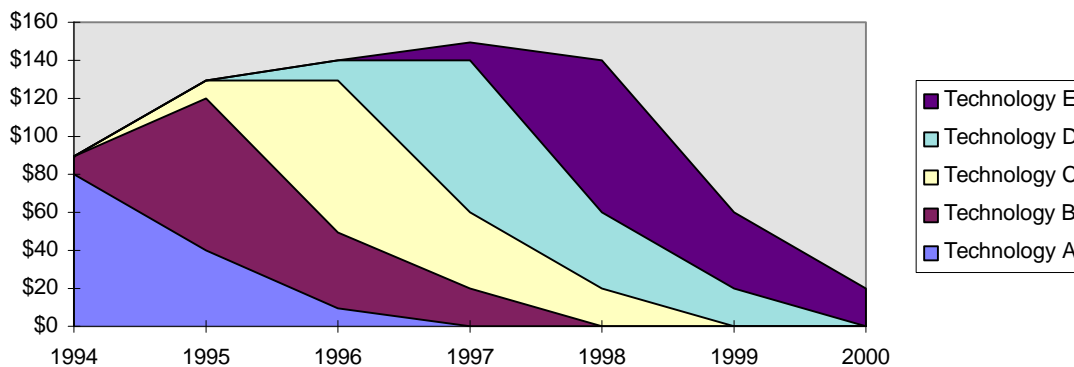
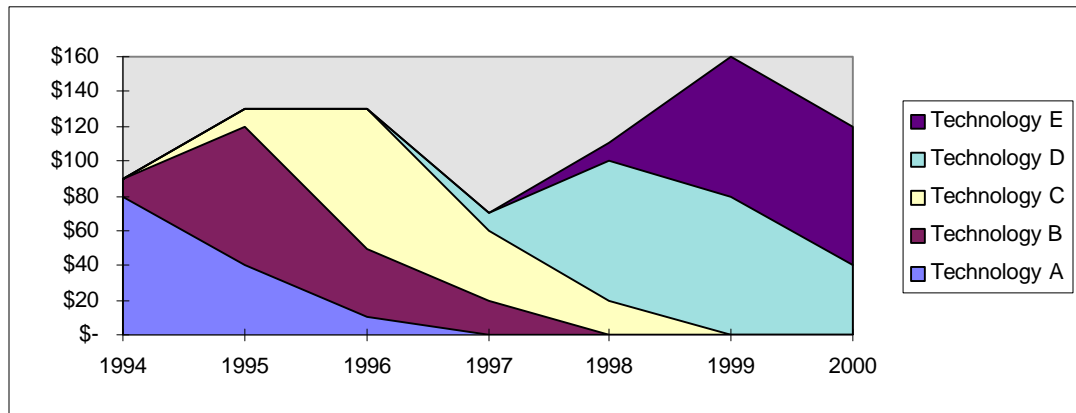


Exhibit Three

Vintage chart showing both the effect of a 1-year delay in introducing technology D, as well as unrealistic revenue forecasts. D and E are forecast to sustain their peak revenues (\$80 million) in years 2 and 3, whereas the historical pattern of A, B, and C has been peak revenue in year 2, followed by rapid erosion.



The TDD project involves far more than data, models, and paperwork. Team members ask questions, listen carefully, and observe the subtleties of operations and management. Offsite research provides the necessary background, but human contact provides detail, nuance, a “feel” for the company. TDD becomes a dynamic process when team members fan out across a target to speak with executives and managers. Every hour of conversation suggests unforeseen opportunities and risks, and more directions for inquiry. Team members should be able to adjust their thinking when unexpected insights challenge earlier assumptions about a company.

Research portfolios are a key topic of discussion. Executives typically balance projects with differing levels of risk and payoff. In a TDD context, an efficient way to evaluate a company’s technology strategy is to ask management to characterize each project along two dimensions:

- Expected payoff through increased revenue, lowered costs, or other benefits arising from patents, new products, or greater market acceptance
- The manageable risks faced by the company, such as risks of technical failure, late arrival to market, loss of capital committed to a project, and likely competition.

The projects should logically fall along a line from “low payoff, low risk” to “high payoff, high risk.” A TDD looks for research that favors projects with low risk relative to payoff. TDD also asks whether the company commands the resources needed to drive its research goals ahead. This line of analysis scrutinizes actual management control over, and attitudes toward, innovation—as opposed to management’s pronouncements on the subject. In one case, TDD found that management had allocated impressive headcount to a key project, but the company actually had *no* staff with the skills needed to fill the remaining slots. There was a severe mismatch between the company’s public statements and the resources available to make them a reality.

TDD teams can gain exceptional insights when they give technology a “test drive.” Demonstrations show whether a company’s products do what they are supposed to

do. A skilled investigator can push a product to its limits, probe for design and operational failures—and then see how executives respond to an unexpected situation. This is a revelatory moment in a TDD exercise. In a few minutes or even seconds, a company will reveal the inner workings of products, its attitude toward quality assurance, the relationships among executives, and how it copes with crisis. For example, an equipment breakdown during one site visit drew forth a remarkable display of professionalism and teamwork as an executive quickly organized her staff to attack and solve the problem. The episode showed a fine combination of technical and managerial skills—always impressive to a TDD team.

After TDD

Once they receive a TDD report, investors and management can use it in several ways. Combined with other due diligence findings, the report can confirm their judgment that an acquisition is worthwhile—or, if it raises concerns, the report may become the basis for a revised proposal. The need for heavy investments in new technology or staff can be reflected in the purchase price.

Insight provided during a TDD remains with investors even if they decide not to buy a target. They learn more about how to evaluate a company and how to work with a TDD team. The features that made one company an attractive target can often be found in competitors, so the investors gain knowledge applicable to the next project. If the TDD team collaborates with management on several deals, the team learns more about management's interests and needs.

TDD shows its value in business transformations other than acquisitions. Management and investors may find an independent technology assessment useful—even required—when they consider a private placement, initial public offering, joint venture, turnaround, or liquidation (valuing assets or establishing market value for creditors). Each distinct situation uses a flexible TDD approach. For example, a merger might anticipate strong synergies through the combination of similar units. TDD would perform a thorough and symmetric review of *both* units, the acquirer and the merger partner.

In internal reviews, corporate management evaluates performance at one or more of their own divisions. Third-party assessment can provide fresh perspective on familiar problems. Compared with an acquisition TDD, an internal TDD needs greater awareness of and sensitivity to internal politics. This type of investigation typically looks at disconnects or clogs in the pipeline connecting R&D to sales and marketing.

Finding problems, finding promise

Top executives turn to technology due diligence to help them evaluate risks, set realistic expectations, and support a fair valuation of a business entity. The findings can range from sobering to exciting. TDD makes a difference: engagements have uncovered problems so severe that they became deal breakers, but TDD has also discovered technology assets that strengthened the strategic fit between the acquirer and the target company.

TDD is complex. TDD teams work under time pressure, sifting vast amounts of information to define a company's critical problems and potentials. While every company is unique, the basic concepts of TDD apply to all technology situations. The four levels—general environment; unique technologies; R&D and operations; and management and staff—define the ways a business derives value from technology. At each level, risks and opportunities will be present.

In our experience, *the* critical factor is the attitudes, motivations, and skills of the people who create and manage technology. Executives will gain the greatest benefit from technology due diligence when their TDD team engages a target's technical and management staff in informed but free-wheeling discussions—followed by a candid report.

¹ “Information Technology Transactions Break Records,” *Mergers & Acquisitions Report*, July 14, 1997. The article quotes numbers provided by Broadview Associates, an investment bank that focuses on the IT industry.

² “IT Companies Cast Acquisitive Eyes,” *Accountancy*, March 1997, p. 59.