Technology Due Diligence--The Need for and Benefits of Technology Assessment in Connection with Investment in High-Tech Companies

Carol Goforth
Ronald R. Goforth
TECHNOLOGY DUE DILIGENCE—THE NEED FOR
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COMPANIES

CAROL R. GOFORTH

RONALD R. GOFORTH, PH.D.

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It seems like technology is in the news on a daily basis,

1. Clayton N. Little Professor of Law, University of Arkansas School of Law; B.A., J.D., University of Arkansas. This paper was supported in part by a summer research grant from the University of Arkansas School of Law.

2. President and general manager, Beta-Rubicon, Inc.; B.Sc., M.Sc., University of Arkansas; Ph.D. (Chemistry), University of Alberta.
particularly the financial news. First, technology investments "skyrocketed," with technology companies serving as the "darlings of the investment community." Then, in mid-April of 2000, the "tech-heavy Nasdaq market plummeted," losing percent of its value.  

This volatility in the public markets means a tougher ride ahead for technology companies, and not just those whose stock is already publicly traded. Venture capitalists are backing away from technology deals, with the consequence that some companies are unable to secure adequate funding for their operations. Meanwhile, merger and acquisition activity in the tech-area continues to boom, with billions of dollars at stake.

In these times of market volatility, technology due diligence is a concept of potentially critical importance. Companies desperate for additional sources of financing need a way to convince investors that their projects have real value. Venture capitalists and other potential investors need a way to investigate such claims. Businesses seeking potential merger partners must be able to evaluate the underlying value of the target company. Lawyers and other professionals involved in these deals have disclosure and other obligations which require them to be able to make good faith estimates about the nature


5. Ritchenya A. Shepherd, Tech Lawyers on a Coaster Ride, NAT'L L.J., May 1, 2000, at A1. The market volatility is credited with causing investors a monetary loss of more than $2 trillion. Id.

6. Id. at A10. "The venture capitalists are reluctant to commit to deals right now in light of the market instability," confirm[ed] Don Keller, of Menlo Park, Calif.'s Venture Law Group." Id.

of these companies’ businesses.8

Without the ability to independently demonstrate or investigate the viability of technology projects, investors will not have the information necessary to support sound investment decisions. Technology-based companies may find it impossible to attract needed investment because their products or processes are poorly understood. Professionals retained to provide advice in connection with the financing of these deals may face the risk of lawsuits claiming that they made false and misleading statements about the technology.9 Finally, the public sector is also likely to make very poor business decisions unless technology claims can be investigated, because of the government’s continuing commitment to support the development of new technologies.10

8. 15 U.S.C. § 77k sets forth the due diligence requirements as follows: no person, other than the issuer, shall be liable as provided therein who shall sustain the burden of proof . . . that (A) as regards any part of the registration statement not purporting to be made on the authority of an expert . . . he had, after reasonable investigation, reasonable ground to believe and did believe, at the time such part of the registration statement became effective, that the statements therein were true and that there was no omission to state a material fact required to be stated therein or necessary to make the statements therein not misleading; and (B) as regards any part of the registration statement purporting to be made upon his authority as an expert . . . (i) he had, after reasonable investigation, reasonable ground to believe and did believe, at the time such part of the registration statement became effective, that the statements therein were true and that there was no omission to state a material fact required . . . or necessary to make statements therein not misleading, or (ii) such part of the registration statement did not fairly represent his statement as an expert . . .


9. See id.

This article will describe the concept of technology due diligence in some detail, and will contrast it with the types of due diligence traditionally conducted in connection with investment in new and emerging companies and the acquisition of more developed enterprises. It will also examine how the divergent interests of potential investors and the proponents of new technologies increase the need for technology-based assessment. In connection with this analysis, this article suggests a paradigm shift in which technology due diligence becomes an accepted requirement any time investment in or acquisition of a technology-based company is proposed or considered. The article also considers the ways in which technology due diligence can benefit each of the different interests at stake when considering investment in a technology-based venture. It will conclude with a suggested approach for evaluating technology due diligence proposals, to insure that the due diligence will be appropriately conducted.

I. WHAT IS TECHNOLOGY DUE DILIGENCE?

When presented with an attractive business opportunity that is based on sophisticated new or evolving technology, anyone with less than expert knowledge of that technology will need help to fully appreciate the risks involved with technology and its use in the business venture. Anyone who fails to undertake a due diligence assessment, which includes a competent analysis of the underlying technology, may unsuspectingly invest in a superficially attractive but ultimately impossible enterprise. Similarly, a company that fails to acknowledge and respond to the risks inherent in new and developing technologies may be unable to attract needed investment or may find

itself exposed to potential liability for claims made in connection with the issuance of securities. Investment professionals may offer inappropriate advice or fail to give adequate warnings if the risks are not fully appreciated or articulated. The public may find its tax dollars being wasted and desirable technologies being underdeveloped if risks are not accurately assessed. These risks will be known only if an objective assessment of the technology is included as a fundamental and integral part of investment due diligence. In order to fully appreciate these needs, it is important to re-evaluate the meaning of certain essential terms.

A. Defining Technology and Technology-Based Enterprises

Why is it important to define such a commonly used word as "technology?" For those not directly involved in technology, at least in any way other than the use of the commonplace, there has been a

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11. Ownership interests in many technology-based enterprises will be in the form of securities. Stock in a corporation, for example, is always considered to be a security. Landreth Timber Co. v. Landreth, 471 U.S. 681, 686 (1985). Limited partnership interests are typically securities. See Mayer v. Oil Field Sys. Corp., 721 F.2d 59, 65 (2d Cir. 1983); SEC v. Holschuh, 694 F.2d 130, 137 (7th Cir. 1982); SEC v. Murphy, 626 F.2d 633, 640 (9th Cir. 1980); Goodman v. Epstein, 582 F.2d 388, 408-09 (7th Cir. 1978), cert. denied, 440 U.S. 939 (1979); Hirsch v. duPont, 396 F.Supp. 1214, 1227-28 (S.D.N.Y. 1975), aff'd, 553 F.2d 750 (2d Cir. 1977). Membership interests in a limited liability company may be securities, particularly if the member in question has no or very limited management rights. See generally Carol R. Goforth, Why Limited Liability Company Membership Interests Should Not Be Treated as Securities and Possible Steps to Encourage This Result, 45 HASTINGS L.J. 1223, 1304 (1994). Even general partnership interests may be classified as securities if the general partners are relegated to a limited role. Williamson v. Tucker, 645 F.2d 404, 422 (5th Cir.), cert. denied, 454 U.S. 897 (1981). See also Leslie J. Levinson, General Partnership Interests and the Securities Act of 1933: Recent Judicial Developments, 10 OHIO N.U. L. REV. 463, 468 (1983); Douglas M. Fried, Note, General Partnership Interests as Securities Under the Federal Securities Laws: Substance Over Form, 54 FORDHAM L. REV. 303, 303-04 (1985).

Financing through debt may also involve the issuance of securities. Notes are generally classified as securities unless they fit within the "family resemblance test" articulated by the Supreme Court. See Reves v. Ernst & Young, 494 U.S. 56, 66-70 (1990). Bonds and debentures are among the list of interests specifically enumerated in the statutory definition of a security under the federal securities laws. See Securities Act of 1933 § 2, 15 U.S.C. § 77b(a)(1) (1994).

12. In a public offering, such professionals are likely to include at a minimum the underwriters and underwriters' counsel, as well as the issuer's attorneys. In privately negotiated deals, the role of the attorneys is much more significant.
considerable loss of precision in its definition. The word "technology" is being both overused and inappropriately used — it has become a buzzword to lend an air of currency and a certain mystique. This misusage compromises the clarity of communications when the word "technology" is used, unless a careful definition, devoid of unintended connotations, is provided.

For the purposes of this article and the concepts addressed here, "technology" is defined as applied science, that is, natural science and the scientific method applied to solving practical problems. It usually involves at least the potential for commercial exploitation, and certainly when one focuses on the need for technology due diligence, this will almost always be the case. Natural sciences, in this context, may include agricultural sciences, biology, chemistry, earth sciences, medical science, mathematics, and all fields of engineering. The social and political sciences are not included. This definition obviously leads to the question of what constitutes a "technology-based" enterprise.

Because technology is evolving so rapidly, it is not possible to identify "technology-based" enterprises by simply providing a list of qualifying tools, resources, or techniques. Today’s conventional photocopy machine, now commonplace in virtually every office, was considered by some to be cutting-edge technology as recently as twenty years ago. The typewriter preceded it in a similar way. As a consequence of the rapidly changing nature of what we consider to be technology, we must use a more systematic and generic characterization scheme.

Again, for purposes of this article, enterprises will be considered to be technology-based when they are using or adopting technologies that have the following characteristics:

1. technologies that represent an effort to improve productivity or efficiency, reducing cost and resource constraints by relying on tools, practices, and recently introduced materials and resources --usually with the anticipation of reducing human resource requirements (in terms of numbers of workers and/or skill levels required);
2. aggressive technologies that are being adopted in
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anticipation of near-term competitive pressures, or that open new opportunities for commercial exploitation; and

3. technologies that represent a substantive evolutionary progression from the current base.

It is probably a good idea to avoid using terms such as "high-tech," "cutting edge," or "breakthrough," since they have been so overused and misused that they have become meaningless. To complicate matters further, there is no well-organized or generally accepted system for categorizing or characterizing technology change. However, it is clear that change is the norm, and what is considered "technology" today may soon become either commonplace (e.g., photocopy machines) or largely obsolete (e.g., typewriters).

B. Conventional Due Diligence

From a legal standpoint, due diligence is commonly understood as a defense against securities fraud claims predicated on false or misleading disclosure documents prepared in connection with the public sale of securities.\(^{13}\) Section 11(a) of the Securities Act of 1933\(^ {14}\) subjects a relatively broad class of persons to potential liability for material misstatements or omissions contained in a registration statement (including the prospectus, which must be filed as part of the statement).\(^ {15}\) Section 11(b)(3)\(^ {16}\) contains the due diligence defense,\(^ {17}\) which basically exonerates any defendant, other than the issuer,\(^ {18}\) who

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13. The term "due diligence" is not actually defined in or used by federal securities laws. Rather, it is a label applied by securities lawyers to describe an affirmative defense available to certain defendants under section 11 of the Securities Act of 1933. See supra note 6. See generally Donald C. Langevoort, The Statutory Basis for Due Diligence Liability Under the Federal Securities Laws in CONDUCTING DUE DILIGENCE 9, 11-29 (PLI Corp. L. and Pract. Course Handbook Series No. B-1052, 1988).

15. Id.
16. See supra note 8.
17. Id.
18. These potential defendants include:
   (1) every person who signed the registration statement;
   (2) every person who was a director of . . . or partner in, the issuer at the time of the filing of the part of the registration
can show, after reasonable investigation, that he or she had reason to believe and did believe, that there was no material misstatement or omission in the registration statement. The due diligence defense requires defendants to prove that they exercised reasonable care in investigating the accuracy of the issuer’s disclosures, with such reasonableness as would be expected from “a prudent man in the management of his own property.”

Although not recent, Escott v. BarChris Construction Corporation remains the leading case on the issue of what constitutes an appropriate investigation. While BarChris adopted a sliding scale for judging the reasonableness of due diligence investigations, the case makes it clear that, at a minimum, affirmative action must be taken to independently verify information in the registration statement.

statement with respect to which his liability is asserted;

(3) every person who, with his consent, is named in the registration statement as being or about to become a director, person performing similar functions, or partner;

(4) every accountant, engineer, or appraiser, or any person whose profession gives authority to a statement made by him, who has with his consent been named as having prepared or certified any report or valuation which is used in connection with the registration statement . . .

(5) every underwriter with respect to such security.


19. Section 11 divides the registration statement into two parts: the expertised portion and the non-expertised portion. 15 U.S.C. § 77k(b)(3). As to the expertised portion, only the responsible experts need conduct any investigation. Id. However, as a practical matter, descriptions of the issuer’s business, products, and stages of development are likely to appear in the non-expertised portions of the prospectus as well, meaning that there will be a general obligation of due diligence with regard to this part of the registration statement under section 11. Id.


22. Id.

23. The BarChris opinion independently analyzed the potential liability of both inside and outside directors, persons who sign the registration statement, attorneys, accountants, and underwriters. Id. at 684-703. Underwriters were deemed to bear the highest burden, as they are expected to exercise a high degree of care in their efforts to ensure the accuracy of all data presented to them by the issuing company. See id. at 697.

The U.S. Securities and Exchange Commission has confirmed the high level of care required of underwriters: “[a]n underwriter . . . occupies a vital position in
The legal conceptualization of due diligence is, of course, a limited one. "Due diligence" can mean more than a potential affirmative defense for those having a connection with a materially false or misleading registration statement. For example, due diligence has a role in protecting the interests of both the investor and the issuer in private placements as well as public offerings.  

Conventional due diligence is, however, an in-depth analysis of the financial and operational conditions of a company targeted for investment, merger, or acquisition. It may be as detailed as an accounting audit, since the operational condition and efficiency of the target's assets are also investigated. Due diligence is generally


24. This does not mean that the "due diligence" defense is applicable to private transactions. See Gustafson v. Alloyd Co., Inc., 513 U.S. 561, 567-84 (1995) (holding that section 12(2) of the Securities Act of 1933 does not include a private sales contract within the meaning of the term "prospectus"). Note, however, that it is not always easy to tell whether a transaction qualifies as a "private placement" for these purposes.

For example, although offerings made pursuant to sections 4(2) and 4(6) of the Securities Act of 1933 are generally considered to be private placements while offerings made pursuant to section 3 are not. See 15 U.S.C. §§ 77c, d (1994). Thus, for an offering conducted under Regulation D, offerings exempt by virtue of rule 506 (which was promulgated pursuant to section 4(2)) would probably not subject the issuer to liability under section 11, while offerings under either rule 504 or 505 (both promulgated pursuant to section 3) could. See generally Robert B. Robbins, Due Diligence in Private Placement Offerings in REGULATION D OFFERINGS AND PRIVATE PLACEMENTS 319, 323-24 (ALI-ABA Course of Study, Mar. 11-13, 1999).

In any event, even if a private placement does not give rise to section 11 liability or implicate the due diligence defense per se, other causes of action may also be based on "negligent" misrepresentations. For example, state securities laws might support such a claim, as well as common law. See, e.g., Del. Code Ann. tit. 6, § 7323 (2000). Finally, if the federal securities laws impose liability only for reckless or intentional misstatements, this might encourage finders of fact to make such a determination. As one commentator has observed, "[t]he effect of Gustafson might therefore be to place a greater, rather than lesser burden on an issuer's ability to demonstrate that a reasonable, thorough and good faith due diligence investigation was undertaken in connection with a private placement." Robbins, supra at 326.

25. Mark Schonberger & Vasiliki B. Tsaganos, Top Twelve Most Frequently
designed to ascertain the economic values and results of operations and then to express them in financial terms. The general objective is to find, identify, and estimate the impact of the purchase price or investment conditions.\textsuperscript{26}

A number of relatively recent publications have addressed the appropriate scope of conventional due diligence.\textsuperscript{27} In fact, some practice-oriented publications have produced detailed checklists of items to be investigated during a due diligence evaluation.\textsuperscript{28} One such checklist mentions in some detail the need to review records and other information concerning the corporate organization, capitalization and stockholders, affiliate agreements and arrangements, indebtedness and obligations, governmental regulation, taxation, financial data, management and employees, litigation, property (focusing on realty), operational matters, insurance policies, material agreements, appraisals, marketing and pricing practices, and intellectual property and licenses.\textsuperscript{29} However, nowhere in this list is there any reference to the potential need to independently assess technology.

This omission might be readily forgiven on the grounds that this particular checklist was prepared in contemplation of the acquisition of an unspecified company that is not technology-based.\textsuperscript{30} However, even due diligence checklists which purport to focus on technology fail to appreciate the need to accurately assess and evaluate the

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\textsuperscript{26} \textit{Id.} (noting that “[t]he term due diligence refers to the investigation into the business, legal and financial affairs of the company concerned in connection with securities offerings or other corporate transactions”).


\textsuperscript{28} \textit{See}, e.g., John F. Seegal, \textit{Initial Due Diligence Checklist} in \textit{Acquiring or Selling the Privately Held Company} 245, 245-62 (PLI Corp. L. and Prac. Course Handbook Series No. B-1125, 1999).

\textsuperscript{29} \textit{See generally id.} at 247-55.

\textsuperscript{30} A similar excuse may be applicable for the omission of technology issues from the checklist presented in Bertil Lundqvist’s \textit{Managing and Directing the Legal Due Diligence Process}, which focused on mergers and acquisitions in the insurance industry. Lundqvist, supra note 27.
underlying technology as part of the due diligence process.\textsuperscript{31} One such technology due diligence checklist focuses on the need to review general business and industry materials; material contracts, agreements, and literature; proprietary rights and related technology matters; litigation; employees; and financial matters.\textsuperscript{32} Another focuses on management and financial information, although it does suggest that a consideration of the “fair price” and “risks” are also appropriate.\textsuperscript{33} Without some discussion of what these factors entail, however, this is at best an extremely lukewarm endorsement of the need to independently assess the viability and value of the underlying technology. Some “checklists” do focus on intellectual property issues,\textsuperscript{34} including patent ownership, protection and infringement issues, confidentiality concerns, employee claims, and similar issues. These are concerns which may be of particular importance for a technology-based company, however, they are not the only issues which require special attention when a company’s prospects depend on the viability of its technology assets.

The truth is that technology due diligence has been neglected in virtually all of the literature addressing the nature and scope of conventional due diligence.\textsuperscript{35} Mark L. Gordon, a regular contributor to the Practicing Law Institute’s annual publication on due diligence, is one of the few who have publicly commented on the desirability of technology-oriented assessment.\textsuperscript{36} Gordon suggests that due diligence must attempt to place a meaningful value on a target’s

\begin{footnotes}


33. Waryjas, supra note 31, at 83.

34. See generally Been, supra note 31 (noting that the list is intended to focus on these issues and is not exhaustive); see also D.C. Toedt, \textit{Preliminary Due Diligence in Technology-Company Transactions}, J. \textit{Proprietary RTS.}, Mar. 1994, at 14-19.

35. See supra notes 28, 29, 31.

36. See Gordon, supra note 7.
\end{footnotes}
assets including its technology and human capital. He urges a multi-disciplinary review which includes not only a consideration of the ownership of intellectual property, but also a thorough review of valuation issues, focusing on such potential problems as the need for confidentiality and short market lives of certain types of technology. Even he, however, acknowledges that “conventional wisdom” implies that due diligence consists of a far more limited examination of a company’s records and assets.

The significance of the ramifications of such a limited approach to due diligence that is suggested by such publications is readily seen when one considers the legal standards by which the adequacy of due diligence is evaluated. In colloquial terms, due diligence (at least as such term is used in section 11 of the Securities Act of 1933) is a “standard of the street.” In other words, the “reasonableness” of the investigation depends generally on “what constitutes commonly accepted commercial practice.”

C. A Proposed Paradigm Shift

This article suggests that technology assessment should be integrated with conventional due diligence, providing a new focus for investment opportunities that are primarily technology-based and/or technology-driven. For technology assessment to augment conventional due diligence, an intimate knowledge of the state-of-the-art in the relevant technology, as well as of technology trends, research and development management, and management technology, is required. Furthermore, a high degree of research and scientific sophistication as well as a well-developed analytical methodology to evaluate the relative potential risks and rewards of the acquisition or investment in technology-based enterprises is necessary. As such, extensive data gathering and information extraction capabilities and the ability to translate technical detail into

37. Id. at 937.
38. Id. at 937-38.
39. Id. at 936.
40. See supra note 8.
41. Robbins, supra note 24, at 322.
terms that make relative potential risks and rewards meaningful to individuals in the investment community is also needed. When these conditions are met, a new paradigm emerges. This type of paradigm shift is needed to respond to the increasingly frequent appearance of complex technology components in new and evolving enterprises.

In situations where potential investors and technology proponents have widely divergent perspectives regarding the risks perceived to be associated with technology deployment, the likelihood of investment is almost certain to be smaller than it would be otherwise. This is especially likely where there exists a substantial degree of uncertainty with regard to the technology. On the other hand, when investment in a technology-based enterprise does occur absent a thorough technology assessment, it is likely being made on something other than an informed basis. How would the new paradigm facilitate economically sound technology investment decisions?

In order to answer this question, it is obviously important to understand what technology due diligence or technology assessment entails. Ideally, technology assessment should include a detailed review and analysis of the technology development proposal documentation and literature, verification of the representations made by the proponent, and a reviewer’s conference. There must be a thorough analysis of the proponent’s technology plan and a search and analysis of the state-of-the-art developments in that proponent’s area of technology. This should include a careful review of related and competitive technologies. It will also entail an evaluation of the proponent’s technology and development plans, schedules, budget, and its management capabilities to respond to the opportunity, including structured interviews with key personnel. Conclusions and recommendations must be formulated, and full details of methodology, sources, and references documented.

This complements conventional traditional due diligence rather

43. For a more detailed consideration of this issue, see infra part III of this article.

44. Throughout this article, there will be references to work performed by “reviewers,” “investigators,” and “assessors.” At some level, each of these terms has a slightly different meaning since a thorough technology assessment will have to include a review of data provided by the technology proponent, an investigation into claims made by the proponent, and an assessment of the entire situation. For the most part, however, this article uses these terms interchangeably to refer to those persons who would be conducting a technology assessment.
than replacing it. All of the factors which are typically considered in conventional due diligence\(^45\) are still relevant. In fact, some of the issues that have been highlighted in conventional due diligence practice will be especially important in the technology sector. The one area that appears to have garnered the most attention involves a variety of intellectual property issues.\(^46\) However, employee issues and management concerns may also present special problems in the case of technology-based enterprises.\(^47\) Thus, conventional due diligence will still be required and added to this new technological inquiry.

D. Where Technology Due Diligence Should be Employed

Generally speaking, independent technology assessment should be included as an integral part of due diligence where one or more of the following conditions or circumstances are encountered:

1. where there is a need for systematic analysis of complex technology issues and in-house expertise is limited, or where there is a need to minimize impacts on such internal resources;
2. where complexity dictates that an interdisciplinary and team-oriented approach is necessary to assure that both a broad perspective is taken during the assessment and that depth of analysis is provided by specialists in the particular discipline;
3. where a response is required and can only be assured through the dedicated efforts of specialists familiar with technology assessment methodologies and

45. See supra Part I.B.
46. See generally Been, supra note 31.
47. Some of these concerns may themselves be related to intellectual property issues. For example, the possibility that employees may leave and take valuable technology with them may be a very significant problem for some technology-based companies. Other employee/management issues include the possibility that a technology company may be particularly dependent on the creative expertise of a very limited number of employees or managers. Loss of these key employees could cripple the company. On the other hand, the fact that a technology-company may be led by persons with a highly sophisticated and capable technical expertise does not mean that those persons will have equal experience or success once development of a technology-based product is complete and the business requires marketing skills.
technology due diligence work;
4. where potential conflicts-of-interest must be avoided, and non-competition, objectivity and impartiality must be assured;
5. where obscure or abstract technologically sophisticated issues must be translated into a form meaningful to investment and management decision-makers.

Any one of these conditions should be sufficient to justify conducting independent technology due diligence (i.e., a review performed by experts from outside the company itself). Obviously, however, the more of these circumstances that are present, the greater the need for such a review.

Admittedly, the inclusion of a technology assessment component to the conventional due diligence process will bring additional costs. These added costs are justified, in large measure, by the reduction of uncertainty of the level and nature of risk associated with the technology. This same rationale also provides justification for the cost of including other activities, such as property appraisal or fiscal analysis, in conventional due diligence work.

II. THE ROLE OF TECHNOLOGY DUE DILIGENCE

It has been said that those who do not know the lessons of history are doomed to repeat its mistakes.\footnote{George Santayana, The Life of Reason: Or the Phases of Human Progress 284 (Charles Scribner's Sons, 1905) (noting that “[t]hose who cannot remember the past are condemned to repeat it.”).}\footnote{For a variety of perspectives on the ups and downs of biotech in the investment world, see Peter J. Howe, Biotech, Telecom Stocks Blazed Bright, BOSTON GLOBE, May 16, 2000, at C19; Jerry Knight, Tech Investor: Mixed Signals Muddy Biotech, WASH. POST, May 4, 2000, at E08; Eric Moskowitz, Is Biotech Flaming Out?, MONEY, May 2000, at 33; Penni Crabtree, Got Biotech? Get Set for a Wild Ride, ORANGE COUNTY (CAL.) REG., Apr. 30, 2000, at K14; Erika Gonzalez, Local Biotechnology Stocks Tread Rough Waters After Slump, Shares Due for Upturn, DENVER ROCKY MOUNTAIN NEWS, Apr. 23, 2000, at 1G.} Certainly there are lessons to be learned from the experiences of those who have invested in a wide variety of new and emerging technologies. For example, in recent history there have been cyclical investor enthusiasms and disappointments in biotechnology and artificial intelligence ("AI").
Too much was expected too soon. Both technological sectors are now dealt with on more realistic terms, but it has been a rocky road for investors in both areas.\textsuperscript{50}

There are also examples of superior technologies having been displaced by weaker ones due to business and marketing issues.\textsuperscript{51} At the same time, there have been examples of extremely successful high-risk technology introductions.\textsuperscript{52} There is clear evidence that at least some learning has taken place as a result of these developments. There is an increasing scientific and technical sophistication in the approaches to the cost/benefit analysis with regard to health services and medical devices,\textsuperscript{53} information technology,\textsuperscript{54} and food

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\textsuperscript{50} See generally supra note 49.


The relative market positions of Macintosh and Microsoft also provides an excellent example of this phenomenon. Liebowitz & Margolis, supra at 316-17. Despite numerous claims that the Macintosh operating system is superior to Microsoft systems, Microsoft occupies the dominant market position. \textit{Id.} The reality is that Microsoft has “migrated toward the Macintosh path,” confirming, at least in part, that “the original Macintosh backers were correct in their view that many of the features that confronted the user in the Macintosh system were theoretically and aesthetically better . . . .” \textit{Id.}


production. On the other hand, there is an increased awareness of the negative impacts of "biased science," and scientists are regarded as being less credible as a result of recent legal actions against the tobacco industry.

These considerations do, however, point to the need to forecast and plan for reasonable development time frames and resource requirements. The need for appropriate assessment is apparent

Similarly, while it is widely acknowledged that new medical technologies to treat injuries could be widely implemented, technology can also be utilized to make cars and highways much safer. See e.g., INS. CORP. OF B.C., Road Safety, at http://www.icbc.com/road_safety/roadsafety_support.html (last visited Mar. 23, 2001). The question in many public policy debates is often whether the benefits of such improvements would justify the costs. For an interesting discussion of the ethics of cost-benefit analysis, consider the contrasting views of Dr. David Boyes, chairman of the B.C. Medical Ethics Advisory Committee, and Dr. Hedy Fry, former president of the B.C. Medical Association. See David Boyes, Factual Policy-Making, and Hedy Fry, Unquantifiable Values, both in RECOVERY (Dec. 1991), available at http://www.icbc.com/library/recovery/back_issues.html.


55. Such developments in the food processing industry have been driven largely by the imposition of Hazard Analysis Critical Control Points (HACCP rules). See generally David A. Kessler, M.D., Remarks by the Commissioner of Food and Drugs, 50 FOOD & DRUG L.J. 327 (1995); Catherine E. Adams, Ph.D., R.D., ISO 9000 and HACCP Systems, 49 FOOD & DRUG L.J. 603 (1994).


For a detailed critique of tobacco-industry research, see Deborah E. Barnes & Lisa A. Bero, Industry-Funded Research and Conflict of Interest: An Analysis of Research Sponsored by the Tobacco Industry Through the Center for Indoor Air Research, 21 J. HEALTH POL. POL'Y & L. 515 (1996). This article reports that the industry-funded studies suffered from a lack of peer review, poor study design, a high potential for bias, conflict of interest in the actual researchers, and, in at least one case, actual alteration of data. Id. at 532.
whether one considers the particular perspectives of the potential investor, the technology proponent, investment professionals, and even the interests of the public sector. Because the interests of these groups are at least somewhat distinct, it makes sense to consider the potential benefits of technology due diligence with particular regard to these different viewpoints.

A. Protecting the Investors

An investor's interest in due diligence\(^{57}\) is first and foremost in making sure that the investment is an informed one, since random or uniformed investment is unlikely to maximize economic value. However, the investor would also be well-advised to perform due diligence in order to preserve the right to make future claims in the event an investment turns out to be other than represented.\(^{58}\) Case law generally supports the proposition that an investor must undertake at least minimal due diligence in order to maintain either an action for securities fraud under the federal scheme or common law fraud under state law.\(^{59}\)

Due diligence plays a potentially vital role not only in the investment process (whether via private placement or public offering), but in the merger and acquisition ("M&A") context as well.\(^{60}\) In fact, the acquirer in the M&A context has an even greater incentive to perform due diligence, not only because the investment is

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57. Courts have distinguished the degree of due diligence an investor should perform from that which lawyers must perform by calling it "minimal diligence." Royal Am. Managers, Inc. v. IRC Holding Corp., 885 F.2d 1011, 1016 (2d Cir. 1989).

58. Id. (dismissing plaintiff’s 10b-5 and common law fraud claims for failure to conduct due diligence); Harsco Corp. v. Bowden, 1995 W.L. 152523, at *2-3 (S.D.N.Y. 1995) (holding that where a plaintiff fails to conduct adequate due diligence, both securities fraud and common law fraud claims are to be dismissed); Sundstrand Corp. v. Sun Chem. Corp., 553 F.2d 1033, 1048 (7th Cir.) (finding defendant’s claim that plaintiff should be barred from recovery for failure to exercise due care or diligence inapplicable in an intentional fraud case), cert. denied, 434 U.S. 875 (1977); Holdsworth v. Strong, 545 F.2d 687, 693 (10th Cir. 1976) (recognizing that plaintiffs’ failure to conduct due diligence in intentional fraud cases is not an available defense), cert. denied, 430 U.S. 955 (1977).

59. See generally supra note 58.

typically larger, but because in many cases the acquirer will be required to assume management responsibilities that will ultimately determine whether the acquisition is financially successful.\textsuperscript{61}

The nature of competent technology assessment is such that it is likely to generate a wealth of information that could potentially be used in the identification and quantification of potential risks for any investor in a technology-based enterprise. A few examples of risks or potential problems that may be discovered by appropriate technology due diligence might help illustrate this point.

The first such example involves the risk that an assessment may overlook critically important problems that are external to the technological feasibility of a proposal. For example, analysis of a particular risk in technology-driven development proposals does not qualify as adequate research of competitive technologies, such as those risks found in potential patent infringement.\textsuperscript{62} A second example can be derived when one considers the expense of technology development. Proponents of technology-based developments too frequently underestimate the resources required (such as money, manpower, and time) to take their project from any early development stage through to full commercial introduction. Examination of this problem, perhaps looked at as a failure to fully appreciate the "80/20 rule,"\textsuperscript{63} may indicate the desirability of adding additional progress check points to the development plan and means for tracking progress against planned resource consumption. Finally, consider the potential impact of the venture’s management structure, and need for information dissemination. In proposals for updating management information systems ("MIS") or information management systems ("IMS"), there may be a failure to adequately plan for varying organizational impacts. The decision-making process itself may have an impact on the acceptability of the product

\textsuperscript{61.} Id.

\textsuperscript{62.} This is the type of technology-driven due diligence that is most likely to be recognized as being of critical importance by commentators. See supra note 31 and accompanying text.

\textsuperscript{63.} The "80/20 rule" is a rule of thumb that implies that the first 80\% of project development work typically takes only 20\% of the time and resources but the last 20\% of the work takes 80\% of the time and resources. See generally Process Edge, \textit{What is the 80/20 Rule?}, at http://www.processedge.com/store/paper8020/whitepaper8020.htm (last visited Mar. 23, 2001).
to the user, training may need to parallel or precede the technology installation, and so forth. If these factors, which may be considered management issues outside of the area of responsibility of the technology proponent, are not appropriately addressed, they may fail to achieve expected returns despite their technical sophistication. Should this appear as a potential problem, plans should be modified accordingly and budgets and schedules adjusted as necessary.

Given the widespread familiarity of computer applications, one can provide a rather easily appreciated illustration of the kinds of traps that await potential investors in technology-based opportunities. Anyone who fails to undertake due diligence that includes a competent assessment of the underlying technology may unsuspectingly invest in an attractive but impossible venture.

For example, Professor Hal Berghel of the University of Nevada, Las Vegas has reported that "[i]t is now possible, with few technical skills, to create an interface at a higher conceptual level and with more sophistication than one can produce in the back end application." 64 Professor Berghel describes "vacuous prototypes," noting that it is easy to create an effective demonstration prototype, but one that is devoid of content and which cannot be implemented with existing technology. 65 He demonstrates this "software surprise" with an example using an application that purports to automatically translate bi-directionally between sets of six languages. 66 The "prototype" can, of course, be programmed to correctly translate certain, specified passages without error. There is, unfortunately, no guarantee that any other statement will be appropriately translated. 67 The risk is that "[t]he modern venture-capital prototype is coming to resemble a spaghetti western[,] all theatrics and no substance." 68 When presented with an attractive and apparently functional software "prototype," the non-expert can be certain of the investment risks inherent in its commercialization as a business venture only if they have an accurate and independent assessment of the technology.

65. See id. at 51.
66. Id.
67. See id.
68. Id. at 50.
involved.

B. The Perspective of Technology Proponents

The issuer’s interest in due diligence is as compelling as the interest of potential investors or acquirers. Although the issuer has no due diligence defense available to it under section 11 of the Securities Act of 1933, the issuer still has every incentive to conduct the appropriate technology assessment. First, adequate due diligence may help insure the accuracy of disclosures made in connection with the transfer of an ownership interest in the venture, thus, minimizing the risk of liability under the securities laws (even absent a statutory due diligence defense) or the common law of fraud. At the same time, disclosure of the results of such due diligence may induce others to invest in the enterprise when, absent the information produced as a result of such inquiry, investment might be unlikely.

The technology proponent will maintain an interest in having accurate and objective information about its technology and the likelihood of commercial success during the corporate life cycle, although the nature of that interest may change depending on the circumstances. For example, during the start-up phase of corporate life cycles, there are frequently concurrent activities in research and development (“R&D”) and those directed towards generating funds necessary to sustain operations and in acquiring private equity investment. The need to attract investment at this point may be acute and particularly sensitive given the nature of potential investors and the stage of R&D.

Statistics suggest that full-time venture capital funds generally invest in only two to four percent of the “opportunities” that they review and angel investors only slightly more. Further, the rate of

69. See supra note 8.
70. An offering or sale of securities may be exempt from the registration requirements of the securities laws, but nonetheless subject to the anti-fraud provisions of the applicable statutes. See 15 U.S.C. § 77d (exempting transactions only from the registration requirements which are codified at section 77e, and not the anti-fraud provisions). Of course, the issuer may not even rely on the so-called “due diligence” defense when a public offering is made. See 15 U.S.C. § 77k(b).
72. Id. at 1 (explaining that an “angel investor” is a wealthy individual who
return they expect on their investment is ten to fifteen percent higher than the typical return on equity investments in developed markets\textsuperscript{73} and, for early stage enterprises, it typically exceeds sixty percent.\textsuperscript{74} If the level of risk is reduced through technology assessment, the gap between the expectations of these investors and that of entrepreneurial enterprises should be narrow, enabling investments to be successfully negotiated.

In more mature technology-based enterprises, new projects may still be in the R&D phase while planners seek resource commitments for commercial exploitation. In this case, as with the start-up company, there lies the problem of trying to obtain venture capital when there is a perceived technological risk.\textsuperscript{75} This perceived risk is an important determinate in the investment decision-making process.\textsuperscript{76}

For any set of investment opportunities having essentially the same projected commercial potential, when the risk is known to be high, the likelihood of securing funds will be relatively low.\textsuperscript{77} Conversely, when the risk is low, the opposite is true.\textsuperscript{78} For a given project, the likelihood of investment is also markedly influenced by the degree to which the investor or the financial decision-maker is conservative or risk-adverse. Proponents of new or evolving technologies tend to be both optimistic and adventuresome. Virtually a prerequisite for entrepreneurship in technology areas is the attribute of being willing to assume and accommodate a large measure of risk.

In sharp contrast to this optimism, conservatism is natural in the investment and financial management community.\textsuperscript{79} The degree to which these decision-makers accommodate risk depends on numerous factors, but clearly their understanding or perception of the likelihood of an investment leading to a successful conclusion is a

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\textsuperscript{73} \textit{Id.} at 3-4. These expectations of high returns are in large part the result of the level of risk being assumed. \textit{Id.}
\textsuperscript{74} \textit{Id.} at 27.
\textsuperscript{76} \textit{See id.} at 205.
\textsuperscript{77} \textit{See id.} at 207-09.
\textsuperscript{78} \textit{See id.}
\textsuperscript{79} \textit{See id.} at 205-19.
\end{flushleft}
dominant consideration. In enterprises with substantive technology components, business success may be a function of technological success. Unfortunately, understanding the likelihood of technological success is usually difficult for members of the investment and financial management community.

Fundamental differences in how the desirability of an investment in a technology-based or technology-dependent enterprise is viewed may lead to misunderstandings. These can be a result of the failure of each party to fully appreciate how the other views the same investment opportunity. The desirability of an investment varies with the perceived likelihood of success and technology proponents and investors typically diverge in their perception of the likelihood of success.

When the parties to an investment negotiation do not appreciate the differences in their understanding and perception of the same opportunity, much less the reasons behind their different perceptions, negotiations can become stalled, even acrimonious. Hopefully, adequate technology due diligence can bring new resources into the process, facilitating sound investment decision-making. Perhaps a more concrete example of the different perspectives of the technology proponent and potential investors may make these points clearer.

Consider the following abstract taken from the non-confidential disclosure of hypothetical Company X’s “Business Development and Investment Opportunity” descriptive information:

Based on its advanced research and development work, Company X plans to introduce into the market a novel system that provides instantaneous language translations. This system allows the simultaneous translation between five globally important languages and has provisions for both the spoken and written languages. Immediately following the commercial introduction of this system, an
online service will be established through our subsidiary, CompanyX.Com. The funding investment of $1.625 million will represent a 27.5% ownership of Company X and will yield an average annual rate of return of approximately 40%.

From this statement, it would appear that Company X is either (1) on the verge of making a stunning commercial breakthrough, or (2) promising more than its state of the art technology will support.

If we use this prototype, coupled with an exploration of the real world program BabelFish,82 as a starting point, we can illustrate some specific concerns that could arise in a technology assessment. Here are a few of the questions that should be considered in determining investment risks that would be present in the Company X project.

1. Implicit in the Company X information is the assumption that algorithms for the understanding and translation of natural languages exist or can be developed in the timeline being considered. Is this accurate? The technology proponent will almost certainly appreciate the necessity for the creation of appropriate algorithms, and presumably will know the current state of the technology. The company may be overly optimistic about the time frame in which the technology can be developed, but the issue is certainly one that must be understood. On the other hand, some potential investors may lack the technological sophistication to inquire about the proposal’s viability, much less be in a position to evaluate the current state-of-the-art in existing technology or to estimate time frames in which further developments are likely to occur.

2. Company X projects (speculates) an investment yielding a 40% average annual return on investment. Has there been adequate consideration of “maintenance phase” costs for a system that is largely software based?83 Here, both the

82. To see a dynamic demonstration of near state-of-the-art for this type of technology, see http://www.babelfish.com (last visited Mar. 4, 2001) (allowing users to translate languages to and from English, French, German, Italian, Portuguese, and Spanish).

83. It is not unusual for maintenance phase costs to be sixty percent or more of the life-cycle costs for software, a figure which is higher than for many other types of products. See ROGER S. PRESSMAN, SOFTWARE ENGINEERING: A PRACTITIONER'S
company and investor may be operating under erroneous assumptions. However, the errors stem from different sources: The technology proponent may be lacking in sophistication when it comes to this type of financial projection, as is the case with some companies where the founders have technological expertise but little real world business background.\footnote{84} Alternatively, those involved in the business may have a sufficient business background to understand how financial projections work but they still may make unrealistic projections.\footnote{85} In this arena, it is often the potential investor who will have greater expertise. Experienced investors are likely to be relatively sophisticated when it comes to projecting maintenance phase costs. However, these investors may lack experience in technology-based enterprises, particularly those with unique problems associated with software applications.

3. The system is said to work with \textit{spoken} as well as written languages. Has the state-of-the-art in voice recognition and speech synthesis in the target languages been adequately researched? Is this to be developed internally or licensed from third parties? Have the options been adequately researched and appropriate costs included? These kinds of issues may or may not be appreciated by either the proponent or the investor. The technology proponent may be familiar with only some of the target languages, and may make inappropriate assumptions about the state-of-the-art in the other cases. The investor may not even appreciate that different issues will be applicable in the case of different languages. Furthermore, licensing issues may be unfamiliar to the technology experts while the investors, if reasonably experienced, ought to have at least some appreciation for the nature of the potential problems. However, even investors may not fully appreciate the complexity of intellectual

\footnote{84}{This can be seen in the "80/20 rule." \textit{See supra} note 63.}
\footnote{85}{\textit{Id.}}
property issues which may be applicable in the software arena.\textsuperscript{86}

4. The translation machine is likely to demand considerable computational resources and a real-time online service in order to access the significant transmission bandwidth required. Have these resource demands been adequately assessed and provisions made to accommodate them in offering an online service? What are the human resource requirements needed to support such a system? Are they adequately planned for in the business proposal? Again, the perceptions of the technology proponent and the potential investor may differ. The technology proponent may have failed to consider the support requirements which will likely accompany the commercial application of the product, while the investor may not appreciate the technical requirements that will exist as a consequence of the proposed technology. If the investor does appreciate the need for these resources, the investor may assess these requirements as being either a greater obstacle than is likely to be the case, or as being less significant than they are likely to be.

In any event, regardless of the specific nature of the technology involved in a given enterprise, it should be clear that the perspectives of the proponent and investor are likely to differ in several important respects. Appropriate technology due diligence can help resolve this gap, making it more likely that the company will be able to attract suitable investors.

\textit{C. The Role of Investment Professionals}

Yet another perspective is introduced when one considers the potential role of investment professionals. Such professionals may include attorneys, financial advisers, accountants, and potentially underwriters and their counsel. The primary interest of most of these professionals will likely be to minimize potential liability under applicable federal and state laws,\textsuperscript{87} in addition to the financial stake in

\textsuperscript{86} See Been, \textit{supra} note 31.

\textsuperscript{87} Underwriters are specifically identified as potential defendants in section 11.
the success of the offering. Financial advisers may be more interested in helping their clients understand the risks of their investment, and so their perspective may differ from that of the other professionals identified here.

As described earlier, professionals such as attorneys, accountants or underwriters who assist in the preparation of disclosure documents used in connection with the public sale of securities may be personally liable for material misstatements or omissions in those documents. If, however, they have conducted appropriate due diligence, they will have a viable defense to any such cause of

15 U.S.C. § 77k(a)(5); see also Exchange Act Release, supra note 23. An attorney may function in a variety of roles in a registered offering, including serving as a director for the issuer, by preparing certain expertised portions within the meaning of section 11(a)(4) (codified at 15 U.S.C. § 77k(a)(4)), or by performing due diligence investigations on behalf of their client. MARC I. STEINBERG, UNDERSTANDING SECURITIES LAW § 6.04[C] at 154 (2d ed. 1996).

88. For example, Wilson Sonsini Goodrich & Rosati, the Palo Alto-based law firm that represented VA Linux also acquired 102,584 shares of its client’s stock. Debra Baker, Who Wants to be a Millionaire?, A.B.A. J., Feb. 2000, at 36. When the company went public, the value of these shares soared. Id. After one day’s trading, the shares were valued at $24.5 million. Id. The article reports that this kind of ownership interest appears to be a growing trend among lawyers for high-tech companies. Id. An ABA Journal analysis of SEC records showed that one in three lawyers representing the more than 500 companies that went public in 1999 held stock in the clients at the time of the offering. Id. at 37. The analysis also showed:

- 63 law firms handled IPOs, either representing the company or the underwriter. Lawyers from those firms held stock in 174 of those companies.
- Lawyers’ holdings in more than 40 percent of the companies were worth in excess of $1 million each. Firms investing in nine of the companies saw the value of their holdings soar more than $10 million each.

Id.

89. See supra notes 13-20 and accompanying text.

90. Section 11 of the Securities Act of 1933 imposes liability on a limited class of persons who participate in the preparation of disclosure documents used in a registered public offering. 15 U.S.C. § 77k.

Section 12(2) may result in liability for sales made in connection with registered offerings and “exempt offering[s] that take on a public nature (such as under Rule 504, Regulation A, Rule 147). STEINBERG, supra note 87, § 6.09[E] at 170; 15 U.S.C. § 77l. For a discussion of the potential scope of such liability when the securities are not sold as part of a registered public offering, see Robbins, supra note 42.
It might be assumed that the due diligence defense will not depend on whether or not a defendant obtained an independent technology assessment because it is not commonly done. However, the fact that this type of investigation has been rarely conducted in the past should not be viewed as an absolute standard by which future conduct should be judged. Consider what has happened to the standards of liability imposed on accountants in a slightly different context. In a section 11 claim, the BarChris court stated that “[a]ccountants should not be held to a standard higher than that recognized in their profession.” The current standard is that “a determination must be made whether the prevailing professional practice constitutes reasonable prudence.”

This is also the appropriate standard for considering the type of due diligence that an attorney or underwriter should conduct. It is a basic premise of this article that reasonable prudence requires an independent technology assessment whenever investment in a technology-based enterprise is being considered or proposed. The fact that such investigations have been rarely conducted in the past does not mean that this failure is reasonable in today’s financial climate. The need for such assessment is particularly critical given the fact that technology is the driving force behind today’s economic growth.

D. The Public Sector Interest

Nowhere is the scope of technology investment greater nor the decision-making processes potentially more cumbersome than in governmental agencies. Billion dollar investments are authorized

91. See due diligence defense, supra note 8. For causes of action predicated on section 12(2), the defense is generally known as the “reasonable care” defense, and the courts are not entirely consistent in stating what this standard entails. Certainly it resembles the concept of due diligence, even in jurisdictions where the courts have articulated slightly different standards. See generally STEINBERG, supra note 87, § 6.09[E] at 170.

92. See supra notes 41 and 42, and accompanying text for a discussion of the due diligence defense as based on the “standard of the street.”


94. STEINBERG, supra note 87, § 6.04[E], at 160.

95. See BarChris, 283 F. Supp. at 682-703.
with no debate and by voice vote. The nation was given a "Call to Action" by President Clinton in which we were asked to confront a "digital divide" that is being recast from a racial issue to one focusing on the disparities in the distribution of wealth. Investment in information technology ("IT") has been hailed as the cornerstone of federal and state level efforts to reinvent government, and has been deemed so for many, years.

The re-invention of government may be a critical matter for the appropriate selection and use of technology in the interest of the public sector. Typically, governmental control is, or has been, largely through the budgeting process. This kind of financial control has traditionally been dependent on two principal means: the mandatory application of generally accepted accounting principles ("GAAP") and annual or bi-annual legislative budget review and approval. With the reinvention of government comes the appearance of more performance-based budgeting, a process that offers at least the prospect of better managerial control.

While the jury is still out on the question of whether this will result in more efficient government control, appropriate technology assessment can and should be a part of government planning and review. Given the importance of technology to the government, and the role that due diligence plays in the budgeting process, there is likely to be an increasing need for careful attention to the technologies employed in any government-sponsored initiatives.

The assessment of technology is already offered by some federal


agencies, but it is typically highly focused on the mission of the specific agency. For example, the EPA has a Municipal Technology Assessment Program that supports the development of alternative technologies for municipal wastewater treatment facilities.

While aggregated cost information for public sector investments is relatively transparent as a result of the budget process, the basis for selection of technologies is anything but clear. Objectivity and rationality may be compromised by political exigencies. Detached, independent technology assessment, integrated into the budgeting due diligence process, holds the promise of correcting this problem and better serving the public interest and its right to know the basis on which its money is being spent.

III. EVALUATING TECHNOLOGY ASSESSMENT

While any objective assessment of the technology component of a new or evolving enterprise is better than none, it should be intuitively obvious that more in-depth analysis provides better information and greater certainty than mere superficial observation. There are, however, diminishing returns if such analyses are too excessive. A cost-benefit analysis indicates that at a certain point, the expense of additional assessment will exceed any economic benefit to be obtained through such efforts. An S-shaped curve results if measures of the thoroughness of the technology assessment are presented in relationship to the resulting confidence in the certainty of the assessed risk.

99. See generally supra note 10.

100. After listing a variety of wastewater treatment subjects for which the EPA supports conventional technology, the webpage maintained by the EPA’s Office of Wastewater Management states that the “EPA also encourages and provides support for the development of innovative and alternative technologies in any of the above areas.” See Office of Wastewater Management, supra note 10.

101. When it comes to evaluating technology, there is a point at which it becomes very expensive to learn additional information about the technology, while at the same time, the utility of that information declines. This is the law of diminishing returns.

102. To illustrate this theory, the authors created this graph, which merely plots the results derived by comparing the effect of widening the scope of technology assessment with the likely value of additional information that might be learned about the potential risk of investment.
Although at one end of the spectrum there are diminishing returns from additional assessment efforts, there is a serious weakness in depending on poorly quantified (low-certainty) determinations of the likelihood of success in technology based or technology dependent enterprises. Indeed, where the level of uncertainty is high, investments may be made where more certain information would clearly have precluded them. In this case, having adequate information would decrease the likelihood that investors will be spending their money on essentially worthless projects. On the other hand, another risk of having inadequate information is that investments may decline where more certain information would support them. In this case, the likelihood of investment should be substantially increased where the certainty in the assessment is good and the likelihood of success is relatively high.

This analysis leaves open the issue of how technology assessment should actually be conducted. One reason for the paucity of information about the process is the limited resources traditionally available to competently perform this type of work, particularly without a high risk of introducing bias. Reliance on consultants and salesmen, a common practice, is obviously fraught with such hazards. University scientists and engineers, although possessing a high-degree of in-depth expertise, are more often than not too specialized and too far removed from the complexities of business and investment decision-making. What, then, are the characteristics of an ideal technology assessment?

Technology assessment requires a relatively wide variety of special

![Diagram](image_url)  
Figure: The degree of certainty in risk improves with the thoroughness of the assessment of the technology.
skills and aptitudes.\textsuperscript{103} We would suggest that, whenever technology assessment is being used to complement conventional due diligence, essential characteristics, at a minimum, include the following:

1. an in-depth knowledge of the applicable technology;
2. a broad knowledge of technology management, implementation, and deployment, ideally including an expertise in the same field as the technology being evaluated, or at least a related industry;
3. objectivity and independence, with no vested interest in any specific outcomes;
4. communications skills to provide meaningful, well-organized, complete, and clear results that will be accessible to all interested constituencies; and
5. responsiveness to client needs relative to scope, timing, presentation, and confidentiality.

Each of these characteristics deserves some additional clarification.

A. \textit{In-Depth Knowledge of the Technology}

As mentioned above, it is impossible to articulate a single set of standards by which technological competence can be judged. Not only is the concept of technology so broad that no single or universal set of criteria can be used in assessing the vast array of rapidly evolving and newly appearing technologies, but technology itself is changing so rapidly that any static set of criteria would almost certainly quickly become obsolete.

It is, of course, true that there are certain general concepts that rather universally apply.\textsuperscript{104} Familiarity with these concepts is necessary but far from sufficient for the kind of technical expertise necessary to conduct an appropriate assessment. Reviewers must have a sufficient background in the type of technology being evaluated to appreciate a variety of considerations. For example, the

\begin{footnotesize}
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\item\textsuperscript{103} \textit{Larry Kahaner}, \textit{Competitive Intelligence}, 95-98 (Simon \& Schuster 1996).
\item\textsuperscript{104} For example, the technology must not violate first principles (e.g., the technology does not require a perpetual motion machine or otherwise violate the laws of thermodynamics).
\end{enumerate}
\end{footnotesize}
reviewer must be capable of conducting a thorough review of the state-of-the-art in the appropriate field, as well as analyzing the existing and competitive technologies. If the reviewer does not have sufficient grounding in the relevant technology, he or she will be unable to conduct even this type of background research, much less the actual assessment of the proposed technology.

In addition to investigating related technologies, the reviewer will have to conduct an appropriate examination of the technology development proposal. This will involve, at a minimum, review of the documentation and literature prepared by the technology proponent, as well as verifying their representations, and will likely need to include a reviewer’s conference, which will be productive only if the investigator is sufficiently sophisticated so as to be able to ask the right questions and understand the answers. Without the ability to appreciate the technology involved, the likelihood that reviewers will know all of the issues is slight, and the risk that insufficient or misdirected answers will satisfy the reviewer is great.

It should be obvious from this discussion that it will generally not be sufficient for the reviewer to possess only enough expertise to begin acquiring the necessary information at the time the technology assessment is to begin. The time frames typically involved in due diligence activities are such that a reviewer must be able to begin his or her intensive examination immediately. Certainly, there will not be time to learn the basics and conduct a thorough review of a new technology. Nor will it generally be feasible for the technology proponent, the investor or even the government to pay for the learning curve involved in such an effort. This means that an expert in that particular technological field must be included among those who are employed to conduct the assessment.

B. A Thorough Understanding of Technology Management, Implementation, and Deployment

A related requirement is the need of the technology assessment to include a thorough review and analysis of the technology proponent’s schedules, budget, and management capabilities relative to its ability to respond to the opportunity. This will likely include not only a review of written documentation, but also structured interviews with key personnel.
There are numerous management concerns related to the development of new products and processes. Several are associated primarily with risk management. Cooper, for example, notes that one should err on the side of thoroughness in designing new products. He goes on to say that "flexibility and short-cuts can be built in, especially for lower-risk projects and when the risks of omission are understood." For higher-risk projects, he recommends the adoption of and adherence to "disciplined, thorough new product processes." These ideas presume a good working knowledge of the level and nature of the risks involved and constitute additional important criteria by which to judge the competence of a reviewer.

It is also worth emphasizing that these are skills which are very distinct from the type of technological competence required to conduct the review of the technology itself. The nature of competent technology assessment is such that, except in the most simple and straightforward cases, the creation of specific assessment criteria requires consideration from diverse points of view. This being the situation, a team-oriented analytical approach is probably always a good idea, and in many cases will be a necessity. Thus, the person or persons who have the technological expertise described above need not be the same persons who have the management perspective articulated here.

C. Objectivity and Independence

For at least some purposes, even companies or agencies with sophisticated in-house technological capacities will require technology assessments to be conducted by independent experts in order to avoid the potentially negative impact of hidden agendas and vested interests. Certainly where the assessment is motivated by a need to provide objective analysis to outside investors, a technological review conducted by employees or others with a vested financial stake in the outcome is unlikely to be satisfactory no matter how competently it is conducted because of the appearance of self-interest.

106. See id.
107. Id.
Consultants and salesmen, though sometimes used by default, fail this test of independence. Frequently, if the total financial considerations are carefully considered, their recommendations are not particularly cost-effective because their assessment is not likely to be seen as persuasive to outsiders. Their judgments are naturally conditioned by, and point to, the products they represent and sell. Even if they are qualified and their research is optimally conducted, the perception of bias is likely to taint their work, making it substantially less effective as a technique for convincing outside investors or investment professionals of the accuracy of projections and estimates for future technology performance.

In addition to the need for objectivity, significant information that can be difficult to access internally may be more readily available in the open format provided by an independent agent who has no vested interests to maintain or promote. For example, where internal promotions, raises, or bonuses depend on, or are perceived as depending on, innovations or creativity, it may be difficult to force employees to share their ideas candidly with other employees who are performing an assessment as of a given point in time.

This means that independent specialists will usually be in the best position to provide effective technology assessments. This presumes, of course, that they are thoroughly competent in the areas needed to undertake the work.

D. *Communications Skills*

One of the requirements for an adequate technology assessment is that conclusions and recommendations must be formulated, and full details of methodology, sources, and references appropriately documented. Moreover, these conclusions and recommendations must be written so as to be accessible and useful to a variety of audiences.

For example, it may be perfectly appropriate to use sophisticated, technical jargon when dealing with the developers of a new and innovative technology. However, if the same terminology is used with investors, it may be perceived as "techno-babble," and

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108. The term "techno-babble" refers to the use of technical terms designed to obfuscate rather than clarify. As such, an apparently impressive discourse can, in
written-off as an intentional ploy to obfuscate and intimidate. Even if the use of technical jargon does not negatively influence potential investors or investment professionals in this manner, they may be incapable of understanding the material if it is presented in such terms. This will also decrease the potential value of the assessment.

From the perspective of the technology proponents themselves, a similar problem may develop if the reviewers present their financial conclusions in terms that are inaccessible to the average person. The fact that someone is a highly trained and sophisticated scientist does not make that scientist an equally trained and sophisticated financial analyst. Thus, financial information will have to be carefully articulated in the same way that technological information will have to be presented.

This does not mean that the results of the investigation should be “dumbed down.”\textsuperscript{109} A shallow report containing nothing but simplistic observations and conclusions is unlikely to be helpful or persuasive to anyone. Instead, the goal should be to provide a written analysis which is accessible to an intelligent, motivated reader who, one presumes, does not have a technical or financial background.

E. Ability to Tailor Review to the Circumstances

By now it should be clear that the type of technology assessment described in this article is such that it will usually have to be conducted by professionals who are not affiliated with the technology proponent. Insiders (i.e., those employed by or otherwise financially tied to the company proposing to develop or market the particular technologies under review) cannot provide the requisite independence or neutrality. In addition, if the assessment is to benefit the company rather than be used solely by a particular group of potential investors, the reviewers should also be independent from the investors. Otherwise, a negative or cautionary assessment may be perceived as being unduly pessimistic or as a bargaining ploy, rather than as a realistic evaluation of the viability of the proposed technology. Thus, fact, be essentially meaningless.

\textsuperscript{109} "Dumbed down" refers to the process of over-simplifying data by omitting technical details and information that may in fact be necessary for a critical assessment. The resulting information is easy to read, but is not particularly helpful.
the ideal situation is to hire outside professionals to conduct the analysis on a completely independent basis.

The clients of the reviewers may be the technology proponent, a group of potential investors, or a governmental agency or entity. The intended audience may be any one or more of these groups, and need not be the client. In any case, the reviewers will need to be able to tailor their evaluation to the needs of the client and the intended audience. This need to be responsive encompasses such concerns as scope, timing, presentation, and confidentiality.

First, the reviewers must be able to provide an assessment that is sufficiently precise without being excessively detailed. The appropriate scope of a particular assessment will depend on a number of factors, including the amount of money at stake and the cost that the client is willing to bear. It will also depend on the needs of the audience. An assessment being conducted solely for the purposes of providing internal documentation to a technology proponent may not need to be as detailed or include the same type of financial analysis that would be essential if the audience included potential investors. Similarly, the need to detail alternative or competing technologies may be greater or lesser depending on the particular needs of the client and the desires of the ultimate audience.

Second, the reviewers will have to be able to meet the client’s time frames, so long as they are reasonable. Obviously, clients have to understand that a satisfactory technology assessment cannot be conducted overnight. It will not be sufficient to simply provide the reviewers with internal documents; rather, appropriate assessments will usually require field visits and personal interviews with key employees. Depending on the scope of the assessment, the reviewer may not only have to meet with the technology people, but also with members of the management team, whose efforts will also be essential in assuring financial success. All of this takes time, and short-cuts may compromise the validity of any conclusions reached. Because an appropriate assessment will also have to detail the methodology employed, an abbreviated assessment may be less effective as a tool for convincing outsiders of the viability of a particular technology.

A third consideration is that the persons responsible for the ultimate evaluation of the technology will have to be flexible with
regard to the presentation of their conclusions. It is essential to be conscious of the idea that a single assessment may be prepared with a number of different potential audiences in mind. In fact, most assessments may have multiple uses: they may be important to help develop or refine internal business and management plans and timetables; they may be essential to attracting outside investment or government support; or they may be required by investment advisors assisting in the issuance of securities. Because of this multitude of potential uses and audiences, those performing the assessment must be able to prepare, configure and present their conclusions in a comprehensible manner that will be useful for anyone interested.

A final consideration is the need to respect a client's confidentiality and non-competition requirements. In the highly competitive world of technology, a technology-based firm will have a very real need to insure that any information divulged in connection with a technology assessment remains confidential and that the reviewer's ultimate report becomes the property of the firm. Finance is equally competitive, and if the evaluation is conducted for the benefit of a specific group of investors, they too will want to insure confidentiality of the analysis. Thus, the avoidance of conflicts of interest (such as might arise if anyone affiliated with a competitor were involved in the assessment) will also be essential.

IV. CONCLUSIONS

Much of what has been said in this article may seem apparent. However, despite the apparent obviousness of the need for and potential benefits of independent technology assessment, available data suggests that such assessments are not being conducted, let alone conducted routinely.

There are probably a number of explanations behind this failure. Even if technology companies, investors or interested governmental agencies were willing to pay for competent, independent technology assessments, to whom would they turn? There is no well-known, established community of professionals like those that exist for many other areas traditionally considered in the due diligence process. For financial advice, there are investment advisors. For a review of a company's balance sheet and cash flow, there are accountants. If environmental concerns arise, there is a growing community of
professionals who will provide an environmental audit. Furthermore, professionals are easy to find if needed to appraise a company's real estate holdings. But when it comes to technology assessment, there is no such community of easily-accessible professionals.

Furthermore, even if there were professionals available who might be hired to conduct such an assessment, the absence of criteria by which such assessments can be judged means that their ultimate evaluation and conclusions may be of little value. For example, even the brightest, most sophisticated technical expert may produce a report that is rendered meaningless because it is too technical for its intended audience. Alternatively, a technical expert might prepare a perfectly comprehensible assessment that is still not helpful because it does not provide a basis for determining the ultimate financial viability of the enterprise, which is the ultimate issue the target audience is interested. Thus, it should be quite clear that not just any expert can prepare an acceptable or useful technology assessment.

Another problem is simply that there is so little precedent for independent technology assessment. Checklists of items to be covered during due diligence do not typically address the need for a review and analysis of technology-based assets. Technology companies are not used to hiring consultants to perform this type of work. Investors are similarly unaccustomed to thinking in these terms and tend to rely on the old rules of the game. Moreover, the government has not included such assessments in its budgeting process. Because independent technology assessment is not expected, it is rarely thought of or planned for, and is therefore rarely done.

In addition, there may be competitive disadvantages inherent in demanding such a review. Consider a company that has developed a particularly promising technology. There are two potential groups of investors: one that insists on the expense, inconvenience, and delays of a thorough technology assessment, while the other does not. Which investors are more likely to be successful in buying into the enterprise?

On the technology proponent's side, those familiar with the technology may already be convinced of its viability. However, they may simply fail to appreciate the need for or potential benefits of an
independent assessment. Even if they recognize their internal vulnerabilities, they may not wish to risk having them exposed.

In the final analysis, the failure to include technology assessments as part of the conventional due diligence process may be an example of the "chicken-and-egg" phenomenon. Which comes first? The demand for the services, or someone able to provide those services? Ideally, creation of a new demand would coincide with the development of a new service industry capable of meeting that demand. In order for this to happen, however, attention must be paid to the importance of technology assessment.

This article has attempted to facilitate this development by drawing attention to this neglected aspect of due diligence by describing the potential benefits of technology assessment from a variety of perspectives, and by articulating some basic criteria against which assessments can be judged. In the end, either technology assessment will become an accepted and expected component of due diligence any time there is potential investment in a technology-based enterprise, or we can expect that investment assets will not be spent optimally and that some potentially valuable technologies will be underdeveloped or delayed unnecessarily.