

A Study of Postinvestment Monitoring Practices in Life Science Venture Capital Firms

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Life science and biomedical technology start ups are a major focus for the establishment of innovation and knowledge-based economies. This article describes themes and practices in the monitoring of private company investments by life science-oriented venture capital firms and the possible relevance to this of project management concepts and techniques. A qualitative approach was adopted, using semistructured interviews with a small number of life science-oriented venture capital firms in the northeastern United States “biotech” corridor. The results are summarized as alternative “rational-explicit” and “complex behavioral” models of monitoring that are described and also compared to process groups found in project management literature.

KEYWORDS *biomedical, biotech, life science, portfolio monitoring, project management, venture capital investing*

In this article, we explore the process of postinvestment monitoring by life science-oriented venture capital firms and also compare it with themes in the monitoring of projects under the Project Management Principles as formalized by the Project Management Institute (PMI) and incorporated in the Project Management Body of Knowledge (PMI, 2008).

Institutional or formal venture capital is increasingly seen by policy makers as a critical structural input to the development and maintenance of strong internationally competitive knowledge-based economies via the creation of innovative technology-based companies and their benefits such as jobs and exports (Lerner, 2000; Cohan & Unger, 2006). Likewise technological

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innovation by new companies specifically directed at the life science market (sometimes called the biomedical or biotechnology industries, although each of these terms has a slightly different meaning) is also seen as a key component in the economic development of regions and countries. Thus, it is important to better understand the venture capital process and the postinvestment challenges it faces with young life science companies.

Much has been written about the high risk of venture capital investments, including the considerable post investment execution risk reported in technology companies in general and the added scientific and regulatory uncertainty seen in the bio-medical field in particular. However, relatively little has been written about the details of monitoring such investments versus that of the criteria for screening and structuring good investments. Most of what has been written about monitoring is either of a checklist nature or legalistic and contractual, rather than discussing the inherent conceptual challenges in this process, and how they are addressed. For example Gladstone (1988) emphasizes requiring written monthly reports, and using quarterly or biannual board meetings to review such matters as financial results, expenditures, inventory levels, changes in order backlogs, and control of the structure of top management compensation, and McCahery and Renneboog (2003) emphasize control of the company through contractual control of board membership.

In our study, we have sought to elaborate on existing general wisdoms about the nature of the monitoring process in venture capital. For example, the World Resources Institute (1998) notes the “ongoing symbiotic relationship” between venture capital firm and portfolio company whereby “the entrepreneurs/unlisted companies benefit, not only from the infusion of capital, but from the expertise and networking provided.” Perkins (2008), one of the modern venture capital industry’s founders, notes “I had in mind more of a hands-on approach than was the mode at the time . . . ‘old money’ investors could more properly be called financiers than ‘operators’ of the kind I had in mind. In my view, they spent most of their time in up-front analysis, rather than in after-the-fact management of the developing venture. To denigrate the approach, perhaps unfairly, it was more like a Las Vegas place-your-bets-and-take-your-chances experience than controlling the game itself, which is what I had in mind.” (Perkins 2008, pp. 101–102).

We also examined venture capitalists’ perceptions of the relevance to their work of the concepts and techniques of “project management.” Project management, a field that developed in the construction and defense industries to control delays and budgetary and scope overruns in efforts of limited duration, is now used widely in such domains as corporate engineering initiatives, public infrastructure and international development. Here too, venture capitalist Perkins is an inspiration in describing the founding philosophy of Kleiner, Perkins, Caufield, and Byers: “I thought that ventures could be managed like development projects within a corporation; the example of

Packard and Hewlett, who were both marvelous entrepreneurs and superb managers, was at the forefront of my mind.” (Perkins, 2008, p. 102).

We have thus (1) interpreted responses to our questions about the overall goals and methods of postinvestment monitoring partly through reference to project management doctrine and tools; and (2) asked in our interviews whether project management approaches were being explicitly used in the monitoring of specific investments, and the reasons for this.

The rest of this article is organized as follows: we review how venture capital funds are structured and review the literature on monitoring; we summarize key concepts from the field of project management, we describe our data collection process; we discuss our results, and in a conclusions section consider whether project management concepts might be applied in a way more relevant to the deeper issues of venture capital monitoring.

VENTURE CAPITAL AND INVESTMENT MONITORING

In the United States, the venture capital industry structure consists of intermediary organizations (venture capital “funds” or “partnerships”) that invest monies in privately held (i.e., not publicly tradable at the time of investment) high-risk promising operating companies (i.e., not financial holding entities), often high-technology firms with high growth and exit potential, (see Figure 1 Venture Capital Diagram).

The Venture Capital Life Cycle

Venture capital monitoring is typically seen as a stage in the “venture capital life cycle:”

1. the “raising” or collection of investment monies into venture funds (often called “pools” or venture capital partnerships),
2. the selection of investments through pre-determined criteria,

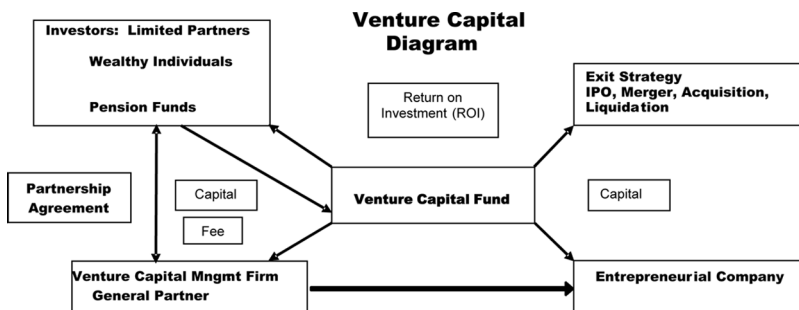


FIGURE 1 Venture capital diagram.

3. the monitoring of the investment and the enhancement of value to the firms,
4. the return of capital to the investors, and
5. the strategic exiting of successful deals. (Gompers & Lerner, 2006)

In the United States, the sources of these funds (generally called the limited partners or LPs) are varied but include pension funds, bank holding companies, insurance companies, corporations, other formal “funds-of-funds” such as private equity consortiums, and wealthy families and individuals.

The professionals who manage these venture capital partnerships are called venture capitalists and in turn are usually organized into management companies or partnerships of several investment professionals (referred to variously as the venture capital firm, management partnership or GP for general partner) legally responsible for the conduct of the fund’s business.

These venture capital firms are directly involved in raising a fund’s money, overseeing its use in specific investments (often some time after informal investments by wealthy individuals or “angels” in an earlier round and typically in tandem or syndicate with one or more other venture capital funds investing in the same round) and then implementing the ultimate return of principal and added return to the limited partners, typically over an extended period of seven to 10 years.

In addition to initial or new investments, venture funds during their lifetime generally do one or more follow-on investments in many of the investments already in their portfolios where they deem this to enhance or protect the ultimate return of their funds.

Venture capitalists typically receive or purchase some limited partnership ownership interest in the funds they manage as well as management fees (typically 2.5% of money under management), and a success fee (often called the “carry” and typically 20%) on the ultimate return above principle on investment of each fund. The success fees can then be distributed to the individual professionals making up the management partnership. The reliance on limited partnerships of finite life with substantial profit sharing has been identified as critical to their success (Jensen, 1993; Shleifer & Vishny, 1997; Gompers & Lerner, 1998).

Venture capitalists typically actively seek liquidity or exit from each specific investment of their funds in a somewhat shorter time frame (perhaps three to six years) in order to expedite the time that they can close the affairs of the whole fund, return capital assets to the limited partners, and hopefully obtain significant success fees for themselves.

The entire process of raising the money for a fund, managing it, and then terminating the fund may in fact take more than 10 years. Typically venture capital firms or management partnerships with a strong performance record and reputation will be raising a new fund each three to five years, as the largest amount of new investment activity tends to occur in the first three years.

This leads to a pattern whereby they are managing several funds of different vintage at once (e.g., Smith Venture Fund I, Smith Venture Fund II, etc.).

Liquidity or exit strategies for specific target investments include: (1) going public in an initial public offering (IPO) so that after a regulatory waiting period shares can be distributed to limited partners of the fund and freely traded; (2) being acquired by a larger firm for either cash or shares in the acquirer; (3) selling off the intellectual or physical assets of the company, often for pennies on the dollar.

Venture capital is seen as an important source of capital for young companies (Gompers & Lerner 2006) (especially those that have not yet achieved revenues or profitability) as the large multimillion dollar financing needed to fund research and development (R&D) and market development is typically unavailable from commercial banks or other traditional financial institutions due to the uncertainty and high risks seen in these companies.

In the United States, the late 1990s saw an unprecedented surge of venture capital activity due in part to the growth of the Internet and the successful ventures of the period such as eBay and Yahoo (Gompers & Lerner, 2001). Moreover, the impact of venture capital on technological innovation is significant and is reflected in the dramatic increase in patents over the past two decades (Lerner, 2000).

The United States, Israel, and Singapore stand apart from other countries in that venture capital funds are invested heavily in early-stage ventures and high-technology industries in comparison to funds in other countries that invest in later-stage financing in lower-technology industries (Milhaupt, 1997; Gilson & Black, 1999).

In the United States, institutional investors like pension funds and wealthy families have been the main contributors to venture capital funds.

In Japan, by comparison, banks are the main repositories of capital and there is little organized venture capital industry—and the few venture capital funds that have been developed by the banks rarely invest in high-tech firms (Milhaupt, 1997). A similar situation exists in Germany where bank-underwritten venture capital funds provide primarily later-stage financing in lower-technology industries (Gilson & Black, 1999).

The European venture capital market is also constrained by regulatory and market barriers that limit early-stage investment, and capital market structures that hinder the ability of portfolio companies to liquidate their positions in start-ups (McCahery & Renneboog, 2003).

By contrast, the United States has a more flexible securities, bankruptcy, tax, and pension system that supports the framework for venture capital and provides more expansive financing opportunities as well as more beneficial exit options.

Moreover, the importance of exit options (e.g., a liquid stock market or active mergers and acquisitions environment including leveraged buyouts) is widely accepted as an important factor in the growth of a venture capital

market. Indeed some writers have noted that the combination of venture capital and private equity (much later stage but still private financing combining equity and debt) may make the public stock corporation less important in the future (Gilson & Whitehead, 2008).

CORPORATE GOVERNANCE AND CONTRACTUAL VIEWS OF POSTINVESTMENT MONITORING

A variety of contractual and formal corporate governance arrangements have been described that venture funds use to add value and protect their interests in the monitoring stage of each investment (McCahery & Renneboog, 2003; Hellmann, 1998; Gompers & Lerner, 2001; Barry, Muscarella, Peavy, & Vetsuypens, 1990). These especially emphasize the conditional gearing of follow-on investments to milestones, disproportionate authority by the venture funds' share class over fundamental decisions such as mergers and acquisitions, and also control of a company's board by its investors in return for the capital invested and the promise of valuable advice and connections. Voting control of a company's board by its investors is used not only to replace CEOs deemed to be poorly performing, but also as a *de facto* (via this implied threat) source of power to influence key decisions such as product, market, sales channel and alliance, manufacturing, and financial strategy.

Venture funds also use their contractual arrangements and power to cause their portfolio companies to provide detailed financial information, reports, asset valuations and other documentation concerning the firm's financial status or operations.

Relevant to the postmonitoring of investments by venture capital funds, writers of international venture capital argue that technical and operational expertise are necessary for both selection and management of investments, and that the relative lack of these skills contributes greatly to the relative failure to develop an aggressive venture capital market outside the United States. As an example, early reports of the emerging venture capital industry in China note that the venture capital firms there have lacked the expertise to select and manage new technology ventures, and they have been unable to add much value beyond financing (White, Gao, & Zhang, 2002; White & Liu, 2001).

Literature regarding venture capital monitoring thus stresses the importance of adding value (e.g., advice on strategy and contacts with investment banking firms, lawyers, and consultants) and the importance of legal structures to ensure a fund's influence and the appropriate flow of data.

However, beyond lists of early warning signals (such as late financial reports, failure to return calls) to detect problems or malfeasance on the part of entrepreneurs (Gladstone, 1988), little guidance or conceptualization is provided on how in practice venture capital professionals should use their data rights and considerable power, nor what the scope and set of actions

of venture capitalists should be in offering advice and helping their investments, other than replacing a CEO.

In addition, beyond the general advice to coordinate with other board members and one's own internal colleagues, no clear guidance exists on how the monitoring process is complicated by the presence of other venture capital funds in a syndicate (the common practice of several venture capital funds co-investing in a company's investment round) or by management dynamics within venture capital firms.

PROJECT MANAGEMENT AND ITS POSSIBLE RELEVANCE TO INVESTMENT MONITORING

Project Organizations

In contrasting projects with venture capital investments, it is important to note that project organizations are complex systems including persons and groups, rules and institutions, work processes, and theoretical concepts (Cooke-Davies, Cicmil, Crawford, & Richardson, 2007). Over the years, appropriate institutional arrangements have emerged to better manage the complexity of projects, and to enable their implementation and successful completion (Crawford et al., 2008; Klakegg, Williams, Magnussen, & Glasspool, 2008). Traditionally, project management has been thought of in terms of large infrastructure projects with a focus on budgets and the dominant problem of managing cost overruns. Historically, construction projects have been prone to severe free cash-flow problems, which can partially be mitigated through leverage, i.e., long-term borrowing via municipal bonds and/or commercial bank loans (Esty, 2004). Projects, however, are utilized for many purposes including research and design, transportation and infrastructure development, and, critically for this research, in new product and technology initiatives. Projects are utilized the world over to build infrastructure, to manage change, to manage behaviors, and to manage and monitor progress across myriad areas (Turner, 1999). Some well-known examples of the use of the project management approach by government and industry include the space missions administered by the National Aeronautics and Space Administration (NASA), the U.S. Department of Defense contracts for research and development, auto research and design projects, and mega projects such as Boston's Big Dig and the English Channel Tunnel (Euro Tunnel).

Projects are commonly defined as sharing three common characteristics (Kanabar & Warburton, 2008):

1. Projects are temporary; they have a distinct beginning and end;
2. Projects are undertaken to provide a unique result or service known as the deliverable; and

3. Projects are developed by breaking agreed work down into smaller steps or stages (progressive elaboration).

Project Life Cycles

Similar to venture capital monitoring, project monitoring is conceptualized as part of a stage within the full project life cycle (Graham, 1985; Adams & Barnt, 1988, Gray & Larson, 2008) consisting of:

1. The initiation stage where the project is defined and approved based on the submission of a detailed feasibility study and high level plan, and given a formal authorizing document know as a charter;
2. The planning stage where the detailed schedules, budgets, risks and resources are determined;
3. The execution of the project which includes status reporting, monitoring and quality control; and
4. The delivery of the project to its customer and the closing of the project.

Monitoring of Projects Through Process Groups

Project management encompasses all aspects of a business including cost, time, and quality and risk management. It is thus focused on a set of activities that produce a specific result and not a set of continuing activities that are repeated. Before addressing the tools and techniques available to monitor and control projects, it is important to recognize that in addition to the project life cycle described above, projects are generally organized into five process groups that contain 44 processes (PMI, 2008). Though projects may vary in terms of the process groups and processes selected, each process selected should contain a methodology for monitoring and controlling that process.

The five distinct phases or process groups as defined by the Project Management Institute (PMI) include: initiate, plan, execute, monitor, and control and close. Initiation involves defining the project objectives and obtaining approval from the project sponsor. Project planning includes defining and scheduling the project activities and ensuring the necessary resources are in place to complete the activities. Execution involves implementation of the project plan. Control focuses on systematically managing changes to objectives, plans, and schedules during execution. Closure ensures lessons learned are documented to ensure the organization is focused on continuous improvement.

Project Monitoring and Process Control Tools

Monitoring and controlling project work is carried out from project initiation through project completion. A project monitoring system consists of a comprehensive methodology for determining what data to collect and how

to analyze it to measure progress and identify problems. Control is the process of comparing actual performance against plan to identify deviations, evaluate possible alternative courses of actions, and take appropriate corrective action (Gray & Larson, 2008).

The previous text highlights the most important processes utilized to monitor and control projects. Many of these processes are iterative and overlap throughout the project life cycle. For example, in project management the concept of a triple constraint—project scope, time, and cost—is critical to understanding how projects manage competing project requirements. The relationship among these factors is such that if any one of the three factors changes, at least one other factor is likely to be affected (PMI, 2008). Project quality is always affected by balancing these three factors.

A project's cost and schedule is controlled primarily through the use of the earned value system (EVS). The earned value system starts with time-phased costs developed through a work breakdown structure that provides the project budget baseline, which is called the planned budgeted value of the work scheduled (PV). Based on this time-phased baseline, comparisons can be made with actual and planned schedule and costs through the earned value system. This is a valuable tool for identifying when a project is off track and from there alternatives can be identified to get the project back on track in as short a time and with as little cost impact as possible.

Maintaining quality is a significant process in project management and all projects must perform quality control. Quality control looks at specific measurements to see if the project and its processes are in control. Quality control answers the question of whether everything is working on the project and whether additional time or money must be spent to help the project succeed. It also involves taking action to eliminate the root causes of poor performance. Project management involves utilizing seven basic tools of quality to ensure the project requirements are being met. These tools include cause and effect diagrams, flowcharts, histograms, Pareto charts, run charts, scatter diagrams, and control charts (PMI, 2008).

The importance of risk control is central to project management and is embodied in a risk response plan. This plan includes tools to identify risk triggers, monitor residual risks, conduct risk reassessments, evaluate the effectiveness of risk management plans, meet stakeholder's expectations on risk, and determine if assumptions are valid among many other risk actions and activities. In addition, because changes occur throughout the project due to requests for expansion or reduction of scope, cost restraints and quality reviews, changes themselves are seen as a major cause of risk of time slippage and not achieving the project's goals. Change control through a formal change control system is an important focus in project management. Such systems usually include a change control plan and procedure, documentation, performance statistics, specification reviews, testing, audits, and creation of a change control board to approve all changes (PMI, 2008).

TABLE 1 Research Questions

Objective	Research question
1. To understand the venture capital postinvestment monitoring process and its relationship to the fund's general goals	Describe your postinvestment monitoring process including major risks and issues, documentation, processes, required forms, status meetings, reporting requirements and data due points.
2. To understand the relationship with preinvestment activities and goals	How directly or not is the postinvestment monitoring process related to the financial goals set for investments?
3. To determine if the investment is managed as a project	Do you manage each investment explicitly as a project with inter-related scope, time, and cost attributes? If you do not manage as a project, why not?
4. To identify the various processes utilized for monitoring investments	Do you use the same process for monitoring every investment? For example, if the stage is different or if you are not the lead investor, or do not have a seat on the board, does this impact the process?
5. To determine the parties responsible for data collection	Who sends what data from the company and to whom do they send it in the venture capital firm?
6. To assess the extent to which risks are part of the monitoring process and how risks are monitored and controlled	What system do you utilize to monitor and control identified risks?
7. To determine the overall view of the postinvestment period and its challenges	What are the major risks, issues, and decisions to be made during the period from initial investment to exit (i.e., liquidation, trade, or sale)?
8. To assess how changes are monitored throughout the life of the investment	Do you require that changes from plan be controlled through a change control system? If not, what other mechanisms do you use to monitor change from the initial proposal?
9. To understand the board governance practice	How does the board monitor the company? How often does the board meet? Who attends the meetings? What are the outputs of the process?
10. To assess the extent to which a contingency fund is utilized to control costs	Do you include in your budget a contingency fund for known risks, and a management reserve for unknown risks? If so, on what do you base the amount of these reserves?

METHODOLOGY

The objective of this study was to learn about venture capitalists' perception of issues and appropriate techniques in life science venture capital postinvestment monitoring, and their perception of the relevance of project management techniques to postinvestment monitoring.

TABLE 2 Background on Selected Firms Interviewed

Background	A	B	C	D	E
Size of Fund (millions)	\$80	\$75	\$60	\$260	\$150
Fund Experience	Second fund	First fund	Third fund	Third fund	Fifth fund
Number of Professionals (Partners & Assoc)	3	3	4	6	10
Number of investments.	10	7–10	NA	10–12	17–18
Take Board Seat	Yes	Yes	Yes	Yes	Yes
Focus on life science and/or medical	80%	100%	100%	100%	100%
Stages of Typical Investments	Mixed	Early	Early	Mixed	Early

The qualitative research design involved three stages: (1) conduct of interview with selected life science venture capital firms; (2) review of data and documents provided at the interview; and (3) follow-up questions after review of the relevant data and documents. The data were collected via semi-structured interviews (approximately 45 minutes to 1 hour) with professionals (generally at the partner level) from five venture capital organizations. Quotes in the results section that follows are generally paraphrased rather than the exact sentences. Data was analyzed on an iterative reduction basis, following the Huberman and Miles (1998) Interactive Data Analysis model. The interview framework is detailed in Table 1 below.

Background on Firms Interviewed

The interviews were conducted over a three-month period and various background information was elicited from these interviews. This information is summarized in Table 2.

To maintain the confidentiality of the venture capital firms interviewed for this study, we have designated the five firms below by letter. As noted below, the venture capital firms range in size from small two-partner firms to very large firms with many institutional investors. Firm E has the largest number of partners and also the most experience. The focus of each firm is primarily life science, including biotech, medical devices, and health care IT. The stage of investment reflects a mix of early and late stage.

RESULTS AND DISCUSSION

Although there were many common goals in the five interviewees' descriptions of the monitoring process, there were also interesting differences among them in how they viewed the process itself and the behaviors they emphasized. (See Figure 2 Two views of the venture capital monitoring process: Idealized rational explicit process with one investor versus actual imprecise process with multiple stakeholders and emphasis on collective behavioral phenomena.)

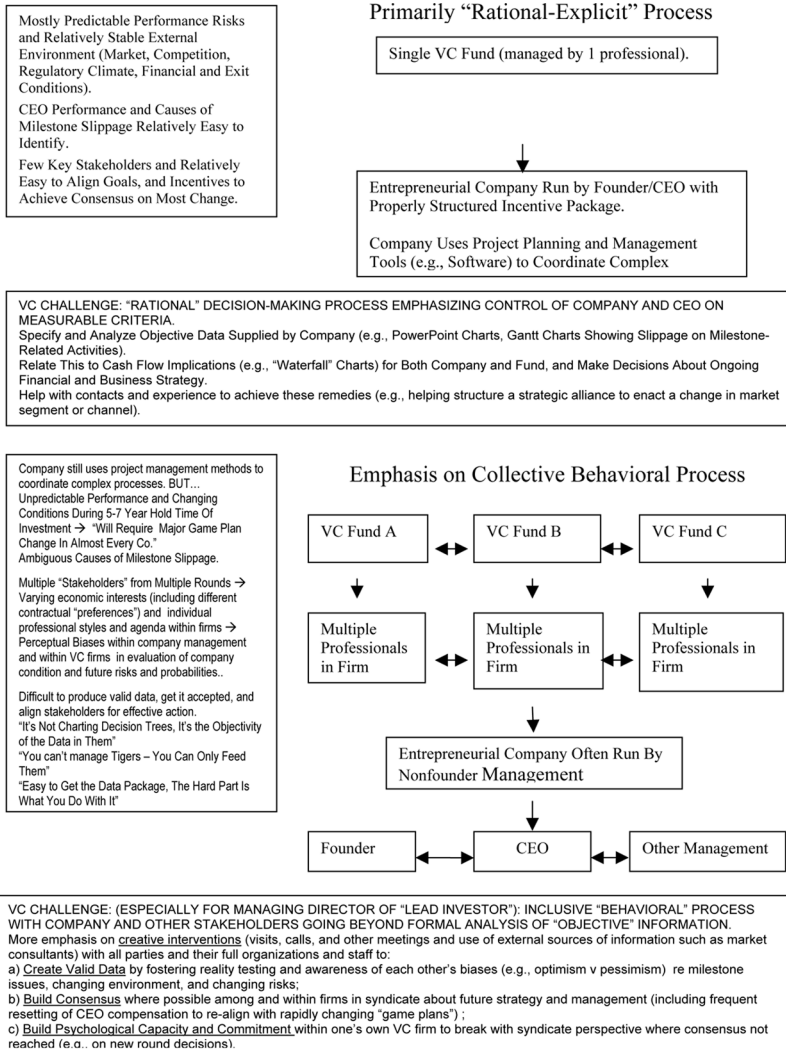


FIGURE 2 Two views of the venture capital monitoring process: Idealized rational explicit process with one investor versus actual imprecise process with multiple stakeholders and emphasis on collective behavioral phenomena.

A consistent theme was the inherent uncertainties-both internal and external to a company- in what happens after the initial investment and that how this is handled – the monitoring phase – affects the success of the investment as a return to the Fund and its investors.

Interviewees cited the rapidly changing nature of the market, competitive, financial, and regulatory environment of life science companies, and the inherent great uncertainties of the company’s own scientific and technical progress, and the consequent need for flexible responsiveness in order to have the best chance at preserving or even enhancing a desirable financial

return for a fund, while not committing to expensive new strategies unless their likely risks and rewards made sense.

“Though a lot of attention is paid at the front end of the investment, for example in the business plan, ultimately, the money is made or lost in the decisions you make after you invest.”

“Our hypotheses about the science, the product, whether the target market will prefer cheaper or better alternatives, the people strategy, manufacturability, how the FDA will act, any one of these can change during the 5–7 year hold time of an investment—and in fact several will—the world totally changes in this period.”

“I can’t think of one company in which we stuck to the original plan . . . There is a need for flexible responsiveness—broken field running—making quick changes based on actual conditions and information on the field rather than in enforcing a strong feedback loop to the original plan where the original goal or business plan doesn’t change.”

Examples of such decisions that have to be made “on the fly” included changes to reimbursement or pricing strategy, product form or mode of delivery, decisions to go a longer period before arranging for the sale of the company, use of corporate partners, amount of outsourcing, and evolving harvest strategy. (For example, do you sell the company before clinical approvals?) They emphasized that there were a “small number of big decisions” and that “some of the most important decisions are not made before you invest,” and these decisions are what make or break an investment’s success.

“Particularly in startups making new products, despite ours and the founder’s best analysis and business planning, we very frequently find that our understanding of the actual market was incorrect or the market changes, and our challenge becomes identifying the real market, and finding the best way to it . . . or bringing the investment to a satisfactory harvest before we risk a further loss.”

VC Monitoring as “Rational-Explicit” Decision Making

The three interviewees from firms with a smaller management structure and less total money under current management (including that from previous funds) focused mostly on a relatively clear-cut process of active decision making and syndicate leadership based on discussion of reports and presentations by management of specific subactivities related to achievement of milestones (what we have called a mostly “rational-explicit” model).

In this process as per earlier literature, the company’s board, and the contractually negotiated presence of venture capitalists on it are seen as the central venue for decision making based on a well-defined package or “board book” of objective data specified by the board and/or the individual investors contractually, and supplied by the company (e.g., head counts, pipelines of sales and prospects, quarterly or monthly cash flow charts, PowerPoint charts,

and Gantt charts indicating status and slippage on milestones related to ability to raise additional cash).

The data required and the process of monitoring were seen as driven by extensive preinvestment analysis. As one interviewee described the process:

“Before we invest, we model—in conjunction with our discussions with company management—who would be likely to buy the company, and create a chart of what milestones—both multi-year objectives and related specific activities and mini achievements—would be needed at the end (as well as along the way to obtain more financing), and the likely valuations these milestones would support. We model this both from experience and from calls to players in the industry. We go backwards from this to determine pre- and post-valuations and amounts of earlier financing events and stock dilution building in the necessary rates of return [expressed as a hurdle rate multiple for the projected time period involved], and therefore the acceptable company preinvestment valuation or price we are willing to pay now for our desired share.”

“The initial preinvestment analysis of necessary milestones and achievements is then used in conjunction with the company budget to develop a cash flow analysis including projection of when additional funds will be needed, and when and on what terms new funds are expected. Because of the lag times in a board agreeing on a new round and in introducing the company to investors, we use three months after achievement of each milestone as the likely time that money will come in related to that milestone.”

“This in turn guides the documents we want sent to us and the presentations we want in board meetings, as well as the internal tools we use at our firm to guide our ongoing decision making. For example, we modify the cash flow plan generated above to produce a “waterfall analysis” chart which we use internally to keep track of when the company will run out of money or need additional investment. This is updated and adjusted monthly with the cost data and milestone achievement data provided by company management to show the impacts of milestone/activity and budget variances, and what this will mean for financing, and for our likely financial return.”

As indicated above, these interviewees reported that board meetings and internal discussions were focused on milestones and selected subactivities related to them, and issues and problems related to them, and whether these problems might be remediated, or whether changes in basic strategy were called for, and the possible impact on financings.

“The spreadsheet for each company is continually modified for activity completions or delays and their impact on milestones and on the return expected and is prepared and presented at every meeting with each key activity being verbally discussed at the meeting. The biggest problem of course is lateness in achieving milestone events and consequently running out of funds or facing major dilution of investment because we have to raise monies at different valuations . . . things don’t work as planned and we have to decide to kill, sell, raise money, or continue to run the company beyond the original plan.”

The view of monitoring as primarily objective data based decision making was qualified to also include:

- Getting accurate data from the CEO depends on developing a trusting relationship (“it’s like a marriage”) via conversations and visits between meetings;
- The board should carefully design the CEO’s compensation plan to motivate him or her toward candidly and resolutely addressing problems and achieving milestones consistent with the investor’s financial interests (e.g., variable additional stock and salary, and rewards for successful harvest);
- Dealing with the persistent problem—even after aligning of financial incentives—of overoptimism by CEOs, especially those who were also company founders, in their view of milestone delays and how easily they could be remedied. All five interviewees, therefore, emphasized getting the “C level” (chief scientific officer, chief marketing officer, etc.) members of management actively in communication with the board to keep the CEO and investors realistic in their appraisal of progress and assessments of risks and probabilities. “In most of our board meetings, we bring in 3–7 C-level persons. We want to get a better sense, not just one perspective.”
- Avoiding micromanaging and meddling especially when things are going well (“we don’t want to bug the CEO with lots of phone calls from investors”);
- Getting more involved (spending more time) in questioning things and talking to management when there were evident significant delays, budget variances, or performance issues (e.g., inadequate early revenues) and in these situations being alert to fundamental CEO problems such as lack of cost consciousness or lack of realism that may necessitate replacement of the CEO. This is also consistent with Gompers and Lerner’s (2006) finding that representation of venture capitalists on boards increased around times of CEO turnover.
- Frequent conversations with the other venture capitalists in the deal in order to present a united front to the CEO on key issues and the importance of dealing with them. Several interviewees commented on the importance of using a persuasive collaborative style with other directors and with the CEO whenever possible and recognizing that that you are not in total control.
- Finally consistent with views in the literature of the venture capitalist role, interviewees all noted the importance of the investor’s networks, experience, and skill set to achieve the remedies developed in the decision-making process (“being part of the solution”). Examples of this included helping find additional key personnel such as marketing and regulatory managers and outside experts, initiate and structure partnerships and strategic alliances (an activity often referred to as business development, Unger and Shavit, 2008) to enact needed changes in market segment or

channel, assistance in structuring new rounds of investment, and other financially related matters such as initial public offerings and mergers and acquisitions, choosing investment bankers, and even finding new directors when needed to bring in needed skill sets.

VC Monitoring as a Complex Collective “Behavioral” Process

Although all five interviewees recognized the importance of utilizing formal data packages and the necessity for behavioral components such as above, the two venture capitalists from firms with bigger management teams and more monies under management (both current fund and prior funds still active) [and possibly more co-investors in their syndicates] went much further in their emphasis on behavioral issues.

They highlighted the importance of understanding and facilitating a data collection and decision process (what we have called a “collective behavioral” model) involving complex multiple stakeholders and going beyond formal analysis of objective information. In particular they noted (1) the different perceptual biases and interests within company management including the founder, CEO, and other key managers; and (2) the differences among multiple venture funds in the syndicate and also among the multiple professionals in each venture firm.

“Waterfall charts, decision trees, and variance charts do not provide all the answers, and the tough decisions involve what to do when the management team appears to have executed appropriately, but everything around you is changing, and you have to get several parties and several individuals with varying personal and emotional stakes in the continuance of the product development strategy, the company, and the investment itself to examine what is really happening and then make open-eyed decisions.” “It’s easy to get the data package; the hard part is what you do with it.”

There was a great concern about: (1) ambiguous causes of milestone slippage (“it’s usually very difficult to determine if a ‘crappy CEO’ is the root cause of a problem, let alone put this possibility into a Gantt chart”) and (2) the lack of objectivity in interpreting and acting on this. Perceptual bias in the evaluation of company condition and future risks and probabilities were seen as natural results of having multiple stakeholders from multiple rounds with varying economic interests (including different contractual preferences) and also the presence of different individual professional styles (e.g., pessimistic vs. optimistic reading of events) and hidden agenda (was it my deal or someone else’s deal in the firm?) within the several firms.

Also in the relationship with management and its CEO, even where compensation had been originally aligned on an economic basis with investor goals there were still unavoidable differences in psychological ownership that affected validity of decision making. When ongoing problems seemed to cast doubt on the financial wisdom of original goals such as completing the

product or finishing clinical trials, an attachment to task completion and a stable operational domain (one's job) could get in the way of management being realistic, for example, in its assessment of the probabilities for turning conditions around in reasonable time, and decisions involving matters such as changing the strategy to sell the company earlier than planned.

In this situation, the venture capitalists saw their greatest challenge as creating a process that could facilitate the production of accurate and widely shared assessments and aligning stakeholders for effective action.

As highlighted in Figure 2, the two venture capitalists from firms with bigger management teams thus placed distinctly more emphasis on (1) creating credible data on often subjective issues; (2) building consensus where possible among the syndicate firms and the company about future strategy and management; and (3) building psychological capacity and commitment within the syndicate and/or the individual VC fund to (a) make the tough decisions (e.g., let the company go down and its competitors "win" because the added investment to keep the company alive no longer makes sense from an investment risk/reward perspective); and/or (b) break with the syndicate perspective where consensus cannot be reached (on such key issues as in decisions on participating or not in new rounds).

As one venture capitalist said about his efforts to build consensus among his partners in the face of perceptual differences: "you can't control tigers—you can only feed them" Another noted: "You are part of a committee. You have less information than you might have wanted. You are not an expert but a builder of consensus. You have to be willing to consider multiple alternatives."

To manage perceptual bias, especially within their firms, the partners at the two larger firms especially commented on the need for creative structures and behavioral interventions such as:

- Within the venture firm's internal deliberations, openly discussing each other's perceptual styles (who is the always optimistic, the pessimist, etc.), so their positions can be better calibrated in discussions of individual situations, and their styles can be used in a positive way to promote a multisided view of things;
- Designating a backup partner to supplement the primary partner on an investment and act as "devil's advocate" in internal discussions;
- Designating a partner to act as advocate for "orphan" companies where the original investment was led by a partner no longer in the firm;
- Hiring experienced part-time mentors (retired CEOs) to consult with the CEOs of the companies and add objectivity in assessments of shortfalls;
- Frequently speaking with the other investors in the syndicate, and trying to make visits to the companies together, and actively benefit from the availability of a "second opinion" Gompers and Lerner's study of choices of co-investors in biotech venture capital syndicates supports this observation (2006, p. 266).

- Having one's whole firm, sometimes even including clerical support staff, go as a group to visit a portfolio company, and hear its progress presentation, and compare notes afterward.
- Frequent (not just a onetime structuring when the investment is initially made) resetting of CEO compensation to re-align with rapidly changing game plans (viewed as helping although not totally eliminating the perceptual biases and self-interest issues of CEOs and founders). For example, if the decision to sell early was made, then the CEO's compensation could be changed to reward success in this new goal.

Use of Project Management Concepts and Tools

All of the interviewees believed in the value of project management tools and techniques for their portfolio companies, especially project tracking software, and two interviewees specifically reported urging their companies to make use of the best tools to manage complex interrelated processes such as the subactivities related to successful regulatory applications. They also endorsed the relevance to their own investing strategies of general concepts (from project management and elsewhere) such as staged financial commitments based on completion of milestones and focus on value created. However, none of the interviewees reported much use of formal project management systems, software, or language in their own postinvestment monitoring process.

The venture capitalists did use tools similar in spirit to project management methods such as cash waterfall charts to keep aware of issues affecting their financial goals and key decisions that had to be made, for example, an emerging milestone shortfall/delay that might dramatically affect the pricing of a needed new round, and therefore affect the viability (value created) of the existing financial model, and therefore necessitate consideration of a major change in the game plan. See Table 3, Comparison of Monitoring Process Used by PMs and VCs.

These tools helped the venture capitalists to focus in board meetings on the problems that were contributing to emerging catastrophic milestone failures, and also within the venture firms to guide considerations and constant readjustment of what the fund has to set aside as reserves for additional likely investment in that company versus expanding their portfolios by making virgin investments in new companies.

However the more formal and precise project management tools and processes such as the earned value system, network diagrams, integrated change control and formal risk assessments, auditing, and reserving were generally not employed directly by the venture capitalists (except that Gantt charts produced by company managements were often discussed at board meetings).

TABLE 3 Comparison of Monitoring Process Used by PMs and VCs

Monitoring process groups	Venture capital process	Project management process
Cost	Waterfall charts prepared by investor.	Earned value system
Scope	Objectives	Contracts and requirements
Schedule	Milestones (with subactivity status reports under each). Gantt charts prepared by company.	Earned value system Gantt chart Network diagrams
Integrated Change Control	Non strategic changes monitored by board on a postreporting basis.	Formal integrated change control process with many checkpoints built in.
Quality	Technical evaluation by management and consultants.	Seven basic tools of quality with formal systems.
Risk	<p>“Informal” ongoing verbal “decision tree analysis” at meetings based on consensus perceptions of hard-to-measure probabilities, and (in one firm) formal periodic reassessments of market conditions by hired outside consultants.</p> <p>“Hot lists” monthly compiled from professionals within fund of portfolio investments seen as in trouble and needing consideration of additional reserves beyond planned further rounds, and how much.</p>	<p>Formal ongoing risk reassessments and audits.</p> <p>Formal computer-generated “reserve analysis” based on models integrating cost and time and impacts of slippage.</p>

Reasons cited for not using more formal project management tools included the following:

- The lack of meaningful numerical data such as probabilities and values that could be used with these approaches, especially for setting up a system at the inception of the investment.
- The excessive cost of data collection investment, especially since as indicated above much of this involved a subtle consensus of interpreting hard to interpret subjective information subject to perceptual bias.
- A belief that project management did not provide useful guidance to the problems of creating objective data and achieving consensus in situations of great ambiguity in the data and perceptual biases in multiple stakeholders. “It’s not about charting decision trees; it’s the objectivity of the data in them.” As one venture capitalist remarked, “I wish project management would offer more help in the art of managing a professional partnership.”
- The difficulty of getting the multiple stakeholders in the syndicate venture capital process to be influenced by and form consensus from relatively unfamiliar categories such as measures of earned value.

- The conceptualization of venture capital investments in a given company as having a single general purpose (return on investment) but no single deliverable fixed objective or hard deliverable versus the project organizations with multiple hard deliverables.

“Of course we use concepts like ‘management by objectives’ in our focus on having key milestones and using this to drive our financial models, but generally we are less involved in the day-to-day management of the business and are more focused on understanding problems and making larger assessments and decisions such as retention or replacement of a CEO, or change of exit strategies. Uncertainties in perception of milestone status and root causes and future probabilities of success are difficult to quantify and thus it’s hard to plug in project management tools such as formal decision trees.”

“As venture capitalists, we are more concerned about responding in real time to a relatively small number of external discrete events or largely uncorrectable or too late to correct internal performance problems (if we ever get to determine the root causes), rather than mitigating the cascading impact of a large number of interrelated events such as a delay in one part of a huge construction project that delays other parts.”

“Furthermore you can’t easily quantify events such as the degree of changes in the regulatory or reimbursement environment or the market for acquisitions, nor quantify the probability these changes will be permanent.”

As one of the venture capitalists interviewed (who had earlier in his career been a project manager for one of the world’s largest construction firms), noted: “Project management in comparison to venture capital monitoring was developed in large part to get by the ‘complexity barrier’ of keeping track of large complicated projects with highly interdependent but very measurable activities.”

Interviewees also noted a fundamental difference in the superordinate or metagoals of projects and venture capital investments. As summarized by one investor, “we are less focused on successful completion (must be finished no matter what) as in a large infrastructure project, and more on adjusting the overall business and exit strategy to whatever is the status of external realities and internal milestone creation.”

In project management a premature exit is generally not an option prior to completion of top level project goals such as creating a river crossing; the only acceptable objective is minimizing setbacks through time, scope and cost control to achieve a “pareto optimal” combination. In venture capital investment by comparison exiting an investment such as arranging an earlier than planned sale on unattractive terms (or even abandoning the investment in the extreme) is often considered acceptable if it preserves ROI or avoids further unattractive risk/reward outlooks. “The only hard and fast goal is to shift as needed.”

CONCLUSIONS

The structure and monitoring of projects and venture capital investments contain some similar but not identical attributes. Venture capitalists, similar to project managers, utilize tools to keep track of and make decisions about their investments, but these are somewhat more limited and less formal than project management tools.

Venture capitalist interviewees, especially those with larger firms, put more emphasis on managing the collective data collection, analysis, and decision-making process of the extended stakeholder group in each investment of syndicate members, their individual investment professionals, and company founders and management.

In monitoring investments, life science venture capitalists portrayed a more complex multiparty behavioral process where the model of rational decision making based on explicit objective information in a relatively predictable environment has to be supplemented with behaviorally focused activities aimed at helping multiple stakeholders secure valid information in a context of great uncertainty and then reach decisions based on awareness of their own perceptual bias and interests.

The venture capitalists also stressed that while their companies typically used project management tools for managing interrelated tradeoffs in time, cost, and scope of their development activities, the venture capitalists themselves faced a somewhat different challenge, that of often needing to facilitate major changes in strategic and financial game plans in an environment of shifting and hard to measure independent events and probabilities and multiple stakeholders. This behavioral side of decision making may be an area where project management concepts and tools can be better elaborated and communicated to be of more benefit to venture capital monitoring.

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