Diagnosing and Managing Unforeseeable
Uncertainty to Improve Venture Capital Returns

by

C. Loch

M. Solt

and

E. Bailey

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By, Christoph H. Loch, Michael E. Solt, and Elaine M. Bailey

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Christoph H. Loch is Professor of Technology Management at INSEAD in Fontainebleau, France. Michael E. Solt is Professor of Finance at San Jose State University, California. Elaine M. Bailey is General Partner of Novus Ventures in Cupertino, California.

Leading fundamentally novel products and services to successful market introduction is a great challenge. Whenever a startup company tackles an unknown market or utilizes a new technology, it will encounter *unknown unknowns* ("unk unks" in engineering speak).[i] Unk unks are unforeseeable influences or events that emerge during the development of the business and can be neither included in the business plan nor mitigated by traditional risk management techniques. Why undertake such nightmares at all when success is increasingly difficult to attain?[ii] The answer lies in the potential for significant financial reward in markets where new companies can compete in unstructured arenas and the winners have not yet been declared.

After the 2001 burst of the dotcom bubble, venture capital (VC) firms were willing to forego the "high risk/high reward" model and became more conservative, preferring to invest in later stage startup companies with known management teams, technologies and markets.[iii] While this strategy has merit, it is often the novel technologies and new markets that are the best plays for companies seeking lasting competitive advantage in uncontested and fast moving industries. Unfortunately, new technologies and markets are fraught with unk unks.[iv]

Dealing with unk unks requires management methods and systems different from those used for classical "plan-and-achieve-target" projects.[v] Conventional wisdom would say that VCs are good at managing highly novel startup "projects". But it turns out that the VC investment process is rigid, runs according to classical target (i.e., milestone and revenues) achievement, and tends to penalize the new venture when it misses its targets rather than nurturing it through a re-definition.[vi] In this article, we demonstrate how the *presence of unk unks can be diagnosed* at the outset (when the VC invests) although the unk unks themselves cannot (by definition) be foreseen. This allows the VC and startup management to apply flexible management methods when necessary.

Risk Management and Venture Capital

The VC business model is to invest in new ventures that can be developed into high-return investments. Successful business creation must combine a strong vision and industry knowledge with the ability to engage in multiple trial-and-error iterations, even rethinking the business model when unforeseeable market or technology events occur. In our view, this is the weakest link in the VC investment process. VCs take a *reactive* rather than a *proactive* approach to dynamic risk management. Guiding new venture development takes constant vigilance and incredible effort at each stage even when development through the stages proceeds as expected.

During the dot.com bubble, VCs had become satisfied with monitoring the execution of initially agreed-upon stages (with some modifications on the way, admittedly). They placed too little attention and resources on nurturing start-ups through phases of unanticipated events and crises and became accustomed to simply walking away, seeking returns through different management teams or opportunities. Since the burst of the dot.com bubble, the ability to nurture portfolio companies through unanticipated crises has become a critical skill for VCs to achieve value creation.

The National Venture Capital Association (NVCA) summarizes how VCs operate:

"Venture capital is money provided by professionals who invest alongside management in young, rapidly growing companies that have the potential to develop into significant economic contributors. Venture capital is an important source of equity for start-up companies … Venture capitalists generally: finance new and rapidly growing companies; purchase equity securities; assist in the development of new products or services; add value to the company through active participation; take higher risks with the expectation of higher rewards; have a long-term orientation … Going forward, they actively work with the company's management by contributing their experience and business savvy gained from helping other companies with similar growth challenges." (*Source: NVCA Web page*)

This overview highlights the resources that VCs provide new ventures: capital, advice, and experience. VCs assist the new venture in attaining a successful harvest, reducing risk and

increasing value along the way, but they expect to generate a 10x return on each investment.[vii] Over the typical holding period of 5 to 7 years, this translates into annual compound rates of return of above 40%. Indeed, VCs tend to use hurdle rates between 33% (later stage firms) and 42% (earliest stage firms).[viii] VCs benefit directly from the returns earned – typically, they receive 20% of what is generated in excess of the capital committed (the "carried interest") by their investors (such as pension funds, life insurance companies, and wealthy individuals).[ix]

Criteria	Seed	Start-Up	Early Stage	Expansion Stage	Later Stage
Definition	Research and develop initial concept	Concept or product under development, but not fully operational; usually in existence less than 18 months.	Testing or pilot production; may be commercially available and generating revenues; usually in existence less than three years	Production and commercial availability with significant revenue growth but may be without profits; usually in existence more than three years.	Wide availability with on-going revenue; likely profitable with positive cash flow; includes spin-outs of operations of existing private companies
Milestones	Business Plan	Complete team; prototype	Beta test; booking orders	Customers	Profitability
Major source of financing	Founders, family & friends, angels	Angels and venture capital	Venture capital	Venture capital	Venture capital and buy-out funds
Financing required	R&D	Product development	Capital assets	Capital assets and working capital	Capital assets and working capital; new product development
Operating cash flow	Negative	Increasing "cash burn" rate	Increasing "cash burn" rate	Decreasing "cash burn" rate	Positive
Risk	Higher				→ Lower
Valuation	Lower				→ Higher
Source of the definition of the stages of development is PricewaterhouseCoopers MoneyTree™.					

Figure 1. New Venture Stages of Development

Figure 1 provides a view of how VCs expect a new venture to progress through the various development stages, from a concept to a functioning business, and the milestones provide the VC

with a roadmap. At the outset, tasks are identified for each stage, and since both the founders and the venture capitalists own equity shares, the goal of maximizing the value of the equity can be constantly kept in mind.

To control new venture development and to encourage accomplishing milestones, VCs "stage" investment over a number of "rounds" (i.e., new financing), and each round requires the new venture to negotiate the necessary financing.[x] Often, each round adds another VC to the new venture's Board of Directors, assuring that VC investors can have active participation in monitoring the company.[xi]

While Figure 1 describes what is expected to happen, it provides few clues about what happens in a crisis. VCs can force cost cutting (to reduce the cash burn rate and "lengthen the runway"), but they are somewhat at a loss if product development glitches occur or if the "dog won't eat the dog food" (i.e., customer acceptance is lacking). If the new venture value grows as expected, the entrepreneurial team and the VC investors will both attain satisfactory returns on investment. However, the terms of financing often give the venture capital investors a bigger share of the value when anticipated growth does not materialize.[xii] Or, VCs simply rely on their "Rolodexes" filled with previous contacts to change or replace the entrepreneurial team.

The investment process in Figure 1 is subtly deceptive because the linear structure suggests steady progress, the entrepreneurial team's business plan implies plannability, and the VCs' financial levers offer seeming security through the power of putting pressure on the team to achieve the milestones.[xiii] Moreover, VCs have their hands full because they typically are investing in several new ventures simultaneously and are constantly looking out for new deals.

In reality, creating a new business is anything but linear and plannable. It requires experimentation and iteration, and flexible changes.[xiv] Unfortunately, success for VC firms has

traditionally been elusive. Before the 1997-2001 bubble, nearly 50% of the value created by venture capital firms was due to the 6.8% of their investments that actually achieved a return of 10x or more. Battery Ventures reported that of 153 companies it backed, 25 were taken public while 43 were acquired—and 25 companies went out of business.[xv]

Monthly Board of Directors meetings aim at providing continuity of oversight but often consider only what has occurred since the last meeting, and this is where the planning process breaks down. The Board hears management's version of the world (i.e., problems, progress, development, cash requirements vs. burn rate, etc.), and if it sounds logical, then the Board may tolerate delays in achieving the milestones. Crises arise because the Board is not asking the right questions and Board members make assessments only from their own experience. Management's story should be viewed as a set of *assumptions* about the world that need to be checked before being accepted as logical and valid. The Board's role would change from reactive ratification of management plans to proactive due diligence that uncovers the right questions to ask to determine the correct actions and decisions.[xvi]

Applying Ideas from Project Management to VC Risk Management

In order to understand and address the limitations of the VC investment process, we can use methods from project management. A new venture is a project, a "unique interrelated set of tasks with a beginning, an end, and a well-defined outcome." [xvii] It starts with the first funding decision and ends when a trade sale or an IPO has been achieved (or failed).

Project Management distinguishes between foreseeable uncertainty and unforeseeable uncertainty (unk unks).[xviii] In the presence of foreseeable uncertainty, managers know the sequence and nature of project activities and have clearly defined project objectives. Deviations

may occur in budgets, schedules, and achieved performance that require buffers (sometimes referred to as contingencies), or individual events (sometimes referred to as "risks") with high impact on the startup may be identified but not predicted with certainty, such as competitive responses, regulatory changes, or convincing a customer who is "on the fence". This requires project risk management methods with contingent action, or backup plans ("Plan B").[xix]

Unforeseeable uncertainty can't be identified during project planning; unk unks are unknowable in advance. There are no contingencies and no Plan B. Classic management methods do not allow for unforeseeable uncertainty.[xx] Classic project management corresponds to a *planning approach*: plan, execute, and manage (modest) deviations.

Unk unks require different management approaches. Two fundamental approaches have been identified.[xxi] The first is *parallel trials* of multiple approaches, observing what works and what doesn't (without necessarily having a full explanation why) and choosing the best approach *ex post*. Large VCs do this when they invest in several start-ups that pursue the same market opportunity – the VC needs only one of those start-ups to win. This approach is also possible, on a small scale, within start-ups, for example, by trying several configurations, user interfaces, or marketing messages to make sure one of them works successfully.[xxii] This approach works when the individual trials are not very expensive, and when the complexity of the business decision is not very high (and thus, each trial can be targeted to be of reasonably high performance).[xxiii]

The second approach to unk unks consists of *learning and adjusting as you go along*. It is characterized by a *mindset* of constantly questioning what is known and being flexible to fundamentally change course if necessary. Management changes from execution and deliverables to experimentation. This mindset must be supported by management methods: more flexible *targets*; *monitoring* focused on what has been learned rather than on what proportion of

the target has already been achieved; fluid and dynamic *coordination*; informal and lateral *information exchanges*; and *incentives* that limit the downside risk for the start-up employees so that they do not become overly cautious.[xxiv] Learning and adjusting has been advocated by innovation researchers for initiatives with high novelty; it works best when time pressure is not extremely high and when novelty combines with complexity.[xxv]

This discussion makes clear that the VC process in Figure 1 is essentially a planning process that uses standard practices to identify the tasks at the outset, to provide contingency alternatives, and to keep the same overall vision throughout. While allowing for contingency planning and flexibility in decision-making, this risk management approach implicitly assumes that events that cannot be foreseen cannot be managed. A central issue is not only about systems, but critically about the mindset that characterizes the parties involved. As a result, business plans have often been faked, information distorted, and relationships between entrepreneurs and VCs strained.

In summary, we have argued that the linear VC process depicted in Figure 1 is often not enough because it does not address unknown unknowns. But the million dollar question is, how can unk unks be diagnosed at the outset if they are, by definition, "unforeseeable"? Our answer is that in essence, managers must sincerely ask themselves, "What do I know, and where do I have fundamental knowledge gaps?" In every knowledge gap lurk potential unk unks.

In this article, we show how diligent and frank self-examination can enable startup management to recognize the areas of concern and focus their attention on these areas. We illustrate the diagnosis of unk unks and their subsequent flexible management using the crisis situation faced by one Silicon Valley startup company, Escend Technologies.

The Escend Story

Escend Technologies was founded in 1999 to enable semiconductor and electronic component manufacturers to connect and collaborate with their extended sales force, namely the manufacturers' representatives (reps) that sell their components to electronics OEMs.[xxvi] During the 1990s, component manufacturers, OEMs, distributors, and contract manufacturers in consumer electronics were becoming increasingly fragmented and disconnected due to outsourcing and globalization. There was a need to create a common customer record that tracked new products through the design, prototype, and manufacturing phases across the multiple companies involved (see Figure 2).
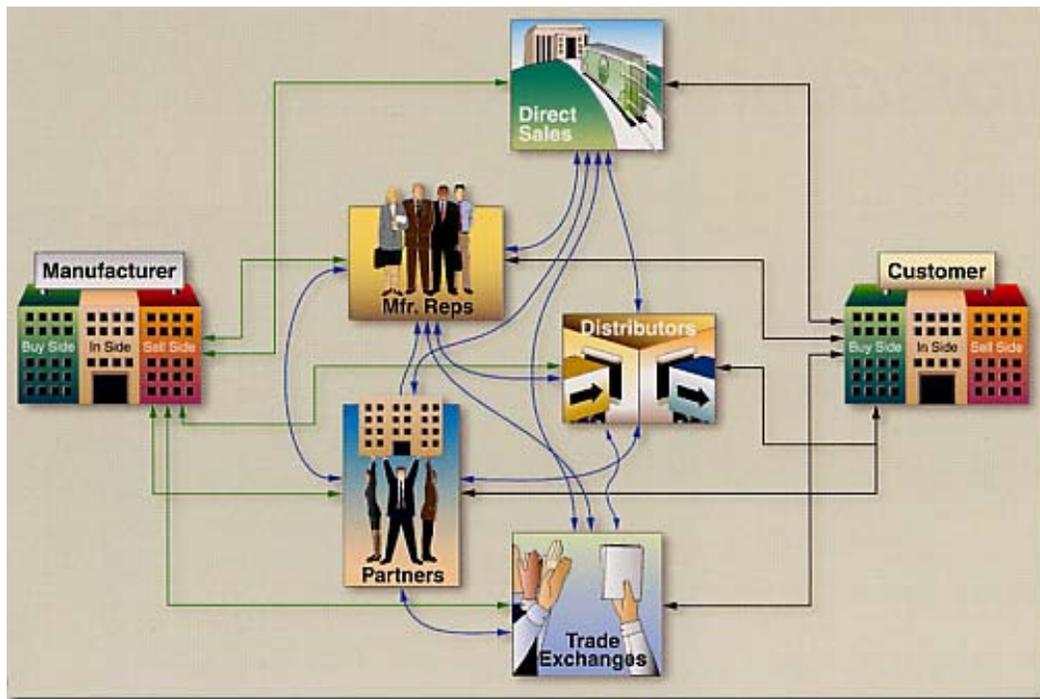

Figure 2: Escend Technologies' Initial View of the Extended Sales Organization

By mid 2003, Escend was floundering, having burned through $16 million in venture funding and asking for $6 million more to continue operations. Escend's customer base consisted of four

manufacturers and 20 rep firms. Sales had stagnated a year earlier, and the cash burn rate had grown to $650,000 per month. The CEO had no convincing plans for improvement, only vague promises. Each month, the company reported progress on the product and pipeline and maintained that it was only a matter of time before the company would be on its feet. When the initial reaction to the $6 million request was not positive, the Board thought that the message, not the business or the management team, was the reason and behaved as usual—packaging the company for another financing round (i.e., rewriting the executive summary and venture capital presentation) and making introductions.[xxvii]

Unable to raise outside money, the Board (comprised of the key investors) had to critically assess management's capability and the company's cash burn rate. It quickly became clear that for the company to survive, major changes had to be made. However, what changes were needed was not obvious. In July 2003, Elaine Bailey, General Partner at Novus Ventures (a Small Business Investment Corporation) stepped in as interim CEO to assess the company and recommend next steps.[xxviii]

Elaine had three weeks to decide whether or not to recommend that Novus participate in another round of financing for Escend. A "yes" decision would give Escend a chance to fix its problems, become successful, and provide Novus a positive return on its investment. A "no" decision would end Escend's existence when the remaining cash was spent, and Novus would lose its investment.

Diagnosing the Unforeseeable

To begin her evaluation, she interviewed each of the 30 employees and the four existing customers. Not satisfied with what she had learned, she then examined the companies' expense

reports and telephone records. She soon realized what a mess she had inherited. The CEO had invited buddies into the management team who drew large salaries but seemed to have no interest in growing the business. The application (the product) had significant usability and reporting deficits (for example, in specifying custom reports); the architecture made the application extremely rigid, causing even small changes to generate up to 200 hours of QA;[xxix] and the Oregon-based design team was naïve and uncooperative. The phone logs revealed that the sales people spent little time talking to customers and prospects and the $15 million pipeline was grossly inflated (the actual figure was $256,000). Additionally, morale had hit rock-bottom.

Elaine sought the advice of her co-authors, two academics with whom she regularly exchanged ideas. "What should I do? Some of the problems and urgent moves are crystal clear. But I have no idea where the real fundamental problem lies. Perhaps it's just execution, but perhaps it's something to do with the industry. It's all opaque, like trying to see through a rock."

Her co-authors recommended to not yet even ask the question of what to do, as the situation was too uncertain and unstructured. They recommended to first ask, "What do I know, what do I think I know, and where am I completely ignorant and unsure?" In other words, they recommended questioning all assumptions and identifying areas of the "mess" where she was on firm ground, versus areas where she had major knowledge gaps.

This prompted Elaine to examine each part of the business and identify open issues. Some, such as reducing the burn rate and the headcount, were obvious for an experienced VC partner, and the actions to address them very clear. However, she began to realize that the fundamental concern was not within the company but was a question of, "Is this a viable business?" Writing down the problem areas resulted, after some consultation and iteration, in the diagnosis summarized in Figure 3.

Problem area 10 wasn't a problem at all; rather, Elaine found out that the customer support team was one of the key assets of the company. Problem areas 4 through 9 were relatively straight forward – they contained risks, but it was quite clear what had to be done. Problem area 3 was more difficult: it was not entirely clear how to plug the software product's functionality gaps. However, a hypothesis was already on the table that would temporarily meet the market requirements for speed and flexibility while the application was being worked on.

Problem Area	Situation	Uncertainty
1. Customer need (external)	Would customers buy Escend's products? Why? What is the customers' pain?	High potential for unk unks
2. Industry readiness (external)	No collaboration SW play had succeeded; minimal competition, slow adoption.	High potential for unk unks
3. Product functionality (external)	Holes in functionality, too rigid, based on once-per-day batch mode when customers wanted real-time product	Foreseeable, possible unk unk
4. Cash burn rate (internal)	$650,000 per month	Variation
5. Executive management team (internal)	Complacent and dishonest, risk of lawsuit	Foreseeable
6. Sales team (internal)	Not sufficiently active; inflating results	Foreseeable
7. Head count (internal)	30 employees (70 at the high point, including 50 software developers), lack of performance	Foreseeable
8. Geographically dispersed operations (internal)	Sales offices in Alaska, California, Massachusetts, New Hampshire, and Texas; development team in Maine, Nevada, Pennsylvania, and Oregon	Foreseeable
9. Development team (external & internal)	Either outmoded or inexperienced, uncooperative	Foreseeable
10. Support team (external & internal)	Strength of the company	Not a problem

Figure 3: Problem areas with uncertainty profile

The fundamental knowledge gaps lay in areas 1 and 2. The technology enabling Escend (XML, Rosettanet) had not existed before 2000. XML made collaboration possible from one data base to another; and Escend aimed at connecting the global demand creation activities with supply

chain management. While a few small competitors offered pieces of the solution, it was still very early. Analysts had not yet defined the problems that existed in the demand side of the semiconductor and electronics manufacturing industry nor were they following the segment—which was both good and bad. Good, because if the market existed it was still early enough to be a significant player. Bad, because customer needs were undefined, and the willingness of the channel players to collaborate on opportunities via common software was uncertain. Thus, the required functionality was unknown. Customers could articulate their problems but not their needs, and different players would name mutually incompatible benefits because no one understood where the product would ultimately create the most value.[xxx]

February, 2000 Escend builds B2B Communities that connect manufacturers with their outsourced sales channels and distributors through its Sales Information Network.
May 2001 Escend provides the only System that overcomes the competitive disadvantages of a many-to-many business environment by: speeding communication, normalizing data interchange, and connecting an entire industry.
September 2001 Escend provides the only online CRM application that includes the infrastructure and data exchange translator required for independent companies to collaborate on any aspect of the order lifecycle.

Figure 4: The evolution of Escend's business model before 2003

In response to inconsistent and changing customer need statements, Escend's business model had already changed several times. The founding team in 1999 had been aware that Escend was attempting to exploit a complex industry opportunity, but conceptualized the opportunity as *collaboration* among industry players who would want to be part of Escend's B2B community. This conceptualization had been evolving — Figure 4 displays three successive descriptions of Escend by previous CEOs, an illustration not of sloppy market research but of the fundamentally unmapped terrain that Escend faced. The implication was that the turnaround effort needed to resolve these unk unks; otherwise, all other phases of the turnaround would be futile.

Descending into Escend's Unknown Unknowns

Escend faced many challenges; however, the unk unk problem areas (1 through 3) required a different mindset from the others. Elaine had to assess the viability of the business opportunity. Her first task was to determine whether the company was funded and managed correctly: could the business provide an acceptable venture capital return? This involved an open-ended search with an unknown result, requiring "switching gears" as compared to the execution mode that characterized the other problems (and most of what VCs usually do).[xxxi]

In parallel to the planning subprojects, the knowledge gap around customer needs and the readiness of the industry for a player like Escend became a *learning project*. Elaine reserved part of her and the Escend team's time to reflect and to gather information from multiple parties about that problem area, not knowing what to expect. She remained open to finding nothing of significance in this inquiry or something that might prompt her to fundamentally re-think the business model—or even to shut Escend down.

During her first three weeks as CEO, Elaine traveled to interview enterprise firms, end customers, analysts, consultants, VCs who did not invest (not believing in either the management or the business model), managers of different collaboration start-up companies, and academics. She searched and probed for reasons why collaboration solutions had not succeeded, the needs of the enterprise customers, and the problems that the complex industry structure really posed.

In face-to-face meetings, people opened up and provided useful non-verbal cues—information that could never be obtained by only attending Board of Directors meetings. Slowly, information emerged (see the Box "Tuning Your Ear to the Unk Unks"), but the information kept changing as the industry evolved.

Box: Tuning Your Ear to the Unk Unks

Escend was creating a large and untapped market "where no one had gone before". Unk unks had to be lurking in the unmapped terrain. The goal had to be to turn unk unks into known unknowns (foreseeable uncertainty). This cannot be done in a classical straightforward "analysis"; it is a process of discovery over time. The table below shows some of the questions that Elaine and her team used to investigate assumptions and to jump-start the discovery process.

The table has a column for Customer Assumptions that Escend was relying on. Escend's Value Proposition was initially only a "guess". Elaine and the team initiated the discovery process that eventually led to the development of the Probing Questions. Two example assumptions, and a few probing questions, are listed in the table. The full list covered a large white board, which they maintained in a meeting room. The management team met daily at first and then weekly over a period of 1-2 months to nail down the unk unks. They reserved part of their time to reflect and to gather information from multiple parties about problem areas, not knowing what to expect. Escend's Board remained open to finding nothing of significance in this inquiry or something that might prompt them to fundamentally re-think the business model—or even to shut Escend down.

Customer Assumptions	Escend's Value Proposition for its Customer (Component Mfgr.)	Probing Questions
Component is designed into OEM products; it is not a commodity	Convert more design-wins to orders. *(Customer need statement: "I'm losing orders from design win to production.*	Once you have a design win, what's the likelihood that you'll get the order?
		How much do you lose (leave on the table) for design wins that don't materialize into orders?
		What influence does your channel play in securing the order once it is designed in?
		What impact do you have in moving it from design win to order? (scale 1-10; least -most)
		What needs to happen to improve your design win to order conversion rate? (… and so on)
Sales is unable to forecast demand	Provides global visibility into all customer activity *(Customer need statement: "My reps are talking to my customers every day, but I don't know what they are saying"*	On a scale of 1-10, how much visibility do you have into your customer base?
		What types of information is it important to know about your customer?
		What type of service (questions) are your customers requiring/demanding?
		What information is the customer requesting that is out of the control of the sales department?

In October 2003, Elaine convened a "No Good News" Board meeting. Letting the unk unks assume form takes time. Through the systematic asking of questions and seeking answers, the unk unks had begun to take shape and she had come to believe that the initial value proposition of the business was not in alignment with the market. She told the Board that the original business model was not viable but that she thought they had an even better alternative. She committed to return in 30 days with a new business plan based on the team's new findings. The table with assumptions and questions was erased and rewritten again and again as new information was uncovered. As Elaine put it, "we kept putting our ear to the ground, and we heard nothing. Slowly, we began to hear some faint hoof beats, then they became louder and louder. By November, we knew that we had it – we knew how to make the company a big success."

After an intense three-week probing of the problem areas where unk unks threatened, Elaine made a leap of faith to conclude that: (a) demand for Escend's product existed, (b) the potential market was large enough to have the potential of a sufficient return on investment, (c) the competitors were far enough behind that the opportunity had not yet been tapped, and (d) Escend represented one of the last remaining large enterprise software "plays" for VC investors. Elaine recommended that Novus provide additional funds, and in August, Escend closed a $7 million round from Novus and NIF Ventures, an affiliate of Daiwa Securities.[xxxii]

Tackling the Planning Subprojects with Foreseeable Uncertainty

Managing foreseeable risks represents "standard fare" for a competent operational VC who knows how to plan and manage resources.[xxxiii] In addition to being foreseeable, these risks also have consequences that are primarily internal to the firm, and the typical VC risk management process described in Figure 1 is sufficient. Elaine executed this part of the turnaround working "part time", delegating and monitoring.

Her first task was to "right size" the company. Elaine moved immediately to isolate and then remove the top management team, after gathering evidence of negligence (avoiding severance payments).[xxxiv] On the product development front, she side-lined the Oregon team and tasked them with maintaining the existing application. She then threw her experience and forcefulness behind solving the *variation and foreseeable risk* problem areas (4 through 9). For each, she set targets, time lines, and progress metrics, following time-proven project management principles. Fixing the burn rate was a methodical, "hunt-search-and-kill" process that resulted in slashing all budgets, consolidating operations/eliminating locations, and letting go 25 of the 30 non-performing employees, securing signed releases in exchange for two weeks severance pay.

She then hired two senior software architects and a database architect to design a solution to the product problems. After several analysis and brainstorming sessions, a powerful and elegant solution emerged: Escend would develop a web shell around the functional kernel, which at facilitated ease of use and allowed adding functionality (such as real-time customized reports) without having to change the base code. In September 2003, the shell could be tested with the first enterprise firms, and they liked it. Escend had solved another hurdle—customer retention.

First Results and Further Adjustments

In developing the business over the 12 months, two large business changes emerged, both of which changed Escend's strategy and neither of which could have been anticipated. First, Elaine learned how fast the electronic components market was becoming global. The "technical vertical" (industry speak for the end user industry application) had to be a complex product that was global in nature.[xxxv] This implied a global platform and design win tracking for component manufacturers in bidding for getting their components into end products. A global platform, another product redesign, would consume precious funds and resources. Thinking that potential competitors also would have to redesign their product, which would put Escend in the lead, Elaine decided to bite the bullet. For example, the redesign incorporated multiple languages and currencies, and multiple access points per customer, into the product. This also meant that Escend's target customers and growth strategy changed.

Second, any firm in the industry network (Figure 2) had limited visibility of the entire network. Component manufacturers, through their rep firms, could not track either sales or the process and, thus, could not ensure full and timely payment. OEM buyers cared about the design win but not about tracking it because they wanted to buy at the lowest possible price and had to

give extra profit margin to the contract manufacturers and design win firms. OEM buyers often gave the job to *different* manufacturers who offered lower costs *after the design was "won."* As a result, manufacturers were changing the way they sold products, shifting away from reps toward relying on distributors and in effect taking back some of the activities that reps were offering. Therefore, Escend would have to build distribution functionality into the product. To this end, Escend produced, in October 2003, a prototype that offered shipping and debiting, samples management, and pricing and quoting functionality. Coding would take another 12 months; the plan was to go live in January 2005.

In late October 2003, Elaine's search for information had led her to another start-up (run by a competitor VC) that had a collaboration software product covering the demand cycle of the industry. The two had the potential of forming a perfect match if their products could be made to work together. Elaine was confident that the two software products could be made interoperable (this was a problem area with foreseeable uncertainty). But the merger fell through because the investors of the other startup got some of their money back and wanted out.

The flexible way of proceeding, including repeated unplanned product changes and three major strategy changes (counting the aborted merger), was very stressful, and possible only because Elaine, combining the roles of Chairman, CEO, and partner of one of the major investors, was leading it. However, while it was Elaine, who had authority, access to the investors, and prior operational experience, it was the new Escend management team that implemented the process. Elaine assembled a new team in the late summer of 2003, but had to make further changes, for example, replacing the VP of sales again in June 2004. Over time, the team became fully engaged in the learning process. "Unk unks" is now a well-known term in the Escend offices, reflecting the new mindset Elaine has instilled in the company.

Escend's business model slowly crystallized. Figure 5 is taken from a white paper that Escend published in the Spring of 2004 and has a clarity that stands in contrast to the complex Figure 2. Tracing the flow of the design-win process is easy in Figure 5, and the demand cycle and demand fulfillment (i.e., supply) cycle is also clearly delineated. Unk unks no longer dominate; the industry structure now looks understandable, and the effect of actions taken can be traced. Foreseen uncertainty has replaced unforeseen uncertainty.
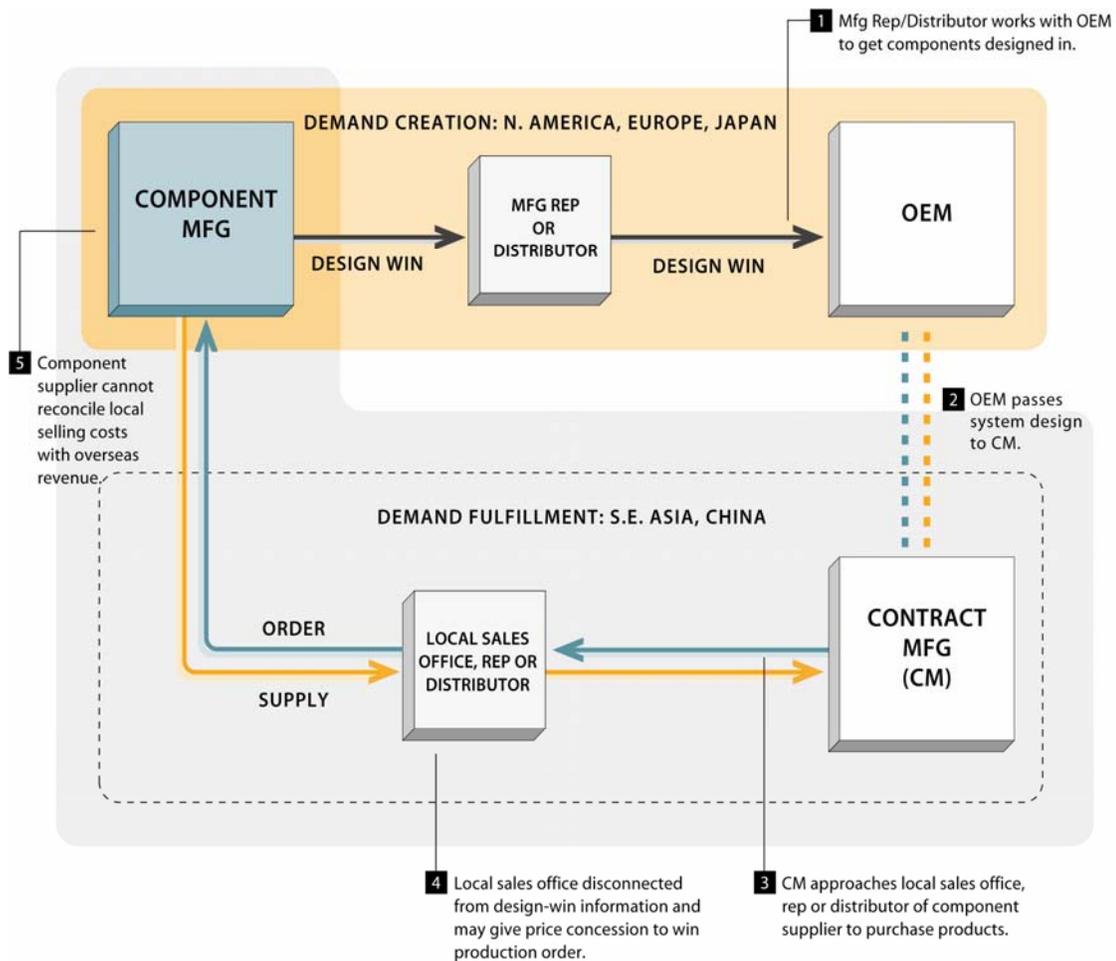

Figure 5: Description of the industry network, Escend Spring 2004

In the Fall of 2004, it seemed that Escend had turned the corner and was becoming an excellent bet for the investors. At the end of October, the company obtained another $3 million from the

existing investors, Novus and NIF Ventures. Daiwa Securities now intended to translate the product into Japanese and to go into Japan in December 2004 having targeted 12 Japanese companies. In November, the plan foresaw cash flow breakeven occurring in Q2 2005. A NEW investor had signed a letter of agreement (term sheet) to invest another $1.5 million in Escend. And Elaine, signaling her confidence, was getting ready to replace herself as CEO.

Summary and Lessons

We have argued that the widely used VC management process for startup companies is a planning-oriented approach that is appropriate for projects with moderate uncertainty, but not for novel startups with new markets or technologies. Novel startups may be subject to unforeseeable uncertainty, or unk unks, which require a different management approach.

But how can we identify unk unks at the outset, in order to choose the right management approach, although they are, by definition, unforeseeable? In essence, it requires asking: *what do I know and what do I not know? Where are the major knowledge gaps?* Every knowledge gap poses the potential of unk unks. Asking for knowledge gaps can be made systematic in the *diagnosis process* outlined in Figure 6.

First, identify the problem structure, as Elaine Bailey did when she identified the mess she had inherited at Escend. Then, break the overall problem ("how do we generate enough sales?") into pieces, for example, software functionality, management, sales force problems, etc. For each piece, ask the question of what you know; in other words, identify knowledge gaps and, thus, the potential for unk unks to emerge. Finally, manage the pieces in parallel, using different management approaches according to the uncertainty category: flexible iteration, including experimentation and learning, for the pieces that are threatened by unk unks, and more structured

approaches for the pieces with foreseeable uncertainty. As the startup progresses toward the next milestone, or IPO, new information emerges, and the problem pieces and approaches must be updated and modified. As the box "Tuning Your Ear to the Unk Unks" demonstrates, this is a highly iterative and gradual process, which tracks the evolution of the industry.

Integrate and learn: re-define, iterate

Learn problem structure	Break problem into pieces	Isolate pieces by uncertainty	Variation
			Risk
			Unforeseen uncertainty

Learning Milestones:

Manage in parallel

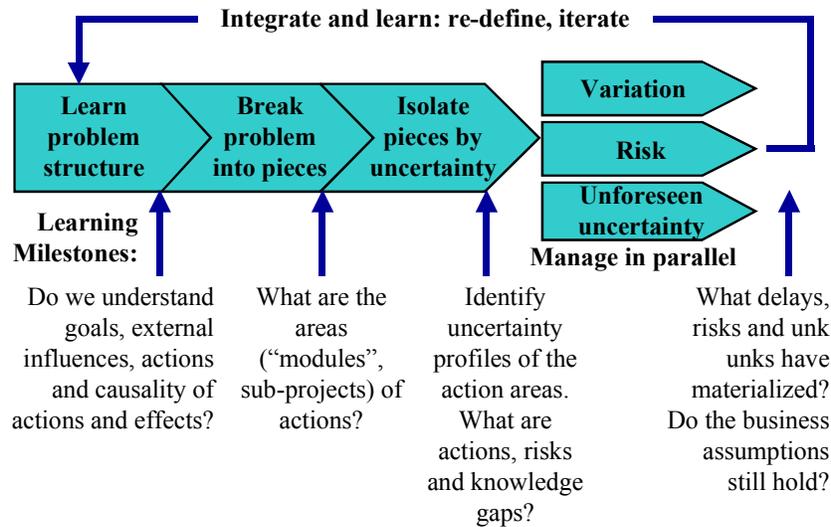| Do we understand goals, external influences, actions and causality of actions and effects?	What are the areas ("modules", sub-projects) of actions?	Identify uncertainty profiles of the action areas. What are actions, risks and knowledge gaps?	What delays, risks and unk unks have materialized? Do the business assumptions still hold?

Figure 6: A learning and iteration process

One way of picturing the differing types of uncertainty is through *uncertainty profiles*. They represent graphically where management sees the biggest amount of uncertainty, whether in schedule and budget variations (deviations from the plan), in foreseeable uncertainty or risks that can be identified at the outset, or in the potential for unk unks. The uncertainty profiles can be drawn for each major problem area of the startup company, or for the company as a whole, representing how uncertainty evolves over the stages of development (Figure 7).

While planning is a critical foundation in all stages,[xxxvi] chaos reins during the seed stage – a business idea is not yet verified, so the start-up must be ready to completely abandon previous

assumptions and re-define the business model. The uncertainty profile shifts toward foreseen uncertainties during the early and expansion stages, as the business model is tested, and fewer unexpected things happen. Still, an emphasis on learning (i.e., changes in goals and approaches, and/or parallel trials) will continue to be necessary.[xxxvii] For the later stage, standard project management methods are sufficient.
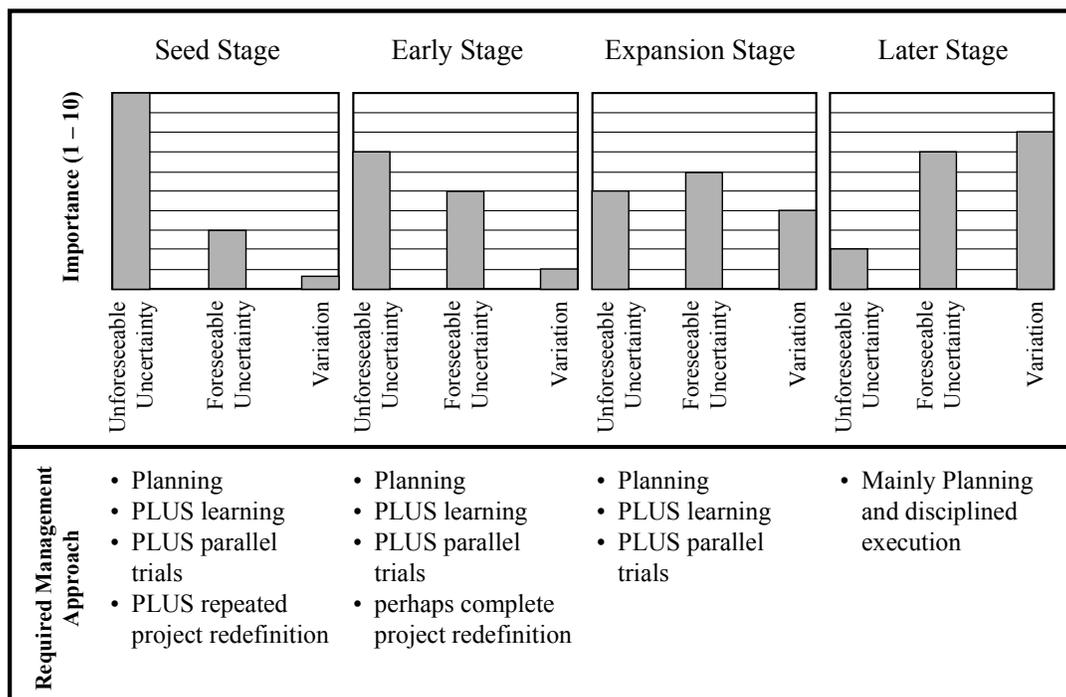

Figure 7: Uncertainty Profiles and Management Infrastructure by Venture Stage

We conclude by emphasizing that managing different parts of the company with different methods, and applying a flexible approach that allows u-turns and fundamental changes, as Elaine Bailey did at Escend, cannot be achieved by applying a "method". Rather, it requires a mindset of openness and a willingness to suffer the discomfort of not knowing where one is going. Such sophisticated and flexible oversight does not come for free. The investors and VCs can no longer just say, "Deliver, otherwise I terminate you." Novus Ventures, the VC, invested a

large amount of resources, by making one of its partners CEO, in order to become stay involved. Elaine Bailey, in turn, invested a large amount of Escend's resources in the form of her and her team's management time, in budgets for extensive travel and for several external investigative reports, and social capital by visiting customers and "picking their brains".

The Escend example demonstrates the limitations of the traditional VC investment process (Figure 1), a process that has remained roughly unchanged from the 1980s to 2004 (see our cited sources in endnotes *vii, viii, xiii,* and *xv*). Under the linear process, Escend would have continued to fester (with a weak or undisciplined VC) or have died (due to lack of progress). Since combining the VC and the CEO in one person (as in Elaine Bailey) is not usually possible, collaboration between start-up management and the VC holds the key to successfully identifying knowledge gaps and responding to emerging unk unks. The two parties can only successfully collaborate if they proceed under the assumption that the other side will be honest and fair. This includes honestly sharing the upside as well as openly working through the pain of a failure. Remaining honest and fair in a failure is, of course, more difficult. For a VC, building a track record of such behavior can be an important asset, not only in winning business but also in managing through a crisis: believing the VC is fair, the management team is likely to be willing to focus more on problem solving than on covering their own backs.

In baseball terminology, VCs tend to "swing for the fences" because they believe that the home runs will cover the strike outs. We are saying that by changing the rigid venture process, VCs would not have as many strike outs. A VC who masters identifying unk unks and flexibly working through them will still suffer failures (that's the nature of the beast). But such a VC will be able to extract more value from his or her investments in the long run. You can't control fate, but you can load the dice.

Appendix: Research Methodology

This paper is based on theoretical work on decision making in presence of unforeseeable uncertainty (what we call unk unks in this paper), see references 1 and 2 below, and on a previous application of that work to how highly novel projects should be managed (reference 3). We have also examined the theory with several case studies (references 4-6 below).

1. Pich, M. T., C. H. Loch, C. H., and A. De Meyer. 2002. On Uncertainty, Ambiguity and Complexity in Project Management. *Management Science* 48 (8), 1008 - 1023.
2. Sommer, S. C., C. H. Loch. 2004. Selectionism and Learning in Projects With Complexity and Unforeseeable Uncertainty. *Management Science* 50 (10), 1334 - 1347.
3. De Meyer, A., C. H. Loch and M. T. Pich. 2002. Managing Uncertainty. *Sloan Management Review* 43 (2), Winter, 60 - 67.
4. Loch, C. H., and C. Terwiesch. 2003. The Circored Project. INSEAD Case Study.
5. Loch, C. H., and S. Sommer. 2003. Vol de Nuit: the Dream of the Flying Car. INSEAD Case Study.
6. Loch, C. H., and D. Clementz. 2004. ChevronTexaco: the NetReady Project. INSEAD Case Study.

Unk unks, or unforeseeable uncertainty, are important whenever companies attempt to tackle new technologies or new markets – standard methods of risk management are then insufficient because they pretend that by "doing one's homework", one can anticipate, and thus manage, all important events that might occur. When facing unk unks, one must change the way of managing a project.

The current paper makes two additional contributions. First, it addresses a critical gap in the previous work, namely, how the presence of unk unks can be recognized at the outset, although the unk unks themselves are unforeseeable by definition. This is always a question that managers ask when we discuss flexible iterative project management with them. The current paper offers a real case, in which we developed a way of asking questions to identify areas where unk unks may loom, and then dividing the project into "chunks", which are managed differently, depending on where the team believes it is vulnerable.

Second, this paper offers implications of flexible unk unk management to an industry that is sometimes believed to be very good in working with uncertainty, but is less so at closer inspection. This appraisal was shared with us not only by the VCs involved, but also by the leadership of one of the world's largest venture capitalists. The method outlined in this paper can help startup companies and VCs to better work together. Elaine Bailey, one of the co-authors, is partner in a Silicon Valley VC firm and reports that this project has changed the way she manages her portfolio companies. Thus, the application of the concepts in this paper already has produced impact, and has the potential of continuing to do so.

[i] See, for example, Wideman, R. M. 1992. *Project & Program Risk Management*. Newton Square, PA: Project Management Institute. But the term is, in fact, "folklore": it has been widely used in aerospace, electrical machinery and nuclear power project management for decades.

[ii] In a study of U.S. venture-backed information technology merger, acquisition, and IPO "exits" from 1992 through June 2004 by Ernst & Young, IPOs were 45.5% of the exits and accounted for 60.4% of value. In 2004, IPOs accounted for only 4.8% of the exits but represented 32% of deal value. (J. de Young and B. Pearce. 2004. The Case for Capital Efficiency, *Battery Ventures Newsletter,* October). The authors conclude that "at some point another dollar or another day does not guarantee you any more value, and that the best companies generally achieve their milestones on time and with the minimum required investment. But the data also reflect that significant amounts of money and time have been and continue to be invested in companies that ultimately return very little—if anything—on dollars invested, particularly those companies that have exited by way of M&A transactions over the last few years." Exiting an investment is how venture investors gain liquidity, and if only the better companies can achieve liquidity events, then the situation is even more dismal for the venture-backed companies that cannot be merged acquired, or taken public.

[iii] Over the last decade, Venture Capitalists have shifted investments from less-developed firms (startup/seed and early stages) to more-developed firms (expansion and later stage). The percent of venture capital investment in the start-up/seed stage decreased from 16.1% in 1995 to 6.1% in 1999 to 1.6% in the third quarter of 2004; the share of later stage investments increased from about 15.4% in 1995 and 1999 to 29.6% in the third quarter of 2004. Over the same period, VC investment fell by 2.5% in the early stage and rose by 3.5% in the expansion stage. Source: PricewaterhouseCoopers MoneyTree™ Survey.

[iv] See Hamel, G., Prahalad, C.K. 1994. *Competing for the Future.* Cambridge: HBS Press. Competition in these environments not only features unstructured arenas and unknown winners (as we mention in the preceding paragraph), but the rules of engagement also typically have yet to be written.

[v] De Meyer, A., Loch, C. H., and M. T. Pich. 2002. From Variation to Chaos. *Sloan Management Review* Winter, 60-67; Mullins, J. W. and D. J. Sutherland. New product development in rapidly changing markets. *Journal of Product Innovation Management* 15, 224-236. See also endnotes *xiv* and *xxv*.

[vi] In effect, VCs are saying that if the "pie" doesn't grow, they will take a bigger slice. For example, see Barret, J. T. and S. M. Muniz. 2004. Managing Risk Through the Use of Milestone-Based Conversion Rate Adjustments, *Venture Capital Journal*, May, 65-67. As part of an increased focus on risk management, many VCs now use milestones, such as success or failure in finishing a prototype, obtaining customer orders, or completing a clinical trial, to trigger adjustments in the rate at which VCs' preferred stock is converted into common stock. Failure in meeting a milestone provides the VC investors with a larger percent of the company's equity. VCs use milestone-based investing to facilitate closing a round of financing in advance of a milestone and to motivate management to achieve the milestones and avoid further dilution in its stake in the company. Also, in milestone-based investing, only a portion of VC funds are invested at the beginning of a round. See A. Weintrab. 2004. Biotech's Tough New Taskmasters, *Business Week* (June 3). Says Chris Ehrlich, a partner at InterWest Partners, "We have a major focus now on milestone-based investing … You've got to sing for your supper." InterWest, with $1.6 B of capital under management, is participating in a $45 million biotech funding in which only about 25% is provided up front.

[vii] See, e.g., I.C. MacMillan, R. Siegel, and P.N.S. Narashimha. 1985. "Criteria Used by Venture Capitalists to Evaluate New Venture Proposals, *Journal of Business Venturing* 1, 119-128.

[viii] B. Elango, V.H. Fried, R. D. Hisrich, and A. Polonchek. 1995. "How Venture Capital Firms Differ," *Journal of Business Venturing* 10, 157-179.

[ix] See P. Gompers and J. Lerner. 1999. An Analysis of Compensation in the U.S. Venture Capital Partnership, *Journal of Financial Economics* 36, 3-44.

[x] For example, P. Gompers. 1995. Optimal Investment, Monitoring, and the Staging of Venture Capital, *Journal of Finance* 50, 1561-1490. Since investors are concerned with corporate control and agency problems when knowledge is incomplete and information is asymmetric (favoring the entrepreneur), VCs monitor the firm and stage investment to keep the entrepreneur on a "tight leash" to reduce potential losses from bad decisions. Gompers finds that total venture financing and the number of financing rounds is higher for successful firms. 22.5% of the sample went public, 23.8% were merged or acquired, and 15.6% went bankrupt.

[xi] See J. Lerner. 1995. Venture Capitals and the Oversight of Private Firms, *Journal of Finance* 50, 301-318. Lerner finds that the average number of Board of Director members increases with each round of financing, especially when there is turnover in the firm's CEO.

xii Such conditions are negotiated at each round of financing and are expressed in the "term sheet." Mergers and acquisitions are typically defined as liquidation events, and multiple liquidation preferences allow the venture capitalists to receive more than their original investment before common stockholders share in the distributions. Fenwick & West LLP, Palo Alto, California, reports that for 81 venture capital investments in the San Francisco Bay Area in the first quarter of 2003, 74% contained liquidation preferences between 1 and 2 times; 16%, between 2 and 3 times; and 10.0%, greater than 3 times. See also endnote *vi*.

xiii VC firms often provide advice and resources to prospective entrepreneurs that stress the regularity of the process detailed in Figure 1. For example, Alan Salzman of Vantage Point Venture Partners ($2.8B of capital under management) along with John Doerr of Kleiner Perkins Caufield and Byers (founded 1972; possibly the best known U.S. VC firm) discuss developing a company financing strategy, the business plan, dealing with VCs, and term sheets in great detail (http://www.vpvp.com/submit/guidelines.asp). Woodside Funds (founded 1983) offers advice on building a product roadmap, grabbing a VC's attention, popular misconceptions about VCs, and what to do with great ideas, among other issues (http://www.woodsidefund.com/ent/res.html). Onset Ventures ($500M under management) offers "Raising Money: Some Tips on Working With Venture Capitalists" by General Partner Darlene Mann and "Everything You Learned About Managing A Company You Learned in Math Class" by Venture Coach Shomit Ghosh (http://www.onset.com/resources/index.html).

xiv See O'Connor, G. C. 1998. Market learning and radical innovation. *Journal of Product Innovation Management* 15, 151-166; Norling, P. M. and R. J. Statz. 1998. How discontinuous innovation really happens. *Research Technology Management*, May-June, 41-44; Lynn, G. S., M. Mazzuca, J. G. Morone, and A. S. Paulson. 1998. Learning is the critical success factor in developing truly new products. *Research Technology Management*, May-June, 45-51. See also the references in endnotes *v* and *xxv*.

xv See W.A. Sahlman. 1990. "The Structure and Governance of Venture-Capital Organizations, *Journal of Financial Economics* 27, 473-521, and "Battery Ventures Returns to Its Ways of Old," VentureOne/The Private Equity Analyst (www.AlternativeInvestorInfo.com), 2002. Sahlman reports that of the 383 companies studied between 1969 and 1985, 34.4% experienced a partial or total loss of invested capital, 49.8% returned between 0 and 5x, and 9.8% returned between 5 and 10x.

xvi However, it is not clear that VCs are good at introspecting about their own decision process. For example, see A. L. Zacharakis and G. D. Meyer, 1998, A Lack of Insight: Do Venture Capitalists Really Understand Their Own Decision Process? *Journal of Business Venturing* 13, 57-76. While most decision makers would like to have all relevant information available to them, VCs performed worse as more information was provided in this controlled experiment, suggesting that VCs lacked a strong understanding of how they made decisions. The authors conclude that "VCs are very consistent in their decision process even though they do not necessarily understand how they make their decisions." The implication is that even if their decision-making process is not optimal, VCs will stick to it. The purpose of our paper is to offer another way to manage the decision-making process.

xvii See the PMI's Standards Committee's Guide to the Project Management Body of Knowledge, Upper Darby, PA: Project Management Institute 1996.

xviii Pich, M.T., Loch, C.H., De Meyer, A. 2002. On Uncertainty, Ambiguity and Complexity in Project Management. *Management Science* 48, 1008 – 1023, and references therein. See also Miller, R., Lessard, D.R. 2000. *The Strategic Management of Large Engineering Projects*. Boston: MIT, p. 87.

xix Chapman, C., and S. Ward. 1997. *Project Risk Management: Processes, Techniques and Insights*. Chichester: Wiley; or Smith, P. G., and Merritt, G. M. 2002. *Proactive Risk Management*. NY: Productivity Press.

xx Williams, T. M., 1999. The need for new paradigms for complex projects. *International Journal of Project Management* 17 (5), 269 – 273.

xxi For example, Leonard Barton, D. 1995. *Wellsprings of Knowledge.* Cambridge, Mass: HBS Press. Pich *et al.* 2002 (*ibid*) show that these are the *only* two fundamental approaches to unk unks.

xxii Parallel trials are widely used in innovation, see, for example, Beinhocker, E.D. 1999. Robust Adaptive Strategies. *Sloan Management Review*, Spring, 95-106; McGrath, R.G. 2001. Exploratory Learning, Innovative Capacity, and Managerial Oversight. *Academy of Management Journal* 44(1), 118-131; Sobek II, D.K., Ward, A.C., Liker, J.K. 1999. Toyota's Principles of Set-Based Concurrent Engineering. *Sloan Management Review* 40, 67-83.

xxiii Sommer, S. C., C. H. Loch. 2004. Selectionism and Learning in Projects With Complexity and Unforeseeable Uncertainty. *Management Science* 50 (10), 1334 - 1347.

xxiv One might argue that it is precisely the dependence on success and the threat of failure that drive start-ups to do their best. But that may be misleading -- in the 1990s, failure of a start-up was not a daunting penalty as the entrepreneur moved on to the next one, and the experience was seen even as a plus. Today, as failure can really

mean a destroyed career, we see very cautious behavior indeed, both by entrepreneurs and VCs, to the extent that opportunities remain untapped and the current stable of portfolio companies receives all of the attention.

xxv Learning and adjusting is also widely found in radical innovation. See, for example, Chew, W. B., Leonard-Barton, D., and R. E. Bohn. 1991. Beating Murphy's Law. *Sloan Management Review*, Spring, 5–16; Lynn, G. S., Morone, J. G., and A. S. Paulson. 1996. Marketing and Discontinuous Innovation: The Probe and Learn Process. *California Management Review* 38(3), 8-37; Reinertsen, D. G. 1997. *Managing the Design Factory*. NY: The Free Press; Thomke, S. H., and D. Reinertsen. 1998. Agile Product Development. *California Management Review* 41 (1), 8 – 30; De Meyer *et al.* 2002 (*ibid*). The comparison of parallel trials and learning when novelty combines with complexity can be found in Sommer and Loch 2004 (*ibid*).

xxvi OEM stands for "Original Equipment Manufacturer". OEMs sell products to the end consumer. OEMs often perform marketing and system design, but outsource component design and manufacturing.

xxvii The investors, buying into top management's view, thought maybe that the Escend story was just not being told well and they, lead by Elaine Bailey, rewrote the executive summary, generated a "VC presentation," and taught the CEO how give the presentation. The result was zero interest by potential new VC investors.

xxviii Elaine's experience running her own rep firm in the 1980s made her the logical choice and meant that she knew the "right" questions to ask—or that she would discover what they were.

xxix QA stands for Quality Assurance; this refers to changes "cascading" to other parts of the code because of many complex interfaces.

xxx It is well documented that technology that enable new uses in the market cause unforeseeable effects, see, e.g., O'Connor, G. C. and R. Veryzer. 2001. The nature of market visioning for technology based radical innovation. *Journal of Product Innovation Management* 18, 231-246. See also Leonard Barton 1995 (*ibid*).

xxxi The open-end process worked because Elaine was the person in charge. When she became CEO, Escend's morale was so low that no amount of cajoling was effective. After the layoffs, Elaine got the 5 remaining employees to make decisions by consensus (via daily and weekly meetings), which created a cohesive team that accepted both responsibility and accountability.

xxxii Elaine reports that she almost threw in the towel in the run-up to the recommendation. The situation was too confusing and opaque. The discussion of unk unks and flexible adjustment to what lay ahead gave her the mindset of possibilities, and the will to continue.

xxxiii During the dot.com boom days, a MBA degree and Wall Street experience was often enough to secure a VC position. An *operational* VC has had hands-on, day-to-day experience running a company (or companies).

xxxiv Elaine kept the Business Development VP, two customer service managers who were holding the operations together, the HR manager who helped with the downsizing, and the CFO. During the interviews, every employee told the same story: each was not at fault but didn't know any solutions, and the market, economic times, or "9/11" was to blame. Each person's anger showed through, and each "broke ranks," revealing to Elaine their information about product problems and top management integrity issues.

xxxv This hypothesis was confirmed in August 2004 by a report from industry experts that Escend commissioned for $40,000. Elaine concluded that "experts are good at messaging what you already know, but not at what you don't know." So she convened the Board together to brainstorm about unk unks for other vertical markets.

xxxvi Without planning, a team has no baseline from which to judge deviations; this is strongly demonstrated on major engineering projects in Miller, R., Lessard, D.R. 2000 (*ibid*).

xxxvii There are cost tradeoffs: learning may cause obsolescence and put customers at risk, while parallel trials may be simply very expensive. In addition, learning becomes more attractive the more complex the business development is (the more interacting influence variables must be considered), see Sommer, S., Loch, C. H. 2004. Learning and Selectionism in Projects With Complexity and Unforeseeable Uncertainty. Forthcoming, *Management Science*.