

**MISTAKES INTO ASSETS: THOUGHTS ON PRODUCT INNOVATION**  
**Discussion Document\***  
July 2006

Dr. Raghu Garud, Research Director and Dr. Anthony Warren, Director,  
The Farrell Center for Corporate Innovation and Entrepreneurship,  
Smeal College of Business, Penn State University

**Introduction**

We recently conducted a survey on innovation by examining the statements made by chief executives of large public companies in the public press.<sup>1</sup> Most recognized that innovation, although crucial for organic growth, is nevertheless difficult to sustain. Difficulties arise because most organizations tend to view deviations from institutionalized organizational practices as mistakes that can only detract from overall organizational performance. Yet, to sustain innovation, at least some deviation is required.

Consider the Post-it® Notes saga at 3M Corporation. Spence Silver, a scientist at 3M, was busy doing his work when he stumbled upon a strange substance – a glue that did not glue. Most would have considered this to be a mistake, but not Silver. Looking at the substance under the microscope, Silver thought that the material was beautiful, and, so, decided to pursue its commercial application. Upon being asked if he had made a mistake, Silver responded that he had stumbled upon a “solution looking for a problem”.<sup>2</sup> Indeed, it is to 3M’s credit that it allowed Silver to carry this strange glue forward. As Nayak & Ketteringham<sup>3</sup> wrote in their description of the origins of Post-it® Notes, “In this atmosphere [3M’s], imagining a piece of paper that eliminates the need for tapes is an almost unthinkable leap into the void.”

As the Post-it® Notes vignette illustrates, there are challenges involved in harnessing the outputs of creative knowledge workers. The very routines that make it possible for organizations to function seamlessly can, at the same time, dampen knowledge workers’ creativity. In being creative, individuals draw not only upon their expertise, but also upon the inputs of many others from different domains of knowledge. The outcome of this process of “bisociation” is the creation of a novel idea that is bound to appear foreign and even as a mistake to those steeped in their everyday activities.<sup>4</sup>

There is yet another issue here. As Francis Bacon in 1625 suggested in his essay titled *On Innovation*: “As the births of all living creatures are, at first, misshapen, so are all innovations...” New ideas appear to be ugly except to the person who stumbled upon them. Such ideas have to be developed further before their utility can be fully appreciated. Indeed, inventions require the

---

\* © Garud & Warren, 2006

<sup>1</sup> Examples include: “InnovateAmerica” (2005), Council on Competitiveness: [www.smeal.psu.edu/fcfe/more/white/nii04.pdf](http://www.smeal.psu.edu/fcfe/more/white/nii04.pdf); “Investment in technology & innovation are what really makes you competitive”, Jeffery Immelt, GE, Fortune.com; “The open innovation model is attempting to unleash all 100,000+ employees to be innovators”, P&G, Fortune.com

<sup>2</sup> Lindhal, L. (1988) Spence Silver: A Scholar and a Gentleman, *3M Today*, January 1998, Vol. 15, No. 1, pp . 12-17.

<sup>3</sup> Breakthroughs”, Nayak and Ketteringham, 1986, pp 50-74.

<sup>4</sup> Koestler, A. (1964). *The Act of Creation*. Macmillan Co., New York.

creation of co-specialized assets before they can become functional.<sup>5</sup> In other words, it takes time for a caterpillar to become a butterfly, and the transformation process is clearly not straightforward.

The asynchrony involved between the creation of novel ideas and their readiness for market commercialization poses a conundrum for organizations – What should they do with such ideas? By definition, these ideas are ahead of their time and appear to be mistakes in real time.

In dealing with such “mistakes,” organizations may commit two others. One is to prematurely abandon such ideas, and, thereby, create a “false negative” response.<sup>6</sup> The second is to escalate resource commitments to such ideas hoping to be the first to market thereby creating a “false positive”. There is a third approach and one that we advocate. Why not let these ideas germinate in the safe confines of the organization until they are mature enough even as the eco-systems that can contain these ideas emerge?<sup>7</sup> In other words, why not take out an option on these ideas? Such “real options” can provide corporations with the right and not an obligation to strike at the right time and right place, thereby significantly reducing risks associated with the commercialization of innovative ideas.<sup>8</sup>

To accomplish this, we may need to move beyond the highly structured “Stage-gate” processes developed by Robert Cooper.<sup>9</sup> We believe these could lead to too many false positives and negatives in the product innovation process. Corporations must innovate continually to spur organic growth and retain/improve their competitive position. Premature rejection of early ideas, or over-resourcing of “exciting” but premature concepts are both detrimental to firm performance.

### **Risk vs. Uncertainty**

In his seminal book titled "Risk, Uncertainty, and Profit", Frank Knight pointed out that uncertainty denotes situations wherein calculation is impossible because of the difficulties involved in inferring the future from the present “with any high degree of dependability.”<sup>10</sup> Such Knightian uncertainty is very different from situations of risk where it is possible to foresee outcomes and to calculate their probabilities.

Uncertainty, within the context of innovation, means that the potential outcome of a development project is, by its very nature, NOT quantifiable. Any innovation journey is fundamentally unpredictable because market preferences emerge even as progress is made with projects that are completed and get compared. Project managers, therefore, are not courting risk, but, rather, courting unquantifiable uncertainties. Indeed, taking advantage of an uncertain future can provide a competitive advantage over companies that are unable to recognize and capitalize upon

---

<sup>5</sup> Teece, D. J. (1987). Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. In D. J. Teece (ed.), *The Competitive Challenge: Strategies for Industrial Innovation and Renewal*. Cambridge, MA: Ballinger, pp. 185-219.

<sup>6</sup> Garud, R. Nayyar, P., and Shapira, Z. 1997. "Technological innovation: Oversights and foresights" in Garud, R. Nayyar, P. and Shapira, Z. (eds.) *Technological innovation: oversights and foresights*, Cambridge University Press, Cambridge, UK, pp: 3-12

<sup>7</sup> Garud, R. and Nayyar, P. 1994. “Transformative capacity: Continual structuring by inter-temporal technology transfer” *Strategic Management Journal*, Vol. 15, pp. 365-385

<sup>8</sup> Such real options may include relationships with small entrepreneurial firms, perhaps through formal partnerships and investments, as a method to reduce the organizational tendencies to see mistakes as something to avoid rather than to build upon.

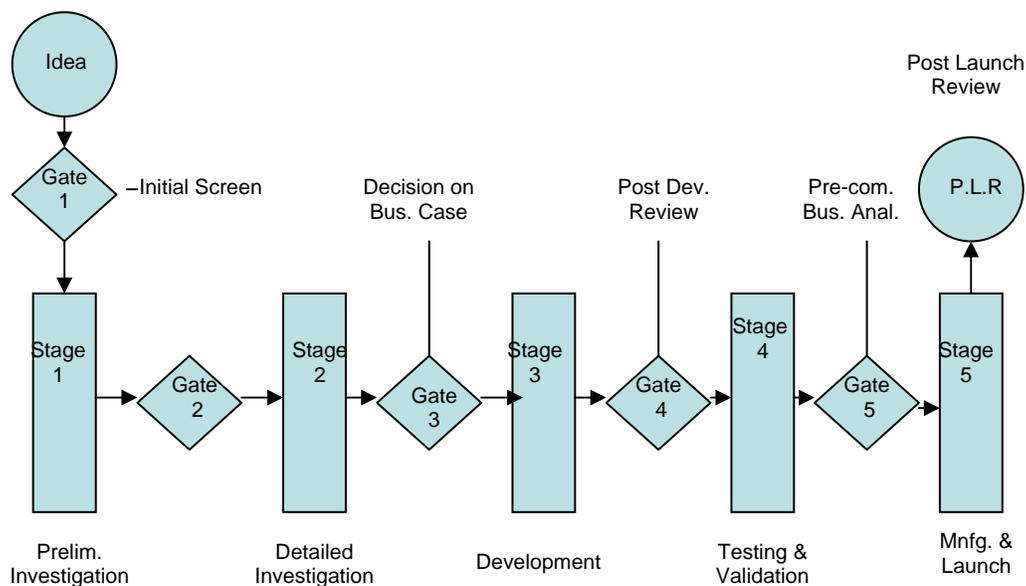
<sup>9</sup> See for example, “Winning at New Products”, R.G.Cooper, 2001

<sup>10</sup> Knight, Frank. 1971. *Risk, Uncertainty and Profit*. Chicago, University of Chicago Press.

unpredictable events.

Of course, embarking on several innovation projects, each characterized by uncertainty, can reduce the overall risk by “backing several horses” and effecting a “portfolio” to manage risk. Risk in this context is both measurable and manageable. For example, pharmaceutical companies commonly take R&D options on promising compounds recognizing that the road to commercialization is risky and that a portfolio of opportunities are required to provide a high likelihood that there will be at least one “blockbuster”. The insurance industry is based on the financial management of the risk of certain events happening. Their performance is highly quantifiable.

### Innovation and the Stage-gate process



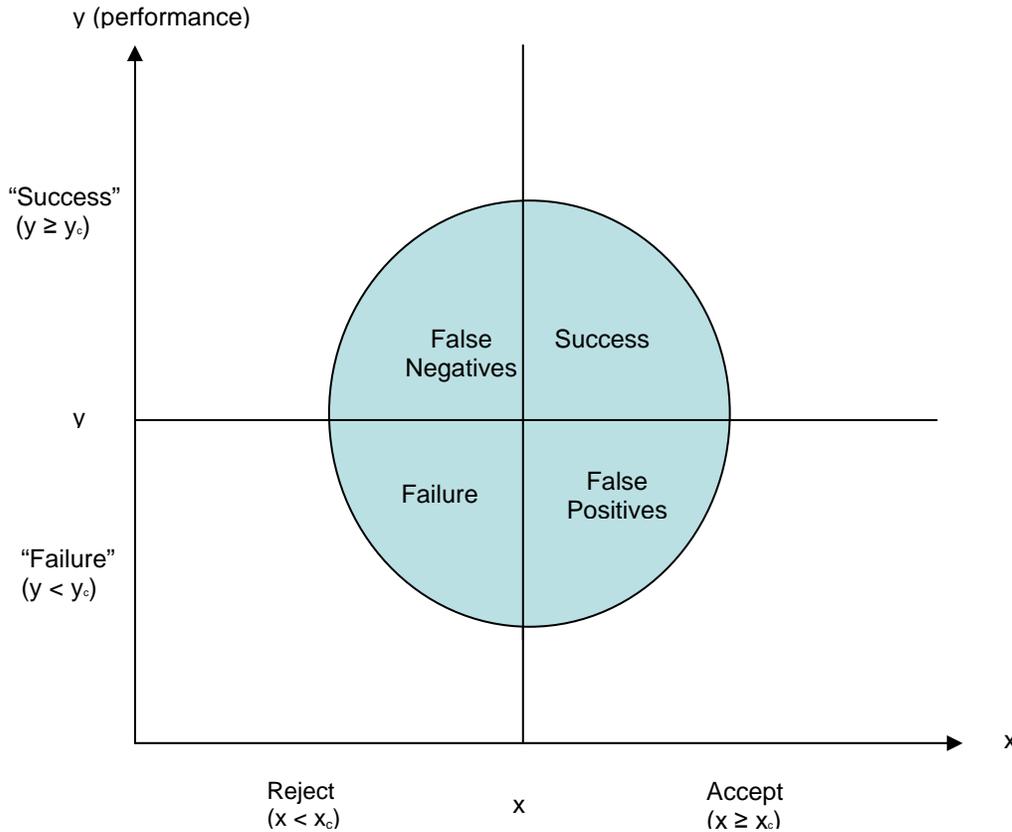
Traditional stage-gate product development processes review the probability of success at each stage or milestone. When the probability of success falls below some pre-determined threshold, the project is terminated or redesigned. These processes are intended to instill discipline and provide decision support in complex development projects. The well-defined “gates” provide a framework for guiding a product development and launch project from concept to production and market entry. In recognizing that the different functions within an enterprise require specifications to become more “frozen” the nearer a product gets into production, the Stage-gate process focuses on removing uncertainty at the earliest possible stage within a development cycle. The target is to enhance smooth operations within the different “vertical” functions such as R&D, engineering, marketing and manufacturing where “requirements” for handover are well-defined.

### The Resulting Paradox

The more uncertainty that is removed in order to make the management of an organization easier, the less the enterprise can innovate. Moreover, stipulating fixed requirements for the interfaces between different corporate functions, presumably based on historical needs, automatically

restricts anything new from emerging. Paradoxically, companies have to embrace innovation, and, hence uncertainty, in order to reduce business risk.

### A Model for Understanding the Trade-offs <sup>11</sup>

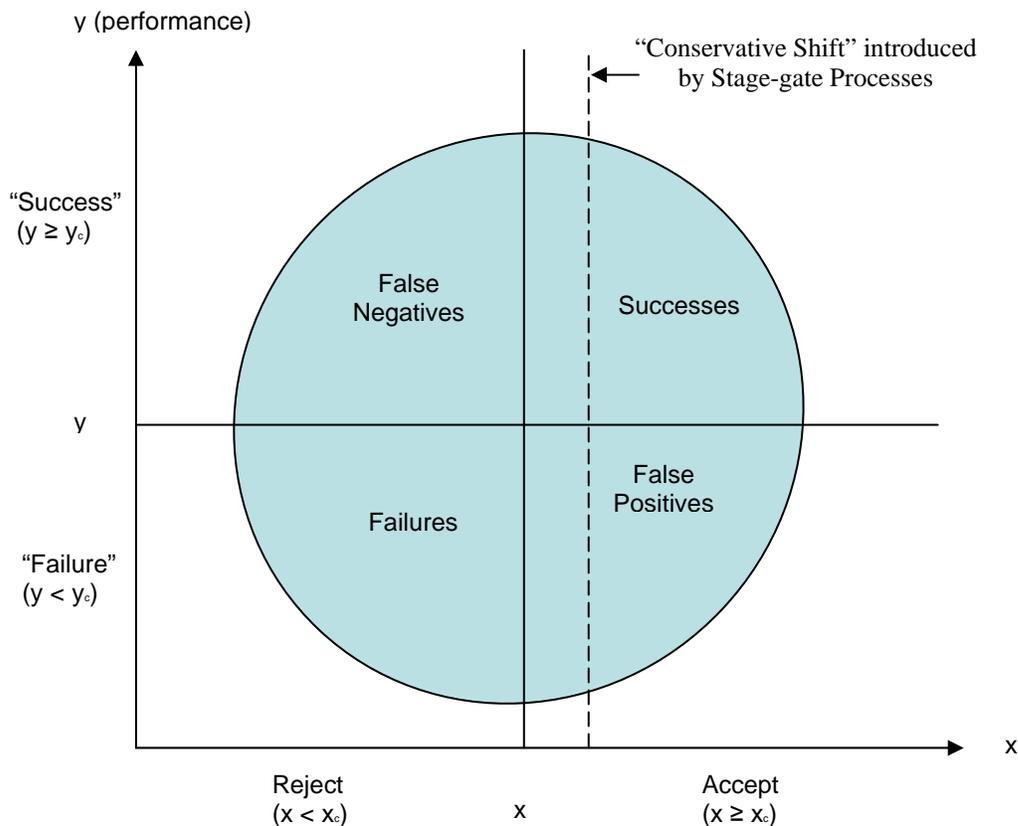


This stylized decision chart shows how successes and failures map. We plot success/failure against the go/no-go decision which occurs at each stage. We show an arbitrary critical level on each axis that indicates a decision. Ideally, of course, we would like to have all successes with no failures, false positives or negatives. Yet, typically only about 20% of development projects result in successes. How can we increase the “innovation yield”?

### The Stage-gate “Conservative Shift”

The rigorous go/no-go decisions demanded by Stage-gate processes move the enterprise inevitably towards a more conservative approach to new product/service development. In the drive to move developments along more quickly and to remove ambiguities as early as possible, projects are often terminated prematurely before sufficient knowledge is garnered. While this will reduce the number of false positives, it also reduces the number of options for future successes. Additionally the ability to continuously innovate throughout the development is suppressed. This is illustrated in the following diagram.

<sup>11</sup> Garud, Nayyar and Shapira (1997) *ibid*.



### Learning from Mistakes

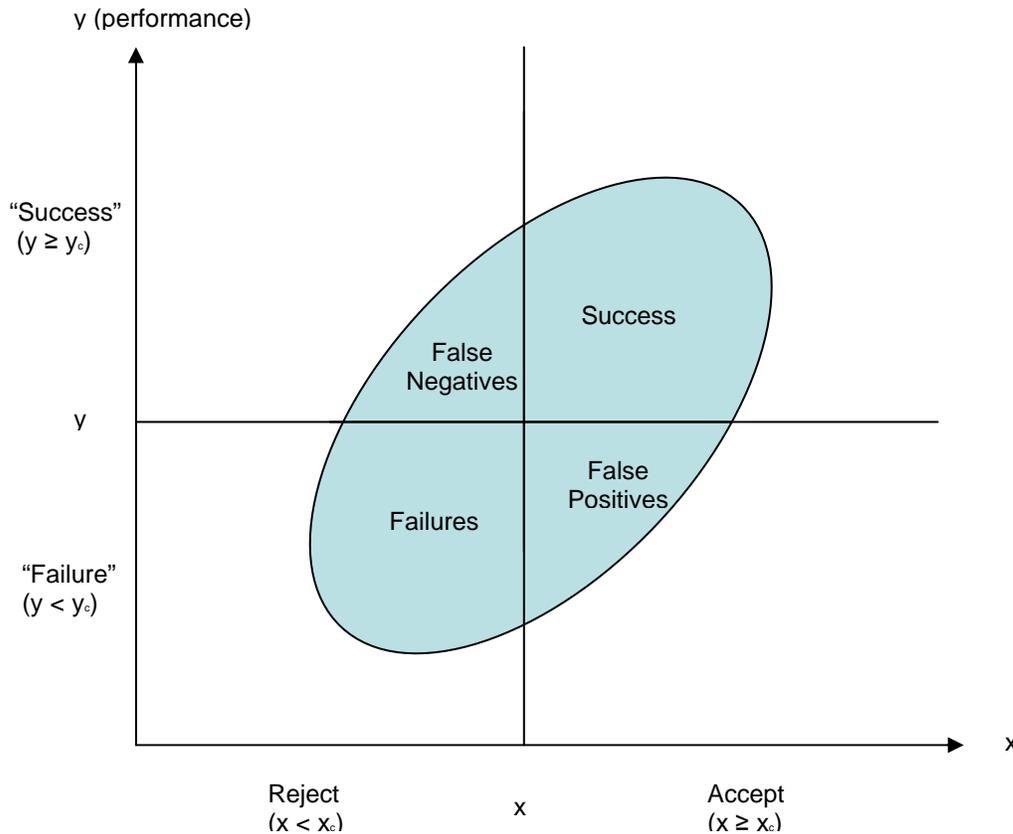
A recent Business Week article highlights how and why failure can breed success.<sup>12</sup> The gist of the argument is that it is possible and a must to learn from “intelligent failures -- those that happen early and inexpensively and that contribute new insights about (a company’s) customers.” Learning from such failures can generate organizational intelligence that can change the balance between the four alternatives. If the enterprise can generate a memory of past events and can apply this to future developments, then, we have an opportunity to learn from past “successes” and “failures” and move our decision process to a more favorable state. In this case, we should be able to reduce the number of false decisions, both positive and negative, while gaining more successes. This is illustrated in the next diagram.

However, transferring knowledge generated in the past effectively to new projects and applying it to new situations is easier said than done. In the innovation process, tacit knowledge is as important as explicit knowledge.<sup>13</sup> Tacit knowledge is extremely hard to codify, search, access and interpret. Many corporations have invested heavily in so-called “knowledge management”

<sup>12</sup> “How Failure Breeds Success”, J. McGregor, BusinessWeek Online, July 3rd, 2006.

<sup>13</sup> “The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation”, Ikujiro Nonaka, Hirotaka Takeuchi, OUP, 1995; “Why Organizations Don’t ‘Know what they know’: Cognitive and Motivational Factors Affecting the Transfer of Expertise, P Hinds, Jeffrey Pfeffer, Research Paper 1697, 2001, Stanford University, Graduate School of Business.

systems and have failed to gain any significant return on this investment. More recent dynamic narrative approaches appear to be more effective and these are the subject of additional research at the Farrell Center.<sup>14</sup>



### A Process View on Innovation

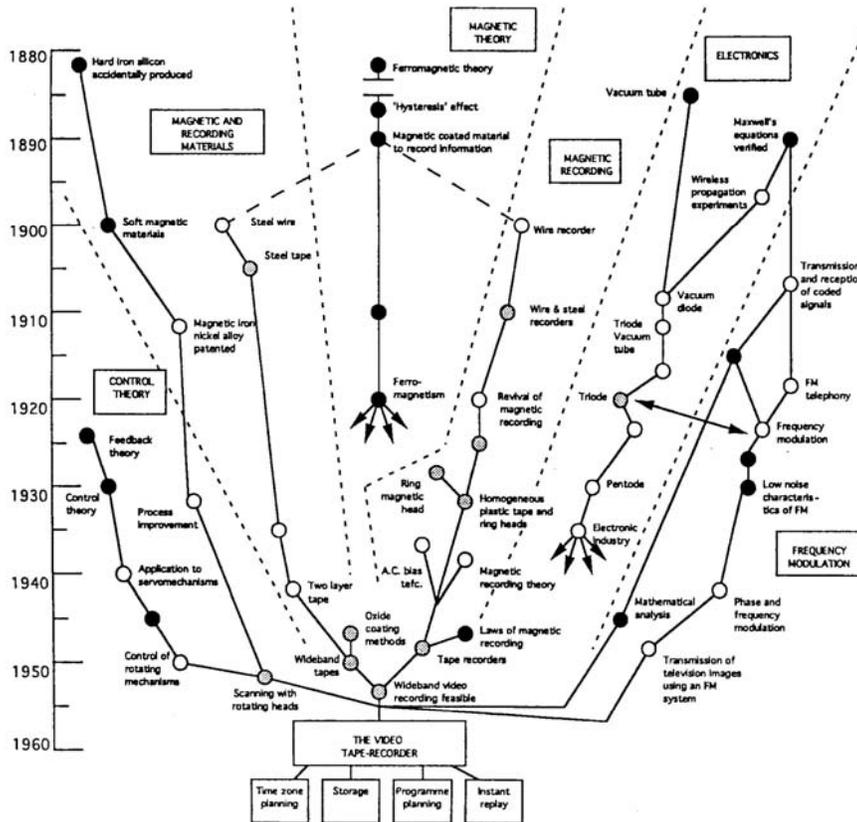
In order to exploit rather than merely learn from mistakes, we must understand the nature of innovation and its changing form within the current business environment. We need to embrace a continuous process perspective in development projects whereby ambiguity is tolerated and any outcomes of our efforts are not subjected to a black/white decision process but are seen as just one step in an overall innovation “journey”. Today’s “mistakes” can become innovations of the future. Two attributes of innovation can guide these processes, namely asynchronicity and non-linearity.

### The Asynchronous Nature of Innovation

In today’s increasingly complex market and technological contexts, new products and services are usually constructed out of a combination of different inventions, insights, and events. It is highly unlikely that these will align to provide a successful outcome concurrently. Some

<sup>14</sup> See Bartel, C. and Garud, R. “The role of narratives in sustaining organizational innovation” PSU Working paper.

“breakthroughs” will be early and will have to wait for other developments before their value can be realized. Additionally, the market may not be ready yet for the innovation; the window of opportunity has not yet opened.



The research origins of the video tape-recorder. Source: Adapted from Irvine, J. and Martin, B. R. *Foresight in Science: Picking the Winners*, Dover, N. H. Frances Pinter, 1984. (●, Nonmission research; ○, mission-oriented research; ○, development and application. Note: BTL = Bell Telephone Laboratories; NRL = Naval Research Laboratory; AEG = Allgemeine Elektrizitats Gesellschaft

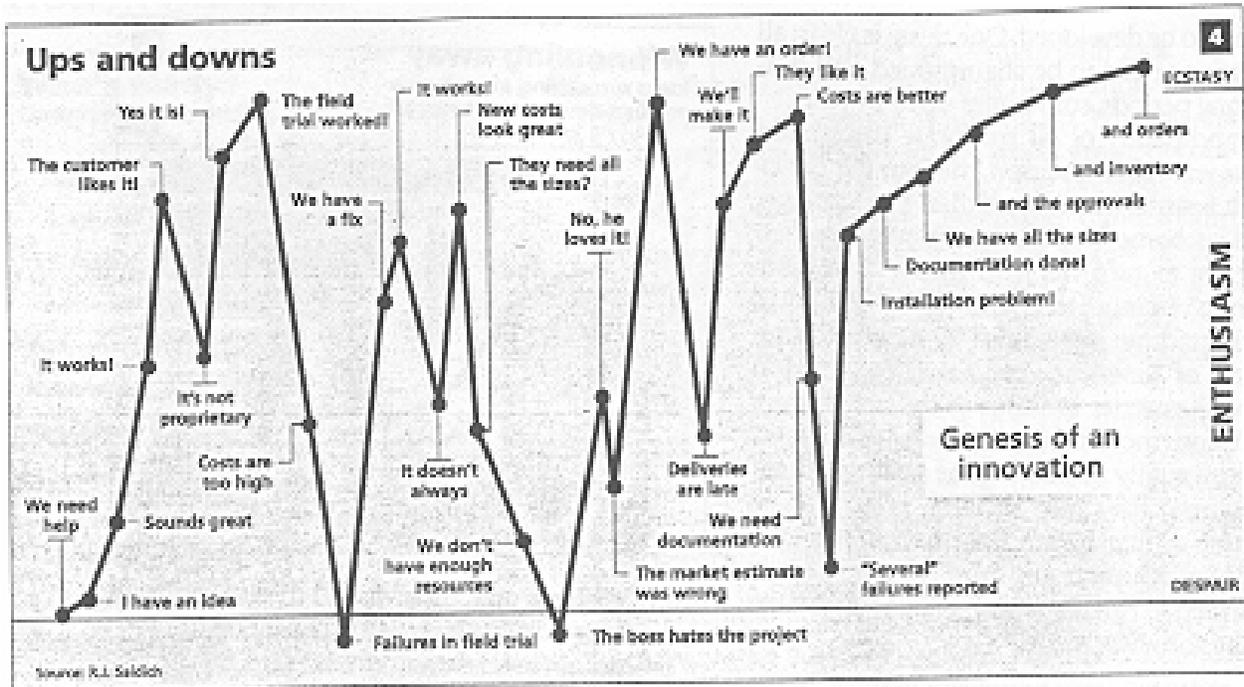
This diagram illustrates the number of individual yet complementary technical developments that had to occur in order for the video-recorder to reach the market together with the time-lines for each “breakthrough” to be ready. Many of the development programs were abandoned when found to be too early or incomplete, with the developers never benefiting from their efforts.

### Innovation is Non-linear

As any budding entrepreneur will attest, the road to success of an innovation always takes many twists and turns before reaching a success. The following chart, from R.J. Saldich shows the typical cycles of an innovation project with the levels of enthusiasm at each twist and turn.

The tenacity of an entrepreneur to persist through the challenging ups and downs of the development process is one of the key differences found between the cultures of small and large enterprises. Larger firms, with their need to manage and control significant resources, must impose well-defined procedures and decision processes. Thus, they are more likely to abandon a project on a down cycle creating a false negative and a lost opportunity. Although it is convenient

to expect and manage a linear process and remove complexities as early as possible, it is just not the way that innovation works.



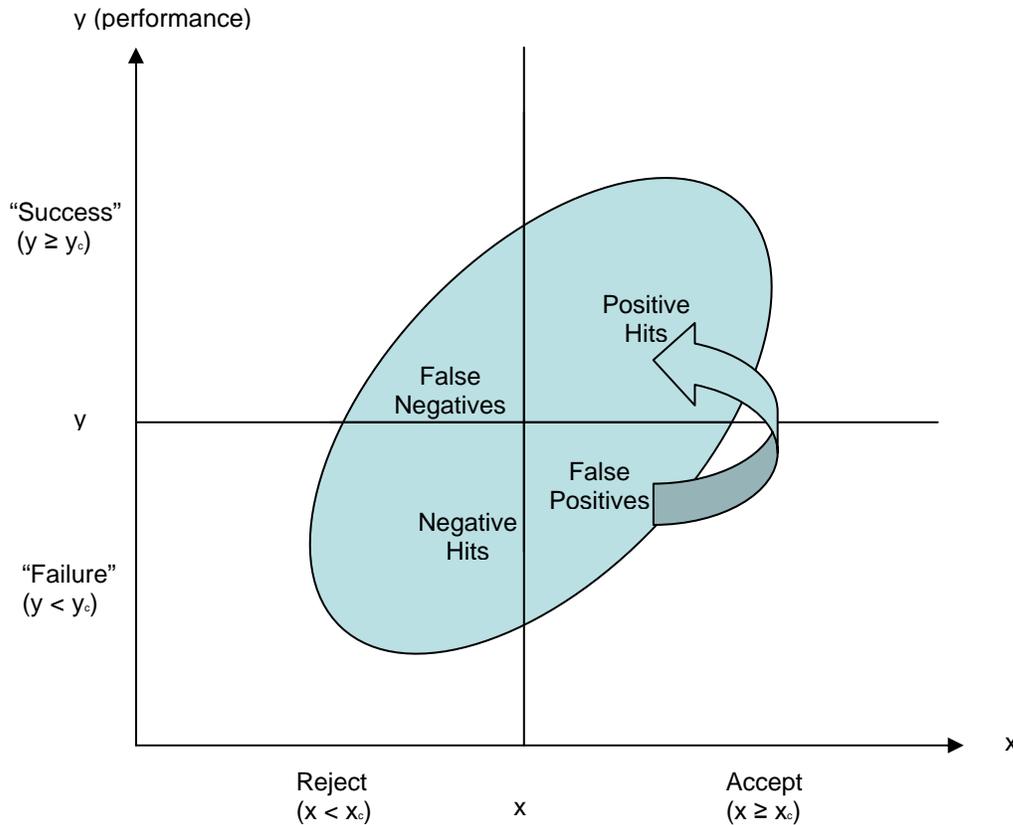
The implications are that innovation favors those who (a) cultivate luck by being prepared rather than those who wait for luck to happen, (b) are patient and view time as a friend and not an enemy and (c) do not view “mistakes” or “setbacks” as something necessarily to be discarded.

### Exploiting Mistakes

William McKnight, 3M’s erstwhile CEO from the 1950s stated:

“Mistakes will made, but if a person is essentially right, the mistakes he or she makes are not as serious in the long run as the mistakes management will make if it is dictatorial and undertakes to tell those under its authority exactly how they must do their job. Management that is destructively critical when mistakes are made kills initiative, and it is essential that we have many people with initiative if we are to continue to grow.”

Implicit in this statement is an understanding that entrepreneurial initiatives can result in “informed” mistakes and that managers may poorly understand such outcomes. Indeed, it is possible for such informed mistakes to become corporate assets in the future. That is, a false positive (because a project may be too early, or may not have the right co-specialized assets etc.) can yield a positive hit in the future? This is illustrated in our model in the next diagram.



Some of the actions that a company can take to improve their innovation success rate by using the assets created from apparent mistakes are:

- Explore ways to keep valuable ideas alive. Methods include encouraging individual or team skunk-work activities, working with outside entities such as small companies or Universities working in the field, etc.
- Scan the technical and market environments for “weak signals” that can evoke an awakening of earlier “mistakes” that remain on the shelf.
- Have an executive structure that allows “quick strikes” when “mistakes” turn to opportunities.
- Use dynamic knowledge systems for collaborative “on-demand” innovation challenges. These should be regular and involve both cross-functional internal as well as external contributors.
- Encourage rather than just tolerate informed experimentation.

## **Topics to Ponder and Discuss**

We would like you to share with our executive group examples that have worked for you or that have been problematic.

1. Do you use some form of Stage-gate process? Do you find this to be effective or inhibitive? Can you interpose some of the ideas in this paper into your current new product development processes?
2. How do you manage tacit information generated in the past and apply it to today's challenges? What mechanisms have you found to be effective across your organization? Have you tried to use "on-demand" knowledge management systems?
3. Can you recall a case where your company turned a mistake into a success? How did this happen? What can we learn from this?
4. How and when do you decide to "pull the plug" on projects?