

INNOVATION AND THE VALUE OF FAILURE

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ABSTRACT

Innovation is a difficult phenomenon to evaluate. Innovation impacts the firm in a variety of ways. It is difficult to analyze the full impact of innovation because there is no single set of metrics that can capture its full significance. The metrics that have been traditionally used only capture a fraction of the true benefit derived by the firm. In addition, since the circumstances, values, structure and strategies vary greatly between industries and firms within industries, the efficacy of specific metrics fluctuates from application to application. An unmeasured and often neglected area of innovation deals with the ideas that, for a variety of reasons, fall by the wayside. This paper examines the uncounted valuation aspects of innovation that occur independent of the market success or failure of the innovation product. These are benefits to the organization that may accrue from discarded or abandoned ideas or innovation products that failed in the marketplace. The sources of innovation valuation error are discussed as well as strategies for maximizing the value of failure and reevaluation.

JEL: O31, O32

KEYWORDS: innovation, value of failure, market success, innovation valuation error

INTRODUCTION

The search for metrics to accurately and comprehensively evaluate the value of innovation has occupied researchers and managers since Schumpeter (1934) identified it as an engine of organizational growth. The ability to quantify this value was limited for decades to direct monetary values (profit increases or cost reductions) and those related to R&D (R&D expenditures, R&D assets, patents, copyrights, etc.). While the limitations of these metrics were well known, there were limited alternatives. As a greater body of theoretical and empirical research developed on the impacts of innovation on the firm, a focused search began for an understanding of the underlying mechanisms and way to measure them in the organization. This exploration led to an understanding that innovation's value to an organization manifested itself in different ways. Observational and theoretical work identified several classes of innovation in an organization that all produced value. Empirical research found that the value of innovation varied based upon other contextual criteria, such as industry sector, markets, customer relationship and previous performance.

This paper will examine the techniques available to measure the full benefit of innovation activities for the firm. The specific application of organizational benefits generated by innovations not introduced or successful in the marketplace will be examined. Finally, recommendations will be made for capturing these benefits and the implications for management praxis.

REVIEW OF THE LITERATURE

The underlying assumption of most empirical research on innovation is that the benefit or utility that accrues to a firm occurs from successful innovation acceptance. Studies relate innovation success to firm performance (Zahra and Das, 1993; Calantone *et al*, 1995; Yeoh and Roth, 1999; Zhan and Doll, 2001). The measurement of potential benefits from innovation activities are correlated to new product or service success. The concept that unsuccessful innovation activities may generate organizational benefit is largely unexamined.

As the understanding of the relationship between innovation and value evolves to a more contextually driven model, so too do the metrics used to capture it. There is a progressively greater understanding of the range of value that innovation provides to the firm and increasingly sophisticated ways to capture it. The strict reliance upon cost reduction and R&D related metrics as the sole evaluative techniques has past. Empirical research confirms this gap between the aggregate value of innovation and the value assessed through traditional measurement. Monteiro-Barata (2005) reports an often-discovered statistic in the analysis of innovating firms from two surveys of Portuguese manufacturing firms. Both the INDINOVA and SOTIP innovation research projects identified that only a fraction of the firms generating product and process innovation engaged in R&D. While the percentage of firms producing innovations were fairly consistent between these studies (36% process innovation and 27% product innovation for the INDINOVA project, and 25.2% process innovation and 20.7% product innovation for the SOTIP project) the number of companies engaged in internal R&D activities is 3.1% according to the SOTIP survey (p.305). R&D metrics, as with most input metrics, fail to capture most of the innovation occurring in both manufacturing and service industries.

Innovation is a localized phenomenon, defined within very specific contextual boundaries in an organization. Innovation valuation models do not necessarily transfer outside of the context in which they are found. This makes it difficult to establish a generalizable framework that can be abstracted and applied to other environments. An interesting statistic reported by Hipp and Grupp (2005) from the 1999 Mannheim Innovation Panel of German firms, reflects the localized nature of much innovation. Of the 1405 firms reporting an innovation in the past 3 years, 34% of manufacturing firms launched innovations that were new to the market and 57% produced innovations that were only new to the firm. This disparity in the level of novelty was even more pronounced in the services sectors. From the 1080 services sector firms with an innovation in the past 3 years, 16% created an innovation new to the market, while 77% produced an innovation new to the firm (p.525). While market novelty is often perceived as a sign of significant innovation for the firm, it may be that the more mundane incremental innovation producing new products for the firm, but not the industry, is where the bulk of the benefit lies.

Models of output performance used as a measurement of the value of innovation are ineffective in capturing the true benefit to the firm. Calantone, et al (2006) found that product innovativeness has no direct effect on product profitability. When controlling for product advantage and customer familiarity, the degree of novelty of a product does not affect its profitability. This confirms the concept that innovation, in and of itself, does not directly result in profitability. Indeed, we can all cite examples of significant technological breakthroughs products that languished in the marketplace when they were first introduced. Many times it is not the inventor of a technology that reaps the profitability rewards from the innovation, but later adopters of the technology that find new customer utility in new markets or applications of the technology. Calantone, et al (2006) approach this by differentiating between product innovativeness, product advantage and customer familiarity. Product innovativeness relates to profitability through two indirect mechanisms, customer familiarity and product advantage.

The product advantage refers to the superiority of a new product to existing products in the marketplace. This factor captures the substitution effect that a new product or service brings about in the marketplace. It is a measure of the new product as a substitute for well understood utility values of existing products by the consumer. The second indirect mechanism impacting product profitability is customer familiarity. This concept captures the utility assessments made by consumers that are outside of the existing product comparisons. Customer familiarity includes an assessment of the product value from the consumer's standpoint. Choosing a new product where there are no close substitutes requires a different set of assessments by the customer. This evaluation includes adoption risk and behavioral changes required for the customer to adopt the new product. Garcia and Calantone (2002) propose that product innovativeness and newness to the customer are positively related. However, it not at all clear that newness to the customer is positively correlated to profitability. Calantone, et al. (2006) test this hypothesis and find it

not significant. Customers base their evaluations of innovativeness on the degree to which a product requires a change in mental models and behaviors. These factors are tempered by an assessment of the risk associated with making such adjustments. This determination by the customer may not result in a positive decision to accept the innovation. While other aspects of innovativeness may positively relate to market success, it is not apparent whether this factor will contribute positively or negatively to innovation profitability in any given set of circumstances.

Pavitt's (1984) work studying the sources of 2000 British technological innovations during the time period 1945-1980 revealed that an organization's industrial sector was a significant determinant in the type of innovations that a firm pursued. Firms in industries that were strongly customer-centric realized more new product or service based innovation, while firms in more production intensive sectors increased cost cutting process related technological innovation. While this reinforces the idea that there is no single set of innovation measurement metrics that can be applied to all firms, it may be related to an underlying flaw in managing the application of the metrics. The sectoral variance in capturing different classes of innovation may be caused by only applying those metrics that have direct relevance to a current operational strategy. The concept that an organization should examine innovations in light of their current strategic plans and competencies misses all but the most trivial of incremental changes. Innovation, whether product or process based, brings about change. While the potential value of an idea may not outweigh the cost of the required organizational change, to eliminate the possibility completely eliminates the ability to recognize and capitalize upon disruptive innovation. If Orville and Wilbur Wright had a board at their Dayton bicycle shop that was evaluating their new transportation concept, we could expect one or all of the following answers:

“Its not part of our current core competencies.”

“Its not aligned with our strategic plan to expand into the tricycle market.”

“We don't have the funds available to explore this idea due to recent input cost increases in bicycle seats.”

The former director of Xerox's Palo Alto research center confirms this phenomenon:

“Scientists there came up with such breakthroughs as the computer mouse. But back at Xerox's home office, upper management's focus was its basic photocopying business, recalls John Seely Brown, a former director of the center. “We would invent all sorts of things that didn't fit into the core business,” he says, “so then they would sit on the shelf or eventually be spun out or licensed to other companies.” (McConnon, 2008, p. 86)

While we all may agree on the cost savings/revenue enhancement evaluation metrics for evaluating an innovation vs. the current *status quo*, we must at least ask the question, “What is the cost of *not* adopting this innovation?” How does rejecting an innovation impact my organization's ability to sustain a competitive advantage, or assist my competitors or change my relationships with employees, customers or suppliers? Asking these questions requires the use of different metrics than the simple direct dollar value realized.

INNOVATION AND THE VALUE OF FAILURE

The concept of failure has several connotations in the context of innovation value measurement. There are failures in adequately capturing the value of the innovation by due to inadequate or incomplete application of the valuation metrics. Chesbrough (2004) discussed the need to measure and manage “false negatives” in the innovation process. He discusses “false negatives” as innovation efforts that have been terminated or abandoned by an organization which later show renewed value. The termination may be because the innovation relates to markets outside of those that the organization currently pursues. It

may be because the innovation relates to a market that is currently undeveloped. In both cases, the organization finds renewed value in the “false negative” at a later point in time. Chesbrough highlights the need to regularly revisit the knowledge base created by terminated innovation to reevaluate the internal and external value of these ideas and to develop strategies to capitalize upon them.

There is another implication to innovation measurement that can be drawn from this work. By discussing the nature of error in valuation metrics for innovation and the need to revisit these evaluations, Chesbrough highlights the fact that almost all valuation metrics for innovation are static measures. The value of an innovation is made based upon an assessment at a specific point in time. This point in time assumes that an organization’s markets, structure and strategies are parametric. The possibility, even probability that these circumstances will change over time is obvious. Labeling an innovation as a failure and discarding it from our organizational knowledge base precludes any possibility of reaping value from its application in another day.

Another type of failure in innovation valuation is the failure to use appropriate measures that capture all aspects of value to the firm. The literature on the social shaping of technology addresses technological innovation from a sociological standpoint as being generated and shaped by competing interest groups. These interest groups each have a vision of the potential of a technology and vie for the resources and acknowledgement of their point of view. Pinch & Bijker (1984) or MacKenzie & Wajcman (1999) are examples of a literature that accents these dynamics in the selection and implementation of innovations. The significance of this theory is twofold. First, that it identifies that users appropriate technology and use it in way unforeseen by the inventor and second, that an innovation’s value is determined by a user group who has a vision of what it can do for them. This perspective reinforces Danneels & Kleinshmidt (2001) and Calantone, et al. (2006) contentions that accurate valuation is a function of a consuming group’s assessment of utility and not that of the producing organization.

When we relate these societal perspectives to an organization, the contextual nature of innovation’s utility becomes clear. Those who bring the innovation to the specific organizational context are primarily responsible for determining and advocating the value metrics for its efficacy. While the originating organization may not find value, the circumstances existing in another organization may find immediate value. Independent of its intended application or original value measurement, it is the evaluative framework that a champion or user group applies to the idea from within their own context that proves determinant. This not only confirms the distinct nature of the valuation configuration between firms, but also that the valuation configuration within a firm may vary over time, group dynamics and other circumstances.

We are faced with the conclusion that an organization’s valuation of an innovation may not be determinant or the last word. Innovations should not be discarded, since it is inevitable that they will find value in some context. The issue for managerial practitioners is to find the correct context through which to capitalize on this value.

FAILURE HAS VALUE

There are a variety of reasons why an innovative idea never becomes realized in the marketplace. There is innovation that is missed because an employee never expresses the idea or shares his insight. This may be caused by perceived or actual penalties associated with a failure. There is some evidence that anonymous methods of contributing ideas in an organization may enhance participation and contribution levels. By reducing the perceived risk to participants of offering ideas that might be seen negatively, anonymity increases their willingness to participate. Valacich, et al. (1994) found that anonymous submission might increase the willingness to participate by reducing the perceived risk of offering ideas that might be seen negatively.

Anecdotal evidence supports the impact of fault tolerant environments on the production of innovation. In a Forum on Innovation, conducted by the U.S. Department of Commerce (2006), William Zollars the Chairman of YRC Worldwide discussed his firm's innovation management policy. YRC Worldwide, formerly Yellow Freight, combines a fault tolerant environment with strong decentralized decision-making. This provides for a more direct hypothesis-testing context at the point closest to where the innovation is generated. This leads to effective exploration of the idea and responsibility for its evaluation. Not only does YRC Worldwide not punish failures, but celebrates them. Zollars elaborates on an occasion when it was clear that an innovation implementation was failing;

“...but we did it anyway, even though I knew it was going to be a mess, because it was more important for us to say, ‘Look we’re trying stuff even though we’re not sure its going to be successful,’ than it was to say, ‘No, that’s a stupid idea, we’re not going to do it.’” (p. 11-12)

Creating a failure-tolerant environment for innovation hypothesis testing and experimentation does not do as much to guide the behavior of an employee with an insight as it does to remind us that all ideas have value. This approach informs us on how processes that capture value should be structured. When we create an internal climate that encourages individual creativity and openness, whom are we really talking to? The greatest affect of such an organizational change may not be our employees, but the organization's culture and value system. Damanpour (1991) found that support for innovation is found in the norms adopted by management. These attitudes include expectations, approval and practical support of attempts to introduce new ways of doing things. McAdam and Keogh (2004) find additional empirical support for the modification of the systems of innovation measurement into more fault tolerant processes. One of the benefits they find is in overcoming past disillusionment from rejected ideas. When such approaches are successful is it because more innovative ideas are developed and presented by employees, or is it because we are sensitizing ourselves toward hearing the stream of ideas already flowing there? Increases in the innovation output may be caused more by changes to the organizational receiver rather than the sender.

Failure of the processes and techniques used within an organization to resolve problems may serve as a significant source of innovation. Thomas Kuhn (1962) describes that the pressure for change in the prevailing assumptions and conceptual framework in a discipline comes from an increasing accumulation of anomalies that are inconsistent with them over time. Many times the pressures for change that generates or brings innovations to the surface are generated from Kuhnian disfunctionality in how the current technology and processes meet the needs of the specific circumstances in the organization. The organization finds that the attempt to solve problems with existing processes and approaches is less and less functional. The developing realization that the current systems are increasingly dysfunctional opens the organization up to the possibility of alternative solutions. It is the energy behind this increasing level of discomfort that motivates the search for new and innovative solutions. This pressure also focuses the attention of value measurement upon the “goodness of fit” criteria as a solution to a specific set of problems.

The results found in the academic literature of the 1980's and 1990's with organizational prescriptions for generating innovation through the construction of nurturing and participative environments to elicit and develop ideas has been tepid, at best. On the other hand, the somewhat disturbing data from organizational creativity studies finds that many times innovations from the shop floor find their birth in anger, frustration and desperation. Canner & Mass' (2005) contend that innovation is motivated by desperate acts needed to keep operations running rather than by a creative environment. In this case, desperation reduces the risk of having an idea be perceived negatively. This motivates the innovator and makes them more willing to share their insights. More significantly, desperation may change the

perspective of managers making them more receptive and attentive to innovative solutions being presented to them.

EVALUATING THE SECONDARY EFFECTS OF INNOVATION

The secondary effects of innovations upon an organization may be greater and more profound than those related to their immediate application. By secondary effects, we mean those impacts that innovation has upon the firm that are not directly related to the immediate reflection of value in a product, process or service. These may be impacts on value derived from changes to the organization, its structure, culture, markets, other innovations, and client or supplier relationships.

Risk becomes an important consideration in the innovation evaluation process. As the element of risk becomes a more significant factor in the valuation of an innovation, the precision and likelihood of an accurate evaluation of the idea's benefit to the organization becomes smaller. The concept that increasing uncertainty for estimates of cost reductions or profit potential leading to a lowered expected value and reduced valuation of the idea is straightforward. However, when we turn to measuring other value returns on an innovation, such as the secondary effects, uncertainty plays a greater role. An example of a significant secondary effect is the value to a firm of introducing a new product that gives it "first mover" status in the marketplace. While we may accurately estimate our product sales in a new market, rarely is the more significant factor of the value to the firm of being able to shape the market with its innovation quantified. Indeed, a firm's ability to define the taxonomy and salient factors of a new market will generate value to the firm long after the value of the specific product being introduced has passed. Think of the value generated for an IBM or Microsoft through defining a market that continued long after their initial product introductions had faded from the marketplace. In hindsight this value is clear, yet *a priori*, it is rarely included in the valuation of an innovation. When we are unable to quantify the impact due to uncertainty, we tend to negate it and ignore it completely. Unfortunately, ignoring what we can't quantify leads to the same set of assumptions as if it had no value.

Whenever a value assessment is made outside of the current context, risk plays a part in that process. However, this does not mean that we discard all concepts of value that contain a level of uncertainty. Risk is quantified and incorporated into the value assessment. These risk quantification techniques provide a window into methods that may be able to more completely capture the full value impacts of innovation.

An additional secondary effect is the chaining effect that innovation takes. One idea leading to another. In and of itself, an innovation may not prove valuable enough to pursue. Yet it may lead to a stream of one or more related ideas and innovations, which may prove valuable. The potential for this chain of events may or may not be apparent at the time an innovation is evaluated. Anecdotal evidence of these events is prevalent, however, unfortunately only apparent in retrospect. Such examples are strong enough to inform our actions to not preclude their possibility.

INNOVATION AND SYNERGY

The impact of synergy on an organization was identified by Cooper and Kleinschmidt (1987). This synergy refers to the firm's ability to produce new products with existing knowledge and skills. These aspects of synergy fall into three main areas; technical, process and administrative. Technical synergy exists where the new product or services falls within the current knowledge base and competencies of the firm. Process synergy is created when the new product or service can be delivered with a minimum of modification to the manufacturing methods and techniques currently used by the firm. Finally, administrative synergy relates the similarity in organizational structure, distribution, marketing and personnel needed to deliver a new product.

An innovative product or service may create new capabilities, knowledge and skills quite independent from the market success that the innovation realizes. These new capabilities in process, technology and administration create synergies that allow subsequent product introduction to generate value independent of their innovativeness. While an innovative product may fail in the marketplace, the technical, process and administrative innovations that it brought about within the firm remain. Indeed, these innovations may contribute more to the enhanced value and performance associated with subsequent product introductions than the innovations attributable to the product itself.

Organizations learn. The enhanced capabilities within a firm that are a result of a failed innovation product introduction may be of a technical, process or administrative nature. New products that take advantage of existing technical knowledge and skills may be developed and brought to market faster resulting in better market performance. The technical capabilities developed as a result of a failed innovation product may form the knowledge base necessary to contribute technical synergies to the next product. New manufacturing processes brought about through an innovative product development effort may result in enhanced efficiency and productivity growth not only for future product releases, but also for the manufacture of the existing product mix. Administrative innovations created to support a failed innovation may provide the flexibility and new structure necessary to pursue previously unfeasible alternative products and strategies. While many studies have examined the contributory relationship between technical, process and administrative factors upon innovation, the empirical evidence relating to measuring synergies is sparse. Those studies that have examined these relationships (Danneels & Kleinshmidt, 2001; Calantone, et al., 2006; Tatikonda & Montoya-Weiss, 2001) posit causality from measures of technical synergy to product innovativeness, not the reverse. Additionally, there is no attempt to address the impact of the innovation product's failure on the subsequent role of synergy in product profitability and organizational performance. The contribution of innovation, whether or not a market success, to organizational performance, learning and growth, remains largely unexamined.

The Ford Edsel introduced in 1957 was an innovative vehicle for its time (Ervin, 2008). It is also a classic example of a market failure. Several factors contributed to its failure, however, technological, process and administrative changes brought about in Ford that were caused by the innovativeness of the Edsel, became the synergies on which future product development and organizational change rested. New features introduced on the Edsel, like self-adjusting brakes and self-lubricating chassis, became technical synergies as they were introduced into all Ford models in 1962. The inability to control quality at Ford division based manufacturing plants producing the Edsel led to a reorganization of all Ford manufacturing under a single manufacturing organization. While this does little to enhance the tale of the Edsel, it does reflect benefits that Ford realized, even from this icon of innovation market failure.

PRESERVING THE VALUE OF INNOVATIONS NOT PURSUED

There is an extensive body of literature on innovation measurement metrics that discusses the need to align the measurement and valuation process with the organization's strategy (Vossen, 1999; Neely, et al. 2000). While this approach has value in the static and immediate timeframe, it misses a much more important aspect of valuation of an innovation over time. Following this strategy we can conceive of innovations being abandoned for a variety of reasons bound to the immediacy of the criteria that are used to evaluate them. There are innumerable examples from almost any firm engaging in R&D where important innovations were abandoned because of a lack of immediate resource availability to develop them. This is understandable from an operational standpoint, but should this necessarily lead to an abandonment of the innovation and the forfeiture of all the value that it can produce? A number of management approaches can be used to derive and preserve the value potential. Internal strategies may find it beneficial to develop an innovation at a lower level of funding, allowing progress and evolution while preserving resources. External strategies may realize value from external partnerships or licensing

revenues. Many times significant innovations that are not related to current operational or strategic plans can find a home in a spin-off organization or joint venture.

CONCLUSION

The establishment of the value of innovation to a firm is difficult to quantify. As our understanding of the full impacts of innovation on the firm evolves, the methods that we use to capture this value changes. There are four significant implications to management practice from these results. The promotion of fault-tolerant innovation systems brings more innovations to light. This may be the result of increased managerial focus, an increased desire to present innovative ideas within the organization or culture changes that do not punish innovation attempt. In any case, tolerance or even celebration of failed innovation trials leads to an increased flow of innovation possibilities and greater probability of success.

The second managerial implication is that the measurement tools that are utilized determine the innovations that are selected and implemented, not visa versa. When the only tool that you have is a hammer, everything looks like a nail. When the only innovation metrics that we use focus on cost reduction exclusively, the only innovations you will identify are those incremental and process innovations that reduce cost. Care should be given to the evaluative techniques implemented because they will, in large part, determine the character of the results.

Another significant implication for managerial praxis is that the value of an innovation to an organization, even an unsuccessful one, is underestimated. Innovation valuation metrics must be selected that take into account the secondary impacts of an innovative idea. The implications of not pursuing an idea or of the longer-term value of an idea must be measured. These impacts on value to the firm may be much greater in scale than a static evaluation.

Finally, innovation ideas that the organization decides not to pursue, for whatever reason, should not be abandoned. Additions to the firm's knowledge base, process evolutions or administrative adaptations, may lead to other synergistic developments. As circumstances, markets and strategies change over time, the value of an innovation to a firm may change dramatically. For this reason, the knowledge base of unimplemented innovations should be periodically and systematically revisited.

This study is limited due to the fact that there is virtually no empirical research that measures unsuccessful innovation. Research has assumed that value is only generated by innovation activities when the new product or service is successfully introduced to the marketplace. While this article describes clear areas of benefit of unsuccessful innovation, more research needs to be conducted to measure the value generated by all innovation activities not just those that generate successful outcomes.

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