AN EMPIRICAL EVALUATION OF THE INTERNAL CORPORATE VENTURING PROCESS

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This paper develops a model of the internal corporate venturing process. The model explores conditions under which entrepreneurs are likely to continue with a course of action despite experiencing negative outcomes. Persisting with a course of action despite associated negative outcomes runs counter to trial-and-error learning behavior. We suggest that entrepreneurs are likely to continue with a course of action despite experiencing negative outcomes when the level of ambiguity is high and slack resources are available. In contrast, trial-and-error learning is likely to occur when either the level of ambiguity is low or when slack resources are not available. We examine these and other aspects of the venturing process with longitudinal data on the development of one venture. The data were collected over a 12-year period during the commercial development of cochlear implants within a large diversified corporation. The results support our core hypotheses on trial-and-error learning and action persistence while extending our understanding of associated processes.

Several researchers have studied the process of internal corporate venturing (e.g., Bower, 1970; Burgelman, 1983a,b,c, 1991; Jelinek and Schoonhoven, 1990; Van de Ven et al., 1989). Their findings suggest that the internal corporate venturing process, like any other entrepreneurial activity, is characterized by uncertainty and ambiguity (Daft and Lengel, 1986). While uncertainty implies imperfect knowledge about the causal relationships between means and end, ambiguity implies imperfect knowledge of which ends are worth pursuing (March and Olsen, 1976; Mintzberg, Raisinghani and Theoret, 1976; Weick, 1979; Ghemawat, 1991).

What guides the development of a venture under conditions of uncertainty and ambiguity? Several authors (e.g., Lindblom, 1959; Quinn, 1978, Chakravarthy, 1982) suggest that 'trial-and-error' learning is an appropriate process to guide the development of a venture under conditions of uncertainty. Trial-and-error learning is an adaptive process that provides entrepreneurs with an opportunity to evaluate outcomes associated with a course of action before deciding upon a future course of action. Entrepreneurs continue with a course of action if the associated outcomes are positive. In contrast, entrepreneurs change their course of action if the associated outcomes are negative.

While this trial-and-error learning process appears to be intuitively appealing under conditions of uncertainty, entrepreneurs sometimes display a different type of behavior. In particular, entrepreneurs may continue with a course of action despite experiencing negative outcomes. As Brunsom (1982) suggests, this type of 'action persistence' is often required to overcome the resistance most ventures encounter from naysayers within and outside the organization. We suggest that action persistence is likely to occur in the presence of ambiguity and when slack resources are available.

Key words: Corporate venturing process, action persistence, trial-and-error learning.
A comparison of trial-and-error learning and action persistence constitutes a central part of our model of the corporate venturing process. To complete our model, we also examine two other aspects that have been widely studied in the context of corporate venturing. These aspects include a study of plans that guide venture activities and the nature of corporate sponsors’ involvement with venture activities (Bower, 1970; Burgelman, 1983a,b,c). We first introduce relevant literature as we develop our model of the corporate venturing process. Next, we provide a description of the field research methods employed to conduct a real-time study of venture development within a large diversified corporation. We then present findings showing how and when trial-and-error learning and action persistence occurred during venture development. In conclusion, we explore the implications of the findings for internal corporate venturing.

CONCEPTUAL MODEL

Figure 1 summarizes our model of the corporate venturing process.

To develop the model, we first examine the two contingencies that characterize venture activities—uncertainty and ambiguity. As we explained earlier, uncertainty implies imperfect knowledge of the causal relationship between means and ends. Recognizing that uncertainty is an essential part of venture activities during early stages of its development, innovative firms do not penalize entrepreneurs for ‘mistakes’ (Jelinek and Schoonhoven, 1990). Instead, they encourage a process of trial-and-error learning (Lindblom, 1959; Quinn, 1978; Chakravarthy, 1982). Trial-and-error learning is a process where entrepreneurs initiate a course of action that they believe could be fruitful, and only continue with the course of action if the associated outcomes are positive. If outcomes are negative, entrepreneurs experiment with a different course of action. This experimentation continues until entrepreneurs experience a reciprocal linkage between actions and positive outcomes. Over time, entrepreneurs come to learn which courses of action they should pursue and which they should avoid in order to accomplish positive outcomes.

This trial-and-error learning process suggests the following connection between actions and outcomes under conditions of uncertainty.

IIIa: Entrepreneurs are likely to continue

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1 Outcomes represent events that reflect venture members’ assessment of performance over time. Positive (negative) outcomes reflect venture members’ assessment of performance above (below) their aspiration levels. Thus, outcome events, as measured in this study, incorporate any changes that may have occurred in venture members’ aspiration levels over time.
with a course of action if the associated outcomes are positive, and are likely to change their course of action if the associated outcomes are negative.

**H1b:** The trial-and-error process is likely to continue until actions and positive outcomes are linked reciprocally with one another.

Several researchers (Staw, 1976, 1981; Bronsson, 1982; Tang, 1988, Van de Ven and Polley, 1992) observe that entrepreneurs sometimes do not change their course of action when they experience negative outcomes. Persistence with a course of action is likely to occur especially when there is ambiguity about the right direction to pursue. While uncertainty implies imperfect knowledge about the causal relationship between means and ends, ambiguity implies imperfect knowledge of which ends are worth pursuing (March and Olsen, 1976; Mintzberg, et al., 1976; Weick 1979; Daft and Lengel, 1986; Ghemawat, 1991). Entrepreneurs experience ambiguity in the presence of several different technological approaches; each approach offering some benefits while compromising on others. Ambiguity is enhanced if entrepreneurs are not able to compare the different approaches in order to conclude which one will eventually be successful.

Under conditions of ambiguity, entrepreneurs simply 'enact' a solution (Daft and Lengel, 1986; Weick, 1979). In particular, entrepreneurs employ their judgments to deal with ambiguity by coming to a consensus on the basis for the interpretation of ambiguous cues. Enacting a solution results in persistence with a course of action that entrepreneurs believe may be worthwhile in the long run even though they might experience immediate negative outcomes (Brunsson, 1982).

This persistence behavior of 'damn the torpedoes, proceed full steam ahead' runs counter to trial-and-error behavior. After all, entrepreneurship does involve a certain deviance from the ordinary where risk seeking individuals create and exploit opportunities that others do not perceive. Several authors (e.g. March and Shapira, 1992; Kahneman and Tversky, 1979; Staw, 1981) suggest that negative outcomes may result in greater risk seeking behavior. Risk seeking behavior manifests itself in the single-minded pursuit of a course of action as entrepreneurs attempt to recoup past investments.

Eventually, if the venture is successful, action persistence creates heroes. If the venture is unsuccessful, action persistence creates villains who continued with a failing course of action.

However, persistence with a course of action despite the associated negative outcomes is possible only if entrepreneurs possess slack resources (Singh, 1986; March and Shapira, 1992). These slack resources are especially high soon after venture inception when corporate sponsors have granted resources that can be used to accomplish broadly defined goals. The presence of ambiguity as well at this stage of the venture's history creates an ideal setting for action persistence despite the associated negative outcomes.

These discussions provide an alternative formulation of a hypothesis connecting actions and outcomes, especially during early stages of venture development when ambiguity is present and slack resources are available.

**H1 (alt):** Entrepreneurs are likely to continue with a course of action despite experiencing negative outcomes when ambiguity is present and slack resources are available.

While entrepreneurs may continue with a course of action despite experiencing negative outcomes, sustained negative outcomes are likely to increase corporate sponsors' involvement with the venture (Tushman and Romanelli, 1985). If a venture sustains negative outcomes, corporate sponsors do not simply 'pull the plug' by discontinuing the flow of corporate resources. Besides their resource allocation role, sponsors perform other important roles as well (Jelinek and Schoonhoven, 1990; Van de Ven et al., 1989). These roles include those of a mentor, a champion, and a critic (Van de Ven et al., 1989). To perform these roles, sponsors increase their level of involvement with the venture. During these periods of increased venture involvement, corporate sponsors examine venture activities and explore different courses of action with entrepreneurs.

Corporate sponsors are also likely to increase their level of involvement with the venture when there are major environmental changes. Major environmental changes represent new and novel contexts for both entrepreneurs and corporate sponsors. It is during these occasions that
corporate sponsors can share with entrepreneurs their experiences with entrepreneurs in order to initiate appropriate changes in the course of action. These discussions serve as the basis for the following hypothesis on corporate sponsors' involvement with venture activities.

**H2a:** Environmental changes and negative outcomes are likely to increase corporate sponsors' involvement with venture activities.

**H2b:** Increased corporate sponsors' involvement is likely to result in a change in the course of action pursued by entrepreneurs.

So far, we have introduced two important aspects of venture activities—uncertainty and ambiguity. Both uncertainty and ambiguity are the result of rapidly changing environments within and outside the organization. As changes take place in the external environment, new opportunities and threats surface that result in either positive or negative assessments of outcomes. Entrepreneurs are likely to change their plans to capitalize on the opportunities and safeguard against the threats.

Entrepreneurs are also likely to change their plans based on the opportunities and threats that surface during the course of venture activities within the organization (Burgelman, 1991). Venture activities imply increasingly complex and differentiated progressions of developmental actions. While some of these actions will be directly related to achieving established plans, others will drift away in divergent directions that in retrospect will either imply interesting new plans for the innovation, or introduce new plans to justify their actions (Starbuck, 1983).

**H3:** Plans are likely to change with environmental changes and with changes in the course of action.

New plans imply new performance criteria that are often at odds with established performance criteria. Shifts in performance criteria are therefore likely to result in either a positive or a negative assessment of past performance. Plans changed to capitalize on opportunities preserve and enhance a sense of success, thereby leading to a positive assessment of past outcomes. Plans changed to safeguard against threats highlight inadequacies of a prior course of action, thereby leading to a negative assessment of past outcomes.

**H4:** A change in plans to safeguard against threats is likely to result in a negative assessment of past performance. A change in plans to capitalize on opportunities is likely to result in a positive assessment of past performance.

**METHODOLOGY**

We examine these hypotheses with longitudinal data collected on the development of a venture within a large diversified corporation. Venture activities began in 1978 to develop cochlear implants. Cochlear implants are biomedical devices that provide profoundly deaf people a sensation of sound. Henceforth, the venture will be referred to as CIP (Cochlear Implant Program).

At its peak, CIP's yearly operating budget was around $6.0 million supporting about 50 full time people. The venture was managed by a steering committee consisting of 9 functional managers and a venture director. The steering committee met once every month to review and decide the direction of the venture. Besides the personnel who comprised the venture team, three corporate sponsors played an important role in CIP's development. These sponsors were vice presidents at increasing levels of the corporate hierarchy. In particular, these sponsors were vice presidents at the division, group and sector levels of the corporation sponsoring CIP.

Data collection continued until CIP's termination in 1989. For the most part (from 1983 onwards), data collection was carried out on a real time basis. Data collection involved: (1) attending and recording proceedings at monthly steering committee meetings and semiannual administrative reviews of CIP, (2) semiannual interviews with CIP members and questionnaire surveys of all key CIP personnel, (3) annual interviews with corporate sponsors, and (4) information gathering from company records and industry trade publications.

A chronology of qualitative events in the development of CIP was developed and updated as events occurred in time. Events were defined as critical incidents when changes were observed in the innovation idea and activities, personnel...
appointments and roles, innovation unit relationships with others, environmental and organizational context, and outcomes. A relational database (Rbase System V) was used to record the date, description, and data source of each event. The event listing for the 12 years in the history of CIP’s existence contains 719 events.

Each event was then coded in terms of five dichotomous variables constituting our strategy process model as follows.

**Outcomes**—When events occurred that were evidence of outcomes, they were coded as either positive (good news or successful accomplishments), negative (bad news), or mixed (results indicating elements of both success and failure).

Outcomes include both tangible results of entrepreneurs’ courses of action and less tangible value judgments about the success or failure of venture activities by corporate sponsors and entrepreneurs. To minimize classification error, events coded as ‘mixed’ outcomes were not included in developing the dichotomous variable.

**Actions**—The directions of the actions that occurred in each event were coded according to whether they represented an expansion (addition, elaboration, reinforcement), contraction (subtraction, reduction, deemphasize), modification (revision, shift, correction), or persistence (in current direction) of the course of action under way.

Because trial-and-error learning consists of realizing which course of action to pursue and which to avoid, we combined modification events with contraction events to develop a composite measure of ‘change.’

Similarly, we combined persistence events and expansion events to develop a composite measure of ‘continuation.’

**Plans**—When a resource controller or CIP entrepreneur stated plans or outcome criteria that were different from the past, it was coded as a shift.

**Corporate sponsors’ involvement**—When corporate sponsors were behaviorally involved in an event, it was coded as such.

**External environmental events**—When an event involved a change in the activities occurring external but reported as relevant to CIP (including changes in competitors technology and industry structure), it was coded as an environmental event.

Two researchers independently coded each event, and they agreed on 91% of all codes. Differences were resolved through mutual consensus.

These coded events are the basis for two types of data analyses. First, we develop a qualitative description of CIP’s activities from the perspective of our strategy process model. Second, we examine our model of the venturing process as a structural system of four simultaneous time series equations corresponding to the hypotheses summarized in Figure 1.

\[
\begin{align*}
O_t &= a_1 + \beta_{12}A_{t-1} + \beta_{13}E_{t-1} + \beta_{14}P_t + e_1 \\
A_t &= a_2 + \beta_{22}O_{t-1} + \beta_{23}SP_{t-1} + e_2 \\
SP_t &= a_3 + \beta_{32}O_{t-1} + \beta_{33}E_{t-1} + e_3 \\
P_t &= a_4 + \beta_{42}A_{t-1} + \beta_{43}E_{t-1} + e_4
\end{align*}
\]

where:

\[
\begin{align*}
O & = \text{monthly count of positive minus negative outcome events;} \\
A & = \text{monthly count of continuation minus change action events;} \\
E & = \text{monthly count of the number of environmental events;} \\
P & = \text{monthly count of the number of shifts in plans/outcome criteria;} \\
SP & = \text{monthly count of the number of times corporate sponsors were involved}
\end{align*}
\]

\[a_i = \text{constant term} \]
\[B_{ij} = \text{parameter estimates} \]
\[e_i = \text{error terms.} \]

and, the signs of the parameter estimates are as shown in Figure 1.

In each equation, the independent variables are lagged one time period \((t - 1)\) in predicting
the dependent variable at time t. Each equation contains a constant term to reflect the accumulated base levels of the dependent variable from previous periods over and above the direct contributions of the independent variables in a given period. Such a simultaneous equation model captures the effects that an endogenous variable (e.g., outcome events) in one equation may have on the effects of that variable in another equation. In this system of equations, external context (E) is the only exogenous variable in the model; all others are endogenous—operating as a dependent variable and a lagged independent variable in the four equations. This means that the model is under-identified. Finally, autocorrelation may exist in both the error terms and the endogenous variables in the model. As a result, ordinary least squares on these equations would very likely produce estimators that are biased and inconsistent (Wonnacott and Wonnacott, 1979).

To deal with these problems of identification and autocorrelation, the model will be tested with the two-stage least square (2-SLS) procedure that Fair (1970) has developed and shown to provide consistent and efficient estimates of simultaneous equation models with lagged endogenous variables and first order serially correlated errors. In the first stage regression, a set of instrumental variables are computed for the endogenous variables in the system which are uncorrelated with the error terms and dependent variables. In the second stage regression, these instrumental variables are substituted for the original lagged dependent variables to yield unbiased and consistent regression coefficients.

To carry out these qualitative and quantitative analyses, we first aggregated the coded event sequence data into a fixed temporal interval. This was accomplished employing ‘SELLAGGER’, a computer software program developed by Lin (1989). Given the absence of prior research on temporal intervals for event sequence data on venture development, we experimented with monthly, quarterly, and semi-annual intervals. A monthly interval was chosen for aggregating events as it provides the most substantively meaningful interpretation of the time series graphs and regression results. Moreover, a monthly count of events corresponds to the temporal frequency of CIP steering committee meetings that were held to review CIP activities.

In aggregating the event sequence data to monthly counts, we chose not to weight the importance of events as this could bias the results before statistical analysis demonstrated the importance of certain temporal relationships. Instead, we chose to rely on our qualitative understanding of the events to interpret the quantitative data analysis.

RESULTS

Figure 2 presents five graphs showing the temporal frequencies and distributions of monthly coded events in CIP’s development.

Figure 2A is a plot of the monthly number of continuation events (totaling 456 events) minus the monthly number of changing events (totaling 263 events). Of the 719 total events, 341 include changes in outcomes, 232 (68%) of which were judged negatively, while 109 (32%) were judged to represent positive outcomes for CIP (see Figure 2B). Figures 2C, 2D, and 2E show a monthly count of the number of times corporate sponsors were involved, shifts in plans and associated outcome criteria, and external environmental events, respectively occurring in 10%, 7%, and 13% of all 719 events during the 12-year period.

This preliminary data analysis suggests the presence of three qualitatively different periods in the history of CIP’s development. These three temporal periods are designated in Figure 3 which superimposes Figures 2a and 2b in order to provide a visual representation of the connections between outcomes and actions.

These three periods include: (1) an agenda setting period between 1978 and 1980 before the formal inception of the venture, (2) an expansion period between 1980 and 1985 when entrepreneurs continued with a course of action to develop ‘single-channel’ cochlear implants despite experiencing negative outcomes, and (3) a contraction period between 1985 and 1989 when outcomes improved as entrepreneurs pursued a changed but contracting course of action. Before we examine the time series equations that constitute our strategy process model, we provide a qualitative account of CIP activities to familiarize the reader with the unfolding processes during these periods.
Qualitative description

Table 1 summarizes the various aspects of our strategy process model that we discuss for each period.

Agenda setting period (1978–80)

This period represents activities undertaken to evaluate the technical and commercial feasibility of pursuing a cochlear implant venture. Business and technological considerations shaped plans that emerged through a series of negotiations between those associated with CIP. Several different types of cochlear implant were considered for commercial development as those associated with the venture assimilated information gathered from around the world.

Based on their search activities, CIP entrepreneurs came to the conclusion that CIP offered a significant commercial opportunity, especially if they were the first to obtain regulatory approvals for the commercial sale of the product.

At a price of $1000 per device, the U.S. cochlear implant market alone could be worth $100 million. Because of the uncertainty about the safety of the cochlea, CIP entrepreneurs decided to begin venture activities with a simple single-channel device. As a simple single-channel device would have limited performance potential, CIP entrepreneurs also decided to develop future generations of cochlear implants based on more complex multichannel technologies.

Expansion period (1980–85)

With the formal inception of the program in 1980, CIP entrepreneurs reaffirmed their plans to be the first in the market with a safe single-channel device. To accomplish this objective, CIP entrepreneurs decided not to make any core design changes in its first generation single-channel device. In anticipation of early regulatory approvals for their cochlear implants, CIP entrepreneurs began creating industry infrastructures (such as distribution channels, trained surgeons...
<table>
<thead>
<tr>
<th>Period</th>
<th>Environment</th>
<th>Actions</th>
<th>Plans</th>
<th>Outcomes</th>
<th>Corporate sponsors</th>
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<tr>
<td>Agenda setting (1978–80)</td>
<td>No competitors</td>
<td>Formal inception of CIP</td>
<td>Be first in the market with a series of products</td>
<td>Assessment of position very favorable—large market with few competitors</td>
<td>Separation of corporate sponsors from entrepreneurial team</td>
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<td>Expansion (1980–85)</td>
<td>Several cochlear implant approaches with multiple testing standards resulting in ambiguity</td>
<td>Actions to be first in market with simple single-channel device</td>
<td>Plans extended to include related projects such as tinnitus and diagnostics</td>
<td>Mixed outcomes—FDA approvals but cues from environment that single channel not appropriate in the long run</td>
<td>Corporate sponsors are involved on a periodic basis</td>
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<td>Competitor's multi-channel device receives regulatory approvals</td>
<td>Emergent activities to develop multi-channel device curbed</td>
<td>Plans to develop multi-channel device abandoned to develop safer device</td>
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<tr>
<td>Contraction (1985–89)</td>
<td>Ambiguity disappears as multi-channel devices considered superior to single-channel devices</td>
<td>Actions taken to develop safer single-channel device</td>
<td>Change of plans to target children and patients with residual hearing</td>
<td>Outcomes worsen as CIP unable to accomplish sales and revenue objectives</td>
<td>Corporate sponsors seek economic rationale for continuing with single-channel device</td>
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<td>Single-channel development stopped &amp; multi-channel development begun; Other programs pruned</td>
<td>Plans to phase out of single- to multi-channel and then to hearing aids</td>
<td>No longer technological leaders; CIP multi-channel devices do not show good results; Mounting financial losses</td>
<td>Change in venture manager: Very close monitoring of venture by corp. sponsors who encourage change in plans to include hearing aids</td>
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<td></td>
<td></td>
<td>Persistence of CIP actions despite decision to discontinue</td>
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and audiologists) necessary for the rapid diffusion of cochlear implants. CIP entrepreneurs also began activities to explore emergent opportunities associated with cochlear implants. These activities included efforts to: (1) employ cochlear implants as a cure for tinnitus (a debilitating ringing sound), and (2) generate revenues from the diagnosis of hearing impairments.

While these activities were unfolding, other firms commenced activities to develop cochlear implants based on more complex multi-channel technologies. Four other firms entered the cochlear implant industry. Researchers associated with these firms claimed that devices based on the single-channel technology (adopted by CIP) were inferior in comparison to devices based on the multichannel technology. Some researchers informed the Food and Drug Administration (FDA) that single-channel devices were ‘archaic’.

In response to the claims made by competing firms about multi-channel devices, CIP entrepreneurs began promoting the importance of cochlear safety that single-channel devices offered over multi-channel devices. To demonstrate the importance of cochlear safety, several CIP researchers initiated research that explored safety related issues. Over time, these safety related activities led to a belief among CIP entrepreneurs that cochlear safety was of paramount importance. As a result, CIP entrepreneurs abandoned their earlier plans to develop future product generations based on the multi-channel technology, and instead, decided to base their second-generation cochlear device on another safer single-channel technology.

During this period of CIP’s development, there appears to have been some ambiguity about whether multi- or single-channel cochlear devices would eventually be successful. Reasons for this ambiguity are twofold. First, sufficient number of patients had not yet been implanted with different types of cochlear implants. Consequently, it was difficult for researchers to come to any meaningful statistical conclusion on the superiority of one type of cochlear implant over the other. Second, single and multi-channel devices had been developed from different design considerations. For instance, multi-channel implants had been designed to facilitate open speech recognition. In contrast, single-channel device had been designed to facilitate the identification of environmental sounds. Single-channel devices were also designed to minimize potential cochlear damage that could occur during electrode insertion by incorporating an electrode that was shorter than the electrodes used with multichannel devices.

To test and promote the performance of their respective devices, researchers associated with each device developed performance tests that almost became tautological with the devices they were supposed to test. Claims made by firms based on these performance tests were therefore ambiguous, possessing relevant tests only to those who understood or employed particular performance tests while being vague to others employing different performance tests. Noting this fact, Popelka and Gittelman (1984) stated that:

A lack of standardized procedures for evaluating the new clinical entity and a lack of reported results obtained with standard audiological measures makes it very difficult to assess pre and post implant performance and to compare cochlear implant results either to those obtained with conventional amplification or to those obtained from other cochlear implant patients (Popelka and Gittelman, 1984; 255).

Ambiguity about the appropriate cochlear implant route adversely affected CIP’s ability to accomplish sales targets and revenue projections. In particular, market surveys carried out by CIP entrepreneurs pointed out that customers were awaiting the availability of multi-channel devices that competing firms claimed to be superior in comparison to single-channel devices.

Competitors’ claims of multi-channel superiority and CIP’s inability to accomplish sales and revenue targets increased corporate sponsors’ involvement with CIP. During negotiations with corporate sponsors, CIP entrepreneurs changed their plans and associated evaluation criteria to project the long-term viability of the venture, even though outcomes in the short term were negative. The main shift in plans consisted of a proposal to expand the potential market size. Entrepreneurs argued that their safer single-channel devices gave them unique access to large untapped market segments where safety considerations were of paramount importance. These market segments included children and adults suffering from hearing impairments but who were not profoundly deaf. CIP’s inability to accomplish earlier negotiated milestones there-
Therefore did not concern corporate sponsors since entrepreneurs projected expanded future commercial potential with their new plans. As a result, even though corporate sponsors became more involved with the venture, their involvement did not lead to a change in the course of action.

Several environmental events occurred in late 1984 that reduced the ambiguity about the superiority of multi-channel devices over single-channel devices. In November 1984, the Food and Drug Administration (FDA) distributed a status report highlighting the potential superiority of multi-channel devices over single-channel devices. Other technical evaluations carried out by several independent associations came to similar conclusions. For instance, a Health Technology Assessment Report (1986) prepared by the Office of Health Technology Assessment (OHTA) stated that:

The National Institute of Health has informed OHTA in 1985 that there were at least 6 different cochlear implant devices currently under development that are substantially different from each other. —The multi-channel device was considered to supply more information to the auditory system than the single channel device which was reflected in improved lip reading scores. —The incidence of potential risks due to surgery or electrical stimulation was considered low (Health Technology Assessment Report, 1986: 37–38).

As environmental ambiguity about cochlear implant performance and safety attributes disappeared, many within CIP began questioning the wisdom of continuing with the single-channel device. Corporate sponsors too encouraged CIP entrepreneurs to begin developing multi-channel devices and to discontinue any further single-channel developmental work. In 1985, corporate sponsors changed the CIP venture manager. The new manager's mandate was to reassess the technical and commercial viability of the venture and to decide whether to continue with the venture or to terminate it.

Contraction period (1985–89)

Several aspects distinguished this period from the expansion period. First, entrepreneurs, by their own accounts, shifted their focus on issues concerning venture survival as the flow of corporate resources diminished and CIP was unable to generate revenues internally through its operations. Second, the level of ambiguity about the superiority of the multi-over single-channel device disappeared. Third, corporate sponsors became more closely involved with venture activities.

The introduction of the new manager led to a fresh assessment of CIP's past performance and future potential. This assessment led to a realization that: (1) CIP was not the technology leader, and (2) CIP was in considerable financial trouble. A realization that CIP was not the technology leader led to a change in plans to reorient CIP with its environment. In particular, a decision was taken to begin developing devices based on the multi-channel technology and to stop developing cochlear implants based on the single-channel technology. Subsequently, CIP entrepreneurs approached corporate sponsors for additional resources to carry out plans to develop multi-channel devices. At an administrative review held in September 1986, corporate sponsors sought more radical shifts in the venture before they agreed to fund the development of multichannel devices. Subsequent discussions between corporate sponsors and entrepreneurs led to another proposal that was finally approved. This proposal consisted of plans to begin development of: (1) multi-channel devices to regain technological leadership, and (2) hearing aids to establish the commercial viability of the venture.

Over time, entrepreneurs began deploying their resources to develop hearing aids. Correspondingly, the number of activities associated with cochlear implants reduced over time (see Figure 3). Over time, CIP's status diminished from a 'program' with independent profit and investment responsibilities to a laboratory project with cost responsibilities. By December 1987, 80% of the entrepreneurs associated with CIP were working full time on hearing aids. The remaining members of the entrepreneurial team continued developing multi-channel devices, mainly as a research activity. However, lacking critical mass and resources, even their activities dwindled. In 1989, the cochlear implant venture was sold to a competitor.

Statistical results

In this section we empirically examine the strategy process for the expanding and contracting periods
separately as there were qualitatively different dynamics and contingencies associated with each period. We do not empirically examine the strategy process during the agenda setting period as the CIP venture had not been formally initiated.

Our qualitative description highlights that the expansion period was characterized by ambiguity about multi- and single-channel devices. Moreover, during the expansion period, corporate sponsors had granted entrepreneurs resources with which to pursue CIP activities. These slack resources, along with the presence of ambiguity, appear to have led to persistence behavior during the expansion period.

During the contraction period, ambiguity disappeared as it became clear that multi-channel devices were superior in comparison to single-channel devices. Moreover, corporate sponsors tightened resource streams making future funding contingent upon a changed course of action. The absence of ambiguity and slack resources appear to have led to trial-and-error learning during this period.

As introduced earlier we test the strategy-process model during the expansion and contraction periods by converting the hypotheses into a set of four time series regression equations. Table 2 presents the results of the time series regression analyses during the expansion period.

For each equation, the table shows the regression coefficient and its significance for each lagged independent variable, and an adjusted $R^2$ for the overall equation. Serial correlations of error terms evaluated using the Durbin-Watson statistic were significant, and were corrected using the Fair (1970) procedure.

When considered together, the results in Table 2 strongly suggest the presence of action persistence during the expansion period of CIP’s history. As we discussed in our qualitative account of venture activities, outcome assessments were negative as environmental changes created difficulties in accomplishing sales and revenue targets. This is consistent with the negative sign linking environmental changes with outcomes. Though assessment of outcomes were negative, entrepreneurs continued with their course of action. This persistence behavior is captured by the statistically significant negative relationship between outcomes and actions.

Environmental changes also significantly explain corporate sponsors’ involvement with the venture. However, corporate sponsors’ involvement is not a significant predictor of the course of action during this period. In the qualitative section we provide an explanation for this result. Entrepreneurs continued projecting the future potential of the venture by changing plans and associated evaluation criteria based on opportunities that emerged from their venture activities. This is reflected in the fact that actions are significant predictors of plans during this period rather than changes in the environment. This also explains the sign of the linkage between actions and plan changes, which is in a direction opposite to the one hypothesized, suggesting that plans changed even as CIP entrepreneurs continued with their course of action.

The results highlight possible modifications of the set of hypotheses that constitute action persistence. Corporate sponsors’ involvement and the environmental changes represent increasing degrees of external influence on entrepreneurial activities. Results indicating that corporate sponsors’ involvement and external environmental changes were not significant predictors of changes in actions and plans respectively suggests that entrepreneurs may have ‘insulated’ the entrepreneurial process to inputs from external sources.

Results for the contraction period between 1985 and 1989 are shown in Table 3.

The results for the contraction period are a ‘mirror reflection’ of the results for the expansion period (Table 2). Paths that were statistically significant during the expansion period become insignificant during the contraction period, while others that were insignificant, become significant. This time, the reciprocal relationships between outcomes and actions are positive (though only the connection between action and outcomes is significant) reflecting trial-and-error learning behavior.

Negative outcomes, rather than environmental events, are significant predictors of corporate sponsors’ involvement during the contraction period, reflecting perhaps sponsors’ closer monitoring of outcomes. Sponsors’ involvement significantly explains changes in the course of action. As we explained in the description of CIP’s activities, corporate sponsors sought changes in the course of action before extending further corporate resources.

Unlike the expansion period, both environmen-
Table 2. Results of time series regression analysis to test process model during CIP's expansion period

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<tr>
<th>Dependent variables</th>
<th>Outcomes: positive-negative at ( t )</th>
<th>Actions: continue-change at ( t )</th>
<th>Plans/criteria shifts at ( t )</th>
<th>Corporate sponsors' involvement at ( t )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independent variables</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outcomes: positive-negative at ( t-1 )</td>
<td>NA</td>
<td>-0.27*</td>
<td>NA</td>
<td>-0.04</td>
</tr>
<tr>
<td>Actions: continue-change at ( t-1 )</td>
<td>-0.12</td>
<td>NA</td>
<td>0.28*</td>
<td>NA</td>
</tr>
<tr>
<td>Corporate sponsors' involvement at ( t-1 )</td>
<td>NA</td>
<td>0.29</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Plans/criteria shifts at ( t-1 )</td>
<td>-0.24</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Environment events at ( t-1 )</td>
<td>-1.31**</td>
<td>NA</td>
<td>0.11</td>
<td>0.49*</td>
</tr>
<tr>
<td>Constant</td>
<td>0.64</td>
<td>2.93**</td>
<td>0.50*</td>
<td>0.28</td>
</tr>
<tr>
<td>Durbin-Watson Statistic</td>
<td>1.82</td>
<td>1.6</td>
<td>1.05</td>
<td>1.86</td>
</tr>
<tr>
<td>Adjusted ( R^2 )</td>
<td>0.41</td>
<td>0.52</td>
<td>0.71</td>
<td>0.55</td>
</tr>
<tr>
<td>( N ) (months)</td>
<td>55</td>
<td>55</td>
<td>55</td>
<td>55</td>
</tr>
</tbody>
</table>

\* \( \beta \) at least 1.5 times its standard error
\** \( \beta \) at least 2 times its standard error

\( NA = \) Independent variable not included in the regression equation

Visual representation of results during CIP's expansion period

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Table 3. Results of time series regression analysis to test process model during CIP’s contraction period

<table>
<thead>
<tr>
<th>Dependent variables</th>
<th>Outcomes: Positive-negative at t</th>
<th>Actions: continue-change at t</th>
<th>Plans/criteria shifts at t</th>
<th>Corporate sponsors' involvement at t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independent variables</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outcomes: positive-negative at t-1</td>
<td>NA</td>
<td>0.12</td>
<td>NA</td>
<td>-0.22**</td>
</tr>
<tr>
<td>Actions: continue-change at t-1</td>
<td>0.53**</td>
<td>NA</td>
<td>-0.11*</td>
<td>NA</td>
</tr>
<tr>
<td>Corporate sponsors' involvement at t-1</td>
<td>NA</td>
<td>-0.77**</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Plans/criteria shifts at t-1</td>
<td>-0.16</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Environment events at t-1</td>
<td>-1.44</td>
<td>NA</td>
<td>0.33**</td>
<td>0.16</td>
</tr>
<tr>
<td>Constant</td>
<td>0.37</td>
<td>-0.97**</td>
<td>0.09</td>
<td>0.63</td>
</tr>
<tr>
<td>Durbin–Watson Statistic</td>
<td>1.73</td>
<td>2.05</td>
<td>1.92</td>
<td>1.75</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.54</td>
<td>0.26</td>
<td>0.47</td>
<td>0.59</td>
</tr>
<tr>
<td>N (months)</td>
<td>44</td>
<td>44</td>
<td>44</td>
<td>44</td>
</tr>
</tbody>
</table>

* $\beta$ at least 1.5 times its standard error
** $\beta$ at least 2 times its standard error
NA = Independent variable not included in the regression equation

![Visual representation of results during CIP's contraction period]

Visual representation of results during CIP's contraction period

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tempal events and internal actions significantly explain changes in plans. This time, the sign of the relationship between actions and plan changes is in the hypothesized negative direction, suggesting that plans were changed as CIP entrepreneurs changed their course of action. When considered together, these results suggest that trial-and-error learning may be accompanied by an ‘opening-up’ of the entrepreneurial process to external sources of influence from corporate sponsors and the environment.

**CONCLUSION**

We have examined processes that characterize the development of a new venture within a corporation. So far, debates on corporate venturing have centered around a comparison of processes that characterize evolutionary and revolutionary changes (e.g. Miller and Friesen, 1980; Tushman and Romanelli, 1985; Burgelman, 1983a,b,c). While fully recognizing the importance of these processes we have compared trial-and-error learning and action persistence that characterize venture activities. Trial-and-error learning occurs as entrepreneurs avoid courses of action associated with negative outcomes while pursuing courses of action associated with positive outcomes. However, entrepreneurs sometimes choose courses of action despite experiencing negative outcomes. We suggest that action persistence is more likely to occur in the presence of ambiguity and when slack resources are available.

We have developed and applied new methods to examine these processes with longitudinal data on the development of a venture within a large corporation. The results support our core hypotheses on action persistence and trial-and-error learning while extending our understanding of associated processes. It appears that action persistence may be accompanied by an insulation of the entrepreneurial process to inputs from corporate sponsors and from the external environment. Insulating the entrepreneurial process may be important for entrepreneurs to make progress with a course of action that they believe may eventually be successful despite experiencing immediate negative outcomes. In contrast, trial-and-error learning may be accompanied by an ‘opening-up’ of the entrepreneurial process to inputs from corporate sponsors and from the external environment.

How can findings from this study better guide the management of ventures within corporations? Based on our real time association with CIP, we find it difficult to fault action persistence in the presence of ambiguity. After all, under conditions of ambiguity, no person associated with cochlear implants could have predicted whether multi- or single-channel devices would eventually be successful.

Daft and Lengel (1986) suggest that one way entrepreneurs deal with ambiguity is to enact a ‘safety’ approach. CIP entrepreneurs appear to have dealt with ambiguity by this approach. Confronting ambiguous cues about the superiority of the multi-channel device over the single-channel device, CIP entrepreneurs became convinced about the importance of the safety of the single-channel devices.

However, in dealing with the ambiguity by enacting a ‘safety’ approach, CIP entrepreneurs did not encourage any experimentation with the multi-channel device at all. Despite CIP’s initial plans to develop multi-channel devices, CIP entrepreneurs employed all their resources to develop only single-channel devices. Moreover, CIP entrepreneurs discouraged emergent activities to experiment with multi-channel devices. Deployment of some of CIP’s resources to experiment with multi-channel devices would have enabled CIP entrepreneurs to resolve ambiguity differently by developing internal resources of organizational intelligence.

Besides compromising CIP’s ability to resolve ambiguity internally, a lack of multi-channel experimentation also compromised CIP’s technological flexibility (Ghemawat, 1991). Single-minded pursuit of single-channel devices in the presence of ambiguity represents risk-seeking behavior by CIP entrepreneurs. Consequently, even a rudimentary multi-channel version was not available to CIP when ambiguity was resolved in 1985. Therefore, CIP’s decision to begin with the development of multi-channel devices in 1985 effectively implied beginning the venture afresh.

Even though CIP’s multi-channel ‘age clock’ (Amburgey, Kelly, and Barnett, 1990) was reset to zero, the venture clock was not reset with respect to its financial performance. CIP’s accumulated losses continued to weigh against future resource allocation decisions. CIP entre-
preneurs continually had to justify their need for additional resources. Moreover, CIP entrepre-
neurs had to make major decisions in consultation
with corporate sponsors who were busy oversee-
ing other ventures in their portfolio as well.

These dynamics considerably reduced the
autonomy and the resources available to CIP entrepre-
neurs pointing to a potential ‘pathology’
(Bourgeois and Brodwin, 1984) of corporate
sponsors’ involvement. Paradoxically, despite the
presence of trial-and-error learning during the
contraction period of CIP’s history, there was a
steady decline in its level of activities. Under
survival conditions, learning manifests itself more
in the contraction of single-channel activities
associated with negative outcomes rather than
in the expansion of multi-channel activities
associated with positive outcomes. Over time,
CIP activities fell below a critical threshold level
necessary to sustain the venture.

These observations raise questions about cor-
porate sponsors’ roles in directing venture activi-
ties. Van de Ven et al. (1989) suggest that
corporate sponsors perform several roles includ-
ing those of mentors, critics and champions. Based
on our earlier discussions on the development of
internal sources of organizational intelligence, we
suggest that the critic’s role may be more
important during early stages of venture develop-
ment when ambiguity is high and slack resources
are available. In performing a critic’s role during
this stage of venture development, sponsors can
crush into account that a portion of the slack resources are
set aside to experiment with alternative courses of
action.

If the venture sustains negative outcomes over
time, the continuation of the critic’s role may
lead to the dynamics of contraction and closure
that we observed with CIP. It is under these
conditions that sponsors may perform a mentor’s
role. Because of their considerable experience
with ventures, sponsors can provide entrepre-
neurs valuable guidance to shape venture activi-
ties. However, in order to perform this mentor’s
role, sponsors may need to be involved with the
venture almost on a day-to-day basis until the
venture begins experiencing positive outcomes.
Association with the venture that stops short
of this kind of involvement, along with the
continuation of the critic’s role, may lead to
the contraction and closure of a venture.

We offer these observations realizing that they
are based on one venture gone awry. Our span
of generalization in this paper is not from a
to a sample to a population, but from a set of events
to a model of the corporate venture process. We
have followed Bower’s approach of beginning
with ‘an abstract version of the problem which
in turn permits one to prescribe the route to
improved performance’ (Bower, 1970: 281). The
important substantive conclusions of this research
about trial-and-error learning, action persistence
and other associated processes are applicable
to other corporate venture settings that are
characterized by uncertainty and ambiguity. We
believe that the systematic methods that we offer
can be employed to carry out similar real time
studies in other corporate settings to establish
the robustness of our findings.

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