The Innovation Journey

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New York Oxford
Oxford University Press
1999

Oxford University Press

Oxford New York
Athens Auckland Bangkok Bogotá Buenos Aires Calcutta
Cape Town Chennai Dar es Salaam Delhi Florence Hong Kong Istanbul
Karachi Kuala Lumpur Madras Madrid Melbourne Mexico City Mumbai
Nairobi Paris São Paulo Singapore Taipei Tokyo Toronto Warsaw

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Berlin Ibadan

Published by Oxford University Press, Inc.
198 Madison Avenue, New York, New York 10016

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Library of Congress Cataloging-in-Publication Data
The innovation journey / Andrew H. Van de Ven . . . [et al.].
p. cm.
Includes bibliographical references and index.
ISBN 0-19-513307-2
1. Technological innovations—Management.
2. Industrial management. I. Van de Ven, Andrew H.
HD45.I5375 1999
658.5' 14—dc21 99-12927

9 8 7 6 5 4 3 2 1

Printed in the United States of America
on acid-free paper

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Mapping the Innovation Journey

A "road map" of how the innovation journey typically unfolds summarizes common patterns observed during the development of a wide variety of innovations studied by the Minnesota Innovation Research Program (MIRP). Providing an empirically grounded map has eluded innovation scholarship because, to date, few studies have directly examined the innovation process in real time. As a result, few empirically substantiated statements about how the innovation journey unfolds were available. One of MIRP's major objectives was to map empirically how innovations develop from concept to reality. The map is based on what MIRP researchers observed, not on what they thought should have happened.

Such a descriptive map represents a useful first step in maneuvering the innovation journey. It identifies the temporal sequence of events, junctures, and hurdles that innovation teams and managers experience along the innovation journey. Knowing how the innovation process typically unfolds provides useful empirical data for analyzing and then developing prescriptions to undertake the journey.

This journey is as much about discovery as it is about creation. The outcomes of the creative process itself may not be imaginable at the outset, but the processes that underlie these endeavors could be mapped, thereby drawing attention to the generating mechanisms that give rise to innovation processes and outcomes.

But as the saying goes, "To be forearmed is to be forewarned!" The map of the innovation journey crosses a rugged landscape that is a highly ambiguous and often uncontrollable and unique to its travelers. Many journeys remain uncharted. However, from among the innova-

tions that were charted by MIRP researchers, we can say that innovation can be accomplished in a number of different ways and that the journey can unfold along many different routes. Moreover, many important elements of the innovation process were observed to be much alike across the highly diverse set of technological, product, process, and administrative innovations studied by MIRP. These common patterns provide the justification for discussing a generic innovation journey in this chapter.

By "generic" we mean that, for the most part, we will focus on an innovation that (1) consists of a purposeful, concentrated effort to develop and implement a novel idea; (2) is of substantial technical, organizational, and market uncertainty; (3) entails a collective effort of considerable duration; and (4) requires greater resources than are held by the people undertaking the effort. This definition includes the forms of innovation in which most managers and venture capitalists typically invest and hope will produce a useful result—be profitable, be constructive, or solve a problem. This generic definition excludes small, quick, incremental, lone-worker innovations. It also eliminates innovations that emerge primarily by chance, accident, or afterthought, although many of these elements may be contained in our description of how generic innovations develop.

This chapter provides an overview map of the key process characteristics commonly observed in the diverse innovations studied by MIRP. Then we examine the details of each process characteristic and explain their occurrences. We also describe instances in which these process characteristics varied among the fourteen innovations studied by MIRP. We exemplify these process characteristics by featuring the cases of innovation that are presented in Part II, chapters 8, 9, and 10.

1. One innovation, within a large diversified corporation, 3M, is the Cochlear Implant Program (CIP), which was undertaken to create a new business by developing a line of products, including cochlear implants, hearing aids, and otological diagnostics instruments for the hearing health industry.
2. The Therapeutic Apheresis Program (TAP) is a joint interorganizational venture among 3M, Sarns, and Millipore corporations. The TAP was undertaken to create a new biomedical products business and diagnostics instruments to treat a variety of diseases by separating pathogenic substances from blood and returning the beneficial blood components to the patient. Both CIP and TAP represent new-to-the-world technologies and products, and both were major long-term investments and commitments to create new businesses that were expected to generate significant revenues in ten to fifteen years for the corporations involved.
3. In the case of a new company start-up, called Qnetics, founding entrepreneurs pursued a variety of new business crea-

tions during the company's nine-year existence. They include a computer distributor and maintenance business, a custom-design computer software business, a line of medical software products for patient and financial records for hospitals and third-party payers, and an electrical load management hardware and software business for the power utilities industry.

Common Elements in the Innovation Process

Schroeder, Van de Ven, Scudder, and Polley (1986, 1989) and Angle and Van de Ven (1989) examined the processes of development among the fourteen different technical and administrative innovations included in the MIRP studies. By comparing longitudinal case histories on the development of these innovations, they found that none of the innovations developed in a simple linear sequence or stages or phases of activities over time. Instead, a much messier and more complex progression of events was observed in the development of each innovation. However, patterns of commonality were found in these developmental progressions. The common elements were empirically derived and pertain to the initiation, development, and implementation periods of the innovations. Although every process characteristic was not observed in every innovation case, and although cases varied in the degrees to which the process occurred, overwhelming support was evident for these process patterns in the majority of cases.

The Initiation Period

1. Innovations are not initiated on the spur of the moment, by a single dramatic incident, or by a single entrepreneur. In most cases, there was an extended gestation period lasting several years in which seemingly coincidental events occurred that preceded and set the stage for the initiation of innovations.
2. Concentrated efforts to initiate innovations are triggered by "shocks" from sources internal or external to the organization.
3. Plans are developed and submitted to resource controllers to obtain the resources needed to launch innovation development. In most cases, the plans served more as "sales vehicles" than as realistic scenarios of innovation development.

The Developmental Period

4. When developmental activities begin, the initial innovative idea soon proliferates into numerous ideas and activities that proceed in divergent, parallel, and convergent paths of development.
5. Setbacks and mistakes are frequently encountered because plans go awry or unanticipated environmental events signif-

icantly alter the ground assumptions of the innovation. As setbacks occur, resource and development time lines diverge. Initially, resource and schedule adjustments are made and provide a "grace" period for adapting the innovation. But, with time, unattended problems often "snowball" into vicious cycles.

6. To compound the problems, criteria of success and failure often change, differ between resource controllers and innovation managers, and diverge over time, often triggering power struggles between insiders and outsiders.
7. Innovation personnel participate in highly fluid ways. They tend to be involved on a part-time basis, have high turnover rates, and experience euphoria in the beginning, frustration and pain in the middle period, and closure at the end of the innovation journey. These changing human emotions represent some of the most "gut-wrenching" experiences for innovation participants and managers.
8. Investors and top managers are frequently involved throughout the development process and perform contrasting roles that serve as checks and balances on one another. In no cases were significant innovation development problems solved without intervention by top managers or investors.
9. Innovation development entails developing relationships with other organizations. These relationships lock innovation units into specific courses of action that often result in unintended consequences.
10. Innovation participants are often involved with competitors, trade associations, and government agencies to create an industry or community infrastructure to support the development and implementation of their innovations.

The Implementation/Termination Period

11. Innovation adoption and implementation occurs throughout the developmental period by linking and integrating the "new" with the "old" or by reinventing the innovation to fit the local situation.
12. Innovations stop when implemented or when resources run out. Investors or top managers make attributions about innovation success or failure. These attributions are often misdirected but significantly influence the fate of innovations and the careers of innovation participants.

Figure 2.1 provides an illustration of how these common process characteristics fit together into an emerging process model of innovation. (The figure was initially developed by Schroeder et al. [1986, 1989] and subsequently extended by Angle and Van de Ven [1989]). Imagine ongoing operations of an organization proceeding in the general direction of point A. An innovation is launched that proceeds in

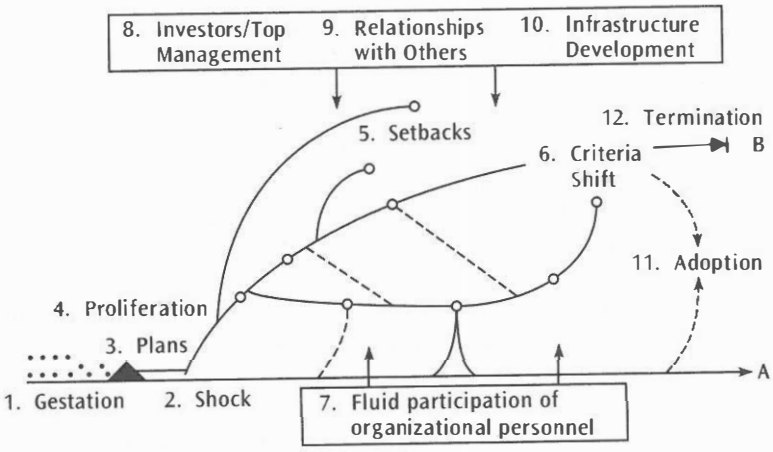

Figure 2.1 Key components of the innovation journey

the new direction of point B. The overall innovation process is partitioned into three temporal periods: (1) an initiation period, in which activities and events occur that set the stage for launching efforts to develop an innovation; (2) a developmental period, in which concentrated efforts are undertaken to transform the innovative idea into a concrete reality; and (3) an implementation or termination period, in which the innovation is adopted and institutionalized as an ongoing program, product, or business or it is terminated and abandoned.

We now discuss the process highlights of this generic innovation journey. Of course, components are not the same in all innovations. As discussed in a later section, the key process elements are expected to be more pronounced for innovations of greater novelty, size, and temporal duration.

Initiation Period

Gestation

What precipitates the initiation of innovation efforts? As innovation historians have found (e.g., Usher, 1954; Layton, 1986), in most of the innovations studied by MIRP, there was an extended gestation period, often lasting three or more years, in which people engaged in a variety of activities that set the stage for innovation (Angle and Van de Ven, 1989). Many initial events during the gestation period were not intentionally directed toward an innovation. Some events triggered recognition of the need for change, for example, deteriorating organizational performance (Cameron, Freeman, and Mishra, 1993) or changing envi-

ronmental conditions (Huber, Sutcliffe, Miller, and Glick, 1993; Meyer, Goes, and Brooks, 1993). Other events generated awareness of the technological feasibility of an innovation, such as the discovery of cytoplasmic male sterilization that made hybrid wheat possible (Knudson and Ruttan, 1989). "Technology-push" and "demand-pull" events such as these set the stage for launching an innovation. Moreover, none of the innovations studied by MIRP support the proposition that the initiation of efforts to create a new innovation was precipitated by a single dramatic incident or inspiration. Instead, the events that ultimately led to initiating each innovation came from multiple and seemingly coincidental sources, and they had the common cumulative effect of triggering the recognition of a feasible new program or business idea.

The Cochlear Implant Program (CIP) in chapter 8 exemplifies the multiple, quasi-independent, and coincidental events that lead to the launch of an innovation within a complex organization. News from Australia in 1977 about the development of a "bionic ear" intrigued a 3M technical director, who visited a variety of U.S. otological research centers and clinics. The results motivated him to persuade his division manager to explore developing a cochlear implant. The division manager could have rejected the proposal, closing off one of many stimulants for innovation, but he did not and assigned the idea to an "unrelated products" group. To take advantage of a normal career advancement opportunity, the technical director accepted reassignment to a 3M manufacturing subsidiary in California, which happened to have a vendor relationship with the House Ear Institute (HEI). Meanwhile, his successor at 3M established a relationship with the University of California-San Francisco, which developed a cochlear device and implanted it in several patients in 1980, after which it terminated the relationship with 3M. But, with the termination of this one source for the innovation, two others were being cultivated independently. Research on hearing aids was under way in a 3M laboratory, and in another part of the organization, a 3M group was exploring the acquisition of a hearing health company. Although all these parallel events clearly set the stage for initiating the program, few were orchestrated by a central actor and none appeared to be individually sufficient to cause program initiation. It was not until his return from California and promotion that another stimulus occurred when the then 3M division vice president (who was technical director at the beginning of the story) expressed disappointment about the lack of progress in developing a cochlear implant. He combined the independent groups and appointed a manager to initiate the program in the fall of 1980.

A similar extended gestation period of multiple coincidental events occurred before the initiation of the Therapeutic Apheresis Program (TAP) (see chapter 9). 3M labs undertook research on blood treatment

systems in 1980 but discontinued it in 1982 because no commercially feasible products were evident from the work. Independently, by 1981 Millipore had developed an apheresis filtration prototype and contacted Sarns as a potential vendor because of its recognized leadership in manufacturing heart blood pumps. But again, for unrelated reasons, negotiations were terminated in 1981 because Sarns had entered into negotiations to be acquired by 3M. In March 1983, Millipore approached 3M about a possible joint venture with its new Sarns subsidiary, when it discovered that 3M itself was also interested in apheresis. Recognition of the complementary competencies of Millipore, 3M, and Sarns precipitated negotiating an informal joint venture and initiating TAP in November 1983.

The third case example presented in chapter 10, Qnetics, includes two independent gestation periods. The first involved the independent parallel events that led two entrepreneurs to leave their employing organizations for different reasons in 1979, start up their own companies, and recognize limitations in making their independent companies commercially viable businesses. The second gestation period began with the coincidental meeting of the two entrepreneurs through a common acquaintance and their subsequent interactions that led them to recognize potential synergies and opportunities to obtain venture capital support by merging their fledgling companies in November 1983.

As these cases exemplify, these gestation events were not planned to initiate a new business in the form that it subsequently unfolded. Instead, it is more reasonable to conclude that the events undertaken by the entrepreneurs and their organizations sent them on courses of action that often by chance intersected with the independent courses of others. These intersections provided occasions for interaction, which led the actors to recognize and access new opportunities and potential resources. And where these occasions were exploited, the actors modified and adapted their independent courses of action into interdependent joint actions and agreements to initiate their new businesses.

Although the gestation processes were more evolutionary and unplanned in almost all cases, it was possible to identify one or more alert entrepreneurs or champions (Kirzner, 1973) who were at the focal points of organizing the subsequent innovation activities. Indeed, these entrepreneurs were the central forces that often coalesced the various seemingly unconnected events, activities, and players into a potential opportunity for their organizations. During opportune moments, these champions offered their organizations an idea or project as the vehicle to solve a crisis or exploit a commercial opportunity. However, as we discuss, in all cases it required a "shock" to actually coalesce the potential opportunity into a formal program of innovation by the rest of the organization.

A comparison of the cases also indicates an important variation in this core gestation process. Different organizational settings vary in the number of potential sources from which stimulants for innovation can arise. The CIP within 3M exhibits the largest number of stimulants for innovation, the Qnetics company start-up the least, and the TAP joint venture an intermediate number of precipitating events. This observation is partially consistent with the initial research finding by Hage and Aiken (1970) that greater structural differentiation enables innovation in organizations. However, the TAP joint venture among 3M, Millipore, and Sarns corporations emerged from the most structurally differentiated organizational arrangement, and yet fewer precipitating events were observed in the gestation of TAP than of CIP. Although it is possible that this empirical finding is idiosyncratic to the cases examined, it is not likely to be due to technology(both CIP and TAP are new-to-the-world biomedical innovations)or industry—(market entry for both CIP and TAP are regulated by the Federal Drug Administration, (FDA).

Boundary-crossing difficulties may explain this empirical finding. The probability of intersecting stimulants for innovation increases with the permeability of organizational boundaries between diverse sources. We observed TAP to experience more difficulties crossing structural boundaries between organizations than CIP experienced crossing departmental and division boundaries within 3M. Organizational boundaries that are permeable through only limited and prescribed modes, such as through TAP's strategic business unit (SBU), limits the probability that ideas for innovation generated within boundaries will transfer across boundaries. This line of reasoning suggests an extension of Hage and Aiken's proposition with an important qualifier: Structural differentiation is positively related to innovativeness if the structural boundaries are permeable.

Although the role of chance has been underemphasized in most managerial perspectives on innovation, these observations emphasize that chance plays a significant role in launching an innovation journey. Increases in the number of initiatives undertaken by a large number of interacting people increases the probability of stimulating innovation. This proposition reinforces the bias-for-action principle of Peters and Waterman (1982). Louis Pasteur's adage, "Chance favors the prepared mind," nicely captures the process that sets the stage for innovation.

"Shocks" Trigger Innovation

Whereas a conducive organizational climate sets the stage for innovation, concrete actions to undertake specific innovations appear to be triggered by "shocks" from sources internal or external to the organization (Schroeder et al., 1989). Many new innovative ideas may be gen-

erated but are not acted on in an organization until some form of shock occurs. Shocks served to concentrate attention and focus the efforts of diverse stakeholders in the organizations.

Shocks might include new leadership, product failure, a budget crisis, or an impending loss of market share, although it is evident from the MIRP studies that shocks can occur in many different forms. In a naval systems innovation, a $50 million failure in a product improvement program triggered the organization to expend considerable effort to uncover the underlying human resources problem for the failure and to resolve that it would never happen again. In two cases, a new leader in the organization was the shock that initiated innovation. In a local school district, new leadership combined with a budget crisis caused rethinking about managing schools in a more decentralized manner. The impetus for developing hybrid wheat was a disease called stem rust blight; a hybrid variety of wheat was expected to resist this disease and provide better yields. Shocks do not need to be viewed as negative. In the TAP case, the proposal to engage in a joint venture was seen as the shock necessary to renew an abandoned effort. Thus, Schroeder et al. (1989) note that in all the MIRP cases innovation initiatives could be traced to some kind of shock that stimulated people's action thresholds to pay attention and initiate novel action.

Shocks were important in each case because they allowed the champions of an innovative idea to gain currency with various potential stakeholders within the organization. Even though the entrepreneurs or champions were often convinced about the potential of their ideas, the rest of the organization did not necessarily share this "insight." In the typical scenario, the champions rarely controlled the resources required to develop their insight or ideas. In most of the cases studied, an opportunistic champion could not move the innovation forward. The idiosyncratic vision or insight of the champions was not widely shared in the rest of the organization. Indeed, potential stakeholders had to be convinced to support an idea. Often they were forced to or had to rely on the champions for critical information to make resource allocation decisions but without the benefit of the champions' special "insight" or knowledge about the commercial or technical prospects of the innovative idea. Because of this natural information asymmetry, the incentive and urgency to move from gestation to implementation required an external force. "Shocks" provided this external force to coalesce support around an idea that had the potential to solve a crisis or capitalize on an emerging opportunity. It is interesting to note that in the case of one of the entrepreneurs who went on to form Qnetics, the previous employer of the entrepreneur never experienced the shock required to take the champion's idea seriously. The only way the champion could pursue the idea was to quit the firm and start his own business.