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A PRACTICE-CENTERED MODEL OF ORGANIZATIONAL RENEWAL THROUGH PRODUCT INNOVATION

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Theories of organizational renewal and organizational design often bear little relationship to the complex, murky day-to-day realities people face. This paper develops an understanding of the renewing organization based on the practice of product innovation. The practice of product innovation is conceived of as the creation and exploitation of knowledge which links market and technological possibilities. Four clusters of market-technology knowledge are described and metaphors for their creation are developed. Then, three organizing principles which can sustain the ongoing development and exploitation of market-technology knowledge are described. The model provides a realistic understanding of the practice of product innovation and of the renewing organization. It also shows how innovation, strategy, and organizational design are inextricably linked.

Expanding worldwide competition, fragmenting markets, and emerging technologies mean that established firms must renew themselves continually, by transforming stagnant businesses and by creating new wealth through new combinations of resources (Guth and Ginsberg, 1990). Product innovation is a primary means of corporate renewal. Through product innovation firms can maintain or build market share in both mature and new businesses (Kerin, Mahajan and Varadarajan, 1990), and also discover new synergies among their resources (Burgelman, 1983). Despite the importance of product innovation, research shows that established firms have difficulty developing and marketing commercially viable new products (Cooper and Kleinschmidt, 1986; Zirger and Maidique, 1990; Dougherty and Heller, 1991). These persistent problems suggest that we do not have an adequate understanding of how to organize for product innovation, and thus how to organize for corporate renewal.

Key words: Innovation, strategic renewal

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This paper develops a model for organizational renewal through product innovation. The model integrates some of the vast literature on innovation around the *practice* of new product development (see Venkataraman, MacMillan, and McGrath, 1992; D. Day, 1992, for reviews of the innovation literature). A practice-centered model emphasizes the intricacies of the day-to-day thoughts and actions that go into successful new product development. A practice-centered model does *not* comprise the simple ABCs of product innovation, since that would be an abstraction which omits or distorts the complex realities of innovation. According to Brown and Duguid (1991), actual practice inevitably involves tricky interpolations between abstracted accounts and situated demands. If people in established firms are to practice product innovation, they need to appreciate the intricacies of this practice.

A practice-centered understanding of renewal through product innovation is important for two reasons. First, studies show that failed product innovators do not understand customer needs, design products that cannot be manufactured,

and launch products without regard for the realities of intermediate and ultimate users (see Cooper, 1983). In other words, they do not practice product innovation effectively. Yet researchers often conceive of product innovation as a whimsical enterprise spawned by intrepid champions, driven by unseen forces such as blind variation or 'technology', and shaped by political forces within the firm. Product innovation is inherently uncertain, but ignoring the realities of its practice exacerbates the uncertainties and heightens the chances of failure. Second, if theories are to be useful they need to speak to everyday reality, as Van de Ven (1989) suggests. Many models of the innovative organization, however, are presented in terms of general metaphors such as Hedberg, Nystrom, or Starbuck's (1976) *'camping on seesaws,'* Weick's (1979) *jelly molds*, and Morgan's (1986) *holograms*. While insightful, these metaphors bear little relationship to people's day to day work. They need to be extended to the practical realities of product innovation and organizational renewal.

The purpose of this paper is to sketch out the essential components of the renewing organization in ideal terms. This paper does not address how to change an established firm into a renewing firm, since such a complex topic requires its own paper. However, I assume that transition to a renewing organization would be aided significantly if we understood what constitutes such a form. The discussion proceeds as follows. The first section defines the practice of new product development as a process of market-technology linking, in which knowledge is created and exploited to craft a comprehensive product package. The second section breaks down market-technology knowledge into four conceptually distinct clusters of knowledge content and knowledge creation processes. The third section sketches out three organizing principles, or higher order recipes for thought and action (Kogut and Zander, forthcoming), which would help sustain the continual creation and exploitation of market-technology knowledge. Insights from field work carried out by the author are used to illustrate the ideas.[1]

THE PRACTICE OF DEVELOPING COMMERCIALLY VIABLE NEW PRODUCTS: AN OVERVIEW

The practice of developing commercially viable new products comprises the *creative* linkage of market and technological possibilities into a *comprehensive* package of attributes. Both of these emphasized terms are central to this definition of the practice of product innovation. 'Comprehensive' refers to the idea that a product constitutes the *integration* of market and technologies, and cannot be understood as one or the other separately. This point is emphasized because both academics and practitioners often refer to technology alone or a market when they speak of products. A product is not a technology nor a set of customers, since, for example, laser technology underlies a wide range of products, such as fiber optic networks or cutting tools, which can be marketed to a wide variety of customers, from banks to surgeons. A product 'operationalizes' (Cooper, 1983) both market and technological issues into a particular configuration of product, price, position in the market, and placement in distribution.

'Creative' refers to the fact that product innovators must engage in a creative and emergent process of development to construct this comprehensive package of attributes. Customers may not be able to articulate their needs clearly, and those needs may change as they learn to use the product. This means that the product's attributes cannot be specified easily and could change over time. At the same time, the product and/or manufacturing technology may be new, which means that technical problems may crop up unexpectedly, or that certain attributes cannot be delivered after all. Product innovators must experiment with sets of attributes, work closely with customers, pursue multiple paths at once, and make discontinuous leaps in imagination as they attempt to craft the comprehensive package of market and technology issues into a viable

[1] This is a conceptual discussion and there is no intent to use the examples cited in the test as anything but illustrations. By agreement with the firms who have participated in the author's research, the cases and firms are not identified. See Dougherty (1987; 1990; 1992), Dougherty and Heller (1991) and Dougherty and Corse (1991) for extensive discussions of the data and summaries of various results. In addition, this conceptual discussion has been informed extensively by Burns and Stalker (1961), Schon (1967), Kanter (1983), Van de Ven (1986), Monge (1990), and Jelenik and Schoonhoven (1990). These works are not cited every time an idea from them is used because their insights have been absorbed into my knowledge base.

product. This creative process may continue for years beyond a product's first introduction.

This definition of the pratice of product innovation does not presume that there is one correct product design. It does presume that there is a feasible set of attributes at a particular time that a product needs to manifest to be viable. The knowledge that product innovators seek is complex, but it can be understood as that configuration of attributes that can provide value to customers in a way that provides value to the firm. The challenge to product innovators is to locate the boundaries of this feasible set of attributes quickly, and operationalize them into the product by creating and exploiting the requisite market-technology knowledge. For very innovative products the feasible set may be nebulous and shifting as the market and technology both emerge interactively over a period of years. For other product ideas there may be no feasible set, and discovering this fact as quickly as possible is also a positive outcome.

Developing the requisite market-technology knowledge requires knowledge creation and exploitation. Combining Nonaka's (1989) theory of knowledge creation with Cohen and Levinthal's (1990) idea of absorptive capacity provides a basic understanding of knowledge creation used in this paper.[2] Nonaka (1989) divides knowledge into tacit and articulable. On the one hand, tacit knowledge is personal, not easily formalized and communicable, and rooted in the specific context. Cohen and Levinthal (1990) also argue that knowledge may be tacit, not codifiable, and thus acquired only through hands-on experience, including experience with the firm's capabilities and idiosyncracies. On the other hand, articulable knowledge is explicit, codifiable, canonical (Brown and Duguid, 1991) and transmittable with a formal or systematic language. Tacit knowledge is rich and dense but not easily shared, while articulable knowledge is thin and grainy but easily shared.

According to Nonaka (1989), the creation of knowledge occurs as the two types expand and interact over time. Similarly, Cohen and Levinthal (1990) argue that the ability to recognize the value of new ideas, assimilate them, and apply them to commercial ends depends in part on the base of prior knowledge, both tacit and articulated. Using an analogy with memory, Cohen and Levinthal suggest that the more objects, patterns, and concepts that are stored, the more readily new information about these constructs can be acquired. Knowledge creation is a social rather than an individual process, however, since the transformation of tacit into articulable knowledge requires, according to Nonaka, direct and continual dialogues between people who are grounded in the same situation. Sociologists of knowledge also argue that knowledge arises from the social construction of shared understandings, within a context of previously constructed understandings (Berger and Luckmann, 1967).

Nonaka (1989) suggests two approaches for transforming tacit into articulable knowledge. One is to create concepts, which are condensations of tacit images into language, drawings, or gestures. Metaphors, which capture one kind of thing in terms of another, help conceptualization since metaphors can capture tacit knowledge. The practice of qualitative research and data analysis as described by Strauss (1987) is a procedure for articulating the tacit themes underlying thought and action in people's day-to-day lives. Similarly, the qualitative processes of customer focus groups and initial product concept development rely heavily on metaphor (Calder, 1977). For example, from customers' stories about how they work we might conceptualize that they want 'user-friendly' attributes in their voicemail rather than 'power'. Or we might *re*conceptualize the technology underlying voicemail from 'packet switching' to 'networks', which places the notion of 'voicemail' in new technological contexts and widens the range of articulable product concepts.

Another knowledge creation process is to cluster and recluster information and meanings as they accumulate. Nonaka suggests that reclustering helps to reconceive of the essence of elusive phenomena. For example, top managers can recluster the firm's direction with new mission statements that can be deployed with more

[2] The literature on knowledge and learning is both vast and confusing. Therefore, these two works are used because both are based on extensive summaries of the literature. In addition, insights from Polanyi (1966), Berger and Luckmann (1967), Argyris and Schon (1978) and Kogut and Zander (forthcoming) inform this discussion. However, my intent is to present knowledge creation in commonsensical terms, and I leave the elaborate, theoretical, and formal discussion of the topic to others.

concrete concepts by middle management. Nonaka says that the Kao corporation, a Japanese consumer products firm, reclustered the categories of its knowledge base such as fat chemicals and surface active agents into a new dimension of surface active science. This reclustering allowed the firm to conceive of product diversification into other areas where surface science was important, such as floppy disks. Using another strategic metaphor, this firm 'stuck to its knitting' by reclustering the contents of its knitting bag.

This perspective on knowledge creation states that people need a rich base of insight and the capability to transform tacit into articulable knowledge. This perspective also shows what is wrong with many of our models of the learning and renewing organization. Many models employ abstract metaphors, such as Nonaka's (1989) six principles of 'self-organizing systems' and Cohen and Levinthal's (1990) formal economic formulae, that are very removed from the situated and intricate details of practice. The models do not explain *what* should be known for a particular practice nor *how* that knowledge can be created and exploited. It is therefore necessary to fill out our knowledge of organizing for renewal through product innovation by filling out our understanding of the more immediate question of what constitutes market-technology knowledge for new products and how it can be created. The next section details the content of market-technology knowledge and the processes by which such knowledge can be developed. The third section then adduces the organizing principles or higher order learning rules (Kogut and Zander, forthcoming) that would sustain the practice of effective product innovation.

THE CONTENT AND PROCESS OF MARKET-TECHNOLOGY KNOWLEDGE CREATION

As the perspective on learning outlined above suggests, some of the market-technology knowledge in the feasible set of attributes for a particular new product is tacit, and some is articulated. The product innovation comprises both the development and the integration of tacit and articulated knowledge over time. The conventional conceptualization of this knowledge creation process for new products, shown in Figure 1a, is a diagram of the relevant departments intersecting. This conceptualization is limited for several reasons, First, it segments market and technology issues by clustering them into different functional areas. Second, it does not explicate the content of the requisite knowledge but rather assumes that each function knows what it needs to know. Implicitly, this conceptualization may also presume that the knowledge is already codified in the expertise of each function. Third, it does not denote the process of knowledge creation and exploitation except as the outcome of the 'black box' of intersection.

To conceptualize the content and process of market-technology knowledge creation in a way that illuminates the practice of product innovation, a *re*clustering is proposed, as shown in Figure 1b. The graphic depicts four clusters of market-technology content which fit together to form a whole. Their creation relies on the contributions of areas of expertise such as R&D, marketing, manufacturing, sales, and finance, but, in a departure from conventional practice, these functional areas are not emphasized. Rather, this conceptualization goes beyond the by now widely accepted need to integrate functions, and emphasizes instead the content and process of the market-technology knowledge that functional integration is intended to produce. The table below the graphic in Figure 1b outlines the tacit and the articulable knowledge for each cluster, and describes the process by which each can be created metaphorically by associating each to practices that already bear meaning: exploring, researching, counseling, and scouting. Each cluster is elaborated below.

Visceralization of the product in user's hands

The core of market-technology knowledge for a new product constitutes the issues of why people want the product, how it fits into the flow of their lives or their work, and how they will evaluate it. 'Visceralization' is borrowed from Schon's (1985) discussion of how the codified aspects of professional practice can be enlivened so that students can learn them. Schon describes how an engineering professor developed a computer program to allow students to move structures around and get a 'visceral' feel for structural behaviors that conceptual abstractions such as

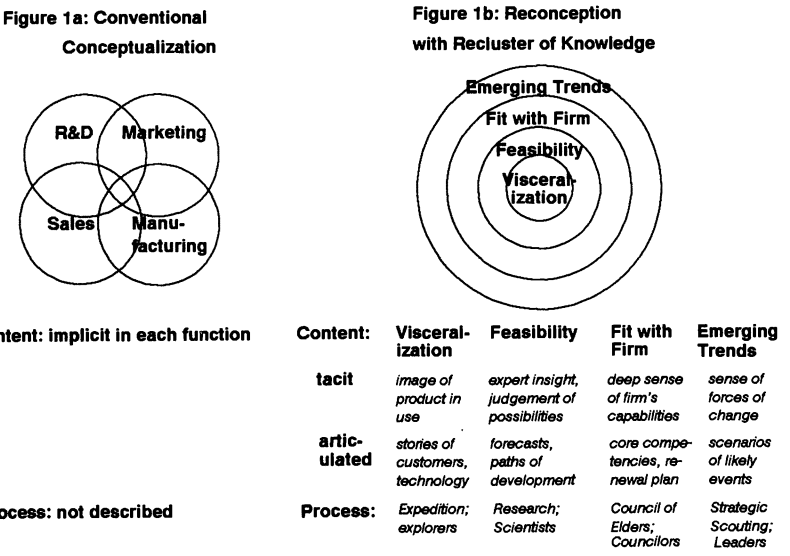

Figure 1. The content and process of market-technology knowledge creation

equations (F = MA) cannot provide. The term visceralization is chosen also because, as a metaphor, it invokes 'gut feel' and 'experience' that are important to innovation. Tacit aspects of visceral knowledge include a vivid image of the product in use and a deep sense of the nuances of user problems and how the technology can solve those problems. Articulated aspects of visceral knowledge would comprise stories of customers and technological solutions.

Through visceralization, product innovators come to imagine the product in use, develop a real sense for the problem that the product will solve for customers, see how customers perceive value (Wilson and Ginghold, 1989), appreciate what customers' preferences and decision-making processes are (Webster, 1988), and understand how to specify customer needs in terms of technologies and manufacturing processes (Hayes, Wheelright, and Clark, 1988). A realistic sense of the customer's actual use from the perspective of all functional expertises contextualizes the product's development. For example, to tell technical people that the product should be 'easy to use' does not provide much insight into *how* easy, nor what use. Visceralization does. Dougherty (1992) suggests that the visceral market-technology insight is where the disparate departmental 'thought worlds' regarding customers overlap the most. Therefore, joint development of visceral market-technology knowledge may be an essential basis for interdepartmental collaboration.

Several quotes from product innovators I have interviewed illustrate how people gather tacit visceral knowledge and transform it into articulable knowledge. First, notice the practised skill in tapping into the customer's needs that this salesperson described:

> A chemical materials salesperson:
> [Once the technical group gives you a product] you go out and try it. You have to learn how to do that, to work with customers to develop techniques to use the material. So, once you have a customer and a conceptual use of the product, you take that product around to others and get them to say: 'Hey, I really like that.' You get them to say: 'Let's build a tool for me.' So then you work together and build a tool...

A planner who worked on a successful new computer described the insight from a focus group that led the team to a new understanding of their customers:

> I remember our first focus group. It was a riot. There was this man in a green T-shirt, long side burns with a flat top, a big silver belt and cowboy boots. He also happened to be the president of the local microcomputer group. It's frightening when you realize that on the other

> side of the one way mirror was a room full of men [in conservative business attire]. We had to understand that that guy out there was our new customer. It took a leap of faith.

As these examples illustrate, articulating visceral knowledge relies heavily on the art of direct interpersonal relations with potential users, and on the art of recognizing surprising juxtapositions. Notice as well that market and technology issues are inextricably integrated. Interdisciplinary teams can also generate visceral insight by imagining customers. In one case, a team for a new consumer product met together in a brainstorming session, and it was the manufacturing engineer who came up with the product concept and advertising campaign that the team ultimately developed.

In contrast, the failure to generate visceral knowledge leads to insurmountable surprises. For example, a chemical products firm cancelled an innovative battery after 3 years because, according to this product manager, they never learned how batteries fit into the flow of users' work:

> We should have learned more about what went into the design of products that use batteries. We finally realized that users choose what battery to use as an afterthought. Had we known that up front, we might have launched the product differently. You need to consider the procedure the people use to select batteries so that you can sell them on yours. All we did was go out and say here's the product and here's what it does, but we never got to the right people.

An engineer with a failed computer product explained why they embodied certain features which turned out to turn off customers:

> We didn't get the system into real scenarios to test out our premises. We were overconfident and we all thought we were very smart. We made a lot of decisions daily to change the product based on what we thought we understood about the market place.

Effective visceralization relies on people's ability to develop spontaneous experiments, tell stories of possible use, engage in face-to-face interaction, and puzzle out the seeming conflicts between new and established expectation. A metaphor for creating visceral knowledge and transferring tacit visceral insight into articulated knowledge is 'expedition'. An expedition connotes the systematic but aesthetic inquiry into the lives of strangers who would be friends. As members of an expedition, product innovators become explorers. They immerse themselves in the community of their potential customers, but, like anthropologists or dinosaur hunters, they also stand back and make sense of what they see from the perspective of what they already know. Product innovators use their field work to help them conceive of ways in which they can create value for these potential customers by synthesizing the firm's technologies and other know-how into a variety of performance possibilities or other product features.

Several processes to generate visceral insight have been articulated. One is a program of customer visits described by McQuarrie and McIntyre (1990). Multifunctional teams visit customers personally, within a program that defines the goals and a plan to implement the findings. (Without a program, the visits can fall prey to mixed agendas such as trouble shooting vs. road shows, or fail to gather adequate insight). Von Hippel's (1986) lead user analysis is also a way to develop visceral insight. Innovators look for customers who have experience with the problem the product solves, because such experience enables these customers to articulate design needs more readily. And, while these techniques are themselves still in development, several firms and scholars are creating holograms, virtual reality, and other simulators to generate the tacit, rich insights into user-product interaction early in the conceptual development.

Mounting an extraordinary expedition to the frontiers of consumption every time the need to innovate arises would be very costly in both time and money. So, while the development of each product requires some unique visceral insight, firms whose people are already practised at visceral exploration would be able to generate this essential cluster of market-technology knowledge more quickly. Therefore an essential skill in a renewing firm is the ability to understand what is valuable to customers, to ferret out unmet needs, to appreciate how that firm's technological capabilities might meet those needs, and to work with fellow explorers from other areas of expertise.

Feasibility

A thorough knowledge of certain customers' needs does not tell you if there are enough customers to make a viable business opportunity, nor if the technology is practicable. Therefore, the 'feasibility' cluster of market-technology knowledge is also essential. Tacit aspects of feasibility include expert insight into the possibilities of an idea, and professional judgement regarding the keys to market and technological development. Articulated aspects would include demand forecasts, estimates of the market size, and analyses of good technological paths to achieve the opportunity. Feasibility assesses whether certain ideas are reasonable to pursue, and, as G. Day (1990) suggests, provides compelling evidence on the scope of the opportunity.

A product idea may be more feasible if its technology is part of a technology 'regime' (Rosenberg, 1976) or a 'natural trajectory' (Nelson and Winter, 1977). Within such regimes or trajectories, technologies can evolve more quickly because complementary technologies are being developed at the same time, so specific problems can be worked out more readily. However, if a technology is in its early stages, fewer problems are solvable, and the product idea is less feasible. Manufacturing competencies may also follow emerging regimes from job shops to 'continuous flow' production. Such competencies can interact with marketability by providing lower costs, higher quality, or greater flexibility in design changes (Kotabe, 1990).

A number of issues make certain markets more or less feasible as well. If the product is different from users' existing patterns of consumption, they may not be able to evaluate the product easily and so the rate of adoption may be very slow (Robertson, 1971). In addition, certain products such as software may require complementary technologies or a dispersion of user know-how before individual users can benefit from the products (Conner, 1991). What the competition might do also affects a product's feasibility. Strong competitors with 'deep pockets' who are entrenched in a market may respond to a new entry by cutting their prices, filling out their product line, or investing heavily in advertising: entry might be ill-advised. Limited investments in R&D on the part of competitors, however, can signal a market that is ripe for development by a firm with the necessary capability. In addition, competition may be limited if the prospective market is characterized by diverse segments and unstandardized technology (D. Day, 1992).

Creating the feasibility cluster of market-technology knowledge relies heavily on the tacit skill and experienced insight of experts. For example the marketer who developed the initial market assessment for a successful new computer explained:

> Bob walked into my office in Atlanta and said: 'I need you to estimate the size of the XX computer market.' I never did anything like that before. I had a rough idea of [an early entrant in the emergent market], but I started from scratch and read everything I could find. I talked to a lot of people in the company, to consultants, and went to computer stores and talked to them too. What I remember most was seeing an ad for Visicalc, and thinking to myself: 'Aha! Software is holding up the development of the market. Software is the key in the lock.'

Notice how she wove data together with imaginative insight to create an informed and expert opinion. She explained that her final 'numbers' were still an opinion, but her analysis provided senior management with enough understanding of the opportunity to authorize entry into the market, an authorization they had been holding back on for several years.

In another example, the manager of an upscale frozen meal explained that she felt that the product needed round, nonmetallic plates. The technology at the time was to produce 'TV' dinners on rectangular aluminum trays, which facilitated high volume manufacturing. When the product manager asked people in manufacturing if they could use round plates, they said 'absolutely not!' The product manager kept looking, and soon found a manufacturing engineer who said: 'Sure, we can do that.' The engineer was enough of an expert to figure out how to reconfigure the manufacturing process to use round plates, and enough of an innovator to appreciate the full product concept.

In contrast, the failure to assess feasibility can leave too many possibilities open to fantasy. In one product I studied, the business plan began with the desired amount of revenue. The developers then 'guestimated' a price for their new product, divided that number into the revenue target, and asked themselves if they thought they

could sell the resulting number of products. The answer was: 'Of course!' The product was cancelled after 3 years because they never truly grappled with the feasibility of this particular configuration of technology and market issues.

In another example, the initial plan for a very new electronic product was to let 'the market' decide which segments were best:

> There is little basis for identifying the prime target now, so we will go wide. We will build awareness, let the customers select themselves, and then focus our marketing and sales efforts on those customer segments who demonstrate the greatest acceptance of the service.

Within this lack of a framework, a year-long test market produced mostly surprises, not a coherent understanding of the opportunity. Not surprisingly, it took corporate decision makers yet another year to decide whether or not to roll the product out nationally. In both cases, the failure to create feasibility knowledge left the product innovators and their managers with no basis for judging subsequent investments or redesign choices.

While visceral knowledge is richly grounded in intense interpersonal relations and action research, feasibility knowledge is richly grounded in expertise and professional know-how. A metaphor for creating this cluster of knowledge is 'research,' or 'doing science.' A good scientist creates insight by applying both knowledge and know-how, and by systematically exploring and testing hypotheses. Innovators as scientists need to create heuristics to judge what elements of a feasibility question to sample first, to assess what is being learned, and to apply what has already been learned. Innovators also need the expertise to assess the current state or trajectory of a technology or market, and to make choices among alternate possibilities.

The ability to assess the feasibility for a particular product relies heavily on the state of existing knowledge. A product does not arise in a vacuum, even in entrepreneurial situations, because innovators build on available knowledge. To enable its product innovators to assess the feasibility of their ideas quickly but thoroughly, a firm needs a baseline of functional know-how which can be applied to more than one product. Firms that have anticipated the trajectory of technology and market know-how for new product ideas and have developed those underlying resources would be able to generate feasibility knowledge even more quickly for specific products. The ability to apply expertise systematically to new product possibilities and thus judge them effectively is also a core skill of the renewing firm.

Fit with the firm

Product innovators need another kind of market-technology knowledge in order to address *what should be* for the firm. Knowledge of a product's fit with the firm refers in part to its 'synergy', or how the product might combine resources, skill, and know-how to enhance the firm's competitive strength (Ansoff, 1965). Tacit aspects of fit with the firm consist of a deep, almost intimate sense of the firm's capabilities. Such knowledge would depend on experience with the firm's businesses, a sense of the firm's history, and extensive insight into the firm's culture. The articulated aspects of fit with the firm include an understanding of the firm's core competencies, a description of how the specific new product fits with those competencies, and specific product attributes that reflect the firm's unique competencies.

Knowledge of how a product fits with the firm frames and focuses product innovators' efforts. It enables people to commit scarce resources (time, money, attention) to an uncertain activity, because fit comprises a longer-term sense of what is valuable to the firm and also provides a unique aspect to the product. Generating this knowledge is a creative process. For example, in one successful case the mission of the division in which the innovators were located was to provide high quality commodity chemicals. The innovators developed a product that fit with the quality and commodity mission, but also extended the array of chemicals the division provided. One explained that they could work out the fit with the firm because they sought to determine *how* their idea fit with the mission, not whether it did.

If an appreciation for how a product fits with the firm is not developed, then the product innovation does not become part of the firm during its development. In other words, it is like a tumor that is continually at risk of being excised (see Burgelman, 1984; Dougherty and Heller, 1991 for some examples). For example, in

a communications firm an innovative use of networking was developed for large industrial customers, based on extensive market research and technical development. Both visceralization and feasibility were well developed, considering the novelty of the product. But the product innovators did not articulate the product's relationship to the firm, so when the vice president who was sponsoring the project left, his replacement quickly cancelled the project.

In another example, the failure to appreciate or articulate the role of a new medical product in the firm's system of value crippled the product's development because resources were allocated arbitrarily, as this angry innovator explained:

> The biggest problem for us is the weekly battles we have to fight for our survival... The company is trying to sell-off a very important piece of the technology [we need.] The VP is doing this for his own personal profitability so it will look good on his bottom line... It's a message that the company isn't serious about the project. I take it very personally. It's not like we work 40 hour weeks around here.

My research suggests that 'old timers' are a vital resource to new product efforts because, in the words of project managers, they know 'the system,' know 'where the skeletons are buried,' and know how to 'make things happen.' Therefore a metaphor to conceptualize the creation of knowledge of fit with the firm is a 'council of elders.' The council needs a 'renewal strategy' (borrowed from G. Day's 1990 idea of a 'growth strategy') as the template of their discourse. A renewal strategy identifies the directions for innovation based on the firm's core competencies (Prahalad and Hamel, 1990), the amounts of resources to be devoted to innovation, and objectives that innovators should address, such as further development of a particular technology, protection or expansion of market share in certain businesses, and exploring possibilities in an emerging market area.

The 'council' would consider the relationship between the renewal strategy and the new product. The relationship may be discontinuous with current practice, so the councillors must engage in active discourse to ferret out whether and how the product idea and the firm go together. New products can also provide the insights for reconceiving of the renewal strategy. The metaphor of a council of elders is not intended to invoke 'old fuddy-duddies,' but rather the 'wise heads' who have the capability to work out the complex strategic issues that new products inevitably raise. The councillors would also need a degree of organizational inclusion (e.g., Schein, 1971) that give people centrality regardless of their formal position. The actual councillors might be quite young and from any location in the hierarchy. And, as with the visceralization and feasibility clusters of market-technology knowledge, fit with firm knowledge inevitably extends beyond a particular product. Developing fit with the firm knowledge takes considerable practice, so firms with a base of such practice would be able to create such insight more quickly for a given new product effort. The ongoing capability to act on a council of elders, to consider whether and how a new product might build on the firm's competencies, to explore possible reconfigurations of assets that innovations suggest, and to examine the implications the new product might have for existing businesses is also a core skill of the renewing organization.

Emerging trends

Finally, knowledge of fit with the firm is oriented internally, so it must be complemented with knowledge that is externally oriented into *what might be*, or trends. What is valuable to customers shifts as their needs and problems change, and as new technologies arise that can significantly increase capability and performance. Trends in taste such as a preference for fresh foods may reduce the demand for prepared foods and open up new food opportunities; rising concern over environmental damage may force producers to redesign their products; the persistent failure of an interest in home networked computing to emerge (in the U.S.) has frustrated many would-be innovators in banking and computing; and U.S. automobile makers' penchant to eschew trends in product quality may have lost them market share for good. Tacit aspects of trend knowledge include a feel for the currents in market and technologies, a sense of those forces of change that are most important, and an ability to navigate among them. Articulated aspects of trend knowledge would include forecasts of product and technology life cycles and scenarios of likely events.

Trend analyses go beyond any specific product, but they help bring closure to the search for the feasible set of attributes that any new product should embody. Trend knowledge bounds the choices of attributes by pointing to the direction(s) in which a product category might evolve over time. Recall the new medical product mentioned in the section, Fit with the firm. Part of the reason the innovators and their managers could not articulate the product's fit with the company was because they could not make sense of the emerging field of cancer care (for which the product was intended). Rather than articulate that emergence and then think how that evolution might affect the firm's plans in the biological sciences, they simply put the underdeveloped product out, to search for markets that might be interested in its rather higgledy-piggledy package of attributes. Trend knowledge creates a vital thought space for envisioning the evolution of a product category, and for anticipating the necessary evolution of the firm in order to maintain the product's value to both the customers and the firm. Without the capability to understand trends and appply them in practice, firms risk becoming static and outdated.

An important source of trend knowledge is immersion in the ongoing flow of events in a field of endeavor. Technologists can stay up with potential breakthroughs if they are encouraged to monitor outside events and keep up with colleagues. Marketing and salespeople can gather insights into emerging opportunities by tracking customers' new needs and problems. Purchasing people can track emerging suppliers if enabled to do so; manufacturing managers can stay up with new techniques for quality and process speed; and all other areas of expertise likewise have their own trends to monitor. Indeed, von Hippel (1986) suggests that a good way to find key trends in a market is to phone experts and ask them what they think. One can also interact with lead users to see what their biggest problems are.

The metaphor of strategic scout[3] conceptualizes the creation of knowledge of external trends and how they affect both the innovation and the firm. A strategic scout pays close attention to emerging possibilities, searches out a direction for the firm within the nexus of trends, and energizes people toward that direction. Trend assessments happen in all parts of the firm, so scouting for trend knowledge needs to happen in all parts of the firm. A strategic business level scout needs to articulate the nature of the business overall in terms of key opportunities and to focus the energy of the people within. A strategic product level scout needs to articulate the nature of a product *vis-à-vis* key trends, shape others' understandings of the product's possibilities, and involve others in the enactment of the opportunity. Firms whose employees have learned to scout strategically will create the four clusters of market-technology knowledge more readily than others. Strategic scouting is also a core skill for the renewing organization.

The practice of product innovation: Comprehensive conceptualization and the management of uncertainty

The practice of product innovation comprises the ongoing development, synthesis, and exploitation of all these clusters of market-technology knowledge. The fundamental challenge to product innovators is to create and exploit the full array of market-technology knowledge as quickly as possible, while at the same time to monitor their efforts to decide whether they are worth continuing. Knowledge is perishable because technologies, user needs, and market opportunities change, so knowledge may decay even as new knowledge is being developed. Thus, a longer development time, a greater discontinuity in the use of the product to the user, the more complex and dynamic the product technologies, or the less well developed the relevant technology regime, the more slowly will knowledge creation proceed.

These uncertainties cannot be eliminated, but the risks that arise from ignoring aspects of the total product package can be managed. Product innovators need to begin with a comprehensive concept of the product, or at least soon arrive at one. This initial understanding is necessarily unclear, since the specific knowledge needs to be generated but it frames the feasible set of product attributes and guides the innovators in creating a whole product. Over time, innovators

[3] The concept of 'scouting' for innovation has been developed by Andre Delbecq, who discussed the idea in a Management Department colloquium, The Wharton School, University of Pennsylvania, December 14, 1991.

clarify the boundaries of the set by filling in the details of the product concept and operationalizing it into a physical configuration of attributes.

In my research successful innovators spent time in the beginning to construct a full definition of the product concept. This enabled them to learn because they could then fine-tune the product, and to respond because they could recognize market shifts or mistakes in earlier knowledge development. The final configuration of attributes often differed from the original plan, but the full definition allowed the innovators to learn effectively. The failed innovators worked with an incomplete or partial product definition, so they were continually surprised by aspects of the product configuration that they had not conceptualized before. With new products, too many factors emerge too quickly for the unprepared to respond to. With a comprehensive product conceptualization, innovators can continually assess the uncertainty of their efforts, at least qualitatively, and make an informed judgement as to whether they should cancel the effort, or shift to another more feasible market or technology.

ORGANIZING PRINCIPLES FOR RENEWAL THROUGH PRODUCT INNOVATION

The fundamental challenge to the organization as a whole is to create the context that enables the creation and exploitation of the four clusters of market-technology knowledge. My research indicates, however, that activities necessary to effective new product development are illegitimate in large established firms (see Dougherty and Heller, 1991). Creative market-technology learning, working with people in other departments, and interacting openly with senior management about an innovation's true progress are not part of the established repertoire of thought and action. Another analysis of the same data suggests that instrumental rationality, an organizing scheme that is strongly embedded in these firms, reinforces anti-innovative practices (Dougherty and Corse, 1991).

New organizing principles or higher-order recipes which govern how work and relationships are carried out (Kogut and Zander, forthcoming) would be necessary to create a renewing organization. This discussion of the practice of product innovation suggests three new organizing principles: (1) a redefinition of individuals' roles and responsibilities in terms of a realistic yet wholistic sense of tasks; (2) a reconception of work as a social and collaborative process; and (3) a revision of strategy as an ongoing process which specifies clear, succinct goals, articulates them across the organization, and revises them.

A new sense of roles and responsibilities

To practice product innovation, people's roles would have to be more complete than is typical in firms where work has been broken down into narrow pieces that have been 'abstracted' from the overall task of the enterprise (Burns and Stalker, 1961). Successful innovators in my research felt committed to and responsible for the entire product effort, and did not simply execute their segmented portion of the overall task. For example, this packaging expert compared his role on a successful new product with his typical role:

> What you lose [in the usual process] is contact. Because we were dedicated in a team, we got involved and spent time in other areas like market research and plant engineering... Because I was more involved, I could ask marketing about the questions they ask in focus groups or surveys. Prior to this, no one ever said to me: 'We're running a focus group. What questions would you like to have asked?' This generated a lot of synergies... Now I am back [in the usual organization] and I have 30 or 40 products to look at...

This research scientist also explains his multidisciplinary group's larger sense of involvement:

> Our group wants to develop new business, so any place we can get it, whether it is existing products or waste and by-products, we get involved. This is not the way we usually do it. Our top management should get a lot of credit because they set up this group and then left us totally alone. We all know what we are trying to do—make money for XCO.

Roles which encompass the whole task cannot be implemented, however, unless people become more adept with such roles, and unless the organization encourages people to adopt the new

roles. People first need to know how to practise the four clusters of market-technology knowledge creation. They need to be competent at exploring, doing research, serving as councillors, and scouting. Hands-on experience such as expeditions to existing as well as new customers, feasibility conferences over the business domain and its various product areas, fit with firm councils, and scouting is necessary to build up people's experience base.

Second, people need to maintain the various areas of expertise that are vital to a firm's businesses, such as core and applied sciences, manufacturing design and engineering knowledge and know-how, marketing, sales and distribution, finance and accounting, programing, and so forth. A system of continued formal training, sabbaticals, and development of two or more areas of competence would enhance such expertise. Unlike the market-technology knowing competencies, an enormous literature deals with functional expertise, especially among technical professionals (see Von Glinow, 1988; Katz, 1990).

Third, a fundamentally new 'psychological contract' between the person and the firm is necessary (Schein, 1978). For employees, it should be taken for granted that everyone is practiced at appreciating customer needs and conceptualizing how the firm's technologies can be made to meet those needs. For the firm, the current instrumental relationship that results in narrow, individually defined jobs needs to be replaced with an appreciation of the worker as a professional who controls the day-to-day execution of her or his work. Moreover, if people are expected to maintain skills which are often tacit, they cannot be assigned to a plethora of projects. Human resource management systems must track people's assignments and development of skills and competencies to assure that they are given an adequate exposure to a variety of market-technology knowledge creation efforts without being assigned to too many projects. The reward system needs to reward the development of expertise, skills, and competencies. Career progression based on a person's breadth and depth of competencies and practiced experience, rather than movement through a hierarchy of contrived jobs, would both fulfill people's needs for development and the renewing organization's needs for realistic but wholistic work roles (see Bailyn, 1985; Kanter, 1989).

Work as collaboration

The renewing organization also needs to incorporate the principle that work is inherently collaborative. The locus of the full array of market-technology knowledge described in the second section above is in the work group. No one person could fully comprehend all of the issues. In my research, successful product innovators always developed effective collaboration across the departments. In one case the innovation group spent a great deal of time 'up front' learning about each other. With that as a base, they were able to work very quickly, and often alone, because they *knew* each other's constraints and needs. In another case, a person explained that group work helped everyone to 'calibrate' what they knew and where they were going. By relying on joint customer visits and informal but regular interaction, the group was able to work without formal meetings, but everyone had an active sense of the whole project. In a third case, collaboration gave everyone a sense that their input mattered. As one explained, even though their particular recommendation may not have been used in a particular decision, everyone felt comfortable that their points of view were taken into account.

Two premises underlie cross-expertise collaboration. One is the need for a diversity of knowledge. Cohen and Levinthal (1990) argue that a diversity of knowledge is important for novel domains because it increases the prospect that incoming insights will relate to what is already known. Speaking of the realm of product innovation, Dougherty (1992) argues that each function or department evolves a different 'thought world' about market-technology issues. Since each thought world is capable of unique insight, they all must work together. The second premise is the need to recognize that knowledge is created through the social process of interaction. Mintzberg and McMugh (1985) and Leonard-Barton (1988) both illustrate how mutual adaptation between people over time created vital innovation knowledge. By working with a diversity of expertise through mutual adaptation, people are able to shape and frame their more complete work and avoid the anxiety which arises from being held accountable for an overwhelming task.

To work in a collaborative mode, people would

need to become practiced at working with other colleagues always in mind. First, training in everyday skills for collaboration such as running meetings, listening, leading, and making group decisions should be a prerequisite for all employees. Innovators tell me how vital such training is to their ability to work effectively on a project, even though these skills seem rather 'obvious' after the fact. Another collaborative skill is to be able to appreciate the perspectives of people in the different departments, who inhabit disparate thought worlds regarding customer needs and new products (Dougherty, 1992). A third collaborative skill is the ability to anticipate what people in another department need to know or do in order to carry out their part of the work. Such anticipatory insights, according to Clark and Fujimoto (1989), enable interdepartmental teams to quickly diagnose and resolve problems, and thus keep the development moving.

There is no one structure for collaboration, since structure is contingent upon the various sources of uncertainty (Lawrence and Lorsch, 1967), and on the nature of the problem and the stage of development. Adler (1990) summarizes a diversity of project structures that can be employed depending on familiarity with the technology. In novel situations with limited analyzability, cross-temporal and cross-disciplinary teams are most appropriate because the participants cannot resolve problems without real time adjustment. When problems are more familiar and departments share a frame of reference, then planning and schedules may be most efficient.

Strategizing for renewal through product innovation

An ongoing process of strategizing provides both the shared cognitive map that enables this organizing system to work, and the capacity to generate and retain market-technology knowledge in all four areas. Regarding the shared cognitive map, insights from organization behavior indicate that a work system based on comprehensive rather than compartmentalized roles and extensive group work cannot function without clear goals. First, considerable motivation and commitment on the part of employees is essential. Specific goals enhance performance, and difficult goals, *when accepted*, result in higher performance than easier goals (Tubbs, 1986). Second, groups work better when they have a shared goal that is aligned with goals of the firm (Goodman and Associates, 1986; also see Gersick, 1988). Therefore, a coherent but specific statement of goals and direction that is rich, explicit, and action oriented is necessary so that each collaborative team can conceive of its purpose in terms of the strategy (Tichy and Charan, 1989). Such a strategy serves to choose one line of procedure out of many possible and focus attention to it. Orientations become channeled, facility and skills are acquired, and those skills can then be applied to related or even different situations.

In addition to enabling the work processes themselves, a strategizing system enables the ongoing development of knowledge. Each of the four clusters of knowledge are both product specific and general. The ongoing directed development of technologies, manufacturing capabilities, sales channels, and market know-how provide the base of competence in the visceralization, feasibility, fit, and trends and the base of the ability to engage in continued incremental change.

These focused strategies eventually exhaust themselves, however, since they are inherently limited. Therefore, an important component of the strategizing system is the capability to evolve and change the strategic direction over time. The continuing process of market-technology knowledge creation and exploitation provides the grist for strategic redirection. As many studies of innovation and change demonstrate, strategic leadership helps to communicate and evoke the strategy (Burns and Stalker, 1961; Mintzberg and McHugh, 1985). Strategic leadership can work out the critical tensions between departmental expertise and product competencies, and between strategic simplicity and strategic emergence. Mintzberg's (1988) summary of strategy processes describes five different ways that strategic discourse can lead to altered directions. For example, business domains can relocate the core of their business within stages of production in their industry and/or from among key suppliers. Or they can distinguish the core mission from competitors with a particular posture, elaborate it beyond its basic industry, or reconceptualize it to encompass new technologies or markets.

Finally, the strategy should be connected in a realistic way to the day-to-day process of product innovation. This can happen if there are rules for monitoring specific innovations which encourage the creation of comprehensive knowledge. As Nelson and Winter (1977) argue, heuristics are needed that take into account the inherent uncertainty of innovation but still guide innovators in identifying, screening, and homing in on promising ways to solve problems. Building on Quinn's (1979) and Block and MacMillan's (1985) ideas, good evaluative heuristics for innovation would: (1) evaluate the progress of the project itself, not its performance against an abstracted and perhaps false sense of 'normal'; and (2) control the project around achievement of key milestones. Milestones can be defined in terms of market-technology knowledge development; how much is known about the five categories of knowledge? What will be done to expand that knowledge? Have preliminary designs been constructed? verified?

DISCUSSION

The renewing organization has been discussed as a conceptual model. This model has been limited to renewal through product innovation, and does not take into account possible differences in competency that incremental vs. discontinuous innovation might require, nor potential conflicts between product, process, or organizational innovation. Additional issues also need to be explored so that the model can be articulated more clearly. For example, *how much* market-technology knowledge is necessary to achieve success? Do the depth and breadth of knowledge for commercial success vary by the nature of uncertainty in the market, in the technology, or in competitive forces? Are there certain kinds of markets or technologies for which less knowledge is most efficient, in terms of costs and time to market? Relatedly, are there certain technologies for which it is efficient to ride the 'technological trajectory' and not seek to generate market insights, as Mowery (1983) might argue? How can the global nature of competition, product development, and markets be factored in? Considerable development of this model is necessary.

If research supports the argument that knowledge creation, more realistic and full job definitions, collaboration, clear strategies, and continual competency development are essential to organizational renewal, then we also need to study if and how established firms can transition to this new organizational form. First, can large old firms in fact change their fundamental principles of management? Or must they 'die' to make way for new forms? We have grainy evidence and abstract theory on both sides of this point. Second, assuming change is possible, must organizations change all at once, or can they emerge slowly? If the latter, should the renewing practices be tried in remote parts of the firm and then diffused? Are specific 'bad habits' such as over specialization in such conflict with the practice of renewal through product innovation that they must be rooted out entirely? Is it necessary to implement all of the renewal practices at once, or can each be implemented separately over time? Such questions need to be answered if corporate renewal is to be more than a notion.

Despite its limits, the core premise of this model of the renewing organization is that an understanding of organizational renewal must be based on the practices that produce renewal—creating and exploiting the knowledge necessary to craft viable products. In addition, the model suggests how ideas from innovation, strategy, organization design, and human resource management that are typically dealt with separately, and abstractly, can be synthesized around practice. Perhaps most importantly, the model suggests that the uncertainties of innovation can be managed more effectively if people carry out the specific practices of market-technology knowledge creation and exploitation. By replacing canonical and abstracted notions of work with practice-centered understandings, perhaps we can deal more realistically with the management of product innovation, and ultimately with organizational renewal.

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