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Epilogue: Applications for Innovation Management

In this book, I have presented a view of innovation as a process that is predictably distributed across innovation users, manufacturers, suppliers, and others. To date, I have only explored some of the attributes of this distributed innovation process. Nevertheless, there is no reason for interested innovators to wait for further research: I believe that much of what we know now can be immediately applied to improve innovation management.

In the few pages that follow, I will suggest practical steps for (1) determining one's innovation process role and (2) organizing for it. Finally, I will give an example of system-level strategy that will serve to give the reader a feeling for that concept. I very much hope that interested practitioners will experiment with, and further develop, the possibilities I suggest here. After all, user-developed improvements to innovation practice can offer high rewards to successful user-innovators!

Identifying an Innovation Process Role

When managers are freed from the conventional wisdom of innovation as a preserve of the manufacturer, they can assess their own firm's most efficient role in the innovation process.

On the basis of what we have learned in this book about predicting the sources of innovation, it would seem reasonable for a firm to think that a needed innovation might be available from others if one's own expected rent from innovation is much lower than the rent others may expect. As we saw in chapter 5, it is not necessarily easy to estimate how expectations of innovation benefit are distributed. Happily, however, innovation managers need not make a careful estimate to achieve their purpose. They need only apply the underlying reasoning of chapter 5 to get a rough idea of where innovation is likely to lie, and then they can quickly test their estimates' correctness by contacting likely innovators. If interesting work is in fact going on and if the information is not confidential, they will quickly find the right people to talk to.

In general, feel free to combine the ideas presented in this book with your own industry insight to go beyond the specific cases I have discussed. If you are interested in the sources of innovation for services rather than the products and processes I have explored to date, go ahead and explore—the same principles apply. If you think that firms other than users, manufacturers, or suppliers may innovate in your industry (distributors, for example), simply include these in your assessments just as you would any other likely functional source of innovation. If cooperation in innovation with others (for example, your customers) is of interest, estimate the innovation-related rents that the combination of firms you propose might expect.

When making a search for useful innovation-related activity, one should keep in mind that the most likely source of innovation is dependent on the likely distribution of innovation-related rents in the *precise* category of product, process, or service being considered. Thus, one may estimate that computer firms will be the likely source of many innovations in general-purpose software such as operating systems. At the same time, however, it would be reasonable to expect users to be the most likely source of innovations in specialized applications. Also one should keep in mind that the locus of maximum appropriable rents for an innovation type will not necessarily be one's own firm's users, manufacturers, and/or suppliers. For example, auto firms might sometimes look to another industry entirely (e.g., aerospace) for information on useful materials innovations.

Organizing for an Innovation Process Role

In my experience, it is relatively easy for interested analysts in a firm to determine that firm's appropriate role(s) in the distributed innovation process. It is much harder, however, to take the next step and make organizational changes that the firm may need to play a new role effectively. This is because the design and staffing of any firm's innovation-related activities inevitably contain strong implicit biases about the source of innovation.

Let me illustrate the problem in the context of the manufacturer-as-innovator bias that often exists in the links a product manufacturer establishes with product users. Such links are currently of great concern to manufacturers who correctly see "getting close to the customer" as essential to successful innovation.[1]

First, consider the link, known as field service, between a product manufacturer and its customers. The job of field servicepersons is to go to customer sites and maintain and repair the products a manufacturer has sold. They are equipped with the parts and the diagnostic manuals and equipment needed to maintain and repair standard company products. And, typically, their performance is evaluated on the basis of measures such as time at customer site, which are based on the estimated time to complete standard repairs if the work is done efficiently.

If, in the course of work at a customer site, a field serviceperson working under these conditions comes across a user-modified product, his reaction might well be strongly negative—even if the modification is obviously useful and potentially valuable to the firm and other users. The reason: He probably cannot fix a modified machine rapidly. Possibly he cannot repair it at all with the standard replacement parts in his kit. And in such cases he cannot do his job and may well receive a poor evaluation. Obviously, the conditions described create a systematic manufacturer-as-innovator bias in field service that may or may not be visible to, or intended by, the manager who set up the system.

Another very important link between product manufacturers and their customers is the sales department. Industrial product salespeople, especially, spend much of their time at customer sites and, so, should be in a good position to obtain information on promising user new product needs, ideas, and prototype solutions. But sales departments are typically not staffed with people trained to do this job; the commission and incentive schemes operating on them may well reward only sales of existing products. As a result, salespeople may have no incentive to learn about user developments that might have potential as commercial products. Instead, they may have a positive incentive to deflect any discussion with the customer away from user-developed products and toward the question, "What can I sell you of my present products?"

Next, a product manufacturer's marketing research group is obviously an important link to users' new product needs. But a marketing research group may also contain a manufacturer-as-innovator bias. Traditionally, the task of such a group has been specified as the collection and analysis of data on user needs. Under such ground rules, it often does not occur to anyone to seek data from users on possible sources of new product solution data as well as need data.

Of course, organizational barriers to user solution data do not necessarily end even after the information enters the firm. A firm's R & D group, for example, may well regard such information with a dubious eye. And, given typical incentives and staffing patterns such a reaction, too, is perfectly logical. Note that R & D groups are often staffed with people who are trained to develop new products and processes in-house and are rewarded for this task. Given such a context, it is reasonable that a conscious or unconscious bias should exist against adopting the ideas or prototyped concepts of outsiders.

In sum, then, the incentives and organizations affecting a firm's innovation-related activities may contain many biases against—or for—outside sources of innovation data. However, once such problems become visible to the manager, many possible ways to correct them—such as specialized incentives and special interface groups—will be apparent.

Three examples of special-purpose groups a manufacturer can use to link to users with innovation data of potential interest are

Applications Laboratories. In many firms these provide free or low-cost research and development help to users interested in applying a standard product to a new application. Sometimes new product variations or markets of general interest are identified by this means.

Custom Product Groups. Such groups produce "special" products and product adaptations at customer request. In product categories where high-volume products begin as special products, these groups can be a major element in a manufacturing firm's new product R & D.

User Groups. Commonly found in the computer software area and occasionally elsewhere, user groups are a mechanism by which users of a particular type or brand of product meet and exchange ideas and information.

Note that such special-purpose interface groups are not inherently focused toward users whose needs foreshadow general demand, nor are they necessarily motivated to consider user-developed solution ideas. A firm may also orient them, for example, to specialize in helping less-skilled customers with fairly routine problems.

A firm that does wish to use such a group to link with lead users, however, may do so by using the lead user marketing research method (outlined in chapter 8) to identify the proper user subset and then realign the group to attract them and serve their needs. The lead user method has intentionally been designed to be compatible with traditional quantitative marketing research methods. Firm personnel familiar with such methods should find it reasonably easy to use. (For full methodological detail, see Urban and von Hippel.[2])

The Distributed Innovation Process as a System

To this point, I have considered how a firm might perceive and adapt to the functionally distributed innovation process as it exists in a particular innovation category. But, as I showed in chapter 7, it is also possible to modify that innovation process and the sources of innovation by shifting the profit expectations of would-be innovators. Therefore, both innovation managers and government policymakers will find it useful to understand innovation behavior at the systems level.

At this point, my research on this topic is at a very early stage. I can, however, convey the flavor and interest of the concept by means of the example of innovation in semiconductor process equipment. As we saw in chapter 2, most important innovations in semiconductor processing equipment in the period examined were typically developed by U.S. equipment users (i.e., U.S. semiconductor manufacturers) with large market shares.[3] Recently, however, discussion with industry experts indicates that many of the most important equipment innovations are being developed by user firms in Japan. The model I have developed in this book allows us to understand the causes and system-level implications of such a shift.

First, note that (as we saw in chapter 4) user firm profits from process equipment innovations will typically come on the basis of expected in-house use. Second, note that many important equipment innovations in the semiconductor field deal with increasing the density of elements on a chip. Third, note that the type of chip that is, and traditionally has been, at the leading edge of the density trend is computer memory chips (such as RAM chips). Finally, note that Japanese firms such as NEC have recently replaced U.S. firms as the major producers of such chips. It is, therefore, reasonable that Japanese user firms currently anticipate more benefit from developing this class of semiconductor process equipment innovation than U.S. firms and have therefore supplanted U.S. firms as user-innovators.

If viewed at the system level, we can also easily understand the consequences of this shift to the competitive position of U.S. and Japanese industry. When major U.S. semiconductor firms were the source of the important process equipment innovations, it improved the competitive position of those firms, but that was just the beginning of the benefits to U.S. industry. It also improved the competitive position of the U.S. equipment manufacturing firms who, owing to geographic proximity to the innovating U.S. users, were typically the first equipment builders to gain access to the innovations. Next, it improved the competitive position of noninnovating U.S. users who, being close to the source of innovation, were able to adopt more quickly than foreign rivals. Finally, it improved the competitive position of U.S. purchasers of semiconductors because they could typically gain access to the cheaper or better output resulting from application of U.S. process innovations more quickly and conveniently than could foreign buyers.

Conversely, of course, when many of the leading-edge, innovating user firms are foreign, all the interlocking effects just mentioned work to the detriment of U.S. industry. Under present conditions, U.S. semiconductor firms must often buy their equipment from foreign firms, and they still end up behind the foreign user firms that developed the technology in the first place. When U.S. equipment manufacturers lose rapid access to state-of-the-art user-developed process technology, they also suffer and decline. Finally, U.S. semiconductor buyers are forced to turn to foreign sources—often competitors—for state-of-the-art components and may lose competitive advantage thereby.

All of the elements in the examples I have just described can be seen as components in a distributed innovation process that clearly interact in a systemlike manner. Eventually, I hope we will understand such systems well enough to have a ready taxonomy of moves, countermoves, and stable states. At the moment, however, we can certainly use our present understanding to help us think about specific problems and possible solution strategies.

With respect to understanding the problem, it is clear that the system-level advantage currently held by Japanese firms in the instance of semiconductor products and equipment (formerly held by U.S. firms) is formidable in part because it is based on process innovation rather than product innovation. As we saw in chapters 4 and 5, user-developed process innovation can be effectively protected as know-how; product innovation typically cannot be and is more quickly imitated. Next, my simple economic model of the distributed innovation process allows us to understand that since key process innovations such as ion-beam implantation and X-ray lithography start out as of use to only a few advanced user firms, such user firms—*not* equipment builders—are the likely sources of the needed innovation. Next, we can understand that individual user firms in the United States are now not really in the position to make up lost ground with their own resources. This is so because firms can typically expect profits only from their own innovation-related output, and the market share of U.S. firms for the chips that require the most advanced process equipment is now low.

Our system-level understanding of the problem also allows us to think about solutions in terms of their impact on that system. We may, for example, think about lowering the innovation-related costs user-innovators expect. One approach to this would be government funding for catch-up process R & D directed to advanced U.S. user firms and targeted to leading-edge process problems. Another would involve encouraging user firms to lower R & D costs by entering into cooperative work on process development. On the benefit side of the equation, we may think about how to make innovators' expected profits from in-house process development higher or more certain. Could one, for example, make it advantageous for chip buyers to negotiate firm orders for major purchases of chips requiring new process technology far in advance? This would allow users a more certain return on their innovation investment.

Obviously, standard solutions to system-level innovation problems such as the one I have just described do not yet exist—creativity is required. At the same time I hope that I have convinced the reader that the functionally distributed innovation process is a helpful way to think about this and other innovation management problems. If so, I look forward to a bright future for related research and practitioner innovation.

Notes

1. R. Rothwell et al., "SAPPHO Updated—Project SAPPHO Phase II," *Research Policy* 3 (1974): 258–91.

2. Glen L. Urban and Eric von Hippel, "Lead User Analyses for the Development of New Industrial Products" (MIT Sloan School of Management Working Paper No. 1797–86) (Cambridge, Mass., June 1986), and *Management Science* (forthcoming).

3. All semiconductor equipment innovations sampled were developed by one of the six firms with the largest semiconductor shipments measured at the time of the innovation (Eric von Hippel, "The Dominant Role of the User in Semiconductor and Electronic Subassembly Process Innovation," *IEEE Transactions on Engineering Management* EM–24, no. 2 [May 1977]: 60–71).