

R&D Continues to be an Important Part of the Innovation Process

by Lawrence
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Process innovation appears as prevalent as product innovation.

R&D is performed by 84 percent of all companies that reported the introduction of a new technologically changed product or process during 1990-92. An even higher percentage of innovators (91 percent) have plans to undertake R&D activity in the future. These and other characteristics associated with innovative U.S. companies were revealed in a 1994 pilot study of 1,000 U.S. companies conducted by the National Science Foundation and the U.S. Bureau of the Census.

The need for better information about the innovation activities of U.S. firms, the innovation process, and the factors that affect it, all led to the National Science Foundation's consideration of a new survey that would systematically examine innovation activities in U.S. industry. Toward this effort, a pilot study was conducted to test a survey instrument and data collection procedures. The pilot study was also designed to produce national-level estimates of innovative activities of U.S. firms. Due to the small sample size, these data are limited in scope but nevertheless provide some interesting insights into the process and characteristics of industrial innovation.

Description of the U.S. Pilot Innovation Study

In 1993, the National Science Foundation and the U.S. Bureau of the Census decided to conduct a pilot study of approximately 1,000 firms during 1994. The industry group surveyed consisted of all manufacturing companies and one service-sector industry (Computer Programming, Data Processing and Other Computer-Related Services) with 20 or more employees. The 1,000 companies included in the pilot study were segmented by employment size into 4 categories: 1,000 or more employees, 500-999 employees, 100-499 employees, and under 100 employees.

The overall survey response rate for the U.S. pilot was 57 percent. However, the response rate for a subgroup of 130 firms that received intensive follow-up was over 80 percent. Item nonresponse was minimal, although several survey questions proved difficult for firms to answer. The addition of the one service industry included in the pilot, computer software companies, tested the utility of the survey instrument for collecting comparable

data from the service sector. Unfortunately, survey response was quite low from these firms. Those that did respond did not report any recurring difficulty with the survey instrument.

Preliminary Indicators

Characteristics of U.S. Innovators

Several characteristics of U.S. innovating companies are evident from the pilot study. For example, one-third of respondents answered positively either to having introduced a new product or process during the 1990-92 period or had plans to introduce a new product during 1993-95. This one-third figure is an estimated national average for the United States (coverage spanned manufacturing industries and the U.S. software industry.)

Certain industries reported above average levels of innovation, in particular, U.S. industries manufacturing computer hardware (84 percent of companies were innovators), precision instruments and equipment (74 percent), pharmaceuticals (69 percent), and chemicals (68 percent).

Process innovation appears as prevalent as product innovation with nearly equal numbers of companies introducing new innovative processes and new innovative products during the 1990-92 period. Almost all (97 percent) of these companies now identified as innovators plan to introduce new innovations (product or process) during 1993-95.

Innovating firms were more likely to export than were noninnovators: 50 percent of companies that reported introducing an innovation during 1990-92 also reported export sales in 1992, compared with only 38 percent of noninnovating firms.

The Pilot Study answered several other questions as well:

Where do U.S. innovators get information that leads to the development and introduction of new products? The three most important sources identified (answers indicating sources as being either "very significant" or "crucial") were internal sources, clients and customers, and suppliers of materials and components. The least important (combining answers of "slightly significant" and "insignificant") were government labs, technical institutes, and consulting firms.

Electronic Dissemination

SRS data are available through the World Wide Web (<http://www.nsf.gov/sbe/srs/stats.htm>) and also through STIS, NSF's online Science and Technology Information System, described in NSF flyer 95-64, "Getting NSF Information and Publications." For a paper copy of the flyer, call 703-306-1130. For an electronic copy of the *STIS User's Guide*, send an e-mail with the phrase "get NSF9410.TXT" to stisserv@nsf.gov. For NSF's Telephonic Device for the Deaf, dial 703-306-0090.

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What are the key factors involved in the decision to innovate? The three most important factors (answers of "very significant" or "crucial") were a desire to improve product quality, increase or maintain market share, and extend product range within main product field.

What channels did U.S. innovators most often use to gain access to new technology? The three channels mentioned most often were hiring skilled employees, purchasing equipment, and using consultants. It is interesting to note that two of these three involve people.

What channels did U.S. innovators most often use to transfer new technologies out of the enterprise? The three channels for transferring technology most often mentioned by innovators were communication with other companies, mobility of skilled employees, and R&D performed for others.

What methods did U.S. innovators employ to appropriate the benefits of their new innovations? The two methods or practices most often mentioned by both product and process innovators were having a lead time advantage over competitors and maintaining trade secrets. Patents were selected as the next most often used method by product innovators while process innovators indicated complexity of process design as the third most important way to appropriate benefits from their new innovations.

How important is R&D to the innovation process? According to respondents, 84 percent of all innovators performed R&D in 1992 and 91 percent of all innovators plan to undertake R&D during 1993-95. Innovators reported R&D activity in a wide spectrum of technology areas.¹ The top three areas were software, materials synthesis and processing, and flexible integrated manufacturing.

Did R&D or other innovative activities involve external partners? More than half (52 percent)

of all innovating companies in the survey had cooperative R&D or innovation-related arrangements with other enterprises or institutions. Customers and suppliers were the most common partners in these cooperative activities; competitors, industry-operated labs, and government labs were the least common.

The U.S. pilot study was part of an international effort to develop systematically collected data about industrial innovation. The NSF, together with U.S. researchers, continues to assess the need for these types of data, the questions being asked, and whether the firm was the right unit of analysis. The NSF also recognizes the need to supply policymakers with more information on the U.S. service industry. Marrying these two elements—the need for information on the service sector and the need for more testing of the questionnaire and collection procedures—will likely guide our next effort. The timing and scope of future innovation surveys by the international community will also be important considerations for future work.

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¹The 1993 National Critical Technologies Report identified nine technologies important to the long-term security or economic prosperity of the United States. The report noted that more information was needed about current levels of R&D activity in these areas. The pilot study included this question in response to the request. This report was prepared by the Office of Science and Technology Policy and the National Critical Technologies Review Group for the President.

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