Incentives to Innovate and the Sources of Innovation: the case of Scientific Instruments

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Abstract

p. 459 In this study the authors explore the relationship between the sources of innovation and incentives to innovate in a sample of 64 innovations related to Auger and Esca, two types of scientific instrument used to analyze the surface chemistry of solid materials.

I. Introduction

User's and manufacturer's and supplier's reasonable expectations for appropriating benefits from a given class of innovation can differ, and such differences are associated with different levels of innovation on the part of such "functional" categories of innovator [15]. Thus, when a product user's reasonable expectations of benefiting from a given innovation opportunity are higher than those of a product manufacturing firm, we would expect to find that the user would be more likely to innovate than would the manufacturer.

In this paper, the authors test the link between incentives to innovate and the sources of innovation at the level of individual innovations.

II. Sample and Methods

p. 460 The study examines innovation patterns in two related types of scientific instrument, Auger and Esca. The decision to focus on these two instrument types was dictated by two very practical considerations. First, one of the authors (Riggs, W.) had extensive prior professional experience in the use and manufacture of both Auger and Esca. Second, the fact that both instruments were developed relatively recently meant that most of the important contributors to innovation in the field are still professionally active, and able to provide first – hand information on their activities.

Prior to the development of Auger and Esca, information on the chemical composition of surfaces was typically obtained via indirect methods. Auger and Esca instrumentation and techniques are a great improvement.

The first publications on Auger and Esca methods appeared in the 1950s and the instruments were first manufactured commerically in 1969. By 1970 several companies had entered the field. In 1992, total world sales for Auger and Esca instruments combined was approximately $100 million.

The sample of Auger and Esca innovations contains a total of 64 innovations. Two of these are the Auger and Esca instruments as initially developed and the remainng 62 are all of the succeeding improvement innovations the authors were able to identify. The latter met two criteria: (a) offered a major improvement relative to previous best practice in Auger and Esca and, (b) were produced commerically by equipment manufacturers prior to 1988.

p. 461 The sample of major innovations was identifiedvia a two – step process[1]. First, the authors reviewed both the scientific literature and the commercial product literature involving Auger and Esca, conducted exploratory interviews with about25 participants in the field and generated a preliminary list of 50 innovations meeting the criteria. Next, the authors asked experts from the Auger and Esca user and manufacturer communities to review the list and to suggest additions and deletions.

The authors collected information on the source of each innovation in the sample, and on the scientific and commercial importance of each. The coding of an innovation as being developed by a user or a manufacturer depended on who built the first hardware or software embodiment of the innovation that was used to produce publishable results.

p. 462 Next, the authors asked five experts drawn from the user and the manufacturer communities to rank each innovation in the sample in terms of scientific and commercial importance on a scale of 1 – 5. Given the unreliability of retrospective data, the authors had no realistic expectation of determining what the expectations of potential innovators would have been on these matters at the time of the innovations.

p. 463 Therefore, the authors assumed that innovators' expectationsat the time of the innovations were at least somewhat correlated with actual outcomes.

[1] This is how one identifies innovations in developed countries.

p. 464 After the ratings were complete, each expert was asked to describe what he had in mind with respect to the “scientific importance” and “commercial importance” of the innovations he ranked on these variables. All viewer commercial importance as meaning impact on manufacturer’s sales, and all viewed scientific importance as having to do with the enabling or achievement of scientific advance.

The distributions of the scientific and commercial importance scores generated by the raters were approximately normal, and so the authors use parametric statistics in our analyses of findings.

III. Findings

The authors find significant support for the hypothesis that innovations having high scientific importance tend to be developed by users, while innovations with high commercial importance tend to be developed by manufacturers.

The data showed no correlation between the measures of scientific importance and commercial importance. This is a desirable state of affairs from the point of view of the clarity of the findings.

While user innovators might have financial motivations in addition to scientific ones, according to both the instrument company and the user interviewees, user innovators almost never gained direct financial benefit from their instrument innovations when these were commercialized by instrument firms.

p. 465 Royalties were never paid, and paid consulting agreements were quite rare. Similarly, an exclusive focus on innovation – related profit seems to be a good measure of manufacturer motives in the sample.

III.1 Type of Improvement and Innovation Source

The authors examine the sample to see if they could make any general observations about the nature of improvements that tended to receive a high scientific or commercial importance rating. It was found that:

1. Innovations that allowed users to do qualitatively new types of things tended to have high scientific importance, and that users tended to develop these.
2. Innovations that had the effect of increasing the convenience or reliability of an instrument tended to have higher commercial than scientific importance, and were usually developed by manufacturers.

3. A third group of innovations that substantially improved three key performance parameters of the instrument – sensitivity, resolution and accuracy – were developed by both users and manufacturers.

III.3 Variations in Innovation Frequency and Importance over Time

p. 467 Industry interviewees inform us that manufacturer R&D budgets tend to be a constant percentage of sales.

IV. Discussion

The authors have been able to show very strong links between appropriable innovation benefit, the sources of innovation and the types of innovation that are developed.

p. 468 These very clear patterns are obtainable because the benefits sought by innovating users and manufacturers of scientific instruments are of two different, non – convertible types.

The measure of the source of innovation used in this study was based on who, user and / or manufacturer, actually built the first software or hardware embodiment of an innovation that produced publishable results. This measure showed no instances of joint user – manufacturer innovation. However, the development of scientific instrument innovations does involve extensive information transfer, and occasionally more substantial interaction, between users and manufacturers.

Joint involvement in an innovation project can serve both user and manufacturer interests well. Typically, the reward to the user under these circumstances is access to the first machine produced that embodies the innovation. The user thus gains lead time that allows him to reap the (priority – based) scientific innovation benefits associated with the innovation even as the manufacturer reaps the commercial benefits.

IV.1 Suggestions for further Research

The authrors' finding is compatible both with a pattern of innovation decision – making in which each type of innovator focuses on its type of importance only, and with a pattern involving some sort of interdependence between user and manufacturer decision – making with respect to innovation. The authors think that the latter possibility is worthy of further research. Some interdependence is likely in that manufacturers undertake development projects based in large part on expressionsof interest by users, and users tend to ask manufacturers to develop improvements that they would like to have, but which they do not think worth developing on their own.

p. 469 There may also be a pattern in which manufacturers encourage users to innovate in areas that they see as having too little commercial importance.

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