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User community vs. producer innovation development efficiency: A first empirical study

Christoph Hienerth[a,*], Eric von Hippel[b], Morten Berg Jensen[c]

[a] WHU Otto Beisheim School of Management, Vallendar, Germany
[b] MIT Sloan School of Management, Cambridge, MA, USA
[c] Department of Economics and Business, Aarhus University, Denmark

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ABSTRACT

In this paper we report upon a first empirical exploration of the relative efficiency of innovation development by product users vs. product producers. In a study of over 50 years of product innovation in the whitewater kayaking field, we find users in aggregate were approximately 3× more efficient at developing important kayaking product innovations than were producers in aggregate. We speculate that this result is driven by what we term "efficiencies of scope" in problem-solving. These can favor an aggregation of many user innovators, each spending a little, over fewer producer innovators benefitting from higher economies of scale in product development. We also note that the present study explores only one initial point on what is likely to be a complex efficiency landscape.

1. Introduction and overview

Representative national surveys have established that millions of users in the household sectors of the U.S., Japan, and the UK spend billions of dollars per year in aggregate in order to create and improve products for their own use (von Hippel et al., 2011, 2012). Of course, it is also true that producers spend billions of dollars per year to develop products for sale *to* users.

Given the large scale of innovation by users, the relative efficiency of user vs. producer product development becomes an important matter. Practitioners would like to know whether innovation development or innovation adoption is more efficient for them. Efficiency also matters from a research and social welfare perspective. Expenditure of resources on low-efficiency innovation processes when better ones are available is wasteful, other things equal.

User and producer innovation processes are known to function very differently (Benkler, 2006; von Hippel, 2005). In fields of widespread interest, hundreds or thousands of product or service users may be innovating at the same time, and may make little or no effort to coordinate their development activities. Users each innovate primarily to satisfy their own needs. In contrast, producers innovate to sell *to* users. Producer development goals and activities are managed with the intention of efficiently developing products that are generally valued, and that are more desirable than competitors' offerings. New product development activities within producer firms may involve just a few developer employees.

On the basis of these rough descriptive outlines, one might speculate that user innovators as a class might be a great deal less efficient than producer innovators in developing generally-valued products. One can imagine, for example, that innovation projects engaged in by thousands of non-coordinating users could be directed at niche needs and/or could be hugely redundant. One might also reason that product developers employed by producers could have advantages over user innovators with respect to efficiencies related to specialization and economies of scale. Producer employees may, for example, have better product development skills than user innovators. They may also have access to much better R&D tools and facilities, justified on the basis of larger volumes of product development undertaken by firms.

On the other hand, it *may* be that in social activities like sports, and in the Internet age, user innovators are reasonably well aware of the innovation activities of others, and that redundancy of innovative effort is low. It may also be that the type of specialization that matters for efficiency in realizing some kinds of innovation opportunities is specialization in *use* rather than specialization in product development – and expert users may well have advantages over producers in that regard. Further, it may be that the diversity in problem-solving expertise present across a user community of thousands of solvers – what we term "efficiencies of scope" – may trump the depth of expertise of many fewer producer-employed solvers (Raymond, 1999; Jeppesen and Lakhani, 2010).

* Corresponding author.
E-mail addresses: Christoph.Hienerth@whu.edu (C. Hienerth), evhippel@mit.edu (E. von Hippel), MBJ@asb.dk (M. Berg Jensen).

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Clearly, empirical studies of relative efficiencies are needed to understand these matters better. We begin this work by conducting a first empirical study of user vs. producer product development via a study of 50 years of product innovation in whitewater kayaking. In overview we find that in this field, users create important product innovations at a per innovation expenditure approximately 3× lower than that of producers. We also find that users tend to innovate early in this field, and producers tend to enter later as innovation opportunities in a field get "mined out" (Baldwin et al., 2006).

In what follows, we first review literature on user innovation and on innovation efficiency calculations (Section 2). We then describe the innovation history of whitewater kayaking, which is our context for this first study of user vs. producer innovation efficiencies (Section 3). In Section 4 we explain our research methods and data sources for information needed for our efficiency calculations. In Section 5, we present our overall findings, and in Section 6 we discuss the implications of these.

2. Literature review

2.1. Innovation by users

Consumer product development is now understood to be a major activity among citizens acting alone and in collaborative groups. Recently, three national surveys of representative samples of users over age 18 have explored the scale and scope of product innovation activities among users seeking to serve their own needs for new and modified consumer products. With respect to scale, these surveys found that millions of users collectively spend billions of dollars annually developing and modifying consumer products. In the UK, 2.9 million people (6.1% of the population) collectively spend $5.2 billion annually on this activity. In the US, 16 million people (5.2% of the US population) collectively spend $20.2 billion, and in Japan, 4.7 million people (3.7% of the population) collectively spend $5.8 billion to create and modify user products for their own use (von Hippel et al., 2012; Ogawa and Pongtanalert, 2011).

Studies of sporting enthusiast communities have found even higher rates of innovation, generally carried out collaboratively by community participants. Thus, Franke and Shah (2003) found 32% of members of four specialized sporting clubs in four 'extreme' sports had developed innovations for personal use. Similar results in additional sporting fields were found by Lüthje et al., 2005 (mountain biking); Tietz et al. (2005) and Franke et al. (2006) (kitesurfing), and Raasch et al. (2008) ('moth' boat sailing).

2.2. Innovation efficiency measurement

Definitions provided by the Oslo Manual (OECD/Eurostat, 2005) guide the collection of innovation-related data in OECD countries. Our definition of innovation adheres to the current Olso Manual definition – with an important caveat. Innovation, according to the Oslo Manual, is the introduction of a new or significantly improved product *to the market* or the use of new or significantly improved processes (transformation and delivery, organizational change and business practices, and market development). In this study of new products, producers do diffuse products via the market, as fits the Oslo definition of innovation. However, diffusion of new products developed by users often does *not* involve the market. Instead, diffusion is accomplished via peer-to-peer sharing of the product within a community of practice or peer group. For example, open source software also is diffused peer-to-peer instead of or in addition to diffusion via the market. This non-market mode of diffusion is increasingly commonly encountered (Baldwin and von Hippel, 2011). In the light of this finding, Gault (2012) proposed to update and broaden the Oslo definitional requirement that to be an innovation, something new must be 'introduced on the market' (OECD/Eurostat, 2005: 47). He suggests a broader condition – that an innovation must be 'made available to potential users', whether via the market or other channels. In this paper, we use the broader definition proposed by Gault, and include novel products diffused peer-to-peer and/or by the market as innovations.

In economics, efficiency is generally measured according to the value of resources (inputs) that are expended to create a given output. If the output being created is an innovation then, other things equal, the more efficient process will be the one that uses fewer inputs to produce that output. There are many types of inputs to innovation development that are recognized as important (OECD/Eurostat, 2005: 36). In the European Union Community Innovation Survey (CIS) 2010, expenditures are collected for four innovation activities, in-house R&D (OECD, 2002), purchase of external R&D, acquisition of machinery, equipment, and software, and acquisition of external knowledge. In the study reported upon here, as will be detailed later, included expense categories are considerably more restricted: we focus only on direct product development time and money investments by user and producer innovators.

2.3. Innovation efficiency and problem-solving economies of scale

Increased specialization is assumed to be associated with increased efficiency, and is made possible by the scale of the market (Stigler, 1968). Thus, economies of scale in production are associated with such things as increased specialization of workers, and the increased specialization of tools and equipment that larger scale production can justify.

Efficiency in problem-solving is also assumed to be positively affected by scale. For example, larger-scale R&D organizations can presumably afford to hire more specialized and expert researchers, and also can economically justify more specialized equipment for these employees to increase problem-solving still further. The expertise of specialized problem-solvers can indeed lead to greater efficiency, but deep specializations can at the same time narrow scope of solutions considered. Expertise in problem-solving is gained through repeated experience with respect to a particular type of problem and solution type. It has been shown that chess masters, for example, are much faster than less-skilled players at analyzing the strategic options available in a particular state of play and finding a good solution. They achieve this higher level skill and speed in problem-solving by long experience in the game. However, their better problem-solving performance is also quite narrow: when the rules of the game are changed, their performance is no better than that of those with lesser expertise (Chase and Simon, 1973; Gobet and Simon, 1998).

Classic studies of problem-solving also build our understanding regarding the limitations associated with expertise. Due to an effect called "functional fixedness," subjects who use an object or see it used in a familiar way are strongly blocked from using that object in a novel way (Duncker, 1945; Birch and Rabinowitz, 1951; Adamson, 1952). Indeed, the more recently subjects observe objects or problem-solving strategies being used in a familiar way, the more difficult they find it to think of employing them in a novel way. Thus, it has been found that experimental subjects familiar with a complicated problem-solving strategy are unlikely to devise a simpler one when this is appropriate (Luchins, 1942). The restrictions associated with expertise are also visible in real innovation settings. Thus, Allen and Marquis (1964) found that the success of a research group in solving a new innovation-related problem depended on whether solutions it used in the past fit that new problem.