

Marketing and Logistics Discussion Paper Series

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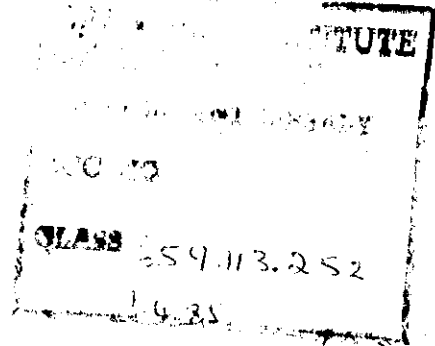
'CUSTOMER-DEVELOPED INNOVATION':

CONCEPTUAL EXTENSION AND EMPIRICAL RESEARCH

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ABSTRACT

This paper offers a critique of von Hippel's 'customer-active paradigm' of industrial innovation. Whilst acknowledging that this perspective offers a step forward from the previous assumption that manufacturers alone were responsible for product innovation, the paper argues for the conceptual extension of the new paradigm. The possibility of users being directly involved in product innovation should be unambiguously included in the reconceptualisation of customer-developed innovation. To the extent of their being entrepreneurially aware of new product opportunities, users may initiate the process of product innovation, not only by producing ideas and designs but by the collection of marketing intelligence to reduce the uncertainties of the commercial exploitation of innovations. Their doing so is evidence of this active involvement in product innovation and disconfirms the essentially passive role in that process assumed by the customer-active paradigm.

The need to develop new products which satisfy users' needs is self-evident. That this often necessitates close interaction between manufacturers and those who use their products is similarly uncontroversial. But the means by which customer-oriented new product development can be achieved are not always as apparent or straightforward. This paper is concerned in general with a frequently-proposed solution to this problem the suggestion that ideas for new products should be sought from customers themselves and, specifically, with the frame of reference put forward by von Hippel (1978, 1979) for the conceptualisation of the role of buyers in the process of innovation, the 'customer-active paradigm'. The paper first describes this concept, making reference to von Hippel's original work, and contrasts it with more traditional depictions of new product development. Secondly, it argues that, while the resulting emphasis on the role of the customer is welcome, the 'customer-active paradigm' requires reconceptualisation in the light of the active participation of users in product as well as process innovation. Without such conceptual extension, von Hippel's novel frame of reference is unlikely to generate empirical work which identifies the full range of manufacturer-user relationships in industrial innovation. In conclusion, suggestions are made for the further empirical investigation of user-developed innovation.

THE 'CUSTOMER-ACTIVE PARADIGM'

The prevailing frame of reference for studies of industrial innovation and the practical management of new product development assumes that it is the manufacturer who is responsible for the entire sequence of activities leading to the launch of new products, as well as beyond it to the management of innovations through their market life cycles. (See, for instance, Rockwell and Particelli 1982). This view of the new product development

process has been christened the 'manufacturer-active paradigm' (MAP) by von Hippel (1978) since the initiative for innovation is assumed to lie entirely with the organisation which makes and sells the product. 'The role of the customer is essentially that of respondent, "speaking only when spoken to". It is the role of the manufacturer to select and survey a group of customers to obtain information on needs for new products or modification of existing products; analyse the data; develop a responsive product idea; and test the idea against customer perceptions and purchase decisions' (von Hippel 1978, p.40). Where the potential customer is unaware of his need for the item, the manufacturer is in a position to influence and persuade, and to do so relatively cheaply in the context of possible sales to a mass market. Although von Hippel does not explicitly define 'paradigm', he is presumably referring to a framework of concepts, methods and analysis by means of which observations are edited and interpreted (Kuhn 1970), which some researchers have called a 'frame of reference' (Thelen and Withal 1949). The manufacturer-active paradigm clearly describes well the majority of cases in which new customer products are developed. In such cases, manufacturers can identify marketing opportunities relatively easily and cheaply, and a wide range of market research techniques and models has been expressly and extensively developed for this purpose. Moreover, in consumer goods innovation, the manufacturer has some discretion over the timing of his innovative activity: although there is always a threat of preemptive competitive entry, those aspects of the market defined by customers' needs, tastes and ability to purchase are of comparatively long and predictable duration. Some new industrial products are also open to development through manufacturer-initiation and control, notably standard components.

But, in other situations which generally involve unstandardised industrial innovations, the development of new products is not

amenable to control by a manufacturer. Often the user of industrial products - typically a development engineer - has only a short time to solve problems which arise in the course of his work; unless his supplier can deliver a problem-solving product within weeks or even days, the user is likely to develop his own in-house process innovation to solve his problem with minimal delay. In many cases, the opportunity to provide the required innovation is simply not accessible to the manufacturer, who cannot act quickly enough even if he is approached at all. This, argues von Hippel (1978, 1979) can be the initiation of a user-developed innovation. Because of the economic and business implications of this process and because the entrenched manufacturer-active perspective is likely to overlook it, user-developed innovation requires an alternative frame of reference, the 'customer-active paradigm' (CAP). The CAP is based upon quite different roles for manufacturer and customer from those assumed by the MAP. The customer generates the idea for an innovative product, finds a manufacturer who is able to produce it and makes the appropriate request to the manufacturer. The manufacturer's role is to await such request, 'to screen ideas (not needs) for new products; and to select those for development which seem to offer the most promise from the manufacturer's point of view' (von Hippel 1978, p.40). In the absence of the request from the user, the manufacturer is inert; indeed, 'so inaccessible is information with respect to the process innovation to the manufacturer that he cannot be involved before the user requests him to produce the product he needs. Clearly, if the potential user is unaware of his need for such a product, the manufacturer cannot persuade him for the manufacturer has no opportunity to discover the need first. Figure 1 summarises the evidence of MAP and CAP as defined by the variables of 'customer awareness of need' and 'accessibility of manufacturer-managed action'.

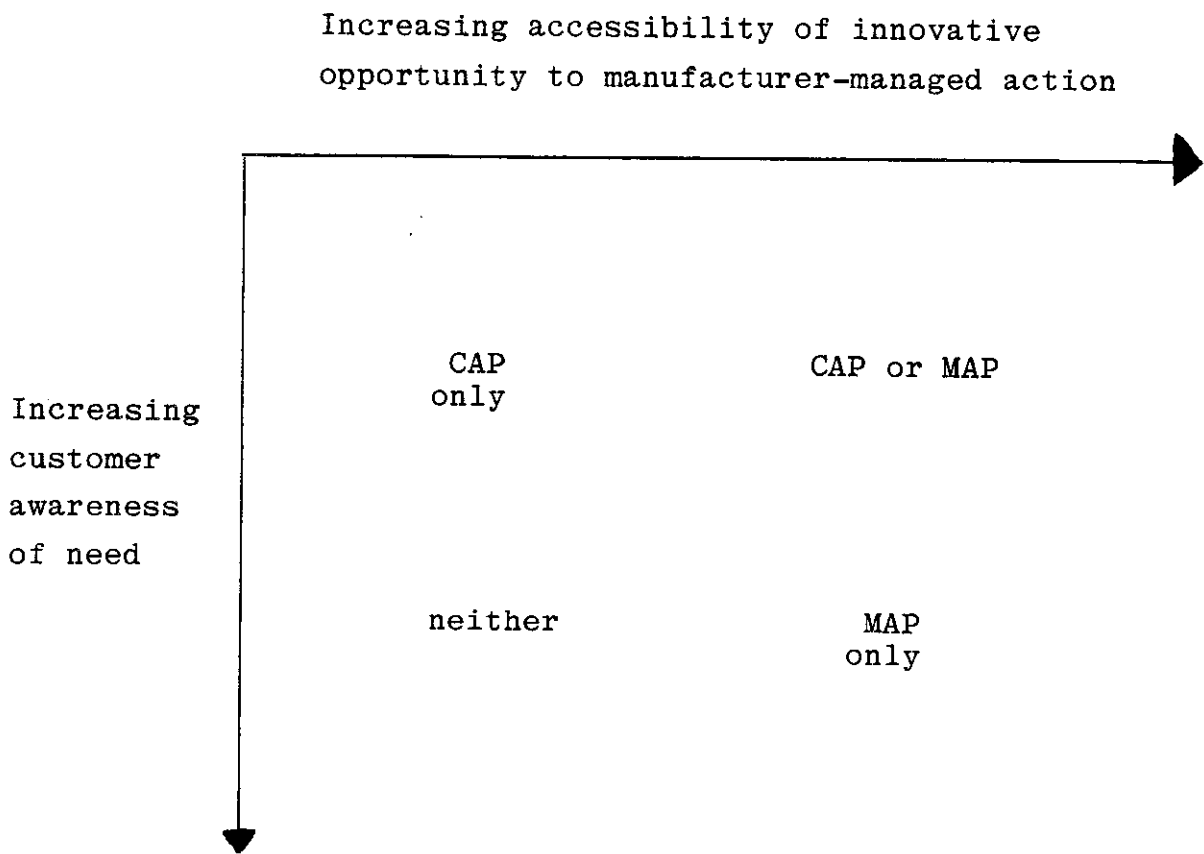


Figure 1 Spheres of Relevance of MAP and CAP (after von Hippel)

A conservative literature search (von Hippel 1979, pp. 92-98) provides evidence for the descriptive accuracy of the CAP in several industries, including the development of new chemical products (Meadows 1969); innovative plant process, process equipment and techniques (Peplow 1960); scientific instruments (Utterback 1971) and a wide range of industrial products (Robinson et al. 1967). In each case the product development process was initiated by a customer request, the content of which clearly specified the product idea/design concept, criteria which von Hippel employs as indicative of customer-initiated action. Moreover on the basis of his own studies of innovation (von Hippel 1976, 1977c), he states that, 'In 77 per cent of the 111 cases of scientific instrument innovation and in 67 per cent of the 49 cases of process equipment innovation, it was ... a product user who: perceived the need for the product innovation; invented a product responsive to the need; built a prototype; proved the prototype's value in use by applying it; diffused ... detailed information on the innovative product's design and utility'. Only after the above had been done was the product offered to a manufacturer whose typical role was the development of the user's prototype and the subsequent manufacture and marketing of the item (von Hippel 1979, p.87).

The case for the customer-active perspective on industrial innovation has been made. The question is, given the remaining restrictive definitions of the roles of manufacturer and user upon which it is based, whether it goes far enough in describing the possible spectrum of roles of these inevitable partners in successful new product development. As the following evaluation concludes, either conceptual extension or conceptual clarification is required.

CONCEPTUAL EXTENSION OR CLARIFICATION

The contribution which the concept of customer-developed innovation can make to the study and practice of industrial new product development has generally been welcomed (e.g. Peters and Waterman 1982; Freeman 1982; Foxall 1984). Without detracting from this, it is possible to extend the concept further, clarifying the range of possibilities for user-manufacturer interactions. The following discussion argues that there is a continuum of such possibilities, whose polar extremes are manufacturer-dominated product innovation and customer-dominated product innovation. Both MAP and CAP, as defined by von Hippel, would appear towards the manufacturer-dominated pole of such a continuum, while the pattern of product innovation in which the user/customer plays a leading entrepreneurial role, would appear close to the opposing pole. (See Figure 2). It is to that pattern of industrial innovation in which the user is entrepreneurially dominant that this paper attaches significant importance; yet, according to the definitions of product and process innovation upon which von Hippel's framework of analysis is based, that pattern appears to be excluded from consideration.

Innovation and Entrepreneurship

Those definitions (von Hippel 1977a: pp. 6-7) draw a clear distinction between the roles of manufacturers and users, each of which is confined within the boundaries of a separate company. Thus, the user of an innovation puts the new device into operation in his own productive processes but does not manufacture it, while the role of the manufacturer is to make and sell the innovation but not to use it. Innovation is a post-inventive function, the first commercial utilization of a new device, product or process ever to occur. It is attributed to the user if he builds and applies the new item in his business before any manu-

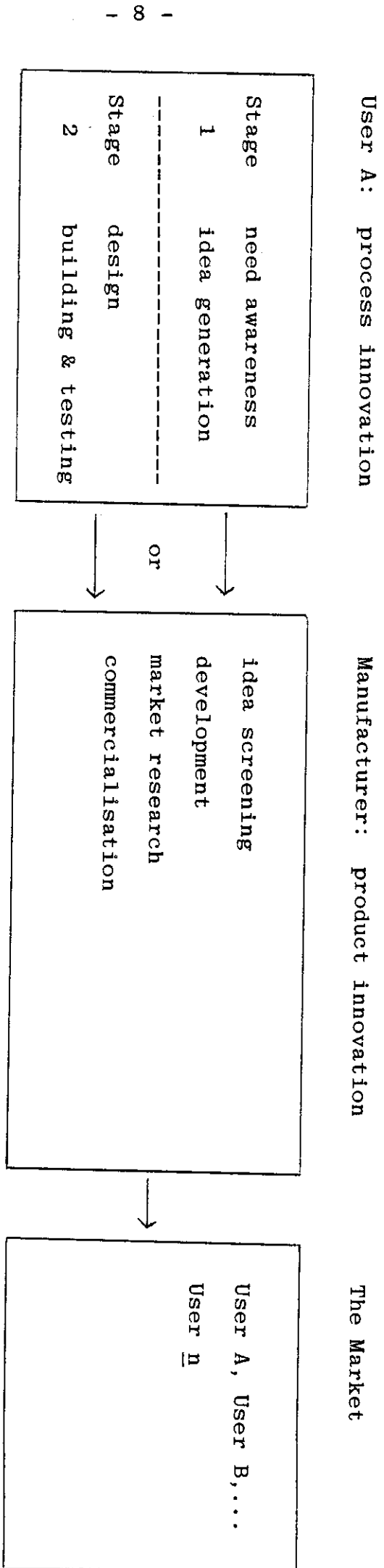


Figure 2

The discrete roles of user and manufacturer in the CAP.

facturer builds and markets it, and to the manufacturer if he builds and markets it before a user makes and applies it in-house. These definitions are consistent with Schumpeter's (1924) widely-accepted distinction between invention and innovation. They also maintain a common distinction between process innovation and product innovation but, significantly in the present context, insist upon a behavioural separation of the roles involved in each: thus, process innovation is presented as inevitably the province of the user. while product innovation is inevitably that of the manufacturer.

Unfortunately, given that the CAP is apparently intended to provide a more useful description of industrial innovation in practice than does the MAP, these definitions are likely to restrict research and the practice based upon it, somewhat unnecessarily. Von Hippel (1977a) himself notes a real world inconsistency with these definitions: some companies both use internally-generated innovations in their own in-house operations and manufacture them for direct sale, as when computer manufacturers employ their own products in production, R & D and design work. Von Hippel's claim that only a few firms come into this category should be treated as a hypothesis and subjected to quantitative empirical research; it may well prove to be more than a few and the roles of user and manufacturer less distinct than he proposes.

But a stronger case for conceptual extension can be made by considering the entrepreneurial nature of product innovation. Figure 2 indicates the discrete roles suggested by the above definitions and shows that it is the manufacturer whose imagination and effort lead to the commercialisation of the innovation and the consequent supply of users in general including the originator of the process innovation on which the product is based. Insofar as the portrayal of these roles as discrete patterns of

behaviour excludes user A from the market-oriented process whereby entrepreneurial profit is earned through the novel satisfaction of buyers' needs, it does not present an entirely accurate and sensitive description of the process of product innovation. A sine qua non of entrepreneurship is alertness to opportunities for gain; indeed Kirzner (1973) defines the entrepreneurial element in decision-making in terms of such alertness to possible worthwhile goals unnoticed by others. Entrepreneurial alertness is the hunch which propels the individual to engage in entrepreneurial buying and selling or to hire others capable of carrying out these functions in response to the original vision (Kirzner 1980, p.10). Both process innovation and product innovation require entrepreneurial alertness as the mainspring of the utilization/commercial activities which secure profits.

Therefore, even if users and manufacturers are distinct in terms of the specific activities which each undertakes, neither can be invariably excluded from the possibility of being entrepreneurially alert to the opportunity for gain through product innovation. Neither can be excluded at the conceptual level from the process of product innovation since users are as likely as manufacturers to engage in entrepreneurship. The CAP should not, therefore, be defined in such a way as to exclude any major role in product innovation.

Current understanding of the CAP, moreover, limits the active role of the user to operations designed to fulfil the internal needs of his firm - idea generation, possibly design, prototype building and testing, and the transmission of idea, design or prototype to a manufacturer. Thereafter, the user passively awaits the opportunity to purchase the resulting product. But, it is the contention of this paper that the user may also appreciate the potential of his innovation as a new product, capable

of general diffusion among users, and carry out some of the entrepreneurial functions involved in realising ,the profitability of his alertness. These functions include market-orientated R & D and market research. They may also, conceptually include the direct manufacture and marketing of the item, though this is not apprent in practice from the qualitative research which underlies this paper. That research consists of interviews with business development managers in several engineering companies; the first case study to emerge from this work has been published (Foxall and Tierney 1984) and the following brief observations, derived from that source, may help clarify the need for conceptual extension of customer-led innovation.

A Case Study

The possibility that users may play an active, entrepreneurial role in product innovation is amply demonstrated by British Aerospace (Warton Division) in its deliberate strategy of exploiting internally-generated process innovations. This has been accomplished through the establishment of a Business Development Group charged with identifying such innovations, projecting them by legal means (patents and copyrights), and by negotiating and administering licensing and agency agreements with external organisations, This process has included the production and use of market intelligence in order to interest the outside organisation in the venture and to strengthen B.Ae's hand in negotiations. The entrepreneurial alertness which initiated the projects involved and the consequent commerical work involved in (i) realising B.Ae's corresponding entrepreneurial profit (its own gain) and (ii) initiating the prodct innovation process are not activities to which the CAP, as presently defined, is likely to draw attention. Indeed, the initiative in recognising the possibilities for product innovation and in realising the

entrepreneurial profits to be gained from exploiting them is attributed to the manufacturer. The entrepreneurial search for new product innovations and the desire to gain as a result, is clearly at the heart of B.Ae's strategy. Of the 127 projects considered by early 1984, ten had been the subject of licensing agreements (though one of these had been terminated), ten were the subject of negotiation and 12 were under extended pre-negotiation investigation of the type mentioned above, 63 were awaiting the development of suitable markets, while, despite their internal success as process innovations, the remainder appeared to have no external, commercial application. Three examples suggest the nature of the transactions involved. A successful licensing agreement has been concluded with respect to a two-tool robot head which drills holes and emplaces rivets sequentially for each required position, increasing the accuracy with which aircraft can be built. B.Ae., patented this device jointly with another company which shared the design work. That second company has been licensed to manufacture and market the product in whose profits B. Ae. shares. A second example is a magnetic position finding device, developed in-house to aid drilling where the required positions cannot be seen. Markets are being sought for this item among lower tool manufacturers since it would form the basis of a relatively inexpensive DIY product for final consumers. The third innovation is an aircraft combat simulator, developed by B. Ae. for the testing of aircraft and training of crew in simulated combat. Several commercial applications of this idea, including its use in fairground entertainments have been identified and technical and commercial research is in progress at B.Ae to develop an appropriate product innovation., These are not examples in which the user passively allows the manufacturer to profit but in which the user-organisation has acted entrepreneurially to secure its own commercial gain, carrying out market research and technical development as necessary and negotiating professionally with the

chosen agents, manufacturers or licencees. As such it has acted to inaugurate processes of product innovation, a role which the CAP reserves for the manufacturer but such entrepreneurship is a process which cannot be confined within the boundaries of the manufacturing and marketing organisation (Minkes and Foxall 1982).

CAP2

The research, of which the B.Ae. case is a part, and which is at an early, qualitative stage of development, does not confirm the simple MAP/CAP dichotomy. Rather, it suggests that the appropriate frame of reference for product innovation is that represented by the continuum shown in Figure 3. The MAP is one configuration of relationships between user and manufacturer, that in which the former produces and refines an idea for a process innovation, to the extent of designing, building and use-testing a model, but with the purpose of solving his own internal problems. A manufacturer, through his own idea generation procedures, may become aware of this - say, through informal contacts or salesmen's reports. The MAP shown in Figure 3 also includes the efforts of manufacturers to discover customer-based ideas for new product development through competitions and other devices designed to stimulate users to develop new ideas or to identify existing process innovations which might generate new product ideas (von Hippel 1982). These activities are included in the MAP because the user plays no part in new product development as such and the entrepreneurial insight with respect to product innovation is entirely that of the manufacturer. Von Hippel (1979:104-5) appears to include this activity in the CAP but, since it comprises entirely manufacturer-active idea generation, it is probably more appropriate to include it within the MAP. At best, the user has acted as a 'catalyst' within a manufacturer-dominated process.

Figure 3 Continuum of Interactions of Manufacturers and Users in Product Innovation

Manufacturer-dominated entrepreneurship in product innovation

MAP

Manufacturer takes full initiative for product innovation: idea generation, screening, development, commercialisation. This may include his finding product ideas & designs through observation of users' process innovations in situ, alertness to reports, etc. The manufacturer remains solely responsible for product innovation, however; if the user has a role in idea generation, it is passive and he is not involved in the entrepreneurial process. e.g. 1 development of chemical additives for plastics and engineering polymers (Berger 1975; Boyden 1976). e.g. 2 IBM's acquisition of user-developed computer programs (von Hippel 1982).

CAP1

The user develops a process innovation and delivers it to a manufacturer as a product idea, his intention being simply to acquire supplies of the required device for his internal use. Any entrepreneurial alertness resulting in general product innovation and diffusion is that of the manufacturer, though the user's technical insight may be a catalyst. e.g. semiconductor and electronic subassembly manufacturing equipment (von Hippel 1977b). The user may engage in design work, prototype building, testing, before approaching the manufacturer. If this is the result of alertness to possible gain with respect to product innovation, the user is entrepreneurially as well as innovatively active in product innovation and we are moving beyond CAP1 towards CAP2.

CAP2

User-dominated entrepreneurship in product innovation

The user shows entrepreneurial alertness in product innovation by patenting his idea/design and by carrying out research to increase his gain from the commercialisation of his idea, by searching for and comparatively evaluating agents, licensees, etc. and thus attempting to maximise his returns from the project. e.g. B.Ae. Warton's Business Development Group (Foxall & Tierney 1984). The user may, if he perceives that he stands to gain thereby become a manufacturer/marketer of the item. e.g. the computer manufacturers who both use and market this technology (Von Hippel 1977a).

The user of a process innovation may, however, offer his model or prototype to a manufacturer and it is his purpose in doing this which suggests a further conceptual extension, shown in Figure 3 in terms of CAP1 and CAP2. Von Hippel's definition of the CAP is unclear in that it embraces two possibilities: (i) that in which the user approaches the manufacturer simply in order to ensure that the user has continuity of supply of a well-produced product, his own process innovation, and (ii) that in which the user offers the product in order to gain from its general commercial exploitation. Von Hippel (1977a, p.16) suggests that the benefit sought might be either of these. Because he usually writes from the point of view of the manufacturer, however, (eg. von Hippel 1979, pp. 105-6), he suggests that it is the manufacturer who is entrepreneurially alert to the opportunity for product innovation. It is clear, moreover, that his definitions of the role of the user would exclude users entirely from the product innovation process. At worst, von Hippel does exclude users not only from product innovation but from entrepreneurial alertness with respect to product innovation; if so, Figure 3 represents a conceptual extension. This certainly appears to be the case from his analysis of innovation in the fields of semiconductor manufacture and electronic subassembly in which he draws attention to the lack of incentives for users to transfer their ideas/designs to manufacturers: 'At the moment, the only meaningful incentive we have seen for such an initiative is the sometimes-present desire on the part of the user-innovator to have an outside source of supply for his novel equipment' (von Hippel 1977c, p.22). The only financial incentive for the user is the possibility of using the new device in his own productive process and the competitive advantages this provides may actually act as a disincentive to the diffusion of the innovation. At best, he has not made explicit on sufficient occasions the difference between the user acting only to secure his process innovation (CAP1) and his acting entrepreneurially in the initiation

of a product innovation (CAP2); in that case, Figure 3 suggests a conceptual clarification. MAP and CAP1 cover the same ground as von Hippel's definitions of MAP and CAP though, as noted, some functions of the manufacturer in his CAP appear to fit the MAP since the CAP1 includes the possibility, however, of users acting entrepreneurially with respect to product innovation if, in designing, building and testing a prototype they are acting in response to alertness to the opportunity to gain from the general commercialisation and diffusion of the innovation. CAP2 indicates an unambiguous move towards user-dominated entrepreneurship in product innovation. This is the situation in which the user acts entrepreneurially by carrying out the functions of concept refinements, limited market research, and product engineering R & D work on the prototype, which von Hippel's (1977a, p.20) CAP attributes to the manufacturer.

CONCLUSIONS

A scientific paradigm or frame of reference is fruitful if it suggests avenues of empirical enquiry which would not otherwise occur to researchers. Too narrow or too broad a perspective may make confirmatory observations inevitable or refutation impossible; either is capable of discouraging rather than stimulating enquiry. The empirical research which has been briefly mentioned here is consistent with the hypothesis advanced elsewhere (Minkes and Foxall 1982; Foxall 1984) that entrepreneurial alertness cannot be confined to manufacturers but is diffused across markets. That empirical research was generated in part by that hypothesis, by work on the intra-firm diffusion of entrepreneurship (Alford 1976) and by von Hippel's suggestion of a customer-active paradigm. The attempt to extend and clarify that paradigm does not, therefore, imply unnonconstructive criticism; rather, it is intended to broaden still further the

scope of research into product innovation. The next problem is to determine the economic, industrial, social and psychological contexts in which users rather than manufacturers act entrepreneurially in the process of product innovation.

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