Adapting Market Research to The Rapid Evolution of Needs for New Products and Services

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ABSTRACT

In order to be successful in the marketplace, new products and services must be accurately responsive to user needs. However, individual products, process equipment, and services are components in larger systems (larger contexts), and the needs for them are derived from their system roles. The need for any given product or service therefore evolves - is created, modified or eliminated - as systems change. Available evidence suggests that such changes are frequent, yet current market research techniques are designed to be most effective under conditions of stable need. New approaches suitable for the tracking and shaping of evolving needs are proposed.

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1.0: Introduction

In this paper we explore the idea that individual products, process equipment, and services can usefully be seen as components with roles in larger systems or contexts (section 2). A consequence of this view is that needs for products and services can be seen as *derived* from their role in such systems, with needs being created, modified, and eliminated by users and designers of systems as they make choices regarding system design. That is, the need for any given component is not stable / *does not exist* until problem-solving - possibly involving changes to both system and component - has specified its function and its interfaces to the higher-level system. Empirical evidence bearing on this matter is brought forward.

The view that needs for new products and services are contingent on the designs of the systems that incorporate them as components has major implications for market research methods designed to measure such needs (section 3). In essence, current methods involve collecting data from many users, mainly prior to the initiation of product development. Market researchers, or market researchers and product developers, then analyze those data, and use the findings as an essentially fixed input to guide the development work. Two important implicit assumptions are associated with this approach. First, it is assumed that needs for new products or services pre-exist the work of design and development and are stable, and that therefore such needs can be usefully measured and analyzed prior to the start of development. Second, it is assumed that information aggregated from many users can appropriately guide the development of new products and services. When needs evolve during the work of development, we will argue that this approach will not work and that new methods are needed that involve joint user-manufacturer problem-solving during the course of new product and service development.

Given the current trend towards continuous improvement of systems, products and services, it is possible that the stability of needs will only decrease in future. If this is so, the need for market research methods capable of addressing needs that evolve during the development process will grow more intense with time, and it will be important to conduct the research required to develop such methods (section 4).

1.1: "Needs" vs Wants and Demands

As we are exploring "needs" in this paper, a prompt definition is in order. In the language of market research, buyers are often said to need or want the products or services that they express an interest in having, using and/or buying. Kotler (1991, 4-5) offers more precision on the matter, proposing that a human need is a state of felt deprivation of some basic requirement for survival, such as food or shelter. He proposes that a want, in contrast, is a desire for a specific satisfier of such a need, while a demand is a want backed up by the willingness and ability to buy. (Thus, one may need food, have a want for an inexpensive bowl of soup or a serving of caviar to satisfy the need, but have a demand for the soup only.)

Although basic needs may lie behind wants and demands, identifying these would not offer much utility to market researchers attempting to develop specifications for new products and services. Product and service developers require very precise information about the attributes of new products and services that potential buyers may demand, because products and services inherently have very precise attributes (e.g., a fork has *some* number of tines). And information about the basic needs a given product or service may satisfy offers little specificity of this type. A given product or service can satisfy more than one need (Maslow 1987, 29) (e.g., a restaurant can provide both food and shelter), and there may be many very different products or services that can contribute to satisfying a given basic need (e.g., the need for food can be slaked by many different food products).

Since analysis of basic needs offers little utility, market researchers interested in identifying "needs" for new products and services have developed methods that directly focus on wants or demands. These generally involve constructing a list of attributes that a type of product or service does or should contain in the view of potential users (and/or buyers). Then, data is collected from a sample of such users to establish the mix of these attributes that they would most prefer. (Lancaster 1971, Urban and Hauser 1992)

As an aid to clarity, in this paper we use the more conventional term "needs" to represent what Kotler calls demands. When we say that a need for a given product or service is stable, we mean that the attributes and related user perceptions and preferences that characterize the need are stable. When we say that a need has changed, we mean that there has been some change to these attributes, perceptions or preferences.

2:0: <u>The Derivation of Needs for Products and Services</u>

Individual products, process equipment, and services are components in larger systems (Marples, 1961, Boyd and Levy 1963, Henderson and Clark 1990). This is clearly visible in the instance of processing machines (which fit into larger processing systems) and in the instance of industrial components (which perform functions within larger products or services). It is also true, but perhaps less intuitively obvious, in the instance of consumer goods and services. For example, a fork is a component part of a user's system for eating, and a component as well of systems for conveying signals on social status and other matters. Similarly, a telephone-answering service or machine is a component of many consumers' complex personal systems for receiving and storing data.

Users and designers of systems value the functions or outputs of a system component only because of and in terms of its role in the system as a whole (Boyd and Levy 1963). That is, the "need" for a function(s) that such a product or service provides is a *derived* one. Thus, computer designers and operators may have an intensely felt need for magnetic hard disks. But this need is derived from the role these data storage components play in a computer system: they would have no need for computer disk drives absent computers.

A system can be seen as having many nested levels. Within each level, many components may be linked to form the next higher-level system. For example, a computer hard disk drive is a "system" assembled from components. In turn, such a disk drive is a component in a computer system, which in turn is a component in a data processing system, which in turn is a component in, for example, a telephone switching system, which in turn is a component in a telecommunications system, etc.. We propose that one can think about the derived nature of a need in the same way independent of the level of system at issue.

Needs for component products and services are created, modified, and sometimes eliminated by design and use decisions made at other system levels. For example, a decision to design a computer data storage system around optical rather than magnetic "hard disks" would *eliminate* the need for many of the components in a magnetic hard disk drive such as the magnetic disk materials and the devices used to sense magnetic fields. At the same time, that decision would begin the process of *creating* needs for the optical disk materials and the optical sensors and lasers and controlling circuits that will be components in optical hard disk drives. Similarly, a decision to change the way a computer system is used, for example, a change to the types of tasks performed, can affect the type and number of data storage devices needed in that system.

2.1: Some Evidence on the Evolution of Needs

Studies of the engineering problem-solving process have shown the process of creating and eliminating needs for components during the process of system development quite clearly. Marples (1961) explored the problem-solving process involved in some industrial process equipment development projects. Allen (1966) studied the problem-solving process involved in the design of a number of aerospace systems. Both found that engineers carried out the work of developing a system or subsystem by conceiving of and evaluating a number of alternative designs, and then selecting the one judged best. Alternative designs involved different components: When the system to be built was finally settled upon, the components in the selected alternative were "needed," while those embodied in the rejected alternatives were not.

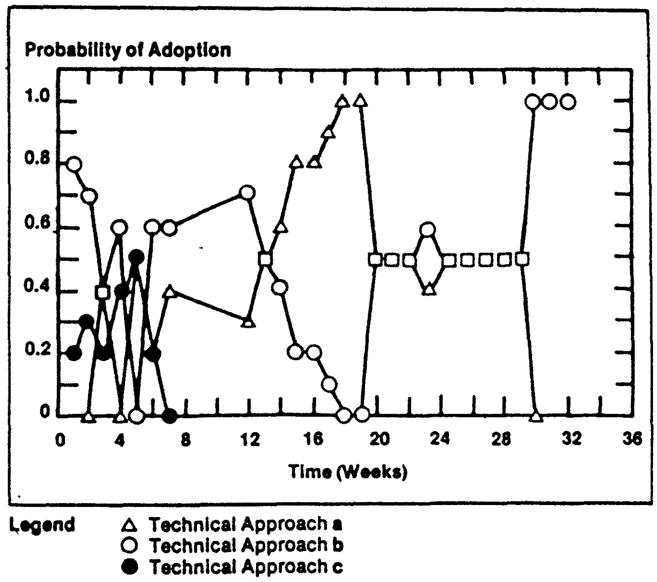

Figure 1: A "Solution Development Record" of an engineering design team designing an Antenna Radiation Subsystem shows a rapid change over time in the probability that one of three technical approaches (a, b, and c) will be adopted. These records are based on data from real-time monitoring of the engineering problem-solving process. (Source: Redrawn from Allen 1966, 75)

Allen also showed that engineers' preferences for alternative solutions (and therefore preferences for related component products) changed frequently and quickly as development work proceeded. He displayed these attributes of the problem-solving process very graphically in "solution development records" (Figure 1). This rapidity in the change of needs is reasonable. If needs change and evolve in response to changes in the systems that incorporate or use the needed products or services, they can shift as rapidly and repeatedly as such changes can be made.

Hauschildt (1986) studied the evolution of needs during purchase decision processes carried out by 308 firms deciding to buy or lease a computer - a component of user information processing systems. He reports that, although conventional decision process literature assumed that a well-defined goal would be specified at the start of a decision process, "...our findings show that the goal-formation process [process of establishing the need for the computer being purchased] is not completed before the beginning of problem-solving activity. It is not a first phase in problem-solving. Even the assumption that goal setting activities recede [are reduced in frequency] during the process of problem-solving is not confirmed by our findings" (Hauschildt 1986, 10). He explains the setting and resetting of goals observed by arguing that insight into possible solutions influenced decision-makers' ideas regarding what they really wanted.

The evolution of needs for new products and services is also very visible when prototypes of new products or services are tested by users in their own use environments with resultant "learning by using" (Rosenberg 1982). Consider, for example, a procedure used in the software industry called "rapid prototyping." Prior to the introduction of this procedure, it was standard practice for software developers to meet users and agree on a product need specification at the start of a project, and then to work isolated from further user contact until the product was delivered. However, via painful and costly experience, developers found that users often rejected the products developed via this method. Users said, in effect, "Although this software does meet the initial specification we both agreed upon, I now find upon experimentation that what you have provided is *not* what I need."

In eventual response, software engineers developed rapid prototyping methods that allowed the simulation of key functions of proposed software products very quickly - sometimes within a single day, typically within a few days. Users could then experiment with prototypes representing what they initially thought they needed, so that they could refine their need specifications in the light of what they learned. This process of alternate need and solution refinement could then proceed as often as needed (Figure 2).

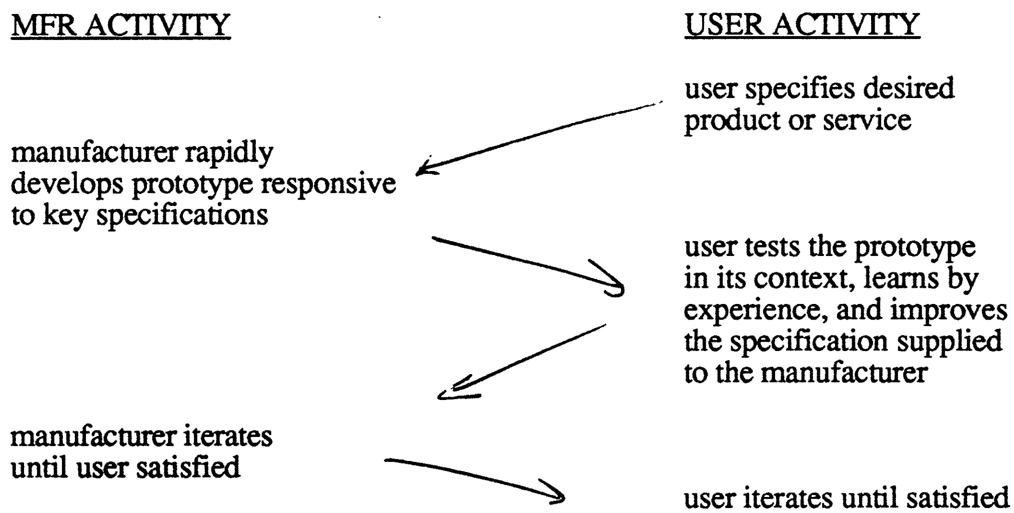

Figure 2: Iterative problem-solving pattern associated with evolution of needs.

Today, the rapid prototyping approach has been tested by many expert software designers and typically has been reported to be far superior to the old approach with respect to accurate responsiveness to user need (Hekmatpour 1987; Zelkowitz 1980; Klausner and Konchan 1982; Gomaa 1983). The single experimental comparison of the two methods we are aware of (Boehm, Gray, and Seewaldt 1984) also comes to that same conclusion.

2.2: Patterns in the Evolution of Needs

When systems change, needs for component products and services may change - but they do not necessarily change. Consider the design of a system and the design of a component to be used in it (a product or service) as two subproblems. If one wishes to make a functional change to a system, many solutions typically are possible. Some may involve changing (the need for) a component, some changing the system, and some may involve changing both. For example, if one wants to create a higher-performance personal computer, solution possibilities exist that will fall into all three of these categories from the point of view of a manufacturer of a given system component - say, the microprocessor. That is, one may find a way to improve system performance that involves: (1) a change in the (need for the) microprocessor only; (2) a change to the system but not to the microprocessor; or (3) a change in both. When a change is being made in the design or use of a system, and a solution of type (2) is chosen, we may say that the need for the component is stable despite the system-level change.

The fact that system solutions that conserve the need for a given component *can* be chosen does not mean that we can know whether or when they *will* be chosen. The three categories listed just above code the attributes of solutions, that is, the outcome of a solution process, rather than an input. And unfortunately, one cannot know the outcome of the problem-solving process in advance because the solution space for design problems is not constrained (Simon 1981). That is, there are an indeterminate number of ways to design a system able to perform a given function, and so the particular way that will be developed as a consequence of problem-solving (and the related stability of a given product or service need) cannot be predicted with certainty.

However, when a solution *is* chosen that does involve an interdependent change to a system and a needed component product or service, it is reasonable that both user and manufacturer problem-solving will be involved. Such problem-solving may be carried out simultaneously and jointly by users and manufacturers, or via a series of iterations as in the rapid prototyping process described earlier.

Paul Hunter (1991) and Mark Taylor (1991) recently developed some empirical evidence that supports this supposition. New components that require system-level changes for implementation on the face of it involve an interdependent change to a component and a system. Therefore the development of these should, according to our supposition, involve problem-solving by both users and manufacturers. Hunter and Taylor built on previous research that shows that efforts by manufacturers to develop new industrial products are sometimes based on a user idea provided to the manufacturer at user initiative - and sometimes not[2]. They sought to explore whether such user initiations of product and service developments (as a proxy for user problem-solving effort) tended to be preferentially associated with innovations that required system-level changes for implementation.

Hunter's innovation sample consisted of all the telecommunications service innovations developed by the New Jersey Bell telephone company during the years 1985-1990 that involved a change to the software of the central office

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2 In von Hippel (1978) I reported on evidence collected from a number of sources that appeared to indicate that projects by manufacturers to develop new industrial products are often begun with a request initiated by customers that has been preceded by user problem-solving to the point where an "idea" regarding the new product or service component has been at least tentatively outlined, a pattern referred to as CAP ("customer-active paradigm"). Since that time, other researchers have elaborated and refined CAP, and some of these also have generated additional data confirming that innovations based on user-initiated ideas do frequently occur in the samples they examined (Voss [n.d.], Vanden Abelee [1988]).

switching systems of that firm (n=20). Taylor's innovation sample consisted of all significant product improvements made to a line of infrared glass polarizers manufactured by Corning Inc. from 1987, the date of the first commercialization of that product line, through 1990 (n=18).

		Did Adoption of Innovation Require Change by Customer?	
Telecom Service Innovation Sample[a] (n = 20)		Yes	No
Innovation Initiated by:	Customer	5	3
	Manufacturer	0	12
Glass Polarizer Innovation Sample[b] (n = 18)		Yes	No
Innovation Initiated by:	Customer	9	4
	Manufacturer	0	5

[a] Data source: Hunter 1991, Table 4 . (We have combined Hunter's categories of "NJ Bell Internal" and "NJ Bell Switching" into a single "Manufacturer" category in our table.)
[b] Data source: Taylor 1991, Tables 3 and 4.

Table 1: In two samples, *only* innovations initiated on the basis of a request from a customer were found to sometimes require changes in pre-existing customer systems in order to function as specified.

For each sampled innovation, Hunter and Taylor determined whether or not adoption by users required a change in the system interfaces of the buyers. Then, they explored the history of each innovation within the firm, and determined whether or not the new product or service had been developed in response to a request by a specific user. (Both Taylor and Hunter had good access to the needed data in the companies that they studied: They were employees of those firms and had management responsibilities in the product and service areas studied.) New products and services developed in response to a specific, contemporaneously-documented request by a specific customer were coded as user-initiated. All others were coded as manufacturer-initiated. Projects in the latter category were sometimes developed as a result of market research initiated by the company, and sometimes as a result of internally generated ideas that had no identifiable market research associated with them.

As can be seen in Table 1, the data show that only user-initiated projects to develop system components sometimes required changes in pre-existing customer systems in order to function as specified. In contrast, all manufacturer-initiated innovations could be simply "plugged in" to existing customer systems. This pattern supports the idea that both user and manufacturer problem-solving is involved - and perhaps required - when a change to a product or service also involves a change to the system "needing" it.

3.0: Discussion: Implications for Market Research Methods

Current market research methods, ranging from simple consumer surveys to multiattribute need analyses to the market research component of QFD or Quality Function Deployment, are designed to identify needs for new products and services prior to the start of the development process. Schematically, one can describe multiattribute methods in terms of the following linear sequence of activities. First, data related to needs for new products or services are collected from a number of users. Next, these data are aggregated and analyzed by market research specialists to identify needs that can be profitably fulfilled. Next, the conclusions of the market researchers are reported to the development engineers as an input to and guide for their work. Sometimes, one or two checks may be made with the customer during the course of development work to see if the product being developed is accurately responsive to the [assumed to be unchanging] need (Urban and Hauser 1980). QFD methods differ in that they prescribe rich interaction between market researchers and product developers in order to insure that the "voice of the customer" is faithfully preserved during the process of converting customer needs into engineering solutions. However, as in the case of multiattribute methods, the data on the customer needs is collected prior to the start of development in QFD, and is not updated during the course of development work (Hauser and Clausing 1988).

Market research methods that rely on need data collected prior to the development process contain the implicit assumption that needs for new products or services pre-exist the work of developing them and are stable - because if this condition is not met the methods simply will not provide accurate data. But in section 2 we saw that needs are often not stable, and that we cannot necessarily predict when they will be. Therefore, manufacturers who decide to use market research methods such as those just described are in effect wagering that the needs for a component under development will be stable for long enough to provide an attractive market

A wager that needs will remain stable may be a good one under some conditions.[3] However, manufacturers who elect to restrict themselves to methods

[3] If one knows something about the costs and benefits likely to attend system users or designers in a position to modify a given system, one may be able to predict the likelihood that a need for a given component will be stable. System users or designers often face economic incentives to incorporate a particular component into a system (e.g., keep the derived system need for it stable) and outsiders can often know something about these. For example, computer designers or users will often have a strong incentive to incorporate X brand or type of microprocessor, perhaps to conserve time or money ("X is already developed and available on the market"); to reduce risk ("X has already been proven reliable in the field"); or for some other reason (e.g.,"X is a standard in the field").

Also, it is sometimes reasonable to expect, in the instance of a component needed by many users that, although the internal problem-solving activities of any given user are not known, the likelihood is that the needs of enough users to constitute an attractive market will stay stable during the development period and beyond to create an attractive market opportunity around creating a product for an existing need.

Finally, an understanding of the likely costs and benefits attendant upon adoption will that work only for stable needs may find the restriction to be a costly one: It is entirely possible that the best new product and service opportunities are those with evolving needs. After all, when both system and component are flexible, users and manufacturers have the opportunity to make mutual adjustments to achieve a better overall solution, as in: "If you can change that specification a bit, this improved solution becomes possible."[4]

Manufacturers who wish to get beyond the constraints of responding to fixed needs will not find it easy to simply modify traditional market research methods to suit the task. In principle, one might simply repeatedly re-run the need data collection and analysis steps of such methods in order to track rapidly evolving needs. However, we have seen that needs can evolve rapidly - perhaps over days or weeks. In contrast, a single pass through the "opportunity identification" steps of multiattribute market research methods can take several months and cost $50,000 for an industrial product and $100,000 for a consumer product (Urban and Hauser 1980, tables 3.3, 3.5, 3.6).

3.1: Towards New Approaches

Traditional market research techniques customarily gather need input data from many users. This data then has been used to both learn about user needs and to segment and size a market. This simultaneous serving of two purposes is

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sometimes also lead manufacturers to take the risk of developing a new product or service that does not fit existing systems (e.g., is not currently needed). For example, designers of speed-sensitive computer systems might be predicted to find it profitable to initiate a redesign to incorporate significantly faster semiconductors if these were introduced to the market.

[4]I am aware of only one study with data related to (and in support of) this test of reason. Leonard-Barton and Sinha (1991) studied user satisfaction with 34 software packages used by firms, and found that development processes that involved mutual adaptation of the software and the user organization created the highest degree of user satisfaction.

Possibly the Hunter and Taylor findings shown earlier indicate that some manufacturers are tapping into some new product and service opportunities characterized by evolving needs despite inadequate marketing research methods. They seem to have a strategy of sticking to (assumedly) stable needs "unless a commercially attractive user asks".

elegant, but one may have to forego it in the instance of rapidly changing needs. Manufacturers who want to be involved in *shaping* system-component combinations need to be put in touch with more than need data. They need to be linked with a (presumably small) sample of users capable of the requisite joint problem-solving work. Product development personnel working for the manufacturer could then be brought together with these users for joint problem-solving sessions that could range freely across the whole solution space of possible system-component configurations.

Market research methods able to serve in this novel way require some new capabilities. First, they must incorporate some means of identifying one or a few users whose system-level problem-solving efforts are likely to result in derived needs that will be shared by many other users. Second, they must have a means of engaging selected users in productive joint problem-solving with manufacturer personnel.

Identifying the "Right" Users for Joint Problem-Solving

The problem of selecting a user capable of deriving a system need that will represent an attractive market for a component product or service is sometimes trivial, and sometimes not. In the instance of many industrial products, one or a few users *are* the market. Under these conditions, identification of a representative user is trivial or may not be needed - manufacturers may be able to afford to engage in joint problem-solving with, and creation of a custom product for, every user. However, the matter becomes problematic when the number of potential customers for a given item rises. Under these conditions, how can one specify the characteristics of one or a few users who can best engage in joint problem-solving to derive system needs that will be representative of several to many customers?

One possible approach is to use a market segmentation approach to identify users who apparently have similar *system* needs for a given new component or service in an attractive market. Then, the manufacturer can select a few of these to work with closely, rather than, as with present methods, collecting a small amount of need data from each member of a large sample. However, the utility of this approach depends on two assumptions. First, there must be significant similarity among user systems in a marketplace made up of many users, and there must be some practical method of identifying such similar systems and grouping them into market segments. Second, the system solutions arrived at by the few users that the manufacturers work with closely must be attractive to other users in the same "system segment" of the market.

Both of these assumptions must be tested and explored via empirical research. Suggestive evidence with respect to the correctness of the first is that traditional market research studies have often found good within-segment uniformity in the needs expressed by consumers for given products. Since, as we propose, these needs for component products and services are derived from the roles they are expected to play in systems, this fact suggests - but does not prove - similarity in the related systems. Suggestive evidence with respect to the second lies in the reasoning that users who seek to change their systems have an incentive to do this cost-effectively. They will therefore have an incentive to follow existing solutions that have been developed for similar systems rather than invent new ones if this appears to be the most cost-effective course of action.

If and as users do have an incentive to adopt solutions rather than develop them when this is cost effective, manufacturers might find it valuable to identify users who are *early* with respect to confronting a need for a given system-level change that others will face later. If a manufacturer can engage some of these early users in joint problem-solving, it may be able to develop solutions that will offer follow-on users an attractive and relatively low-risk system-level solution of demonstrated effectiveness. In essence, this approach involves "making a solution needed" rather than "making the needed solution." For example, if automated bank teller systems can be predicted to be an emerging trend in banking, a would-be manufacturer of automated teller machines could will work with early user-innovator banks to develop equipment in conjunction with developing needed changes to related bank systems. Then, when other banks consider adopting such systems, that firm would be in a position to offer a solution to both system-level and component-level problems at the same time.

Elsewhere, we (von Hippel 1986, 1988) have proposed that a "lead user" segment of early users will be especially able to engage in useful joint problem-solving work with manufacturers. Lead users of a novel or enhanced product, process or service are defined as those who display two characteristics with respect to it: (1) they face needs that will be general in a marketplace - but face them months or years before the bulk of that marketplace encounters them, and (2), they are positioned to benefit significantly by obtaining a solution to those needs.

Each of these two characteristics provides an independent and valuable contribution to the utility of lead users in joint user-manufacturer problem-solving. The first insures that users have actual experience with a system-level need that others will encounter later. And, as studies in problem-solving have shown (summarized in von Hippel 1986), users who have real-world experience with a need are in the best position to understand it well. The utility of the second lead user characteristic is that users who expect high benefit from a solution to a need have the highest incentive to engage in the problem-solving needed to understand it well, and perhaps to resolve it. (Mansfield [1968] and others have studied industrial product and process innovations and shown that higher expected benefit is associated with higher investment in obtaining a solution.)

A few trials of a market research study method in which lead users have been recruited to develop new product concepts for and in conjunction with manufacturer personnel have been reported, and these have shown positive results (Urban and von Hippel 1988, Herstatt and von Hippel 1991, Bailetti and Guild 1991a). Also, some work is now being done to explore whether one can "create" lead users by subjecting them to an "information acceleration" process (Hauser, Urban, and Weinberg 1991).

Joint Problem-Solving with Users

The idea of engaging in joint problem-solving with a few selected users will be familiar to some firms, and alien to others. Some manufacturers have long practiced joint problem-solving with some customers. For example, suppliers of suppliers of airplane components and suppliers of auto components (Clark, Chew, and Fujimoto 1987) have long had a practice of having their engineers work directly with the system design engineers at the same site. Similarly, the engineers who staff the special applications laboratories of plastics suppliers, etc., work directly with users and engage in joint problem-solving. Other firms, however, have isolated their engineers from customer contact either through organizational happenstance or design. These firms may find adopting an approach of joint user-manufacturer problem-solving requires considerable experiment and adjustment.

There are a number of possible ways to conduct joint problem-solving with users. Among these is, as noted earlier, the direct interaction of user and manufacturer engineers at a common site. The method of rapid prototyping, also described earlier, is a joint problem-solving process in which the problem solving work is repeatedly passed back and forth between users and manufacturers that each remain at their separate sites. Udwadia and Kumar (1991) discuss the possibility of users and manufacturers "coconstructing" products and services.

Bailetti and Guild (1991a) report on a method that involves developers visiting user sites but not vice-versa. Herstatt and von Hippel (1991) report on a joint user-manufacturer product concept development process carried out in the context of a three-day workshop.

4.0: Summary and Suggestion for Further Research

In this paper we have discussed how needs for new products and services are derived, and some empirical data on the matter has been reviewed. A major implication of the view presented here is that needs for new products and services are often evolving and therefore unstable. A review of fundamental attributes of traditional market research techniques suggests that these are not suitable for the tracking and shaping of rapidly evolving needs, and that new methods are needed. We have outlined a novel approach that may be worth developing, and pointed out some extant method components that could serve in a new approach to the determining and shaping of evolving needs for new products and services. Clearly, this represents only a start to addressing the problem.

As was noted at the start of this paper, the need for market research methods capable of addressing unstable needs and capable of drawing system developers and users into joint problem-solving with the developers and manufacturers of system components will probably only grow more intense with time. The current trend towards continuous improvement of systems, products and services suggests that the stability of needs will only decrease in future. Eventually, we propose, what will be needed is methods that can facilitate a continuous collaboration between users and manufacturers engaged in the interdependent development of both system needs and responsive new products and services.

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