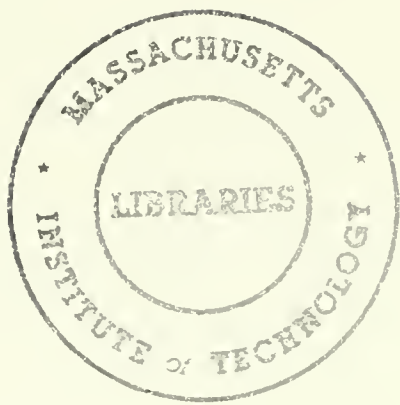
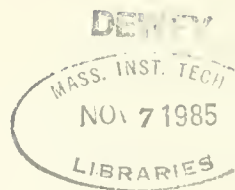


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New Product Strategy
in Small Technology-Based Firms:
A Pilot Study

Marc H. Meyer
Edward B. Roberts

August, 1985
WP# 1428-2-85

Revised 1985-2

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ABSTRACT

A pilot test is reported on a method for relating the degree of "newness" within a firm's portfolio of products and the firm's economic success. The embodied technology and market applications newness is measured in the sequences of 79 products developed and released by a sample of 10 small technology-based companies, each under \$50 million in most recent sales. A two-dimensional "technology newness/market newness" grid is prepared for the product set of each firm, based on the conditions existent at the time of each product's development. Alternative weighting schemes are used to generate a "newness index" for each firm. The degree of "strategic focus" is shown to relate directly to corporate growth in that small firms with more restricted degrees of technological and market change in their successive products outperform companies with wide diversity. The evidence suggests, however, that some product "newness" is better than no "newness", and that more technological change can be effectively employed in small company product strategy than market change.

NEW PRODUCT STRATEGY
IN SMALL TECHNOLOGY-BASED FIRMS: A PILOT STUDY

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This article presents a pilot study of an empirical method to examine the effectiveness of new product strategies in small technology-based firms. The research methodology enables exploration of a possible relationship between the degree of "newness", in terms of the embodied changes of technology and market applications within a firm's portfolio of products, and the firm's economic success. Specifically, does the degree of "strategic focus" exhibited in small technology-based companies' product lines affect corporate growth in a systematic manner?

RESEARCH BACKGROUND

Building Blocks in the Literature

While the research in corporate strategy and innovation is extensive, the subject of new product strategy as a specific research topic lacks both conceptual modeling and methods for empirical testing. Nonetheless, as synopsized below, the existing strategy and

innovation research points to a large number of important variables that, together with the new product strategy, affect the firm's performance.

The goals and business implementation tactics that emerge from corporate strategy have a direct bearing on new product decisions. Accordingly, from a research perspective, the study of new product strategy should find a home in the corporate strategy literature. Abell and Hammond (1979) and subsequently Abell (1980) have described the complex interrelationships between defining business missions, developing functional strategies, and allocating resources to implement strategies. Porter (1980) conceives the process of defining business activities in terms of differentiation, where the firm identifies specific market opportunities that are defined by customer requirements and competitive analysis. Lorange and Vancil (1977) focus on the process of strategic planning itself and present formal mechanisms for integrating planning that occurs at different levels of the organization. Techniques for corporate planning and business portfolio management are a logical outgrowth of this research. However, new product strategy is treated as a tangential issue to this research and is commonly viewed as the outcome of market segmentation and other forms of market planning. The technology factor in new product activities, which would appear equally important as the target markets of new products, is the orphaned child of strategy research: it is certainly there, but nobody knows what to do with it!

A second vein of strategy research is empirical in nature. This research has focused on the relationship between patterns of

business diversification and organizational structure. Chandler (1962) defined the hypothesis that structure follows strategy, and supported it by tracking developments within seventy large corporations over a twenty year period. Rumelt (1974) expanded upon Chandler's thesis with another sample of large corporations, demonstrating that corporations with related business units outperformed those with wider business diversity. Roberts and Berry (1985) most recently reviewed the research on diversification strategy at the level of a firm's portfolio of businesses. But that research does not seem to extend downward to the product level.

The technological resources of the firm and their utilization also have a direct bearing on new product strategy. The forecasting of technological change has been explored in some depth, both at the general level (Martino, 1969; Fusfeld, 1970), and in terms of contrasting rates of product versus process innovation over time (Utterback and Abernathy, 1975). Using a different approach, Petrov (1982) describes how a firm may profile its technologies in a fashion similar to standard portfolio management techniques, using two parameters of technological "attractiveness" and "relative technological position" of technology units identified in the firm. Gluck and Foster (1975) indicate conceptually how this profiling approach can be applied to competitive analysis at the product level. While the technology strategy research thus has many interesting components, it suffers from a lack of empirically-tested cohesive models.

Innovation research provides a broader foundation for the study of new product strategy. Research in this area has been both diverse and substantial. The subset most applicable to the authors' research interests are the empirical studies of the sources of innovation. While research in this area has examined a broad range of innovation-facilitating factors, the outcomes are often presented in the context of the roles of "market pull" versus "technology push" in effective innovation (Myers and Marquis, 1969; Langrish, et al., 1972; Rothwell, et al., 1974). Those factors deemed important for new product success by these researchers have included a clear understanding of user needs, strong marketing investments, active new product champions and sponsors, and the flow of relevant technical information into the organization from external sources.

Since the sample of the present study is comprised of small to medium-sized technology-based enterprises, prior entrepreneurship research may also be of background utility. The "need to achieve", identified by McLelland (1961) as the primary motivating force affecting entrepreneurs, was further examined by Wainer and Rubin (1969) as a factor affecting performance of the young technology-based corporation. Similarly, the role of prior business experience in successful technical entrepreneurship is examined in Cooper (1970) and Cooper and Bruno (1977). Roberts (1968) has identified a range of factors associated with success and failure of technology-based startups, including the presence of a diversified management team, the implementation of proactive rather than opportunistic marketing programs, and a high degree of technology transfer from former places of employment. But none of these

entrepreneurial studies has concentrated on product strategy issues.

Research that has specifically targeted new product strategy has usually focused on multi-company samples of individual products or paired product comparisons. Calatone and Cooper (1981), for example, reported on 195 new product cases from 103 firms, finding 18 cluster dimensions that related to individual product success. Marquis (1969) and Rothwell, et al., (1974), cited above, and Cooper (1979) reported similar analyses on large samples of single products. But by their nature studies of single product successes and/or failures within a company cannot empirically explicate the firm's historical new product strategy.

In his latest works Cooper (1984, 1984a) has surveyed company managers' responses to an extensive questionnaire to define new product strategy at the overall company level and to relate these strategies to various company performance measures. But the authors have not uncovered any prior research that has focused on examining the sequences of product releases that become, eventually, a firm's product line or multi-product portfolio. Yet intuitively the product line or portfolio of products must be a more evident manifestation of a company's strategy than any single product. The resulting research question is therefore: Does one pattern of sequential product development, identified in this article as a "new product strategy", lead to different corporate success than another pattern?

This question of what new product approaches contribute to successful corporate growth would appear elemental to both the

strategy and entrepreneurial fields. Yet, with few exceptions, empirical research on the subject is absent. Further, some potential models that might be applied to the study of new product strategy, namely business or product portfolio management, have been developed primarily for large diversified business settings. The development of a cohesive framework for the study of new product decisions in smaller technology-based firms, one suited to empirical testing, therefore assumed high priority in our research agenda.

Conceptual Framework

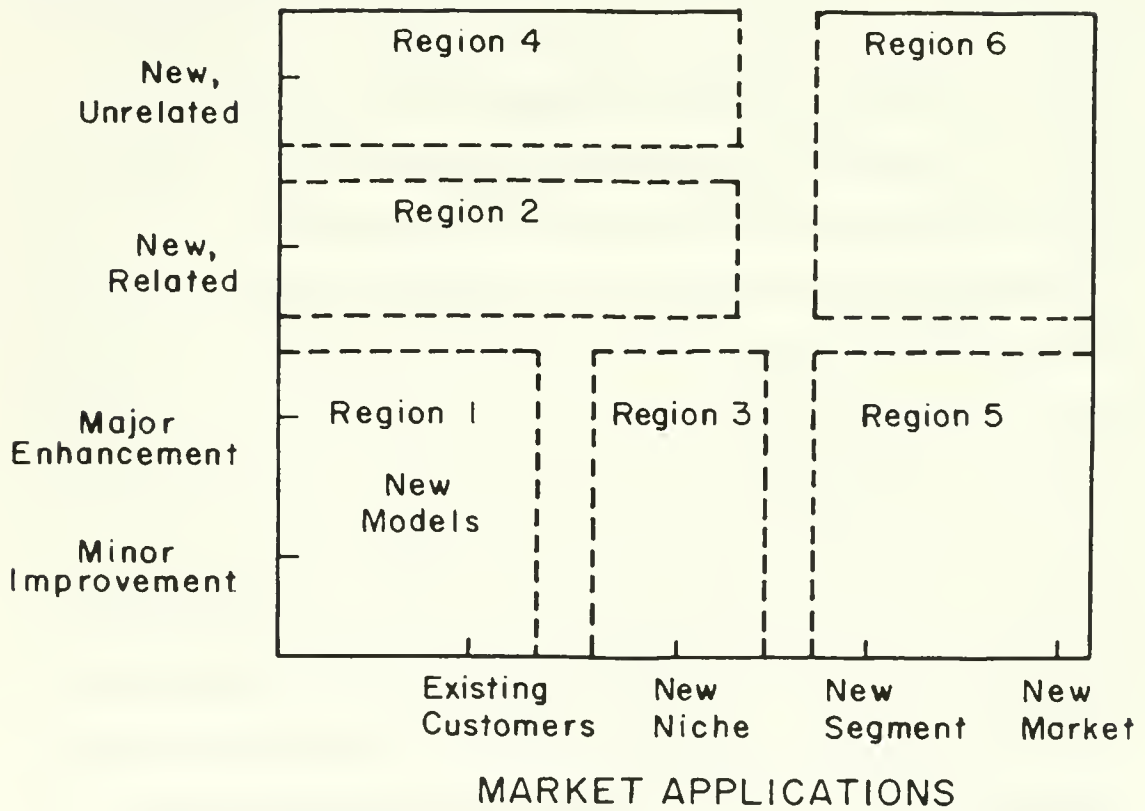
New product strategy requires a historical base for assessment. Only an understanding of a firm's past product activities can provide the full context by which to evaluate the challenges posed by its next set of new products. Cooper (1984) identified 66 individual product strategic elements as falling into four clusters involving the nature of: products developed; markets sought; technology employed; and the new product process. In turn, these four elements suggest that measurable comparisons of present to past products may be performed along two basic dimensions. The first dimension is the newness of the technology within the new product relative to technology(ies) already developed by the firm. The second dimension is the newness of the market application for which the new product is targeted compared with the users of past products. The pairing of embodied technology and market application for the examination of new product strategy is an idea used previously by many authors, including Johnson and Jones (1957) among the earliest, and more prominently by Rumelt (1974). Each of the two

dimensions incorporates a set of factors. For example, the degree of newness in market application includes levels of newness regarding product packaging, buyers, distribution channels, and support mechanisms. As each new product comes on stream, the cumulative body of the firm's technology and market experience grows accordingly, and is that much broader for the evaluation of the next new product effort. This framework is shown in Exhibit 1.

For the technological dimension of Exhibit 1, the critical unit of analysis identified is the "key core technology(ies)" of a product. A core technology is a discrete, unique set of skills or techniques which finds application within one or more products or services. A given product embodies at least one identifiable core technology, and it may include several or more separate technologies. However, not all core technologies embodied within a product have the same impact upon the firm's competitive advantage. Accordingly, those particular core technologies which provide the firm with a proprietary, competitive edge and differentiate it from other companies making similar or substitute products have been identified as key core technologies (Ketteringham and White, 1983). Key core technologies can be distinguished from other technologies used by the firm that are commonly available in the marketplace as components. This latter, more broadly available group of core technologies are referred to as "base technologies". A firm that is engaged in an industry characterized by rapidly advancing technology typically concentrates on one or more specific key core technologies, and by packaging or integrating it with a variety of component base

Exhibit I
The Product Innovation Grid

KEY
TECHNOLOGY



technologies, generates its final product. The key core technology becomes the basis for the "value added" of the firm. Clearly, this process occurs only in those firms that undertake their own product development and are not simply sales or support organizations.

Therefore, the differentiating element along the technological dimension of a firm's product portfolio is the degree to which each new product entails changes to the embodied key core technology of past products. This level of change runs along a conceptually continuous range of expended resources and effort. However, for the purposes of research, specific discrete levels of change or newness can be identified. The spaces in the diagram between "regions" suggest areas of overlap or ambiguity.

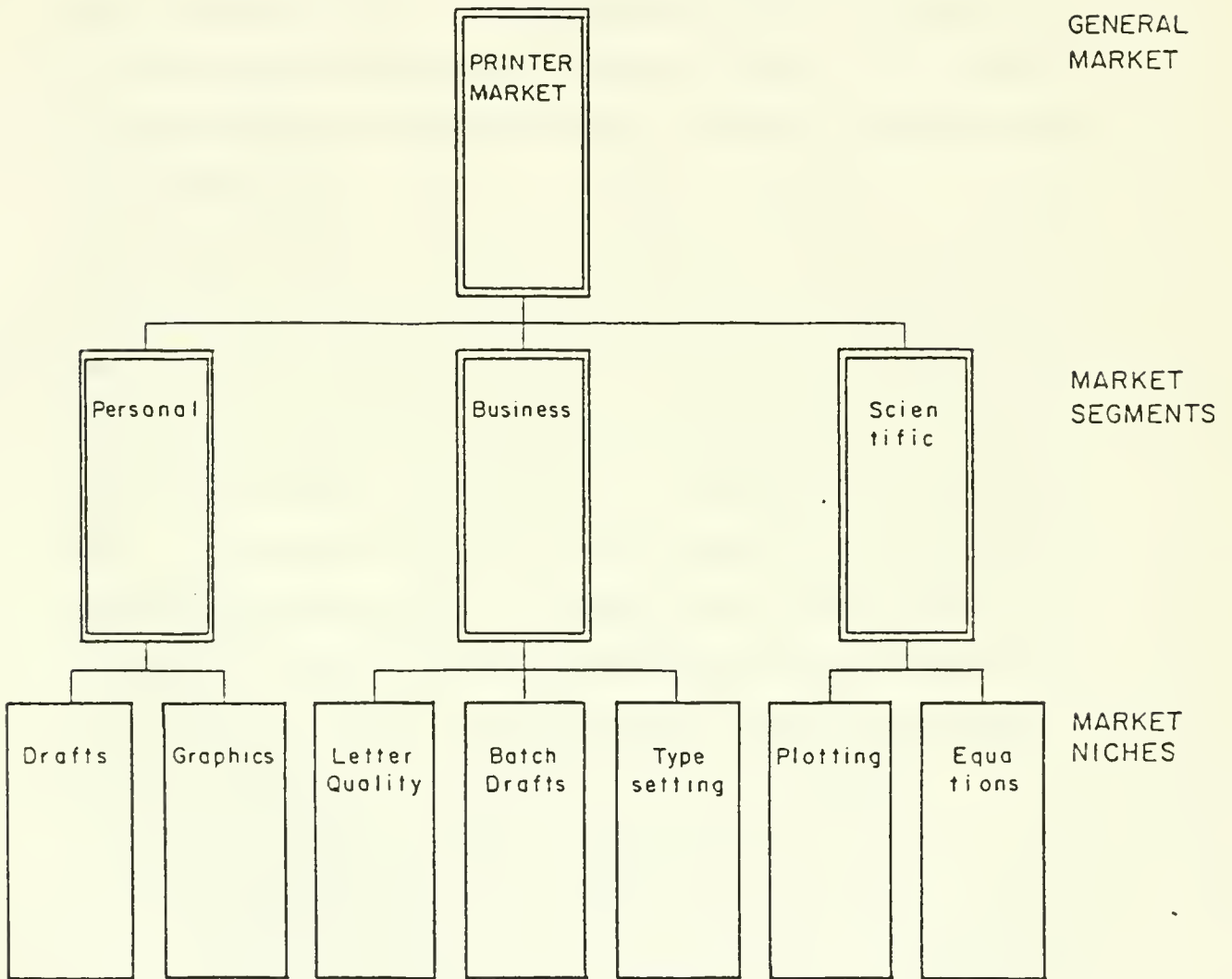
The first two levels identified are "minor improvement" and "major enhancement" to a key core technology that the firm had developed some time in the past. Major enhancement is often achieved through the addition of new base technologies to a product line. It often requires a substantial development effort. By adding new components or subsystems, the firm can leverage its existing key technology into new product/market areas without having to develop additional new technologies of its own. While still concentrating on a single set of internal core technologies, a firm may expend considerable R&D resources to remain a consistent leader in that technological area or aggressively to advance its chosen key technology into new frontiers of application. The third level of technological newness is the development of a "new, related" key core technology, "related" by virtue of either sharing a product

application in which the firm is presently involved or being combinable with an existing key technology into a wholly new product application. The development of a "new, but unrelated" key technology presents no such opportunity for combination with the firm's existing product technology. This is the most extreme level of technological newness, a major departure from what we have labelled "technological focus".

A schema for identifying levels of newness in the market application dimension of Exhibit 1 has been adapted from the competitive structure model of Urban, Johnson, and Brudnick (1979). This model, shown by example in Exhibit 2, segments a market into a hierarchical tree structure by assigning possible product attributes to specific tree branches. These branches are defined by an analysis of the types and effects of product usage and the characteristics of users.

In the conceptual adaptation of this model to the present pilot research, the market tree structure(s) for a firm's products is derived by extensive discussion with the interviewees. However, individual tree branches are not statistically tested by random sampling of consumers of the firm's products, as had been done by Urban et al. Additionally, the layers of the market structure are restricted to three generic levels: the general market, segments within the market, and niches within each segment. This taxonomy captures most of the degrees of newness in the target markets for new products. Since the market structures facing a firm can change over time, the degree of market newness assessed for a particular product

Exhibit 2
The Hierarchical Market Structure



is based on the "current" structure at the time of the new product's release. As illustration, the market tree in Exhibit 2 was developed with the founder of a printer company that is part of the sample of this pilot study.

The intersections of technological and market newness on the Exhibit 1 grid, sixteen in all, can be grouped into regions of new product activity. Region 1 represents the release of new versions or models of current product lines, requiring some degree of enhancement to existing key core technology. In Region 2, the firm broadens its activities in an existing, or to a closely related, product/market by developing a new key technology that is combined in some fashion with the firm's existing technology. Forward integration from components into systems is an example of this type of new product activity. Region 3, on the other hand, is characterized by adaptive innovation. Here, the firm applies its existing technology to new sets of users who are closely related to current ones. In Region 4, a high degree of technological newness is combined with relatively low market newness. This is a "customer-bound" focus where the firm tries to make markedly different products for a single set of customers. Region 5, on the other hand, represents extreme instances of adaptive innovation. Finally, new products that require the largest amounts of technical and market diversification fall within Region 6.

HYPOTHESIS

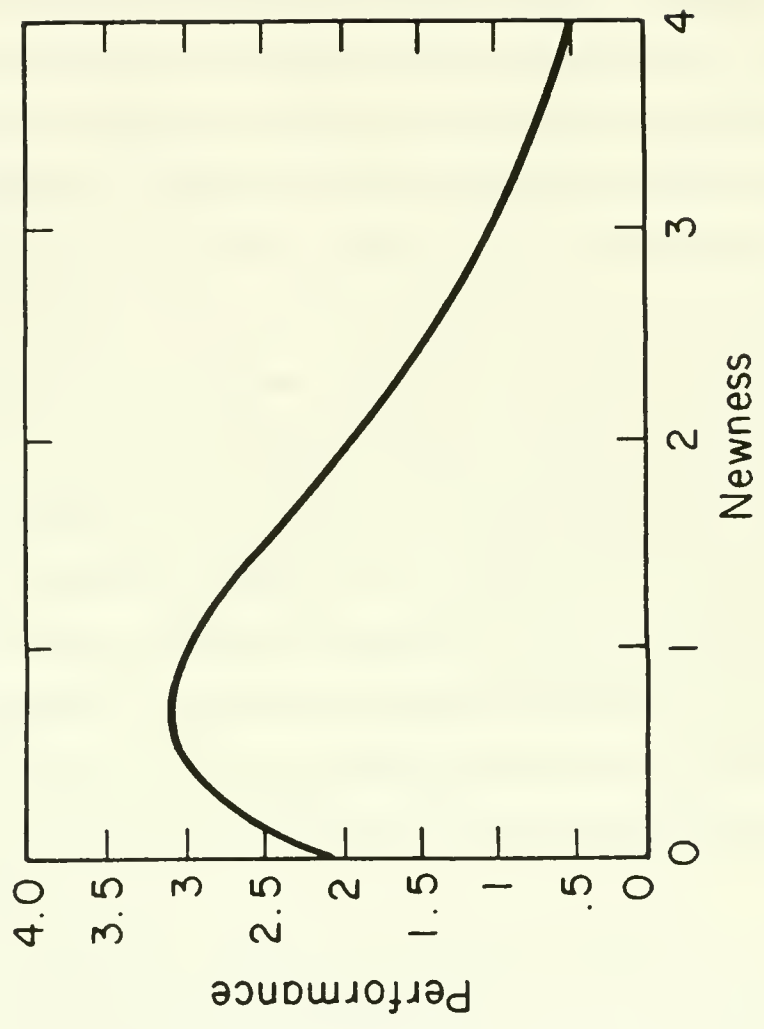
The general purpose of the research is to examine the possible relationship between patterns of new product strategy and the economic performance of the technology-based firm, i.e., a firm that participates in an industry characterized by substantial rates of product innovation. The authors hypothesize that technology-based firms which exhibit a high degree of strategic focus in their new product development activities are more successful than those which have less focus.

The extreme of a focused strategy would be represented by a firm that without fail takes small steps of incremental improvement in a single key technology for one basic customer set. At first glance, this may seem the least risky of strategies because the firm takes no chances in exploring new technological areas or market applications for its products. However, a dogged faith in the continued viability of a single technology/customer set could, over time, prove to be a risky course of action. The opposite extreme strategy is a firm that, with each new product introduced, consistently attempts to implement radically new technologies for substantially different applications than those with which it has previous experience. Between these limits lies the gamut of possible strategic variation in degree of change in technology and market applications.

The hypothesized relationship between the degree of focus in new product strategy and performance in small technology-based firms follows a bell-shaped curve that is skewed to the left (Exhibit 3). The most successful firms are posited to be those that on average pursue a focused strategy, with relatively low levels of cumulative product newness, but which, in several or more critical new product development efforts, have substantially enhanced their existing key core technology to exploit new market niches or segments. Those firms which remain narrowly focused and never undertake major technological enhancement, nor the application of their technology to new related niches or segments, may achieve a certain degree of economic success by virtue of their resource concentration and expertise, but it is hypothesized that their growth potential will remain limited. On the other side of the coin, those firms that exhibit high degrees of product diversity will be trapped into trying to achieve too much with too little in terms of practical working experience with both the new technology and marketplace demanded by their new products.

The hypothesis suggests that a firm may undertake either substantial technological improvements in a related sense for its current customer base or try to reach new related applications with enhanced existing technology, but not both types of product newness at the same time. If a firm cannot remain stagnant, is it better, in assessing relative risk of new product moves, to try to learn new complementary technologies to substantially enhance a product line for essentially the same sets of customers, or to try to reach new

Exhibit 3
Newness versus Performance



markets that will require only customization of existing technology? In other words, can the small technology-based firm more effectively learn new technology or new markets?

We posit that for such a company, mastering new, related key technology is on average a more certain, achievable task (such as in backward integration) than is penetrating new market niches or segments with customized existing technology. The reasoning behind this assertion rests upon the very character of the subject organization: long on technology skills, often lying with the founders, and often short on the marketing skills and resources required successfully to target, distribute product, and otherwise support new customer sets, even those closely related to the firm's existing ones. In terms of the conceptual grid shown in Exhibit 1, the authors hypothesized stronger performance for those firms whose new product activities generated products characterized as "minor improvements" or "major enhancements" in the technological dimension, and targeted for "existing customers" or "new market niches".

The strategic direction suggested by the authors' "strategic focus" hypothesis runs counter to the tendency of many American businesses to pursue wide diversity in their product technologies, as described by Rosenbloom and Abernathy (1982). "Since the 1950s, a penchant for diversification has led U.S. firms away from their core technologies and markets." Part of the justification behind this asserted trend lies in corporate financial portfolio theory, which, as misapplied by some leading consulting organizations to business strategy, argues that overall risk can be minimized by having

assets spread across a variety of product/market areas. Heavily oversold "learning curve theory" has also played a role in the tendency observed by Rosenbloom and Abernathy. By placing a high priority on major increases in manufacturing output to achieve economies of scale, management may forego the flexibility needed to implement new, innovative features in existing product lines, a danger documented in the automobile industry by Abernathy and Wayne (1977). Product development resources may, by default, be allocated primarily to other, newer business areas.

"Strategic focus", on the other hand, implies a level of concentration on a key technology area which, on average, may be the most important factor in the firm's effort to compete in the world marketplace. This source of competitive advantage seems even more critical for the particular type of company examined in this research: the small technology-based firm. That firm characteristically has limited financial resources, may well have relatively undeveloped market strength, but may possess advanced technology (Roberts, 1980).

THE SAMPLE

In development of a pilot study of the "strategic focus" hypothesis, the framework described above was applied to a group of ten small technology-based firms and their 79 products, a subset of a larger sample developed for a multi-subject study on technological ventures (Utterback and Rietberger, 1982). The larger Utterback/Rietberger sample consisted of firms started between 1965

and 1975, incorporated in the state of Massachusetts, and whose main business involved the manufacture of computer hardware, e.g. whole computers, component boards, and peripheral devices. The products of these organizations are based on a relatively high degree of complex and changing technology. The ten firms used for the present research on product strategy were chosen by the convenience that the first author had carried out the earlier multi-subject study interviews with these firms and therefore had access to them for follow-up data collection. The product-related sales of each of these ten firms for 1982 was less than \$50 million.

METHODS

Several criteria were imposed to determine what constituted a "product". The sample firm had to make each "product" with its own resources, either in part or in whole, and commercialize the product under its own name at some point in time. Consulting work, such as contract R&D, and projects which never resulted in released products were not included in the analysis; nor were "process improvements" which were not themselves marketed as products to the outside world. Even though contract R&D and process improvements may play substantial roles in a firm's overall effort to generate revenues and search out new product opportunities, they were not deemed to be direct aspects of product strategy for the purpose of this pilot study. And products not released, though conceptually relevant, become too ill-defined in a retrospective study to serve as a credible basis for empirical analysis.

The extensive interview process, which, with one exception, was conducted with company founders, relied on a joint determination with interviewees of the levels of newness in both the technological and market dimensions contained in each new product in the respective firm's history. Care was taken to avoid bias of measurement, but a competitor rating scheme might produce less questionable measures in a larger scale follow-up study. The level of newness was measured relative to all product development activities undertaken by the firm prior to the specific release of a given product. Therefore, the base against which both technological and market newness were determined grew with each successive product of a firm. The "newness" data were then plotted for each firm on a grid like that of Exhibit 1. A firm that had released ten products over the course of its history would have nine specific points placed appropriately on the grid (one for each product after the first). Data for all ten firms in the pilot study are presented in the Appendix.

The data were processed for analysis in three steps. First, each point on the grid was multiplied by a predetermined set of factors representing levels of technological and market newness. A variety of weighting scales were tested, with each set increasing by different margins for each level of newness (i.e. 1,2,3,4 or 1,3,6,10). The results of the analysis proved insensitive to variations in the several scales tested, albeit the maximum scale range used was one order of magnitude.

The second step was to sum these multiplications for the entire grid of the firm. Also added to this sum was the number of

initial key core technologies developed by the firm for its first product, multiplied by the weighting factor for "new, but related" products to reflect the pre-company technological background of the founder. This addition accounted in part for those firms which embarked on ambitious startup projects, involving multiple key core technologies.

The third and last step was to divide this total newness sum by the number of points on the grid, e.g. the number of products which had been released by the firm. This normalized the data for different numbers of products among the firms, and produced the overall "product newness index" employed in subsequent analyses.

The operational hypothesis was that a firm's strategic focus, as indicated by low product newness index values, would have a significant relationship with a firm's economic performance. Cooper (1984) had developed three different measures of product strategy success, all reflecting appropriate alternative dimensions for the established company. But for the young companies included in this sample, the authors decided that corporate growth was the most sought-after overall performance attribute. Thus, the dependent variable chosen for the pilot research is sales growth rate, calculated by dividing annual sales by the age of the firm at each respective year of sales, so as to avoid possible inappropriate bias towards younger fast-growing firms. It was not feasible to collect sales figures for every year of each company. However, the past three years of sales were obtained, and after dividing each yearly figure by the age of the firm at that time, a

mean sales growth per year was calculated. For example, the calculation for a ten year old firm whose past three years sales were \$4 million, \$9 million, and \$10 million respectively would be $[(4/8 + 9/9 + 10/10)/3]$ or 0.83. In contrast, a three year old firm with the same sales would have created a growth index of $[(4/1 + 9/2 + 10/3)/3]$ or 3.93. This index serves as the measure of "growth" for the firm, in million dollars per year. Using this growth variable, a broad range of "success" existed in the sample: some firms were strong performers, while others were on the verge of bankruptcy.

In addition to the analyses using the weighted "product newness index", additional tests were also made of possible relationships between corporate growth and each of the two dimensions of "product newness" separately. Factors other than product newness dimensions, drawn from the literature on entrepreneurial research, such as entrepreneur characteristics (Wainer and Rubin, 1969) or new company orientation (Roberts, 1968), while possibly relating to company growth, were obviously not tested in this analysis of product strategy.

The primary goal of the pilot study was to develop and test an empirical methodology, and not to generate predictive conclusions. A small sample was employed to that end. Nevertheless, the statistical relationship between strategic focus, as reflected in product newness, and corporate growth is significantly high.

This finding, which holds true for all sets of weighting factors used for determining product newness, was derived from significance testing of the data using Spearman's rho coefficient. The basic procedure is that the firms are first ranked according to the product newness index (in order of low to high) and then ranked a second time by the growth variable (from high to low). Exhibit 4 illustrates the rankings and calculations for one of the weighting sets, the results indicating that firms with high degrees of strategic focus, as reflected in lower product newness indices, tend to be stronger performers, as indicated by higher growth rates, and those with greater strategic diversity as reflected in high product newness scores are poorer performers.

The significance of these findings was established by a comparable margin for each of the several sets of weighting factors employed in the analysis. Further, the rank-order method was applied to each dimension separately. The coefficient for the technological dimension was .70, which indicates a significant relationship at the .05 level. The relationship with strategic focus as measured by market newness only was even stronger, with a coefficient of .89.

Next, an effort was made to test the issue of whether it is strategically more effective for the firm to learn new technologies or to learn new markets. The skewed bell-shaped curve hypothesis was temporarily substituted with an assumption of linearity so that a regression could be performed. As shown in Exhibits 6 and 7 each dimension of newness versus corporate growth performance appears, on

Exhibit 4
Newness Predicting Growth

<u>Company</u>	<u>Main Product</u>	<u>Product Newness</u>		<u>Co. Growth</u>		<u>d²_i</u>
		<u>Index</u>	<u>Rank</u>	<u>Index</u>	<u>Rank</u>	
3	Line Printers	2.75	1	2.73	1	0
2	Large Computers	2.80	2	1.96	2	0
9	Optical Character Recognition Systems	3.11	3	1.72	4	1
4	Portable Terminals	3.18	4	1.29	5	1
7	Peripheral Processors	3.29	5	1.85	3	4
5	Electronic Funds Transfer Terminals	3.57	6	0.23	6	0
10	Microcomputer Systems	4.00	7	0.01	10	9
8	Tape Calibration Devices	4.25	8	0.11	7	1
1	Access Control Systems	4.38	9	0.05	9	0
6	Speech Recognition Systems	5.25	10	0.06	8	4

$$\text{Spearman's rho } (r_s)^* = 1 - \frac{6 \sum d_i^2}{n^3 - n} = 1 - \frac{6(20)}{990} = 0.89; \quad \rho < .001$$

*From Siegel (1956).

an "eyeball" basis, to support the linear hypothesis. (In fact, the positioning of the first point on each graph further strengthens the untested skewed bell-shape hypothesis.) A regression on the data was performed with Growth, Market Newness, and Technological Newness as the three variables. The R^2 , with Growth as the dependent variable, was .63, which was significant at a .03 confidence level using the F-Statistic test (with 7 degrees of freedom). Remembering that there should be a negative correlation between the Newness variables and Growth, the correlation coefficient matrix in Exhibit 5 shows a stronger relationship between low market newness and corporate growth performance than between low technological newness and growth, as the authors had hypothesized.

The sample includes some companies whose new product strategies have focused specifically on a set of customers, adding new, related key technology to their existing technology to provide "new generations" of a product line to these same customers over the years. This aggressiveness has been combined on occasion with joint development or close consultation with larger opinion-leading customers in the niche, assuring that the "new generation" is "on target" in its functionality and that other customers in the niche pay attention. As an alternative model of product development strategy, other sampled firms have leveraged their existing key technology into new niches and segments. An example might be an "intelligent" terminal company which, by buying several peripheral devices and licensing systems software, can market a "personal computer". Technology improvement is relatively minor; the

Exhibit 5

Correlation Coefficient Matrix for Growth vs. Newness

	<u>Growth</u>	<u>Market Newness</u>	<u>Technological Newness</u>
G	1.0		
M	-0.79	1.0	
T	-0.55	0.59	1.0

identification of specific user needs required to customize the technology, and the development of appropriate distribution and support mechanisms can, on the other hand, be major undertakings.

Exhibits 6 and 7 display the sample data in terms of the newness versus growth hypotheses. While the sample is too small for rigorous testing of the "skewed bell-shape" hypothesized relationship, the curves at least satisfy a "rough-cut" sense of appropriateness. Exhibit 8 displays the growth measures for each company used as labels for the Technology and Market Application intersections for each firm. The grouping of the relatively high growth firms in the lower left quadrant of the grid is indicative of the trend asserted in the hypothesis.

A final test was performed to see whether the number of products alone that each company produced might independently explain company growth performance. A coefficient of correlation was derived on rank-ordered pairs of total products and performance. In neither possible direction (i.e. the more products, the better the performance; or the fewer products, the better the performance) was the Spearman coefficient significant (0.19 and -0.22, respectively).

DISCUSSION

These empirical results served as a foundation for further examination of the strategies of the ten firms and of the research methodology itself.

Exhibit 6
Technological Newness versus Growth

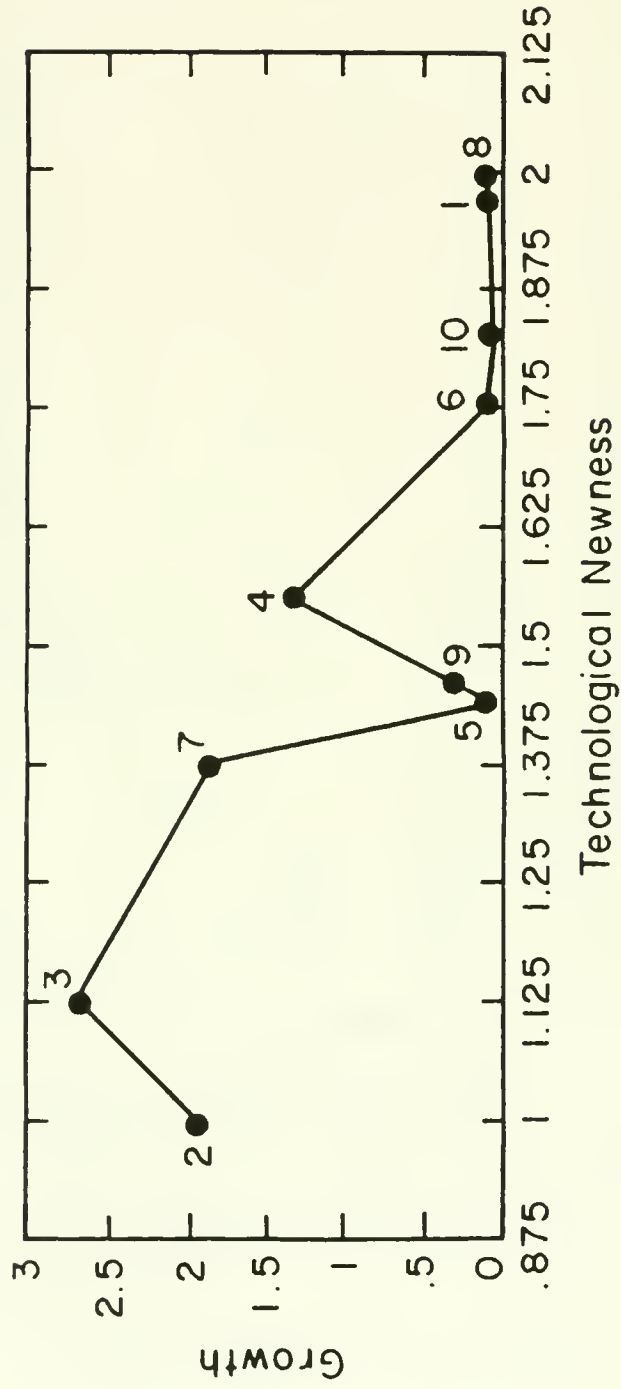


Exhibit 7
Market Newness versus Growth

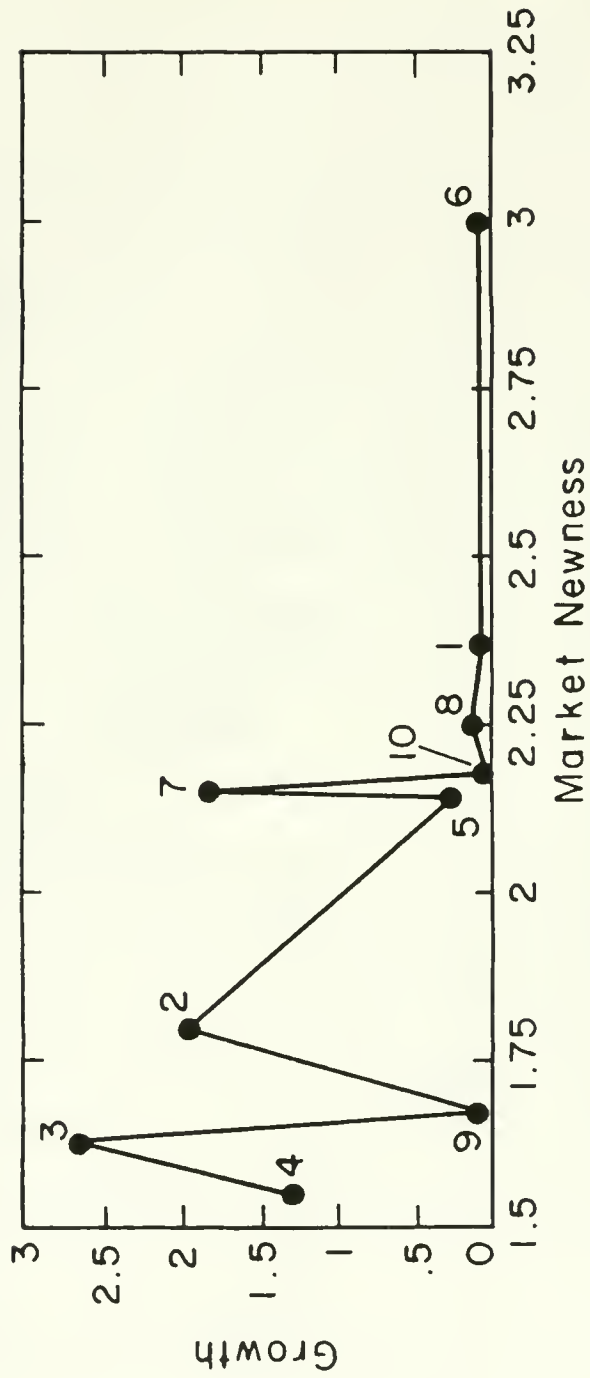
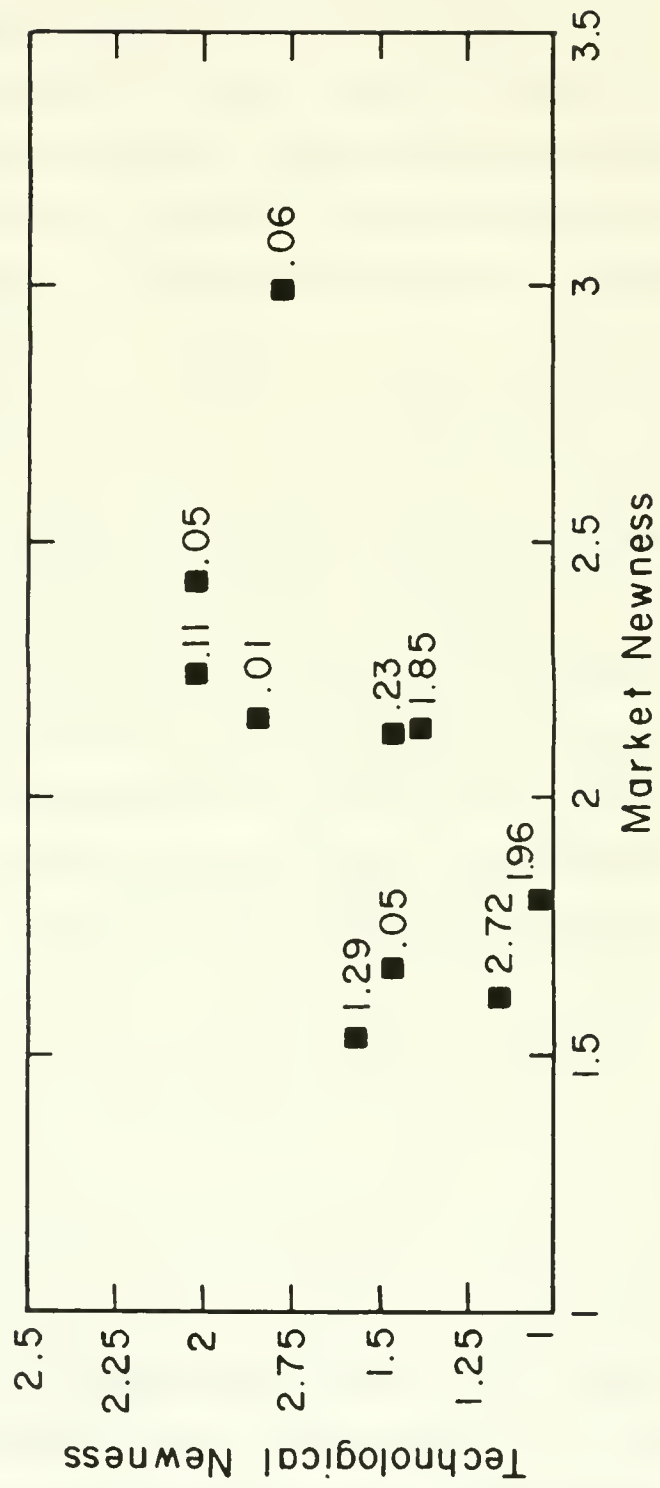


Exhibit 8
 Company Performance Plotted on Market / Technology Positions



As stated above, the result of the analysis was that strategic focus, as manifest in lower levels of product newness, had an observable relationship with corporate economic performance, as manifest in sales growth rate. Firms that over the course of their evolution primarily remained in one key technology area for applications in familiar markets tended to outpace those which did not. Implied within this finding is that successful firms tended to choose a growth-sustaining core technology to begin their product development activities, thereby enabling them to avoid the high levels of product line technological diversity which would necessarily accompany a switch from an ill-fated technology to a new, more promising one. Interestingly, these firms have marked similarity to the "Balanced Strategy" firms found by Cooper (1984a) to have had the most successful new product strategies: technology-oriented, a high degree of product fit and focus, and involvement in high potential growth markets.

The sample contained firms whose activities centered on a single core technology from startup to the present time, as well as companies which redirected their energies into new areas in order to remain in business. A descriptive portrait of a "good" initial key core technology which emerged from conversations with the entrepreneurs was that the technology needed to be challenging to implement, yet difficult enough so as to present a significant barrier to entry for would-be competitors. Also the key founders required a clear perception or vision of how to achieve distinctive functionality in a sequence of future products utilizing the initial key technology.

More specific growth strategies were suggested from the interviews. One effective strategy was that firms that developed products for new market segments or general markets were most successful if they leveraged their efforts on existing proprietary key technology. This could be accomplished by combining an existing key technology with new types of components to generate the new product.

For example, in the sample were two firms each of which had developed technologically similar desktop microcomputer systems. One of these companies was able to leverage its "intelligent" input/output (I/O) controller board technology into the new product by purchasing or licensing all the necessary additional elements. This included the CPU, memory components, the Winchester disk, the CRT display, and the operating system which were assembled together with a specialized I/O controller board. The microcomputer was marketed a year and a half after its formal project initiation to systems integrators and software developers, many of whom were existing customers of the I/O controller board line.

The second firm, on the other hand, did not leverage its existing key technology. Its main product was a line of magnetic tape head calibration instruments sold to computer manufacturers. Even though the firm acquired all the necessary hardware components from outside vendors, it chose to develop both its own proprietary operating system and a set of business applications packages. Additionally, the new product was targeted, rather unsuccessfully, for retail distribution. The level of diversity represented by the

firm's actions was therefore high, falling into Region 6 in Exhibit 1 as compared to the Region 3 pursuits of the first firm described above.

A larger sample, now being gathered in a follow-on study, will provide the data required better to examine specific strategy alternatives. Further, although the analysis methods presented in this article produce a "focal point" of each firm's degree of focus, equally important insights may be found in the measurement of the variance around that focal point. Time dependent movement upon the grid is another possible technique for examining the strategy of the firm. Additionally, one might be interested in the portability of the authors' experimental results concerning strategic focus and performance to larger firms. With these thoughts in mind, the framework and methods presented in this pilot analysis may serve as tools for continued research on new product strategy in the technology-based firm. Absenting that continuation, the present study concludes that the small technology-based firm should avoid wide diversity in its product offerings, leveraging its technology more than its marketing strength, not ignoring the innovative potential of the "core" technologies on which it is founded.

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APPENDIX: PRODUCT NEWNESS DATA

COMPANY	PRODUCT	Technology					Market Applications			
		New Key Core	Some Minor	Major	New Related	Unrelated	Existing Users	Niche	New Segment	Market
1	1	x							x	
	2	x				x				x
	3			x			x			
	4		x					x		
	5	x			x				x	
	6			x				x		
	7		x					x		
	8	x			x			x		
2	1	x							x	
	2		x				x			
	3		x						x	
	4		x				x			
	5			x			x			
3	1	x							x	
	2			x			x			
	3		x					x		
	4		x					x		
	5		x					x		
	6			x			x			
	7		x				x			
	8		x				x			

COMPANY	PRODUCT	Technology					Market Applications			
		New Key Core	Some Minor	Major	New Related	Unrelated	Existing Users	Niche	New Segment	Market
4	1	x							x	
	2			x			x			
	3			x				x		
	4		x				x			
	5		x				x			
	6		x				x			
	7	x			x			x		
	8			x			x			
	9	x						x		
	10			x				x		
	11			x				x		
5	1	x							x	
	2			x				x		
	3	x			x				x	
	4		x				x			
	5			x				x		
	6		x				x			
	7		x						x	
6	1	xx								x
	2	x			x				x	
	3			x				x		
	4			x					x	

COMPANY	PRODUCT	Technology					Market Applications			
		New Key Core	Some Minor	Major	New Related	Unrelated	Existing Users	Niche	New Segment	Market
7	1	x							x	
	2			x				x		
	3			x				x		
	4		x					x		
	5		x					x		
	6			x				x		
	7		x					x		
	8				x			x		
	9			x				x		
	10			x				x		
	11			x				x		
	12				x		x			
	13				x					x
8	1	x							x	
	2		x					x		
	3		x					x		
	4			x			x			
	5			x			x			
	6	x			x				x	
	7	x				x				x
	8	x			x			x		
9	1	x							x	
	2	x			x		x			
	3		x				x			
	4			x				x		
	5		x					x		
	6		x					x		
	7		x				x			
	8		x					x		
	9				x		x			

COMPANY	PRODUCT	Technology					Market Applications			
		New Key Core	Some Minor	Major	New Related	Unrelated	Existing Users	Niche	New Segment	Market
10	1	x							x	
	2	x			x				x	
	3			x				x		
	4	x			x				x	
	5		x				x			
	6				x		x			

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