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**Evolving Toward Product and
Market-Orientation: The Early Years
of Technology-Based Firms**

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**EVOLVING TOWARD PRODUCT AND MARKET-ORIENTATION:
THE EARLY YEARS OF TECHNOLOGY-BASED FIRMS**

ABSTRACT

Research studies of 114 technology-based firms within the Greater Boston area indicate evolution over the first several years after founding toward: (a) more product-oriented businesses, away from consulting and R&D contracting; and (b) increased orientation of the founders to sales and marketing, with lessened emphasis on engineering. Evolution toward market-orientation is manifested in many ways. The use of direct sales forces as well as sales representatives both grow over time, as does the adoption of more formal mechanisms such as marketing departments, sales forecasting and analyses of potential markets. Greater orientation toward marketing in all its dimensions is especially true for multi-founder firms, the single founder company being slower to evolve in the characteristics cited.

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EVOLVING TOWARD PRODUCT AND MARKET-ORIENTATION: THE EARLY YEARS OF TECHNOLOGY-BASED FIRMS

People, technology and/or an idea for a product or service, and money enable a technical enterprise to get formally initiated. But what do the founders do in getting underway? And how do their companies change during the first several years of existence? While research on technology-based enterprises has increased significantly, especially in recent years, most studies (not cited here) have focused upon characteristics of the entrepreneurs, the venture capital financing of these firms, some elements of their strategies, or their overall success and failure. Few research projects have focused upon aspects of change during the early life of these new technology-based firms. Yet it is safe to assume that evolution of both the founders and their firms may be necessary for companies to benefit from experiential learning and to adapt to environmental changes in technologies and markets. This article seeks to add empirically to the evidences of change during the early years of technology-based companies. How much occurs and in what ways? Can prospective entrepreneurs learn from their predecessors any clues for more effective launch and development of their companies?

THE RELEVANT LITERATURE

Researchers have long been interested in how and why organizations change over their life cycles of birth, growth, maturation and death. And yet, in their synopsis volume, The Organizational Life Cycle, Kimberly & Miles [9] decry the absence of "the dynamic quality of organizational life ... from most research and writing in the area." (p. 3) Quinn & Cameron [11] hypothesize four distinct phases, beginning with "an entrepreneurial stage characterized by innovation, creativity, and the marshalling of resources sufficient to survive." In an excellent identification of eighteen alternative "stage models" to depict the evolution of complex phenomena, especially in organization and management theory, Kazanjian [7] provides further specifications that should facilitate concrete empirical research. Two studies that postulate organizational life cycle theories of the firm have attempted to relate psychological characteristics of entrepreneurs to the adaptation needed during a firm's transition, but neither study examined technological companies. [4,17] Only the few works cited below have been found that

applied these models toward data collection on technical firms.

Van de Ven [21] classifies the research on the creation of organizations into entrepreneurial (focusing upon personal characteristics of founders), ecological (focusing upon shifts in organization populations and their reasons), and organizational (focusing upon managerial processes involved in initiation and early development). Our research presented in this paper clearly falls into the last category. Van de Ven's study of 12 educational software companies, treating all three research dimensions, identifies five stages in the development of these technical firms, of which two stages, gestation and planning, occur prior to actual company operation. On a number of dimensions Van de Ven documents major differences (few unfortunately of statistical significance due to small sample size) between the firms classified as in their early poststartup stages and those in later stages. A critical organizational finding is that mean percentile time allocation of principals to working on products decreases from 26.6% in early stage companies to 21.1% in later stage firms, while time spent on customer contacts increases from 34.1% to 48.6%. (p. 98)

Robinson & Pearce [16] investigated the shifts in company strategy as a function of the life-cycle stage of its products for 77 small North Carolina manufacturing firms; they found little significant differences among the relative importance of ten factors affecting strategic management as the stage of the product life cycle changes. Rather consistent with Van de Ven's findings above, they did find a strong decline, as products evolved from development toward maturity, in CEO concerns for: changes in process design; changes in product design; risk of producing the product; and emphasis on creativity. All these shifts contribute to diminished focus on technical issues as products evolve. However, Robinson & Pearce did not have complementary information available in regard to changes in concerns for market-related factors. Tushman & Romanelli [19] have traced the more dramatic changes that occur over the longer-term growth of companies from their emergence to maturity. Neither study looks at the early perhaps more modest changes that occur immediately post-formation, as the primarily technically-trained entrepreneurs begin to operate the companies they have founded. In contrast Teach, Tarpley, Schwartz, & Brawley [18] have recently examined the changes in key actors during early evolution of software

companies. "While only 12.5% of the original founders came from the marketing area, almost double that, 23.5% of the new principals came from a marketing position... This shift was compensated in a large part by the almost disappearance of "R&D" as a source of new principals." (pp. 467-468)

In their recent paper Kazanjian & Drazin [8] present and test a model of technology-based firms, "postulated to evolve through four discrete stages of growth -- Conception and Development, Commercialization, Growth, and Stability". (p. 1489) Tracing 71 companies with tangible products over an 18 months period, they found that 28 ventures advanced and 14 regressed one or more stages during this relatively short period of observation, providing partial support for their model. The dominant problems faced by management change significantly as the high-tech firms proceed through the four stages.

Research Hypotheses

Inferences from the systematic research cited, supported by intuition, personal experience, and anecdotal testimony from the likes of Inc. and Venture magazines, provide the bases for general hypothesis formation in this area of still essentially unplowed ground. Technical companies are founded primarily on the basis of some technological advance, rather than on the presumption of competitive advantage in regard to marketing, sales or distribution. [13] The founders are for the most part engineers, with some marketing/sales and business experience present in the multi-founder teams. [5, 6, 12] Not all technical entrepreneurs have unique ideas and high need for achievement; some of them are initially merely fleeing dissatisfaction with a prior job or are pursuing independence, without specific ideas for product or market. [3] Consequently, reasonable general hypotheses might include:

- (a) Technology-based firms are initially divided between the intended sale of manufactured products (and/or repetitive services) and the intended performance of technical consulting and contractual development work, with evolution occurring toward more product focus;
- (b) Their founders are initially primary oriented toward engineering and technology, not sales and marketing, with evolution toward marketing occurring over time, if the firm survives; and

(c) The multi-founder firm shows a greater tendency toward both product and sales/marketing orientation initially, and also evolves more rapidly in both areas, than the single founder company.

No basis exists for specifying these hypotheses in greater detail. The research presented in this paper is clearly exploratory in this regard.

However, the author perceives that technology-based enterprises might be seen as falling into an evolutionary process such as that shown in Figure 1.

 INSERT FIGURE 1 ABOUT HERE

In this hypothesized model the only solid forces that necessarily precede the Founding of a Technology-Based Company are shown as a set of Entrepreneurial Drives and Technical Capabilities. Although the author believes it is desirable for the founders also to have both a Product Idea and a Market Orientation even at the outset of their firm, the above hypotheses suggest that many companies are started without these presumed assets. Indeed, both a Product Idea and a Market Orientation might strengthen latent Entrepreneurial Drives (arrows not shown in Figure 1 for simplicity) and actually lead to company initiation through their impact upon entrepreneurial behavior. Effective Product Development, if it is to occur, obviously demands both a Product Idea and Technical Capabilities. The broad research literature on the importance of marketing inputs to product success [see 20 for review] supports the assumption that Effective Market-Related Activities are also essential to Effective Product Development (also omitted from Figure 1 for simplicity). Furthermore, while the author also believes that Effective Product Development and Market-Related Activities are critical to achieving a high rate of Company Growth and eventual Company Success, the above hypotheses again suggest that some companies never evolve in this manner. Their Company Growth is thus stymied by lack of products and/or market perspectives. The Figure 1 model thus presents alternative paths toward eventual success of the technology-based firm, paths that might never be taken due to lack of company evolution toward product and market-orientation. Omitted from this partial model of technology-based company founding, growth and success are numerous other potentially

important influences, including capital and other resources, environmental influences, and strategic factors. But even in its simplified form the model conveys the potential role of product and market-orientation in affecting a firm's development. Explicit support for the relationships between these hypothesized organizational changes and later corporate success will have to await a later stage of our own research life cycle [see 15].

SAMPLE SELECTION AND DATA COLLECTION

The data analyzed here in order to test the rough hypotheses presented above come from: (a) a general analysis of the formation and growth of high-technology new enterprises, part of a broader twenty years research program on entrepreneurship; and (b) a special analysis of time allocation of founding team members of high technology firms during their early years.

The overall data set used for this article is assembled from information collected from five organizations (shown in Table 1), that are the sources of one hundred and twenty-five firms founded by former employees of the major laboratories and engineering departments of the Massachusetts Institute of Technology (MIT).

----- INSERT TABLE 1 ABOUT HERE -----

Beginning with strong cooperation of senior managers in each of these five MIT source organizations, initial lists were developed of people who were thought to have spunoff new enterprises from that organization. Follow-up interviews were used to generate further suggestions in a "snowball" sample creation process as well as to screen the initial lists for errors. Rigorous criteria were applied to include only those who had been former full-time employees of the source organizations, who later participated as founders of wholly-new for-profit companies. (As very few female entrepreneurs were found in these samples of technical entrepreneurs, the male pronoun is used in the remainder of this article in referring to the entrepreneurs.)

Structured interviews with a detailed questionnaire, lasting typically one to two and one-half hours, were used to gather data from each founding

entrepreneur personally, with telephone interviews used in less than ten percent of the cases and mailed interview responses used only as a last resort in less than one percent of the cases. Some interviews stretched to seven or eight hours over two or three sessions. Despite extensive efforts to include all spin-offs from each source organization studied, no doubt some minor bias has crept into the sample of companies studied in that it is likely that any companies not located were less successful than those traced. The bias did not prevent many companies from being found and studied that were clearly failures or not very successful. However, in the absence of attempts to measure and then link performance to company characteristics in this study, we can only provide warnings that lower performing companies may be underrepresented. The high participation rate in the data collection of 91 percent of those firms identified provides some assurance of representativeness within the MIT "spinoffs", but no follow-up analysis was made to test for bias among the few non-participants. Data were collected from the participants in regard to their initial conditions at the time of company formation as well as conditions at the time of the data gathering, on average five to seven years post-founding.

Within this overall sample, a special sub-sample was generated in order to gather more detailed information about founder time allocation and company change over the first two years of new enterprise operations. To assure reliable data recall on the first years of existence the original group of 96 MIT laboratory spinoff companies was screened to exclude those companies over five years old at the time of data collection. Limiting the sample further to be within the Greater Boston area for ease of data gathering, and omitting the high outliers in regard to size of initial capitalization to assure more comparability, twenty prospects were identified. Eighteen of the twenty companies (90%) agreed to cooperate with a more probing set of structured interviews using a detailed questionnaire that covered the first two years of company activities. The resulting small group constitutes 16% of the larger overall sample described above. The research design thus provides a form of longitudinal study, with data gathered for three time periods in the lives of the participating companies: founding, two years, and five to seven years.

Answers to all of the detailed questionnaires led easily to the

quantification of information. Most of the answers were coded and arranged in computer data files. Incomplete information on some of the companies does not particularly affect the data analysis as relevant codes were given to isolate missing information.

Naturally no claim of generality to the population of technological enterprises throughout the United States (or abroad) can be made from the primary data and their analyses, drawn as they are entirely from companies founded by former employees of major MIT laboratories and departments. But, as will be shown, the results are at least supported in general by other studies cited in this article of firms originating from non-academic source organizations in the Greater Boston area. Research on the evolution over time of new technology-based enterprises formed in other parts of the United States and abroad would provide welcome comparisons.

MACROSCOPIC CHANGE: THE FIRMS' FOCUS

Data from the overall sample provide insights into changes in the general focus and direction of the companies, in terms of what businesses they were in and their primary activities in achieving business objectives.

Initial Type of Business

The structured interviews we conducted demonstrated that many of the entrepreneurial founders were unclear when they started their companies as to who would become the initial customers for their products or services; some were not even sure as to exactly what their companies would be doing. A number of the entrepreneurs, especially among the sole founders, might be regarded as rather flexible! In many cases the founders hoped to do some consulting or contract research and development and, while living on the income from this work, planned to develop a product or find a product that they could exploit. It should not be surprising then to find a great number of the firms engaging in consulting and R&D work at the beginning, as the Beginning Totals row of Table 2 indicates. Forty-one of the 109 companies

 INSERT TABLE 2 ABOUT HERE

listed (or 38%) were solely engaged in consulting or R&D contracted to government agencies or to larger industrial firms. It is difficult to define the difference between these two categories of business, as various "consultants" described their work as including analytical work, designing or developing a special system for a customer, or solving a particular technical problem for a customer, usually for an industrial client. Conceivably other entrepreneurs might have categorized the same work as being "contract R&D". The remaining 68 of the 109 firms (62%) were producing or refining for production software and hardware products, including 24 that were producing while concurrently carrying out contractual R&D work.

About one-third of the producers began as "job shops", making limited numbers of products to special orders; the others had proprietary products from the outset or under development. Occasionally this is a fine distinction, because some of the "standard" products of a technology-based firm are expensive machines or instruments with high unit cost (several thousand dollars each), that are adapted individually to each customer's requirements. Nevertheless the underlying product is the same in these cases.

As partial confirmation of the first hypothesis, note that only somewhat more than a majority of the technology-based firms in our sample began with a product focus. In a separate unpublished study performed by the author, 23 companies that had emerged from a large diversified technological firm, 61% started out with production focus, often also in conjunction with providing R&D services. More severe are the results from Olofsson et al.'s research on young technically-based companies originating from seven Swedish universities. [10] Half of the 90 "significant companies" in the Swedish data primarily carry out contract development work for customers; 30% do mostly consulting; and only ten to twenty percent have their own products as their main line of operation. Presumably even fewer of the "less significant" Swedish spin-off firms have a product focus.

Changes in Type of Business

The overall data enabled reexamination of the state of the companies at a time when they averaged five to seven years old. By this point in time these firms have certainly evolved from their initial condition and some have

already demonstrated important growth and success. Other companies, while evolved and perhaps more stable, are less impressive in their achievements, except perhaps for their survival to date. The companies will continue to change and grow past this point of assessment, and our later research analyses attempt to distinguish those influences that affect corporate success and failure. [15]

Table 2 also presents information on the later (average age, 5 to 7 years) type of business activities for the overall sample. Underlying these numbers is a basic change in the nature of work done within the firms. For example, when operations began for these new firms only 57 out of 109 (52%) of the enterprises possessed (or were developing) a hardware product. By the point in time several years later, documented here in the Later Totals column, 78 (or 72%) of the firms have at least one hardware product that has been marketed. In most cases the products were continuations and evolutions of their startup activities, including for some bringing to fruition the product development efforts that were initially underway but not yet completed. For other firms products resulted as an indirect (and sometimes unintended) consequence of contract R&D or consulting efforts carried out for governmental or industrial customers. One company, for example, became a major supplier of industrial electronic security systems as a result of bootlegged internal efforts by technical staff who had been working on somewhat related military contract developments.

In other instances the development of a product was the result of a conscious decision to change the character of a firm. This was especially true for several firms that had initially been engaged solely in contractual development work. Although this work often provided a stable source of entrepreneurial income, a number of the founders of these firms realized that far greater profit margins and better opportunities for corporate growth existed in the sale of products. These companies set about deliberately to develop products or to acquire ongoing firms with products that might complement their R&D service work. A few companies moved in the opposite direction, supplementing their product sales with contractual R&D work, occasionally with the intent of using these funds and exposures to develop still further products.

The hierarchy of type of business preferred by the technical firms is suggested by the changes shown in Table 2, which presents a scattergram of the firms' beginning and later functions. Only 8 of the 20 original consultants are still doing that kind of business; no firms in this particular sample shifted over time into consulting work. Firms originally doing just contract R&D (21 of the 109) remained intact, added production efforts to their R&D, or evolved into production alone. When shifts occurred for companies that were initially in both production and contract R&D, they were either to a more encompassing scope of those initial activities or into hardware production only. In the cases where initial producers evolved it was only to add contract R&D to their work mix.

Despite the changes in product status and manufacturing orientation described, the figures in Table 2 present a relative lack of change for most of the firms in their overall types of business being pursued. The bold numbers along the principal diagonal, when compared with their column totals, reflect this constancy. Except for those firms initially engaged in consulting or in contract research and development alone, only fourteen companies out of 68, the off-diagonal firms (21%), deviated from the type of work they had initially undertaken. And in ten of those fourteen the change was to add other types of work to their original activities, five of them adding software production. Three of the four firms which reduced their scope of work went from hardware production plus contract R&D to hardware production only. The companies as a whole have clearly evolved toward more general business operations as firms engaged in their own product development, manufacture and sales, moving from 62% initially engaged in production of some form to 84%.

In confirmation of the first hypothesis, note that the sample has indeed evolved more toward a product focus. But also recognize that 16 percent of this sample, now on average 5 to 7 years old, still do not qualify for inclusion in samples such as that of Kazanjian & Drazin [8], limited to surviving companies with tangible products. A comprehensive "stages of growth" model of technology-based companies must take into account the large number of firms that never evolve into product manufacture and sales.

Supporting evidence for the first hypothesis is found in several other

independent studies performed by the author. In an unpublished study of nineteen computer-related firms, principal changes occurred over time in the two firms initially doing consulting and the two others initially performing only contract R&D. In that sample the number of firms involved with computer hardware and/or software production, alone or in combination with contract R&D work, grew from 79 percent at their foundings to 100 percent by the time of data collection. Comparable transitions occurred in our separate sample of 26 biomedical companies. The two medical companies that started in sales and distribution only, plus the four that initially performed R&D and consulting work exclusively, moved into integrated operations covering the spectrum from R&D to manufacturing and sales, joining eleven other companies that started in that integrated mode. Nine of the biomedical firms maintained development and/or production focus throughout their lives, not undertaking any sales efforts, a pattern not unusual in the medical field where many smaller companies license or distribute their products entirely through other much larger corporations. And again in a cluster of 18 recently formed technological companies R&D contractors went from 4 initially to only 1 six years later, while consultants went from 3 to 1. In contrast, among the 23 spinoffs from the large diversified technological firm we studied, several who were initially engaged at least in part in production dropped their hardware activities after encountering major problems in developing or selling products. For them a shift to consulting was undertaken in order to survive. These are among the only companies in all our entrepreneurship studies who "regressed" in the product-focused evolutionary pattern.

The many company changes in these several samples from original work in contract R&D or consulting indicate that much of this had been done merely "to get things going". For example, within the overall sample described in this article, 9 of the 15 firms that left the MIT Instrumentation Lab and started as consultants claimed that they intended this consulting activity to be transitional only. For a few firms, however, these areas still remain as the desired work. Several of the entrepreneurs have no inclination to expand beyond their consulting work which provides for them substantial personal income even if their organizational size remains small. (This is consistent with the finding in our earlier research that not all entrepreneurs have high need-for-achievement. [14] Unfortunately we do not have sufficient data to

test whether the individual entrepreneur's motivational characteristics relate to the type of business he pursues.) On the other hand, contractual R&D work is not necessarily done just "to get by" or to maintain independence. One firm in our sample, remaining entirely in the R&D contracting business, has already achieved significant sales and is growing rapidly. But a number of founders of the seventeen companies that are still doing only R&D or consulting are genuinely frustrated. They had hoped initially to find or develop a product and transition into a manufacturing firm but they have been unable to make the change; some still assert they will shift their businesses in the future.

MICROSCOPIC CHANGE: THE FOUNDERS' ACTIVITIES, TIME ALLOCATION, AND ORIENTATION

Turning to the second hypothesis, our assumption is that most technically-based companies start with technology uppermost in their minds and time commitments. But we presume that many entrepreneurs evolve toward more market-oriented perspectives and activities. The smaller but more detailed sub-sample (18 firms) was assembled to permit analysis of founder time allocation and activities that can evidence evolution of market-orientation, the two periods of sampling being the first six months of the company and eighteen months later, the end of year two. Except where specified, this smaller sub-sample is the source of data used in this section.

The First Six Months

Time Allocation. Aldrich & Auster [1] note that young companies suffer "the consequences and strategic implications of two variables which affect metamorphosis -- age and size." How technical companies begin to adapt to these variables is evidenced in Table 3, displaying for the four major

INSERT TABLE 3 ABOUT HERE

operational areas the average percent efforts by company founders during the first six months of existence of the eighteen technical firms in the sub-sample. About 30% of their total working time was spent in engineering efforts, with a similar proportion in sales and marketing efforts.

Twenty-five percent was devoted to manufacturing while the least percentage of time was used in financial and administrative activities. The variations among the firms in these functional allocations are discussed below.

The only companies spending more than 50% of their time in engineering both produced custom products. In contrast two of the three firms with no engineering activities supplied services while the third was selling a fully developed standard product. Three firms spent no time in manufacturing. One of these was still developing its product. Another had a product which was engineered for special uses. The third firm was solely involved in supplying programming services and classified none of its efforts as manufacturing. Among the 18 firms providing detailed time allocation data there were no relevant statistical associations of manufacturing efforts with other variables, product manufacture being treated in the embryonic firm as largely an end result of all other activities.

Similar variation occurs in the sales and marketing time allocations. Only one firm did not spend any time on sales during its first six months. That company devoted its entire first year to developing a marketable product. Two other firms spent less than 10% of their founder time in sales/marketing; both made custom products.

The amount of initial capital correlates significantly with the early time allocation to financial and administrative activities ($p=.02$). Perhaps more money requires more time to manage money, or technical entrepreneurs might just assume increasing financial responsibility as the funds dictate. It is not difficult to discover why several firms did not spend any time in this area. Four of the five firms with zero finance time had initial financing of only one thousand dollars, with the fifth firm being unwilling to reveal its initial financing!

The monitoring of founder efforts during the first six months included an attempt to identify the extent to which they were aware of their competition, one aspect of market-orientation. This seems so obvious that some may be surprised to know that entrepreneurs frequently claim they have no competitors, their own products or services being so unique in their own

opinion that no one else's outputs are relevant. These entrepreneurs sometimes discover, too late, that other firms are offering similar capabilities to the marketplace. Being aware of competitors should help to shape the course of entrepreneurial efforts, as indeed is shown simply in Table 4. Here we split the small sample into two clusters based on our

 INSERT TABLE 4 ABOUT HERE

measure of competitor awareness and display the mean percentage efforts for each group. Those who are aware of their competition reveal a more balanced effort allocation across the operational areas, even during the first few months of the firm's existence, with about twice the orientation toward sales and marketing (at the expense of engineering and manufacturing), the primary prospective sources of still further insights to customers and competitors.

Sales and Marketing. The backup details on the early sales and marketing function are enlightening. This area of activity includes determining the existence and needs of a particular market, sales and distribution within this market, customer service, advertising and promotion. In a large company each of these activities is generally performed by a different individual or group who in turn reports to a Director of Marketing. These same functions must be accomplished somehow in the small firm, albeit with considerably less available manpower, and therefore by allocation of scarce time, especially initially. Our data here show that the percentage effort devoted to sales correlates negatively with the percent of customer contact made to take orders ($p=.13$), but strongly positively with the percent of customer contacts made to determine customer needs ($p=.09$) and to estimate market potential ($p=.07$). To some firms the sales/marketing function was narrowly proscribed, just the direct selling of the product. The more this order-taking perspective applied, the less was the time allocated overall to sales and marketing efforts. The more the firm viewed sales and marketing as a mechanism to observe and use market information, the greater the proportion of founder time devoted to this function. For example, some unusual founders believe that how customers might use their products is critical to eventual company success. They therefore spend lots of time visiting prospects to increase their own understanding. The presumed result is increased visibility of the total market by the company's leadership, with attendant impact on

such issues as product targeting, design, selling approach, and accompanying service.

Fifty percent of the enterprises relied solely on direct contact by a founder to sell to its customers. While this is self-limiting it also seems beneficial in several ways. In the new technology-oriented firm the founding entrepreneur is very possibly in the best position to explain the virtues of his company's product to customers. In general he is not selling a standard product which the customer needs to run his operation, but rather one the entrepreneur strongly advocates for improving the customer's operation. Perhaps more important is that direct contact of a founder with a potential customer is an excellent means for synthesizing product ideas with market needs. One downside consequence is that the entrepreneur frequently responds to specific customer issues by redesigning his product on the spot, adding special features, and becoming a multi-product custom-oriented firm before he has given his intended standard line a chance to sell.

The numerous means of selling other than direct contact were almost nonexistent during this earliest period of company life. For instance, only three of the eighteen companies used a sales force and only two others used outside sales representatives. As we shall soon see, when the companies gradually begin ironing out their startup difficulties their selling practices shift significantly.

The high incidence of direct contact selling by a founder (occurring in whole or in part initially in 96 of 109 companies in the overall sample) definitely reflected both the newness of the firms and their small size, the "liabilities" mentioned earlier by Aldrich & Auster [1]. But personal contact was not necessarily an ineffectual way to proceed. Indeed the personal representations of a founder to a potential customer were frequently perceived as the primary reason a project or product were sold. Of more than incidental note is the fact that the sales methods used did not vary significantly across the several different types of business initially undertaken, nor were there perceived differences in effectiveness of these approaches as a function of any other company characteristics.

It seems interesting to note these entrepreneurs' identification of the

primary source of new product ideas during their first six months. One entrepreneur answered, "From the V.P.'s brain", communicating what I too often find to be the case in technical enterprises, the presumption that the uniqueness of a single person's ideas will suffice to generate product innovation and corporate growth. Research studies over the past twenty years [reviewed in 20] have demonstrated far higher success for products that are responsive to "market pull" rather than "technology push". In many industries some customers go beyond "demanding" a new product and actually create products to meet their own needs; following this pathway can become the most assured means to achieving successful innovation for the responsive producer. [22]

Numerous companies in our data samples, founded by technologically sophisticated entrepreneurs, "presumed" market needs based on their own prejudices or "feel" rather than on probes of potential customers. Due to the high technical competence of most of these entrepreneurs, and the high regard in which they are often held in their particular technological field, such a "feel" is often a legitimate and sufficient basis for producing and selling a product or service. Too frequently, however, despite our lack of quantitative evidence to support this charge, it seems that the engineer part of the entrepreneur overrules his as yet underdeveloped business sense, and a product is produced because it is technically appealing. Unfortunately no market may exist for this ingenious bit of engineering wizardry. The classic miscalculation of market "need" (and a stereotyped one) was the firm in the first study that decided to produce a circuit because it was a "cute" engineering design. When the company tried to sell it, it found dozens of competitors making similar circuits and few customers with a need for it. Another misperception was an MIT spinoff firm that made a small and inexpensive transistor tester to replace a popular unit costing several times as much. No sales resulted. "Everyone buys the expensive system", the entrepreneur decried. His market, the defense industry, was far more concerned with versatility than with price.

Table 5 shows the primary idea sources identified by the sub-sample companies. Those noting previous job requirements as a product idea source are indicating one form of sensing of market need. One example from the overall sample, Ken Olsen, the founder of DEC, started his company by

producing high-speed transistorized circuit modules that he said he could have used in his MIT Lincoln Lab computer development projects. The table

 INSERT TABLE 5 ABOUT HERE

suggests about a 50-50 split between external, i.e. market, "sourcing" of product ideas and internal, i.e. founders, sources. Later in our overall research program the possible ties between product sources and new company success will be assessed. [15]

In partial confirmation of the second hypothesis, note the variety of measures that indicate relative lack of market-orientation by the typical technological entrepreneur at the time of company founding. The dominant time allocation to engineering and the lack of formal marketing and sales organizations reflect this condition. Yet clearly some founders are more sensitive than their counterparts, aware of their competition, placing more investment in the marketing function, using market contacts from the outset of their companies to assess customer needs and develop new products based on customer inputs.

The Next Eighteen Months

Sales and Marketing. By the end of year two of existence fifteen of the eighteen companies studied in detail had a sales force (up from three during the first six months), used either alone or in combination with other methods, to sell to their customers. The number of potential customers contacted per week by these sales forces ranged from one to forty, with a surprisingly low median of three customer contacts per week. Although this small number might reflect a high concentration of customers, we lack sufficient data to test this possible explanation. This contact number did increase as a function of the company's concentration upon the industrial market ($p=.077$), government or consumer orientations apparently tending to demand fewer direct selling contacts.

Sales representatives were also used increasingly as the new enterprises developed during the next eighteen months, nine firms employing them both to contact potential customers and to distribute the company's

products and one company using reps just for distribution purposes. Five other methods of selling were used in varying degree by the firms, including mailing lists, new product "releases", attendance at technical shows, authoring of technical articles, and magazine advertisements. In addition those companies oriented primarily to government markets responded to formal government Requests for Proposals or Quotations and also submitted unsolicited proposals to various agencies. All these methods tend to reflect the selling of a product's technical content or performance, an attribute usually associated with the industrial and governmental markets that were the dominant customers of the firms studied. The low use of magazine advertising is consistent with the lack of consumer products.

As the company develops, its understanding and use of various aspects of customer contact also changes. Contacts can be divided into three categories: selling, servicing and researching. Selling includes both direct sales efforts and taking orders. Servicing covers discussing technical or delivery problems and procuring product specifications. Researching involves evaluating competition, determining customer needs, finding other possible customers and estimating market potential. Table 6 shows the average percentage contacts in each of these categories as computed from the data collected from all eighteen companies.

 INSERT TABLE 6 ABOUT HERE

Only by knowing the needs of the market can an enterprise develop highly saleable items. By knowing its potential market size the management can better decide if undertaking a development program is worthwhile. Equally important, the market is a haven for suggestions for new products. Yet technical entrepreneurs often do not particularly appreciate these perspectives. Those teams with prior experience in marketing operations best understood the need to research the market and not just sell to it. Years of prior founder experience in sales correlated closely with the time allocated toward contacts made to estimate market potential ($p=.065$) as well as with contacts made to determine customer needs ($p=.047$), but negatively with contacts made solely for selling. ($p=.082$) Interestingly this focus on getting insights from the customer, rather than just selling to the customer, was strongest for those firms that served the defense market.

Close statistical associations were found between the overall percentage contacts with the military market and the percent of customer contacts made to determine customer needs ($p=.006$) as well as the percent contacts made to estimate market potential. ($p=.082$) Perhaps those technical entrepreneurs trying to sell to the military are more willing to accept that customer's demands as "givens" which need to be uncovered, rather than assuming that the market will beat a path to the door of "brilliant" entrepreneurial ideas.

Evolved Operations

Turning back now to the overall sample we can assess the extent of further evolution of company operations as the firms reach an average age of five to seven years. As a baseline a study of Michigan technical entrepreneurs provides some details that suggest possible implications of the shifts that occur in business type, as shown earlier in Table 2, upon the founders' time allocations. Braden [2] divided 69 firms, which were on average eight years old, into standard products/services, custom products/services, and R&D/consulting. The percentile distribution of founder time differed substantially among these three different business types: (a) engineering/R&D--16.3, 23.2 and 47.3 percent, respectively; and (b) marketing--20.1, 17.4, and 16.7 percent, respectively. To the extent that the Michigan cross-sectional data can be applied to changes over time in our sample, the founders in our sample might have been expected similarly to shift their time allocation heavily away from engineering/R&D and to somewhat increase their marketing percentage as the mix of their business activities shifted over time from R&D/consulting to custom products to standard products. Our founders would also have been expected to increase their attention to production and finance activities as their mix of business types changed.

Sales and Marketing. The sales methods employed by the technological firms at their later stage of evolution remain heavily dependent on the founders. Forty-two percent of the MIT spinoff firms still use only the founders for selling contacts, but nineteen percent have added sales reps and nine percent utilize a sales force as founder supplements. The other thirty percent of the companies split between sales representatives and the company sales force, alone or in combination. Sales representatives serve to bring together the

products of a number of companies, usually small ones, for hopefully efficient and complementary presentation to prospective customers. This "shared sales force" is seldom seen by the entrepreneur as the most effective means of achieving a significant penetration of the market but rather is regarded as a "necessary evil". A broad product line and some level of achieved sales are usually perceived as necessary economically for a firm to afford its own direct sales force. The increase of direct sales forces is therefore an indication of both growth and transformation of the firms. Initially only nine companies in the first study had sales forces; now thirty-two have their own sales forces. The sales methods used do not vary greatly among the different types of businesses.

About thirty percent of the enterprises studied have still not used any means to advertise or promote their work. For those that do advertise the methods characterize the technical nature of the work being done, including direct mail, trade shows, trade advertising, product releases or combinations of these four. None of the statistics on promotional approaches used relates significantly to any other major variable associated with these technological enterprises.

Although existence of a formal marketing department is neither necessary nor sufficient for establishing a marketing-orientation in a technological firm, its use here as an index of organizational evolution seems reasonable. Only forty-six percent of the 110 responding companies in the sample have created marketing departments, apparently in all types of businesses. Sixty percent of the 110 firms do sales forecasting, primarily those engaged in hardware production. Formal sales forecasts are generated by eighty-five percent of the firms doing solely hardware production, sixty percent of those doing hardware plus contract R&D, fifty percent of those producing both hardware and software products, and eighty percent of the companies engaged in contract R&D along with both hardware and software production. Only twenty percent of the companies without any hardware production do sales forecasting. Thirty-five percent of the firms carry out analyses of market potential, again done primarily by hardware producing firms.

Our data do not indicate the exact timing of establishment of the

specific marketing related operations just described: the existence of a marketing department, the development of sales forecasts, and the performance of market analyses. Some of these conceivably may have begun at the very outset of the firm; others were no doubt established later as the firms evolved.

The data analyses at the three time periods -- founding, year 2, and years 5 to 7 -- provide strong confirmation of the second hypothesis. A small percentage of technological enterprises begin with an orientation toward their markets and toward serving their customers' needs. But many of the companies gradually evolve in this direction, manifesting their shift in both time allocation and formal market-related activities. Clearly not all technical entrepreneurs have made this transformation by the latest time studied, five to seven years post-founding. Some may change at a still later time in their company lives but skepticism on this issue seems reasonable. This evolution toward a market orientation "split" among technically-trained entrepreneurs seems to have held over several decades of new company formations: A similar 40 percent of our most recent separate sample of new computer-oriented firms have also developed marketing departments at some point in time after they were founded, moving away from initial 100% dependence upon one or more of the founders. The cluster of spinoff companies that originated in the large electronic systems firm we had examined independently also includes fifty percent with marketing departments, the slightly higher ratio perhaps reflecting a benefit of their industrial experience.

EFFECTS OF MULTIPLE FOUNDERS

The third hypothesis asserts that larger-size founder groups reflect stronger product and market focus at the outset of their companies and evolve more rapidly in these dimensions. Both the overall sample and the more detailed time data from the sub-sample help test this hypothesis.

Smaller founding teams which therefore have available and work fewer total hours are constrained by the requirements of engineering. Being a necessary part of initiating a product-producing technological enterprise, engineering activities therefore consume a large proportion of a small group's

time. If the founding group is larger, the entrepreneurs can fulfill the requisite engineering activities and still have some time remaining for filling the other "buckets", therefore ending up devoting an increasing portion of their time to contacting the market. The actual hours spent in engineering are not diminished, but the proportion of their time spent on engineering is. Statistical findings from the detailed sub-sample are in accord with this explanation. Total founder hours worked correlate positively with the number of hours spent on engineering efforts ($p=.13$) but are negatively associated with the percent of time on engineering ($p=.08$).

As the size of the founding team increases greater proportions of their time are spent in efforts to sell the company's products. ($p=.04$) Another measure of the same phenomenon is that total founder hours worked per week correlates positively with percentage time spent on sales ($p=.018$). This presumably draws upon the increased years of prior sales experience encountered within the larger founding teams. ($p=.004$)

Data from the overall sample confirm and amplify the findings from the smaller but deeper analysis presented above. In particular the advantage of multiple founders is evidenced in several characteristics of business operations, even during the early months. For example, none of 43 single founder companies initially had a sales force. Ninety percent of them relied upon the founder to do the selling, with the remainder depending upon sales representatives alone or in conjunction with the founder. Nine of the multi-founder companies set up sales forces immediately and 30% were able to use selling methods other than personal contact by a founder. The single founder has to sell along with performing all his other tasks. In many multiple founder companies, the sales/marketing task was the responsibility of one (or occasionally several) of the founders who devoted his principal time to that job, reflecting a natural division of labor.

The figures in Table 7 from the overall sample do demonstrate that the carrying out of these market-oriented operations is strongly associated with the number of company co-founders. Thirty-five percent of the companies founded by one person versus fifty percent of the multi-founder firms set up marketing departments; 41% of sole entrepreneur firms did sales forecasts in contrast with 70% of the multiple entrepreneur companies; and market

analyses were performed by only 26% of the enterprises founded by one person as opposed to 41% of the other firms. Teams of founders obviously can

 INSERT TABLE 7 ABOUT HERE

undertake more tasks in parallel than a single founder, which indeed may well have motivated the establishment of many of the multiple founder groups. The detailed sub-sample data showed above the shift of founder time allocation toward sales and marketing as the size of the founding group increased. Table 7 supports the perspective that when limited by available human resources the technical entrepreneur gives priority to the technical aspects of the business with which he is most familiar, and the development of a marketing organization and its related activities may be delayed by default. The evidence strongly confirms the third hypothesis on the positive impacts of multiple founders.

SUMMARY AND IMPLICATIONS

Primary changes occur in technology-based companies during their first several years of existence. Those documented in this article relate principally to the firms' orientation to product-based businesses and to marketing and selling activities within them. In support of our first general hypothesis, the sample of 114 MIT spinoff companies went from 62 percent initially engaged in development and sales of their own products to 84 percent over the course of the first few years, the bulk of change coming from a number of companies departing from or supplementing initial focus upon consulting or contract research and development work. At least those changing firms have shifted from engineering and technology as their almost total initial involvement toward some mix of product and market orientation.

These early years also witness increased formal commitment by the entrepreneurial founders to marketing and sales activities, as predicted by our second general hypothesis. Evidences include a reduction in the number of firms that are solely dependent upon their founders for direct customer contact, paralleled by a dramatic increase in direct sales forces and even larger growth in the use of sales representatives. Awareness of competition is a strong influence on company orientation, with those sensitive to

competitive environments placing far more effort in the direction of marketing activities. Evolution of these technological firms, however, leads to still less than half with their own marketing departments, even after five to seven years of company growth and development.

In support of our third general hypothesis, companies founded by more than one entrepreneur devote a larger proportion of their efforts to marketing and sales even from the outset, with less effort going into engineering. This tendency relates in part to the increased presence of prior sales and marketing experience in the backgrounds of multi-founder teams. The multi-founder firms more quickly employ sales forces than single founder firms, and also are more likely to develop marketing departments, carry out sales forecasts, and perform analyses of potential markets.

The author hypothesized in Figure 1 a partial causal model of growth and success of the technology-based firm. While key elements of it await further verification, its structure highlights the likely dependency of success upon both product and market-orientation. Entrepreneurs and investors who accept the plausibility of that model should note from our analyses that most firms which started without product either are slow to evolve or never get to production status. Half the companies that originate without a product at least in development stage never make the conversion into manufacturing. Similarly, lack of market-orientation at the outset is frequently not corrected merely by the passing of time, with formal market-related activities still missing from the majority of technology-based enterprises even after several years of company existence.

Both entrepreneurs and investors also need to recognize the more balanced and accelerated approach to company development that is typically undertaken by the multi-founder firm, which initially targets an explicit product market. Single founder firms are especially slow in developing formal sales and marketing approaches that go beyond their own personal skills and effort, thereby retarding the firm's evolution. Including sales and marketing skills in the initial founding group seems especially appropriate. Confirmation of the possible relations of these variables to eventual success and failure of the technology-based firm will have to await further analyses. [15] But in the meantime prospective entrepreneurs should strongly consider

taking the rather low "risk" of adopting a product/market-oriented team approach toward company formation and development.

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Figure 1. A Partial Model of Evolution of the Technology-Based Company

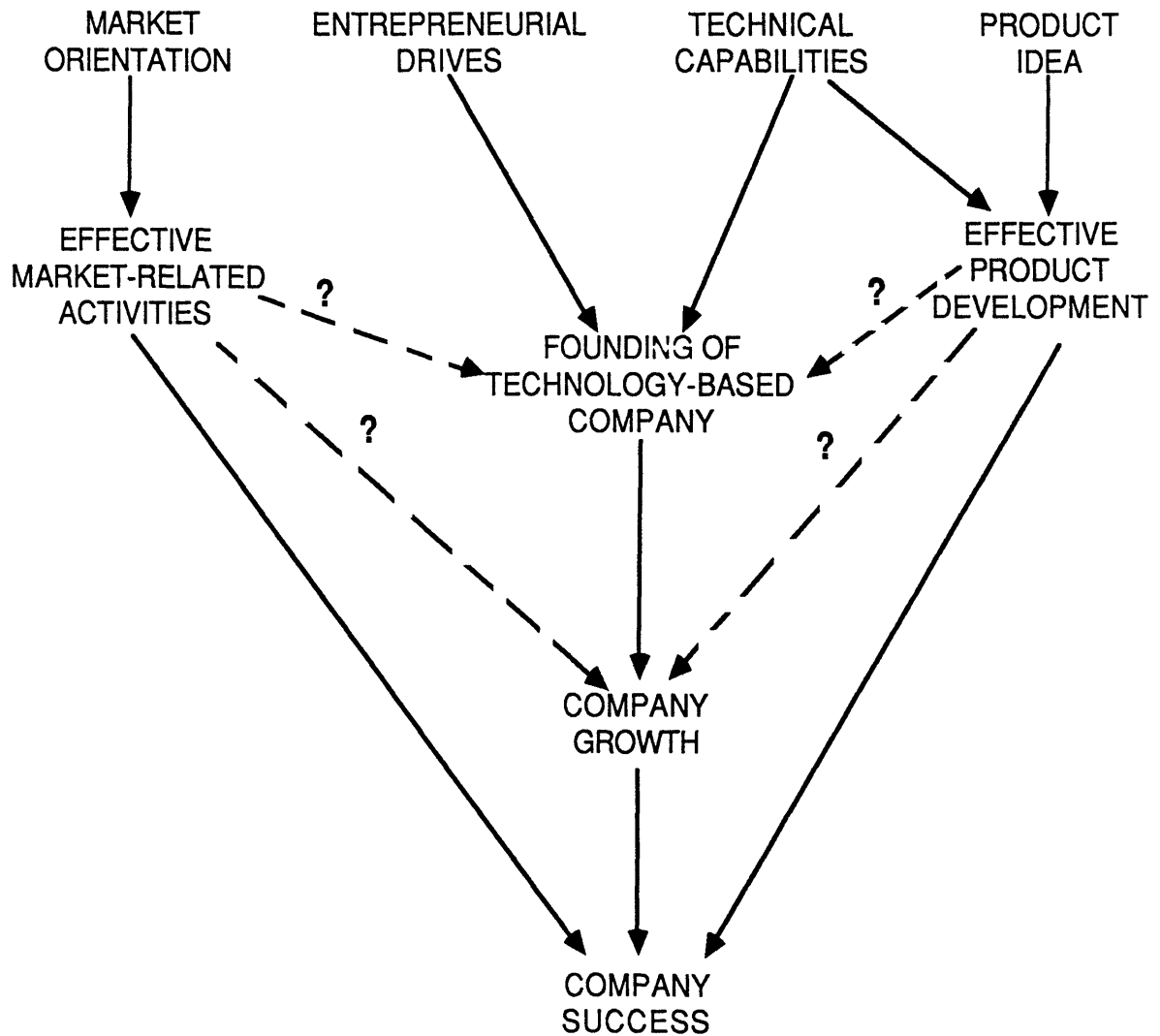


Table 1. Data Sources for Study of Product and Market Evolution
within New Technological Enterprises*

<u>Sources of New Enterprises</u>	<u>New Companies Identified</u>	<u>Participants in Research Study</u>
MIT major laboratories (4)	107	96
MIT academic department (1)	<u>18</u>	<u>18</u>
Totals	125	114

* Among my many former research assistants and thesis students who contributed importantly to the data and analyses contained within this article were Howard A. Cohen and S. William Linko, Jr., as well as my former research associate Herbert A. Wainer.

**Table 2. Business Orientation of Technology-Based Firms:
Changes from Founding**

Table 3. Effort Allocation by Founders During First Six Months (n=18)

<u>Operational Area</u>	<u>% Total Work Time</u>
Engineering	31
Sales/Marketing	28
Manufacturing	25
Finance/Administration	16

Table 4. Early Effort Allocation Based on Awareness of Competition (%)(n=18)

	<u>Finance & Adm.</u>	<u>Sales/Mktg.</u>	<u>Engineering</u>	<u>Manufacturing</u>
Aware	17.8	31.2	28.7	22.3
Unaware	5.0	17.6	40.7	36.7

Table 5. Primary Source of New Product Ideas (n=16)

	<u>Number of Firms</u>
Previous job requirements	5
Customer	1
Customer-sponsored R&D	1
Founders, key employees	6
Product line evolution	1
Other	1
None	1

Table 6. Purpose of Customer Contacts (%) (n=18)

<u>Selling</u>		<u>Servicing</u>			<u>Researching</u>		
<u>Taking</u>	<u>Orders</u>	<u>Technical/</u>	<u>Procuring</u>	<u>Evaluating</u>	<u>Determining</u>	<u>Finding</u>	<u>Estimating</u>
<u>Selling</u>	<u>Orders</u>	<u>Del. Problems</u>	<u>Prod. Specs.</u>	<u>Competition</u>	<u>Cust. Needs</u>	<u>New Custs.</u>	<u>Mkt. Potential</u>
31.9	6.5	18.2	10.5	3.6	19.3	4.2	5.8
38.4		28.7			32.9		

Table 7. Marketing Operations as a Function of the Number of Founders
(n=110)

Number of Founders	<u>Marketing Department</u>		<u>Sales Forecasting</u>		<u>Analyze Potential Markets</u>	
	<u>Yes</u>	<u>No</u>	<u>Yes</u>	<u>No</u>	<u>Yes</u>	<u>No</u>
1	12	22	14	20	9	25
2	8	16	15	9	8	16
3	13	9	14	8	9	12
4	4	2	4	2	4	3
5	3	3	6	0	3	3
6	3	1	4	0	1	3
7	1	0	1	0	1	0
8	0	0	0	0	0	0
9	<u>0</u>	<u>1</u>	<u>1</u>	<u>0</u>	<u>1</u>	<u>0</u>
Totals	44	54	59	39	35	62
*	p=.027		p=.000		p=.038	

* Mann-Whitney U significance levels, indicating the strong association of each of the three characteristics of marketing operations with multiple founders.