The marketing literature has traditionally assumed that people in marketing and sales play a central role in product development activities. Though recent work has recognized that marketing may be less central in high-tech firms, there has been little empirical examination of the role marketing does play in these situations. This article, based on nine months of participant observation in a computer systems firm, first provides an overview of the product development process and then describes impediments that prevent marketing groups from exerting greater control over product development decisions. The author then turns to ways in which marketing groups work within these constraints, exerting their influence through informal networks, coalition building to champion specific projects in engineering, and going to the external market to "complete the product" for their respective market segments. He concludes by assessing the implications for research in high-tech firms and considering managerial implications.

Marketing's Limited Role in New Product Development in One Computer Systems Firm

"The biggest danger to us is market surveys. When my friend came up with the Sony Walkman, he said in his book, 'don't ask marketers for surveys.' ... Marketers will never come up with a new idea. They are taught formally you ask the customer what he wants. But he only wants what he's seen. And nothing will come out of it. One of the most serious dangers is if we say, 'here it is black and white, the market survey says this.' That's almost as bad as 'the consultants predict this.' ... Market surveys think it will go on that way forever."  
["Zytek" chief executive officer in a speech to top managers]

What is marketing's role in product development in high-tech firms? It has implicitly been assumed in the marketing literature that marketing and sales groups should have a significant role in product development decisions and are able to guide the efforts of other groups in the firm. However, the rapid growth of high-tech firms whose operations are dominated by entrepreneurial founders and technical personnel and at which marketing is assigned a marginal role, contradicts the roles prescribed in marketing texts. Though a number of researchers (e.g., Roberts 1991, Shanklin and Ryans 1987) and practitioners (e.g., Davidow 1986, McKenna 1986) have argued that marketing in high-tech firms is different from consumer products marketing, there has been little empirical examination of the actual role and activities of marketing groups in high-tech firms. My purpose is to present a realistic account of the constraints on marketing's role in new product development in one high-tech firm and the ways people in marketing respond to these arrangements and seek to influence product development decisions.

LITERATURE REVIEW

Over the past 25 years, there has been a large amount of work in marketing developing quantitative data analysis techniques and models to help in analyzing market research data (cf., Urban and Hauser 1980; Wind, Ma-
hajian, and Cardozo 1981). Though many techniques have been developed and used in consumer nondurable product categories, there is growing awareness of the limitations of these approaches for high-tech products. In rapidly growing markets, respondents to market research may not have the knowledge needed about the category to respond intelligently (Wilton and Pessenier 1981, p. 163), may lack a suitable frame of reference (Shocker and Hall 1986, p. 94), and may have “functional fixedness” with regard to current attributes being offered (Von Hippel 1986, p. 792). A number of ideas have been proposed for testing product ideas in these situations, such as identifying and using information from “lead users” (Urban and Von Hippel 1988, Von Hippel 1986) or attempting to educate potential adopters up to levels they would be at when making an adoption decision (Weinberg 1992, Wilton and Pessenier 1981).

Whereas much effort has been directed toward developing normative procedures to help in product development, there has been little empirical research on what actually goes on in marketing and where new product development activities take place within a firm. Much of the research on marketing activities has used surveys to measure the tasks and responsibilities of product managers in consumer packaged goods firms (e.g., Clewett and Stasch 1975, Cosse and Swan 1983, Hise and Kelly 1978). Though a number of studies have compared the activities of consumer and industrial product managers (e.g., Cummings, Jackson, and Ostrom 1984; Eckles and Novotny 1984), few studies have been done of marketing personnel other than product managers.

There has been a greater use of observation and in-depth interviews to study product development activities in the management field (e.g., Ancona and Caldwell 1988; Bucciarelli 1988; Dougherty 1990, 1992a; Dubinskis 1988). One theme common to these accounts is that new product development is not portrayed as a rational, linear process that progresses from concept generation to data analysis to development. There is relatively little mention made of surveys, models, or for that matter, marketing. Rather, new product development is characterized as an iterative process, with social interaction and political dynamics being of primary importance.

Similar portraits of product development are presented in a wide range of books written by participants, journalists, and industry observers in the computer industry (e.g., Davidow 1986, Kidder 1981, McKenna 1986, Rifkin and Harrar 1988, Rose 1989). The emphasis in these books is on engineering, technology, entrepreneurial drive, and political dynamics in the firms. For example, the heroes of Kidder’s (1981) Pulitzer Prize-winning account of minicomputer vendor Data General are Tom West and the young engineers, with marketing and sales having minor roles in the story. Likewise, the accounts of Apple during the days of Steve Jobs and the Macintosh development (e.g., Rose 1989) portray new product development as a fast-paced, dynamic activity with a heavy influence of personal vision, determination, competing product teams, and coalition building.

In summary, though there is general recognition that product development in high-tech industries is different from the more widely studied consumer goods industries, there has been little research in marketing that attempts to understand how high-tech firms do make product development decisions and what role marketing may play in these settings. This lack of attention led to my decision to do a participant observation study in a single computer systems firm (referred to as “Zytek.”) I start by providing an overview of the research method and the field setting. This is followed by a description of Zytek’s product development process. I then indicate some of the impediments that limit the role marketing has in influencing product development decisions in engineering. A description of mechanisms by which marketing does exert influence over engineering follows. The final sections provide an assessment of the implications for the marketing literature.

**METHOD AND FIELD SETTING**

I began exploring the questions of how decisions were reached on which products to develop and marketing’s role in this process by interviewing managers in a range of high-tech firms. Over a ten-month period, I conducted 37 interviews with managers in 25 different firms and spoke with several dozen other managers by phone. The picture that emerged was one in which marketing frequently had a minor or nonexistent role in influencing product development decisions. Rather than being an exception, it seemed to be the norm for engineering managers or senior managers with technical backgrounds to make the decisions about new products, with marketing being assigned the role of getting the products out the door and working with the field to develop and support customer applications.

This gap between the literature and managerial practice led to my decision to do a participant observation

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1There has been increasing interest in marketing in the utilization of market research information (e.g., Deshpande and Zaltman 1982, 1984, Moorman, Zaltman, and Deshpande 1992). These studies have typically used surveys or experiments to see how managers process and use various types of information. However, these studies have not explicitly examined the organizational dynamics and the role of marketing within the firm.

2The findings reported in the descriptive parts of this article do not draw on the initial 37 interviews from a range of firms, but rather on the data collected within Zytek. Some of the insights from the broader sample of firms are used in the final discussion sections, in which implications and directions for future research are discussed.
study in a single firm. I sought to better understand the process by which decisions were reached and precisely what it was that marketing was doing and why they seemed not to have a significant role in many situations. After spending three months negotiating site access, I spent nine months on a full-time basis between September 1988 and June 1989 in one large computer systems firm, observing the activities of the engineering, marketing, and field groups. Using Adler and Adler's (1987) terminology, I was a "marginal member," having a badge allowing access to Zytek facilities and an electronic mail account I could access from home. I did not receive any compensation or research funding from Zytek and did not act as an advisor or consultant to Zytek managers. (See the Appendix for an overview of my activities in the field.)

Overview of Zytek

Zytek is a large computer firm that offers a range of systems with associated peripherals and software. Insiders describe Zytek as an "engineering-driven company" and most people within Zytek (including people in marketing) agree that engineering has the most power, particularly with regard to new product decisions. Most of Zytek's vice presidents (VPs) and senior managers have technical backgrounds and many have come up through the engineering ranks—a sign of competence and legitimacy. Zytek's chief executive officer (CEO) is one of the original founders and his influence and imprint on the company is significant, particularly in establishing and legitimating the power and influence of engineering.

It is difficult to comprehend Zytek's organizational structure, because though there are formal reporting relationships, the management hierarchy is not the primary mechanism for controlling internal activities. Rather insiders emphasize "dotted line" relationships, the informal networks, the exercise of influence through budgetary control or committee approvals, and the corporate culture, which rewards individual initiative and coalition building. My informants claimed that the term "matrix management" did not fully capture the complexity, since more is involved than having two bosses. The internal financial systems provide for overlapping ways of counting revenues and profits (e.g., by product, application, industry, channel, geography) and summing the revenues of all the decentralized groups with profit and loss responsibilities produces a figure three to four times larger than Zytek's total revenues. Since there is so much overlap, engineering, marketing, or sales managers frequently have control of only a small portion of the revenues or costs associated with their own profit and loss statement—thus providing incentives for them to seek out and lobby for support from other groups.

Zytek had been very successful in its chosen markets and its financial results reflected this success. Over the five fiscal years preceding my fieldwork, revenues had increased at a compound annual rate of over 20% and net income had outpaced revenue growth, growing at over 30% per year. As a result, the profit margin (earnings after interest and taxes) had grown from less than 7% to over 10% of sales, higher than Zytek's competitors. In short, Zytek's financial results had been impressive and the stock price had more than tripled over this time period.  

OVERVIEW OF THE PRODUCT DEVELOPMENT PROCESS AT ZYTEK

Computers are modular systems configured in a variety of ways for a range of customer applications. Given the nature of the systems offered by Zytek as well as the range of peripherals that can be attached, there are many interdependencies between design teams within Zytek. Because of these interdependencies, there is a range of committees whose approval is required to proceed through various stages of development. This section provides an overview of these stages.

Overview of Product Development

Projects within Zytek originate from a range of sources. Most typically, new projects come about from engineering teams moving from one technology generation to the next, often taking the existing hardware and either cost reducing it or increasing the performance for a given price level by incorporating the next generation of chips, disks, displays, and interconnect technologies. 286-based machines are upgraded to 386s. More options are given for add-in memory or add-in boards. Newer disk drives

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2I was sponsored by an engineering VP who had several thousand people in his organization. He asked the Base Product Marketing manager who reported to him (responsible for about 130 people) to watch over my activities. A one-page electronic mail memo from the engineering VP providing an overview of my project proved to be important in setting up interviews and obtaining permission to attend meetings.

3These financial figures are for the five fiscal years preceding the fieldwork. Since then, Zytek's financial performance (as well as that of most of Zytek's competitors) has not been as favorable. Though it is possible to argue that the restricted role marketing had in this firm was not appropriate for the changing marketplace in the 1990s (with a growing emphasis on lower cost distribution and standardized components), the task remains of explaining the superior financial performance Zytek had earlier in its history when engineering was dominant.
are incorporated. In addition to incremental changes, other new product concepts come from the basic research and development (R&D) labs, from ideas taken from competitive products, or from ideas championed by marketing or sales personnel.

At any given time, there are several hundred projects at various stages of development within Zytek engineering and these projects use Zytek's "Phase Review Process" to help coordinate activities (see Table 1). The main controls over projects are the transitions between stages of development. The phase review process manual outlines the responsibilities that must be performed by each relevant group (e.g., engineering, manufacturing, marketing, service and support) for the project to enter the next stage. Weekly cross-functional design review meetings are held to discuss the project's progress and identify "action items" that must be completed by each group in order to get past various phase review committees. Typically five or six people attend the weekly meetings early in the product definition stages (from engineering, manufacturing, product management, field service, and marketing), with more people attending as the product progresses through development. As introduction approaches, it is not unusual to meet on a daily basis and for as many as 20 or 30 people to be present, representing the interests of their respective constituencies.

There is a range of committees that a project must pass through on its way to market. Some of the committees are an integral part of the Phase Review Process (committees signoff must be obtained to proceed); others are advisory or consultative. The most powerful committees are chaired by vice presidents (VPs) or corporate officers and include the Marketing and Sales Strategy Committee, the Systems Task Force, and the Phase Review Committee. These three committees respectively (1) coordinate the development of sales and marketing strategy across all product lines, (2) allocate the R&D budget and review product development plans, and (3) review progress on the "Top 100" projects under development on a monthly basis. All projects must also pass through the Announcement Strategy Committee, which is headed by a manager in the U.S. field sales organization. This committee is powerful in that it plans and choreographs the details of the major product introduction events. Somewhat less powerful are two advisory committees headed and primarily staffed by marketing personnel—the Pricing Advisory Committee and the Marketing Advisory Board. Though all projects have to pass through the pricing committee, its role is only advisory, since the final approval for pricing rests with the Marketing and Sales Strategy Committee. The Marketing Advisory Board seeks to coordinate marketing input at the front end of product development and tries to have engineering groups come and present their plans eight to 12 months before the planned introduction date.

**Product Managers and Marketing Groups**

The product manager, who is part of engineering rather than marketing, is the person who takes responsibility for ensuring that all the information is present and items are checked off as development proceeds through each phase. The product manager is typically responsible for preparing presentations to the various committees, though the presentations are often made by engineering group managers or engineering VPs. Closely related to the product manager is the project manager, who is responsible for the technical and engineering aspects of development. Product managers handle the "business issues," the external coordination with marketing and sales groups, and the committee approvals, whereas project managers

<table>
<thead>
<tr>
<th>Phase</th>
<th>Name of the Phase</th>
<th>Primary Tasks to Be Done</th>
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| 0     | Strategy and Requirements | Identify market opportunity  
Identify corporate resources needed  
Develop preliminary financials |
| 1     | Planning and Preliminary Design | Create functional specifications  
Create business plans for manufacturing, service, marketing, and sales |
| 2     | Implementation and Design | Prototypes developed, lab tested  
Product functionality demonstrated |
| 3     | Qualification | Parts certified; Field tests of product  
Training, service, support plans made  
Manufacturing ready to ramp up |
| 4     | Production, Sales, and Service | Achieve steady-state production  
Product responsibility shifts from Design to Support Engineering groups |
| 5     | Product Retirement | Plans established for phasing out manufacturing while continuing service |
handle the “technical issues” and coordination with other groups in engineering and manufacturing. The weekly design review meetings are where this implementation and coordination is centered.

Since computers are sold into a wide range of applications through many distribution channels, Zytek has developed a range of marketing groups, each representing various ways of segmenting the market (see Table 2). In terms of more familiar marketing concepts, the primary marketing groups at Zytek can be viewed as segmentation by the various constituencies within the customer buying center. In brief, Base Product Marketing communicates with the “Techies” in the customer account and with technical partners such as OEMs, VARs, and ISVs. The Product Marketing Groups tend to direct their messages toward functional managers and end users, showing specific applications that can be used in a department or work group. Finally, the Industry Marketing Groups address how information technology can be used for competitive advantage and to “add value” in a given industry. Their messages tend to be industry specific and directed at high-level managers. Though information from these marketing groups is needed by product managers to satisfy requirements of the Phase Review Process and obtain committee approvals, the marketing groups do not have direct control over the product development process.

**Formal Input by Marketing Groups to Engineering**

Though there are a number of formal systems and processes by which marketing groups provide information to engineering groups, the three most frequently mentioned are the phase review process, annual long range plans, and quarterly sales forecasts. For projects to proceed through development stages, marketing groups are required to provide various types of information for their respective market segments. During the initial phases of development, most product managers spend a large amount of their time working with marketing groups to collect information in order to write the “Market Requirements” and “Product Requirements” documents. The limitations discussed most frequently about the phase review process are the detailed focus on attributes of hundreds of projects underway in engineering and the difficulty from engineering’s point of view of translating, synthesizing, and making trade-offs among the requirements of all the different marketing groups.

The annual planning process, in contrast to the project-focused phase review process, is more strategic in nature; the plans are developed by each marketing group as well as each engineering group. The marketing groups are asked to forecast the revenue and profit for their market segment for the next year and indicate the products and programs needed to achieve their goals.

A third formal system by which marketing communicates to engineering is the sales forecasting system. Once every three months, sales forecasts are simultaneously prepared by engineering groups, marketing groups, and the field sales organization for the next eight quarters (two years). One product manager explained the process:

Table 2

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<th>Overview of Zytek Marketing Groups</th>
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The Base Product Marketing groups report to the VP of each of their respective engineering groups. These groups range in size from 30 to 150 people and handle marketing tasks specific to their group’s products. Representative activities are developing training material for the sales force, writing demonstration software, working with other marketing groups to determine which applications and industry sectors are most important for their products, and developing promotional materials ranging from brochures and technical specification sheets to ads and trade show exhibits.

There are over 1000 people in the Product Marketing Groups. Many insiders refer to these groups as the “application marketing groups” since their main focus is on the application the system is used for. There are five main product marketing groups (lab and data products, engineering systems, manufacturing systems, business and office systems, and corporate information systems) corresponding to departmental applications in large firms. In addition to this “vertical segmentation” of the parts of a firm, there are also “horizontal” product marketing groups that address applications, such as desktop publishing, word processing, and spreadsheets that are used in all departments of the firm. The Product Marketing Groups spend much of their time working with external hardware and software suppliers as well as internally developing software and demonstrations to show how the systems can be used for various applications.

The third major set is the Industry Marketing groups which are aligned with specific industry sectors. Though the number and reporting relationships of these groups seems to constantly change, over the course of my fieldwork there were roughly 25 industry marketing groups. The industry marketing groups’ role is to follow general trends in their industry sectors and then help relate Zytek’s products and applications to these broader business issues. Many people in these groups had extensive work experience in these industry sectors and typically knew more about the industry than about computers. However, given Zytek’s engineering-driven culture, this often was a liability rather than an asset.
We develop the product assumptions book for all the products we’re working on. The other groups then take these descriptions and forecast the product volumes, and then we have an issues resolution meeting.

The assumptions book is several hundred pages long and contains a brief description of each project under development. The marketing groups then prepare their forecasts and also draw up a list of issues they have with each project. A series of issues resolution meetings are then held between marketing and engineering groups to discuss changes that marketing wants in various projects.

Though the formal systems no doubt provided valuable information, many people in engineering and marketing claim they are not the primary means by which to influence product development decisions. One product marketing manager, who had previously worked for more than five years in engineering, acknowledged that marketing had limited influence over product development decisions. He briefly summarized the formal systems for communicating with engineering and noted,

The problem is that the right people aren’t listening on the engineering side. Decision makers don’t typically sit in on these meetings. They typically listen to the following—and in this order: (1) their own engineering VPs, (2) the Systems Task Force, (3) their own engineers and product people. It’s very difficult for us to talk directly to them, because they don’t think we add any value.

To conclude this overview, I now turn to the committee the product marketing manager mentioned, the Systems Task Force.

The Systems Task Force

The single most influential committee affecting new product development is Zytek’s Systems Task Force (STF). Though the STF was originally conceived as a task force that would meet a few times a year to review the technical direction of the company, over time it became a committee that met on a biweekly basis and took over the responsibility for allocating the R&D funds in engineering and overseeing product development activities. There are approximately 20 people in the STF, with members coming from engineering groups representing the various parts of a computer system as well as the various sizes of systems. Though some STF members are also managers of engineering groups, VPs, and/or corporate officers, the majority do not have these general business responsibilities. More significantly, there are no representatives from the sales or marketing groups on the STF.

The STF is concerned with Zytek’s total family of systems and their positioning with one another. Since Zytek offers hardware systems over a wide range of “price points” and its systems software runs on all these machines, positioning systems within the line is critically important. It is common for Zytek employees to say “the architectures are the strategies” since architectural decisions lay out long term plans of how current and future parts of the system will interconnect. Some of the attributes used to differentiate the product lines are processor speed, internal bus speed, expandability, input/output throughput, and special capabilities such as fault tolerance and transaction processing. Because the STF controls the R&D budget, they are able to assign specific roles to project teams. Much of the activity I observed in the design review meetings was working to develop systems that met these constraints. For example, in one meeting a product manager said,

We need to start with a marketing vision of what we want to do with this product, . . . The cost, schedule, processor and investment dollars are pretty much dictated to us. Now we need to figure out what we need to do within these constraints.

In other meetings it is common to see “product road maps” which have been approved by the STF and specify several generations of products. Typical attributes of each project are the processor chip being used, the cost goal, the internal bus being used, the graphics system used, and the introduction date. Because of the continual movement down the price/performance curves, the most important characteristic is often the planned introduction date since there are targets of how many MIPS per dollar should be delivered at various dates.

In sum, Zytek’s Phase Review Process provides formal road maps of committee approvals and information needed for projects to proceed from one phase to the next. Product managers are the key players in engineering who work with marketing and sales groups and guide their products through the various reviews. The powerful STF combines the functions of allocating the R&D budget with watching over the new product portfolio and ensuring that various system parts work together and fit into the overall strategy and system architecture. Though there are such formal processes, it is important to realize that much of the work and influence is done informally and outside the formal systems, and Zytek’s organizational culture, structure, and processes tolerated deviations from the top-down plans and allowed competing approaches to proceed. With this background on the product development process, the remainder of this article focuses on impediments to input from marketing groups, marketing’s response to these impediments, and a discussion of the implications for the study of marketing’s role in high-tech firms.

**Impediments to Inputs from Marketing Groups**

Most employees characterize Zytek as an engineering-driven firm where engineers do not have a high regard for people in marketing. Representative of engineering’s attitude is the following comment made by a strategy manager who reported to an engineering group manager:
The field sells what engineering develops—the product development process is dominated by engineering and marketing really doesn’t have a large role in it. Marketing is caught in between these two groups—their job is to develop marketing programs and sales strategies for the products engineering turns out.

In this section, I discuss three impediments that prevented marketing from having direct control over product development decisions. These impediments are the engineering-driven culture, the organizational structure, and the intense time-to-market pressures. After describing these impediments, I discuss some of the reactions people in marketing have to engineering’s control over new product development decisions.

**Zytek’s Engineering-Driven Culture**

One of the greatest impediments to inputs from the marketing groups is Zytek’s engineering-driven culture, which supports engineering’s control over new product decisions and justifies not listening to marketing. The most frequent reason engineers give for not making more use of market research is some variation on the theme, “Customers don’t know what they want.” They say the marketing input is reflective of what customers are asking for today and is based on what the competition is doing. One manager phrased it, “Customers just extrapolate from current concepts and ideas they are familiar with.”

On numerous occasions, people told me that no amount of market research would have come up with the Sony Walkman. I eventually discovered that Zytek’s CEO had used the story in a videotaped speech to a large meeting of managers and it had diffused throughout the organization. This story (refer to the excerpt at the beginning) seems to be repeated so often because it is what the engineers want to believe—it allows them to be “technology driven” and provides a rationale for not listening to marketing. Furthermore, since it originated with Zytek’s CEO, it provides legitimation for their disregard of information from marketing.

A second reason engineers give for not relying on information from marketing is the lack of technical expertise and competence in marketing. They complain that marketing people provide simplistic product requirements and that the information is not very useful: “Marketing wants everything right now at no cost—they have no concept of feasibility—they want a $5000 Cadillac tomorrow.” With the technology changing at a rapid rate, it is even difficult for the engineers to stay abreast of technical capabilities and approaches taken by competitors. Because it typically takes 18 to 36 months before leading edge technology shows up in products and since marketing spends the majority of its time working with products that either have been or are about to be introduced, it is inevitable that marketing will know less about the leading edge technology than engineering. The varying levels of expertise between engineering and marketing are compounded by selection and retention biases—the most technical people tend to take and hold onto jobs in engineering rather than marketing.

An example of marketing’s perceived limitations is the ability to identify the design assumptions embedded in competitors’ products. Engineers claim that a high level of expertise is needed to unravel key design decisions. For example, at one day-long design session (attended by 20 people from engineering and only one person from marketing), a manager of the power and packaging design group spent 35 minutes taking apart a competitor’s system, explaining their design decisions along the way. By having the top-notch engineers together at the same time in the meeting, it is thought possible to quickly identify the assumptions made by competitors. The analysis of competitors’ approaches helps to generate new ideas, and, with expertise from all the relevant groups present, it is possible to quickly make trade-offs, discuss interdependencies, and rule out alternatives that are not technically feasible within the time horizon for the product. This usually is not possible with marketing people since they typically do not have the same level of technical expertise the engineers do.

In short, Zytek’s engineering-driven culture systematically limits the types of input marketing groups are able to make. Key symbols of these limitations include the powerful role of the STF (which has no representatives from marketing or sales) and the attitude of the CEO and other top managers that marketing’s primary role is to help the field organization sell systems rather than tell engineering what systems to build. I now turn to aspects of the organizational structure and processes which provide further impediments to input from marketing.

**Organization Structure and Processes**

Zytek’s organization structure and financial systems provide for many overlapping ways to divide up revenues and costs. Though marketing and sales groups have their own profit and loss statements, the most important are those in engineering. As engineering managers advance in their careers, they have the opportunity to move into general management without leaving engineering. Because virtually all the engineering group managers come out of engineering, they typically have a high level of technical competence and are expected to develop a general business orientation and understanding of their customers as they advance. Though the engineering group managers do not have direct control over the marketing and sales expenses for their products, they do have the incentive to try to lower their allocations for these costs, and they also have the incentive to develop the products that meet the needs of their customers.

Though I often observed engineering personnel trying to address the concerns of marketing groups, this was often difficult given Zytek’s unusual organizational structure. A design team in Zytek has to deal not only with its own Base Product Marketing Group, but also
with half a dozen Product Marketing Groups and roughly two dozen Industry Marketing Groups. Even if engineers are predisposed to cooperate with marketing, it is impossible to accommodate the varying needs of over 20 different marketing groups. The critical design decisions often revolve around whether to optimize a system for specific applications or specific industries or whether to design more flexible, modular systems that can later be customized by marketing groups or external third parties to a broader range of applications. These decisions of how modular and flexible to make a product are made in engineering. Prior research on marketing and engineering interaction (e.g., Gupta, Raj, and Wilemon 1986; Ruekert and Walker 1987; Hauser and Clausing 1988) has implicitly assumed that the functional groups are focusing on the same object. For many products, this is not a bad assumption. However, this was not the case with Zytek because of the modular nature of their systems.

Given the overall negative attitude toward marketing within Zytek, many tasks traditionally thought of as marketing (such as product management, competitor analysis, and strategy development) are done in the engineering groups. Because the engineering managers have a profit and loss statement, they have latitude to fund people and projects that help them better understand their markets. Several people said the Base Product Marketing groups (which reported to engineering VPs) had been created because of the desire on the part of the engineering managers to control the marketing activities of their own products. In some sense, an orientation toward the concerns of customers has been created within Zytek’s engineering groups by making engineering group managers responsible for their products’ financial performance.

One vivid example of this development of business responsibilities within engineering came when I was invited to attend a two-day session between MIS managers of seven key customer accounts (representing over 10% of Zytek’s revenues) and my VP sponsor’s staff. The Base Product Marketing group reporting to the VP claimed it was critically important to get this “unfiltered input” directly to the engineering group managers. What was most significant was that ten of the engineering group managers in the VP’s organization attended, with only two base product marketing people and no representatives from product marketing or industry marketing groups present.

It is possible to argue that these engineering group managers are actually “doing marketing” since most of them claim to meet with customers at least several times a month and they have profit and loss responsibilities. Given the way the “market orientation” construct has been conceptualized (cf. Kohli and Jaworski 1990), Zytek could conceivably score high on this scale since engineering personnel directly interact with customers and closely monitor competitors’ activities. However, it is important to note that marketing can be conceived as a (1) functional group within the firm or (2) a set of activities or roles. Each conceptualization leads to different types of research questions and insights. Here I focus on the terms used by my informants, and thus I use a functional rather than an activity, or process-based definition of marketing. Given the negative connotations the label marketing carries within engineering, it is doubtful these managers would agree that they are “doing marketing.”

Time to Market Pressures

There is consensus within engineering that the continual reduction of semiconductor line widths and chip density has lead to steadily decreasing prices for a given computing capability, typically reported in the range of 25 to 30% reductions per year. Given these continual changes in the price performance trend lines, there is enormous pressure on design teams to make decisions quickly and not let the schedule slip. The most important constraint facing the design team is often a planned shipment date (“You WILL ship an [18 MIP] machine in Q3 ’89”). On several occasions, I observed design teams working backwards from this date, to determine what would go “in the box.” The importance of price performance varies significantly by market segment, with general business applications generally being less concerned about it and engineering and technical applications (especially high end PCs and workstations) being highly concerned about it.

One result of this continual time pressure was encouragement for product managers and other engineering personnel to directly interact with customers. For example, one product manager said,

I try to meet at least one customer a week.... The customers tell us ‘we’d love to talk to engineering, but for God’s sake, don’t bring any of those marketing folks—keep them out.’ ... I went to see some leading edge customers for feedback on the Neptune concept—only four of us [from engineering] went. A small group’s the only way to do it—go around all the marketing groups in the way.

On numerous other occasions I heard similar stories of people from engineering (typically product managers or high-level managers in engineering) directly calling on customers in order to get direct feedback on new product concepts.

Marketing Reactions to Engineering’s Power

People in marketing generally agree that engineering controls the critical strategic decisions, though they differ over whether things should be this way. “We make the marketing messages fit the products rather than the products fit the marketing messages,” lamented one Industry Marketing person. Another in Industry Marketing said, “The engineers think marketing is what you do when your products aren’t selling.” One Base Product Marketing manager joked, “Marketing Research—that’s when marketing goes down to engineering to see what they’re working on.”
Many marketing people say that the attitude that engineering doesn’t have to listen to marketing is propagated by Zytek’s senior managers. In one meeting, a Base Product Marketing manager said,

We don’t succeed because engineering management isn’t interesting in marketing input. Their managers tell them, ‘Don’t listen to marketing—they don’t have the expertise anyway.’ . . . That attitude comes from the top.

Another person added, “Their attitude is, engineering does its thing and then marketing helps get it out the door.”

Others in marketing told me that it was not appropriate for marketing to tell engineering what to do. Rather, they believed the ideas should be technology-driven, but with feedback from marketing, customers, and the field to determine both the usefulness of various product concepts and the relative size of the market. The chair of a marketing advisory committee that coordinated feedback from marketing groups to engineering reacted to my question of how marketing provided input to engineering in the following way:

Have you been in any forums where there WAS input to engineering? . . . At Zytek we look at it from the technology out. If we could build this, what could you do with it? It means marketing input is used to refine the concepts. . . . Our crystal ball isn’t very good—all we see is the past extended. . . . It has to be iterative—here’s what we can do, could you use it?

This section has described and illustrated some of the mechanisms by which marketing was systematically shut out of direct control over decisions about products to develop. If engineering does maintain control over the new product decisions, what role (if any) does marketing have? I now present some of the means by which marketing groups exert their influence.

**MECHANISMS BY WHICH MARKETING INFLUENCES PRODUCT DEVELOPMENT**

Though there are formal systems by which marketing provides information to engineering (discussed earlier), when talking with marketing people about how they influence engineering, the most frequent response I heard was “the informal networks.” In this section I consider these informal networks, discuss how marketing groups form strategic coalitions to change development plans, and show how they take on a role of “completing the products” for their respective segments.

**Informal Networks**

People in marketing continually emphasized the importance of having contacts in engineering. According to one product marketing manager,

What works is knowing the right people. . . . Things often happen so quickly and outside of the formal processes that it’s critical to have contacts and keep tabs on the pulse of engineering.

Because of this emphasis on informal networks, physical and organizational proximity to engineering is important. The product managers are generally perceived as the most influential group for channeling marketing concerns to specific project teams, since they usually sit next to the engineers, meet with them on a daily basis, and report to an engineering manager. The Base Product Marketing groups tend to be the next most influential group, with Product Marketing and Industry Marketing groups generally having less contact and influence within engineering.

From engineering’s perspective, the amount of influence marketing has tends to be related to what they call “credibility.” Engineers frequently say that they don’t mind talking to marketing people “if they’re competent and know what they’re talking about.” One person in product marketing, who many people in engineering spoke highly of, spoke of credibility:

Some marketing people have credibility in engineering. First, it tends to be people that understand the products and technology. . . . Sometimes engineers say to me, ‘Oh yeah, I use the editor you wrote.’ Doors swing open, it helps enormously. And second, it helps to be fortunate enough to do things that engineering recognizes as being useful. . . . My credibility comes from talking technical without looking like an idiot.

Some of the most effective exchanges seemed to occur between marketing and engineering managers in which each recognizes their role of asking questions and relating stories, but not trying to tell the other what to do. One Base Product Marketing manager with several dozen employees, who met on a weekly basis with his counterpart in engineering, used the term “broker” and “interpreter” in describing his role and then elaborated.

Feedback from Industry Marketing is pretty general. . . . Their focus is the next six month’s agenda—they don’t have technical backgrounds. . . . I try to understand what it is the Industry Marketing and Product Marketing Groups are trying to do and then provide that information to [the engineering group manager]. . . . He has to internalize it.

Another Base Product Marketing manager also claimed engineering had to “internalize the needs” and emphasized persistence in working with them. She provided a graphic description of using the informal networks to gradually build up the evidence “one straw at a time”:

You can tell engineers the requirements forever—but if they don’t have a FEEL for it, it doesn’t enter their plans. They’re not going to buy in to it if they don’t believe it. If you send them to [Zytek’s users’ group meeting], they can feel it. Or if they use the product themselves, they can sometimes see the holes. . . . The engineers have to internalize it. . . . It’s one straw at a time—you keep piling them up. Finally they see it—finally it breaks. Things really move quickly once it breaks.
In addition to direct contact between people, the electronic mail system and electronic bulletin boards are critical forums for passing information back and forth (see Workman 1992). It was not unusual to hear of people receiving 80 to 100 mail messages a day. Others comment on their distribution lists of hundreds or even thousands of people that they can forward any "interesting stories" to with just a few keystrokes. Because the marketing and engineering groups are often geographically dispersed, the electronic mail system is critical for communicating with one another.

Though the concept of a "boundary spanner" has frequently been applied to linking differentiated parts of the firm (e.g., Tushman and Katz 1980, Lysenski 1985), the role described here is more similar to Schon's (1963) "product champion" (see also Lawless and Price 1992). Each of the various marketing groups lobbies for the needs of their respective segments, and since there is a diverse spectrum of markets a given product may go into, personal contacts are often essential to being heard. Given constraints on the part of engineering to listen to all the marketing groups as well as differing priorities on the part of various marketing groups, marketing groups have differing degrees of success in establishing informal links with engineering. The picture that emerges is one of a dense network between hundreds of nodes, with some paths having strong ties and others very weak ones. For this reason, many Zytek employees claim that hierarchical or matrix reporting relationships do not capture the reality of the organization structure. Further research might examine the relative importance of informal ties and/or product championing as a function of technological uncertainty and environmental turbulence. Additional work is also needed in conceiving of boundary spanning and product championing as roles carried out by organizational groups rather than individuals (see Friedman and Podolny 1992 for one such study).

Forming Strategic Coalitions

A second source of marketing influence comes from developing coalitions and going through high-level managers to override a proposed project or to choose between competing projects. On several occasions I observed coalitions being built among various marketing groups in order to push through changes that engineering was resisting. One manager mentioned, "If you feel strongly enough about something, you can get a hearing in Zytek. A base product marketing manager elaborated,

"Influence management is a key task in product development. I can influence product decisions through whom I can get lined up behind the project. Zytek is very distributed and they expect you to fight for your ideas and build consensus among others and show them you are right.

"Building consensus" requires convincing "the right people" to support the change one is advocating. There seems to be general awareness in both engineering and marketing of who "the right people" are as well as the credibility and political standing of various managers who might be needed to "push through" a given strategic change. On many occasions, marketing managers pointed out that I probably was not seeing a lot of direct marketing input by attending the weekly design review meetings for specific projects in engineering. "Most of our influence is at higher levels," said one Base Product Marketing manager. A product marketing manager pointed out,

"We use informal processes to address these strategic issues. A lot of times we elevate the issues, the senior managers fight it out, then decisions go down to the design team. That's why you haven't seen a lot of direct input into engineering . . . there are subtle ways of influencing them, and the engineers think they made these decisions.

Another product marketing manager provided a specific example of overturning engineering objections by appealing to senior managers:

Engineering pays a lot of attention when there's noise at the VP level. Let's take an example—should we put UNIX on Capricorn. [One engineering VP]'s position was UNIX goes on Libra so he said no. . . . So we had to go through [a marketing VP] to [the senior VP of engineering]'s staff . . . . [Two of the Product marketing groups] were pushing for it. I presented to [the marketing VP]'s staff and then to [the senior VP of engineering]'s staff . . . . they finally agreed to do it . . . . But you can only do the major decisions through the VPs so often—it's very time-consuming. And it's hard to unite the product marketing groups like that.

As this manager points out, there is a cost to "building coalitions" and "elevating the issues," and others in marketing emphasize the importance of continual communication with their peers in engineering.

Strategic coalitions among the marketing groups are typically formed when there are issues that are common across the marketing groups in which engineering is proceeding in other directions. Sometimes these coalitions point out overlapping projects in different engineering groups and force strategic decisions by acting as a distribution of channel bottleneck. One committee that sought to facilitate this coordination of marketing input to engineering was the Marketing Advisory Board. This ad hoc group, composed of roughly 20 people from various marketing groups, met on a biweekly basis and had engineering group managers and project managers present their product development plans. Though this committee was sometimes able to make changes in product plans, it was not perceived by engineering to be very powerful, and sign-offs from this committee were not required to proceed through development phases.

Completing the Products

Finally, in other cases, marketing groups do not influence engineering at all. Rather, they either undertake
the development of software and hardware for certain applications themselves or turn to external partners for this development. As discussed earlier, Zytek engineering is organized around the components of a computer system and by the size of the system. They tend to be most concerned with ensuring that the parts of the system work together and less concerned with customizing these components and modular systems to the unique needs of each market segment. This customization and provision of applications software is one of the dominant tasks of people in the Product Marketing and Industry Marketing groups. One VP used the term “completing the product” for these activities: “It’s the 5% that’s uninteresting to engineering that can produce five times the level of sales you would otherwise have.”

Gaps in the product line are most frequently identified in the context of specific sales situations in which Zytek does not provide the full range of hardware and software needed by a customer. Though much of the customization to specific applications has historically been done by MIS departments in customer organizations, it often does not make economic sense for MIS groups to develop their own applications. For example, with a wide range of packaged software available, it is difficult to justify writing applications such as word processing, spreadsheet, desktop publishing, or data base software. When gaps turn up in the product line, the marketing groups then must determine how widespread the demand is for this capability within their segment, whether other marketing groups also have this need, and whether external firms are available with hardware, software, or services that can fill the gap. When external sources are available, the marketing groups must then evaluate the make (internally develop) versus buy (strategic partner) decision. According to one Base Product Marketing manager,

Product Marketing doesn’t provide much of the solution themselves—they primarily build alliances with external solution providers in the various sectors. Their job is to figure out who the key partners are in each segment, and then establish alliances with them.

The type of hardware and software provided by these strategic partners includes external peripherals, add-in boards that connect to the system bus, communications hardware and software, “personal productivity software” (e.g., spreadsheets, word processing, data bases, desktop publishing), departmental application software, and industry-specific software.

In addition to lining up and negotiating with the individual firms that provide these pieces, there is also a need to develop demonstrations and recommended configurations for various tasks. Many customers do not want to sort through the hundreds of possible configurations and thousands of software packages but would rather have someone provide a “total solution.” In some cases, marketing groups develop, communicate, and train the Zytek field organization on these “total solutions,” and Zytek’s Systems Integration group develops any needed software and installs the complete system. In other cases, this “final assembly” of systems for specific applications is provided not by Zytek but by external distributors such as OEMs, VARs and independent systems integrators.

Discussion

Though marketing may not have direct control over new product decisions at Zytek, they are not powerless and do exert influence over product development efforts. Two general themes tie together the means by which marketing influences product development decisions.

First, marketing’s role in Zytek is more one of refinement and feedback than of initiation of new product concepts. This is somewhat different from traditional discussions of new product development, which prescribes a more central and direct role for marketing. For example, a number of empirical studies of successful and unsuccessful products (e.g., Cooper 1992, Souder 1987, Zirger and Maidique 1990) have argued that product concepts originating in marketing are more successful than those originating with technical opportunities. However, a growing number of organizational researchers (Dougherty 1992b, Galbraith 1982, Morgan 1986, Van de Ven 1986) have argued that it may be more productive to view innovation in a holistic fashion. For example, Van de Ven (1986, p. 599) argues against a machine metaphor of innovation, in which activities are broken down into “an assembly line of stages” and argues instead for a hologram metaphor, in which the essential nature of the whole is incorporated in each of the participant’s perspectives. In the specific context of product development, this argues for looking at simultaneous shaping and interaction between functional groups in which there may be substantial overlap of responsibilities across groups.

Second, marketing groups in Zytek play an important role in forming coalitions and linking specific projects underway in engineering with high-level corporate strategy. Though the Systems Task Force directly controls R&D funding decisions, marketing personnel participate on a number of highly important committees that can raise strategic issues. On several occasions, marketing and sales groups played an instrumental role in overriding existing corporate standards and architectures by championing specific projects that did not fit with Zytek’s corporate strategy. Zytek’s marketing and sales groups also serve as a distribution channel, whose support engineering groups must have if they are to get out the door. Though these links between specific projects and corporate strategy have been explored by fieldworkers in strategy (Burgelman 1983) and management (Dougherty 1990, 1992a), there has been relatively little investigation in marketing of how new product development teams compete for corporate resources and marketing’s role in this process.

There are varying opinions at Zytek over whether en-
engineering's control over product development decisions makes sense. Whereas Zytek had historically sold to technical customers, as revenues increased, its sales force was increasingly selling to managers in departments outside of MIS and engineering. Common folklore at Zytek was that their past success was caused by selling to customers who were "like them" and thus their engineering orientation had been appropriate. However, many people (particularly those in marketing and field sales and support), argued that as an increasing proportion of sales came from commercial rather than technical customers, it was necessary to modify business practices. Yet there seemed to be little consensus among senior managers that Zytek needed to move away from its historical engineering orientation.7

DIRECTIONS FOR FUTURE RESEARCH

Most research in marketing on new product development has implicitly assumed an adaptation model, in which firms first attempt to understand their customers and then develop specifications of what the products are to do (often termed, "Find a need and fill it"). The model portrays firms as rationally studying and analyzing their environments and includes such steps as designing surveys, collecting data, segmenting markets, developing and testing product concepts, and forecasting demand. Yet, at Zytek, there were many impediments to marketing influence, and market research did not play a major role in influencing design decisions. It may be that in high-tech environments there are limits to models based on measurement and adaptation. Rather, models that recognize that many new ideas may be technology-driven and allow greater roles for experimentation and organizational learning may be needed (cf. Organization Science 1991, volumes 3 and 4). In the following section, I discuss several possible directions for future research.

An Ecological Perspective of Product Development Activities

Within the marketing strategy area, there has been increasing interest in the use of ecological models to examine competition between firms (e.g., Lambkin and Day 1989, Milne and Mason 1990). In these models, firms compete in a multidimensional space, looking for niches with sufficient resources to allow them to survive and grow. Though these models have been widely applied to competition between organizations, there has been relatively little application of these concepts to competition for resources within the firm. However, recent work in strategy (Burgelman 1991) and organizational anthropology (Baba 1993) has used an ecological perspective to examine product development activities in a semiconductor firm and an automotive firm. In this section I consider how an ecological perspective might account for my observations.

In the Zytek engineering-driven culture, the impetus for most new products comes from engineering rather than marketing. The Systems Task Force, which controls the allocation of R&D funds without marketing representation, is the most visible symbol of the dominance of engineering over product development decisions. Many of the more influential marketing people claimed it was not their role to tell engineering what to do—as the head of the Marketing Advisory Board commented, "We'd be in a world of hurt if engineering only listened to marketing." Given these institutional arrangements, ideas originate in engineering, yet must make it through the maze of committees and phase reviews to survive and get out the door. Additionally, there is the continual threat of project cancellation, and engineering groups must seek out allies who can either fund their projects or have the political power to ensure their survival.

From marketing's perspective, influence can be exerted over engineering by forming coalitions with other marketing groups to champion one approach over another, canceling unwanted projects, and, most significantly, going to external markets to "complete the product" for their respective market segments. Because marketing groups have this option of choosing between internal projects and external suppliers, there is indirect pressure on engineering groups to come up with projects the marketing groups will support. The fact that engineering VPs have profit and loss statements provides one of the mechanisms to seek marketability for their products. Further influence is exerted through the informal networks within Zytek and through the committee review structure.

The implication for the marketing literature is that an ecological perspective shifts the attention from issues of market research, data analysis, and model development to issues of organizational design, internal coalitions, and organizational learning. In dynamic markets, it may be impossible to predict what customers will want; thus the optimal strategy may be to pursue many alternatives, with the ability to quickly change the strategy as new information becomes available. In terms of markets and hierarchies (cf. Williamson 1985), the dominant mode of governance over product development efforts at Zytek seems to be internal markets rather than hierarchical control. Though such an organizational design may be appropriate for encouraging creativity and a range of options, it is not very efficient and may not be appropriate if the basis of competition shifts to efficiency rather than flexibility or responsiveness. There is also a tension between encouraging cooperation and open sharing of information between design teams to ensure interconnec-

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7 As footnote 5 noted, the financial performance of many of the large, vertically integrated computer firms has been poor in the past four years since this fieldwork was carried out. Zytek has undergone many changes, including a change at the CEO. However, it should be noted that two of the most successful firms in the computer industry over the past four years, Intel and Microsoft, are headed by technical rather than marketing personnel. In short, further research is needed to determine whether marketing's limited role in new product development is unique to Zytek or is widespread in high tech firms.
tivity and competition between these teams for resources to ensure their survival.

Organizational Learning

A second direction for future research is on the broad issue of how organizations learn about and respond to their environments, marketing's role in this learning process, and management actions that can facilitate learning. When environments are changing rapidly, it is imperative that firms be able to understand quickly the impact of changes and have alternative courses of action available. Numerous studies have been done within the management field on actions and contexts that facilitate organizational learning (e.g., Burgelman 1983, Mintzberg and McGhugh 1985, Cohen and Levinthal 1990). A general theme of these studies is that organizations need to somehow capture and utilize the "learning" that people do every day in the firm, but that it is often difficult to bring the needed information to the right places and draw the proper inferences.

What has been missing from the literature on organizational learning is a specific focus on the role of the marketing and sales groups. The unit of analysis in these studies has typically been either business units or the organization as a whole, with less attention paid to the responsibilities of various functional groups or their interactions. Since marketing and sales groups have traditionally been responsible for interacting with customers, tracking competitors' actions, and monitoring broader environmental factors, additional research is needed on how people in marketing and sales learn about the environment and then communicate this information within the firm. Recent research on developing a "market orientation" (e.g., Kohli and Jaworski 1990, Narver and Slater 1990) and the utilization of marketing research information (e.g., Moorman, Zaltman, and Deshpande 1992) are initial efforts in this direction of understanding how people in marketing learn about and respond to changes in their environments. However, there has been little effort to relate insights from this literature with the organizational learning literature.

Marketing as a Socially Constructed Entity

The social construction perspective (cf. Berger and Luckmann 1966) implies that the definition of what is considered to be marketing is constructed through social interaction among people in an organization. However, prior attempts to define marketing (e.g., Bagoozi 1975, Enis 1973; Hunt 1992; Kotler and Levy 1969) have focused not on organizational definitions of marketing (a functional group within the firm) but rather on more abstract activities. Since a social construction perspective implies that marketing is defined by people in each firm, the activities, roles, responsibilities, credibility, and power of marketing should be expected to vary across firms. Several implications follow.

First, the study of topics such as the marketing/R&D interface needs to be sensitive to the fact that practitioner and academic definitions may vary. For example, it has traditionally been assumed that product managers are a part of marketing, but this has not been empirically examined, and it was not the case within Zytek. The emerging "market orientation" literature (Kohli and Jaworski 1990, Narver and Slater 1990) avoids these problems by not specifically examining whether activities take place in marketing or other places in the firm. Rather, this literature looks at the overall responsiveness of the entire business unit to customers and market concerns. Though this perspective is helpful, it may be operationally troublesome since members of Zytek and the other firms I studied tend to use the label "marketing orientation" in opposition to "engineering" or "technical orientation." Though most people at Zytek would agree they are an engineering-driven firm, they might score high on the measures used to operationalize the market orientation construct since engineering VPs have profit and loss statements and people in engineering frequently interact directly with customers. Further research on cross functional communication should be sensitive to how tasks and processes are organized in the firm.

Second, a theoretical perspective that has received little attention in marketing is institutional theory (for a review, see Powell and DiMaggio 1991), which provides a means for examining how institutional arrangements become established and legitimated. It would be very naive to argue that marketing rather than engineering should be making new product decisions at Zytek, because such a prescription is not sensitive to the historical and situational factors that led to the current arrangements. Some of these factors that had become institutionalized and supported engineering's power include the socially constructed myths and ceremonies (Meyer and Rowan 1977) that accounted for Zytek's success, the pay scales and professional development programs, the organizational processes such as the committee reviews, and the financial and accounting systems. Though there have been several conceptual articles on corporate culture in marketing (e.g., Deshpande and Parasuraman 1984, Deshpande and Webster 1989), additional research is needed on how work processes become institutionalized and how these arrangements can be changed if environmental conditions change.

Marketing's Role in the Firm

Given the limited number of studies that have empirically examined marketing activities, additional studies are needed to develop a general theory of marketing's role in the firm. Initial steps toward such a theory have been made by Anderson (1982), who draws on Pfeffer and Salancik's (1978) resource dependency theory to argue that marketing represents the interests of its customer constituency. Walker and Ruekert (1987) have advocated a contingency view of marketing's role in implementing business strategy, linking marketing's role to the type of business strategy being pursued. For example, they argue that "prospector" business units will
have more participative decision making and less hierarchical control than "defender" business units. On the basis of my fieldwork at Zytek and interviews at other firms, I suggest the following three propositions regarding marketing's role in the firm.

First, people in marketing will tend to have less power when there is a high degree of environmental uncertainty. Other writers on high-tech marketing (e.g., Achrol 1991, Davidow 1986, McKenna 1986, Shanklin and Ryans 1987) have noted the overall level of uncertainty in the environment, though they have not directly examined whether this affects the relative power of marketing in the firm. Research in organization theory on subunit power has shown that one factor that affects the relative power of each group is the nature of the tasks they do and the relative importance of these activities to the firm (Enz 1988). Thus, for example, financial people would tend to have more power than marketing people in an investment banking firm, the accountants would have more power in an accounting firm, and scientists would have more power in biotechnical or pharmaceutical firms (see Dubinskas 1988). To the degree that understanding and coping with technological uncertainty is a central concern of high-tech firms, this proposition suggests that marketing will have relatively less power in high-tech environments than in more stable environments.

Second, marketing will tend to have less control over product decisions when products are highly modular and there is a need for parts of a system to interconnect. If we envision a continuum with custom-built products on one end and mass-produced products on the other, Zytek's modular systems fall somewhere in the middle. Some component parts have high production quantities, but there is a significant amount of customization and tailoring for each customer's application. Because of the modularity of these systems, Zytek's marketing and sales groups spend much of their time customizing the systems for individual market segments and working with third-party suppliers to address specific applications. Since the architectural road maps specified how the various components would interconnect, these decisions were primarily made by Zytek's STF and senior managers in engineering. This proposition also suggests that marketing would have less power in firms that make custom built products.

Third, the relative power of marketing, engineering, and manufacturing can be expected to change as a business unit moves through the product life cycle. In rapidly growing markets that have not yet established a "dominant design" (Dewar and Dutton 1986), the most appropriate organizational design may be one such as that observed at Zytek, emphasizing innovation and creativity in engineering and allowing many approaches to be considered. However, as market growth slows and standardized designs become established, the relative importance of R&D and innovativeness may decrease. In this case, the competitive advantage may shift from product innovation and creativity to efficiency, cost control, and process innovations (cf. Abernathy and Utterback 1978). Marketing's role in the firm would predictably shift as a firm moves through these phases.

These three propositions are illustrative rather than exhaustive. Additional work is needed to elaborate further the range of roles that marketing groups play in the firm as well as to develop normative statements about which roles lead to higher performance in various situations.

MANAGERIAL IMPLICATIONS

First, the research reported in this article suggests that it may not always be appropriate for marketing to be the dominant coalition in the firm. In fact, my 37 interviews at other firms, before beginning the fieldwork at Zytek, suggest that it may be the exception in high-tech firms for marketing to have direct control over new product development decisions. However, though marketing may not be the most powerful group in many high-tech firms, to be effective, marketing must learn to work within the imposed constraints.

One implication for marketing managers in high-tech firms is to develop an understanding of the corporate culture and be sensitive to marketing's role within this particular setting. Some of the most effective marketing people in Zytek were those who had substantial work experience in engineering and understood enough about how engineering worked to know when and how to intervene to influence events. Though these people's effectiveness was not doubt facilitated by having technical experience and credibility with engineering, I believe the most important aspect of their influence was having an understanding of how marketing could contribute to a development process largely controlled by engineering. Other people, often those coming from firms where marketing was more central, sought to change the institutional arrangements and give marketing a more central role. However, changing organizational culture is a difficult task, and they appeared to be unsuccessful at their efforts. In short, in many high-tech firms, marketing's role may be more subtle and indirect than is traditionally prescribed in marketing texts.

Second, in rapidly changing markets, it may not be possible to use traditional market research methods to determine which products to develop. In these cases, the key role of managers may be to develop an environment that allows many options to be pursued, facilitates organizational learning, and helps the organization to rapidly respond to trends once they become apparent. It is noteworthy that the dominant images in the press of rapidly growing high-tech firms are ones of youthfulness, lack of hierarchy, informal communications, and irreverence toward traditional business models. It is precisely

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8 In accord with Moore and Tushman (1982), I consider the life cycle of the product concept, rather than the life cycle of individual product offerings.
the lack of these characteristics in established firms that may impede their ability to create new markets.

Third, though a flexible, "organic" organizational structure may be most appropriate in the development and growth stages, I argue for a contingency view of the relationship between the environment and organizational structure. This implies that as the environment changes, the most appropriate way to structure the firm also changes. One of the key roles of senior managers is to help facilitate these transitions over the life cycle of the business unit, realizing that strategies that were effective at one stage may not be appropriate later (see Moore and Tushman 1982).

SUMMARY

Though marketing researchers have recognized that there are limitations to the application of traditional new product development procedures in high-tech settings, there has been little empirical examination of how firms in these settings actually make their decisions. This article describes a number of impediments at one high-tech firm that prevented marketing groups from directly influencing new product development decisions. These constraints were reflective of an engineering-driven culture that had been shaped by Zytek's senior managers and embedded the myths and legends associated with Zytek's historical success. However, marketing groups did exert influence over product decisions, albeit in indirect and nontraditional ways. Rather than provide a definitive answer to what marketing's role may be in high-tech firms, this research seeks to spur additional research examining marketing's role in a range of organizational settings.

APPENDIX

OVERVIEW OF FIELDWORK ACTIVITIES

Though many activities and types of information contributed to my understanding of the product development process, I will limit my discussion here to four of the most important data sources (for more detail, see Workman 1991). First, I attended a wide range of meetings, including weekly design review meetings, daily "war-room meetings" of engineering for an approaching introduction, marketing and engineering staff meetings, announcement planning meetings, and numerous committee meetings that reviewed product and marketing plans. In all, I attended 68 different meetings averaging almost three hours in length. For meetings I wanted to regularly attend, I asked to be put on the electronic mail distribution lists for the meeting and thus received notice of all meeting dates and the written minutes from the meetings. I also was able to get invited to a number of special events such as three product introductions, a two-day training event for an approaching introduction, four different all-day meetings with customers, and an evening focus group session.

Second, interviews and informal discussions provided the opportunity to ask questions and go beyond the activities I observed. I had 144 formal interviews, averaging 65 minutes in length, with Zytek managers and employees from a wide range of organizational groups. The general topic for the scheduled interviews was how decisions were made on the products to develop and the sources of information on which to base these decisions. In addition to the formally scheduled interviews, I also had "informal discussions" with well over 100 other Zytek employees. These discussions typically resulted from my walking past someone's office, running into people in public places such as the cafeteria or a hallway, or talking before, after, or during breaks in meetings. Though many of these discussions lasted less than ten minutes, some lasted several hours. They were most useful for providing the context for my observations and clarifying technical, historical, political, organizational, or development process issues.

A third general data source was the internal documents, such as newsletters, product manuals, sales literature, planning documents, market research reports, financial reports, and copies of presentations made at meetings. Zytek has several corporate libraries and I sometimes would spend hours looking through internal documents as well as external market research reports from computer industry market research firms (e.g., Gartner Group, IDC, Dataquest, Forrester Research). There were also hundreds of videotapes on a broad range of topics including major "introduction events," executives making speeches to employee groups, and engineering managers reviewing the history of development projects.

A fourth data source that was critically important was information accessed through Zytek's electronic mail system, mostly from my personal computer at home at night and on weekends (see Workman 1992). The electronic mail system is an essential part of the communication system at Zytek—many of my informants claimed they received over 100 mail messages a day. I learned of the time and place for meetings and often requested and set up interviews through electronic mail. I also received a large number of mail messages forwarded to me by people I met.

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*Though I did not explicitly ask each person how many levels of managers reported to them, my best estimates are that seven of my interviews were with VPs, 51 were with "middle managers" (those below VP but with other managers reporting to them), 32 were with first-level managers, and 54 were with people who supervised no one else.*
MARKETING'S LIMITED ROLE IN NEW PRODUCT DEVELOPMENT


