Engineering's Interactions with Marketing Groups in an Engineering-Driven Organization

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Abstract—**It is widely acknowledged that engineering personnel should work with marketing and sales personnel to increase the chances of market acceptance of new product ideas. While many studies have shown that products are more likely to succeed when this integration occurs, there has been little observation of the actual interactions and the underlying sources of communication difficulties. This paper, based on nine months of participant observation in a single firm in the computer industry, presents engineering objections to information from marketing groups and then discusses the complaints marketing people have about engineering. The author argues that for complex systems products in technology-driven environments, there may not be a dyadic interaction between marketing and engineering but rather many conflicting requirements coming from marketing groups representing different customer groups. In such situations, decisions concerning the overall system architecture may be among the most critical strategic decisions.**

Index Terms— **Marketing-R&D interaction, cross functional integration, participant observation, new product development, organizational processes, culture.**

I. Introduction

SUCCESSFUL new product development requires firms to link their technical capabilities with products or services which customers want. While many researchers have called for better cross functional integration [11], field researchers have found that marketing and R&D personnel in high-tech firms frequently have difficulties in communicating with one another [4], [7], [35]. There has been relatively little inductive research into the underlying reasons why marketing and R&D groups have a hard time communicating and working with each other. The research reported in this paper was motivated by the desire to better understand the communication issues as seen by people in marketing and R&D groups.

One approach to innovation management, popular in the technology management literature, has used surveys to understand development practices and to identify those practices which lead to more successful development. One of the earlier studies by Dean [6] found that slightly more R&D projects originated in "research and engineering" rather than "sales, marketing, and planning" (33 versus 30), however he did not relate the source of the idea to success. Later work by Myers and Marquis [23] and Utterback [32] presented evidence that most successful new products came from market needs rather than technical opportunities. More recent research has argued that the source of the innovation is less important than the interactions between the groups in product development [2], [3]. Organizational researchers who have studied innovation by using field interviews [15], [24] have also argued for a greater focus on organizational forms to promote creativity and continuous innovation and have been less concerned with where ideas originate.

Another stream of research on organizations and innovation has focused on cross functional communication and "integration" between marketing, R&D, and manufacturing groups. While many studies have focused on theoretical constructs such as integration [21], [27], [36] and conflict between marketing and R&D [12], [28], there has been less study of the actual organizational processes involved in product development. Rather most of the papers on integration have been either conceptual reviews or have used surveys from single informants in the organization and they have not probed social constructions [1] and social processes within firms.

There has been a greater use of field interviews and observation to study organizational processes for product development in the management and strategy fields. Dougherty [7], drawing on field interviews with 80 people on 18 new product teams in five firms, argues that people in various functional groups (such as engineering, production, planning, and the field organization) have different information about customer needs, technical possibilities, and financial consequences. However, these groups tend to focus just on their part of the new product development process, dismiss the contributions of the other groups, and define the entire process from their own perspective. She uses the term "thought worlds" to characterize these varying sense-making contexts and claims that the problem is not really one of conflict:

> "... the collaboration problem runs deeper than conflicts over personality types or goals. Indeed, to attempt to resolve the problem through negotiation over goals may only begin to touch on the divergent understandings which lay at the heart of the problem. Nor is the problem like the proverbial blind men touching a different part of an elephant. It is more like the tales of eye witnesses at an accident, or of individuals in a troubled relationship—each tells a 'complete' story, but tells a different one." [7].

A similar portray of different cultures emerges in one of the few ethnographic accounts of marketing and R&D perspectives in high-tech firms—Dubinskas' [8] account of scientists and managers in biotech firms. Dubinskas uses

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TABLE I
ALLOCATION OF OBSERVATION AND INTERVIEW TIME BY ORGANIZATIONAL GROUP (IN HOURS)

	Scheduled Interviews	Zytek Meetings	Presentations	Informal Discussion	Total	% of Time
Engineering	28 h	98 h	15 h	26 h	167 h	29%
Base Product Marketing	37 h	16 h	6 h	56 h	115 h	20%
Product Marketing	35 h	24 h	1 h	1 h	61 h	11%
Industry Marketing & Sales HQ Groups	25 h	28 h	0 h	10 h	62 h	11%
Field Sales Groups	22 h	27 h	42 h	46 h	137 h	24%
Corporate Groups	12 h	0 h	20 h	2 h	31 h	5%
Total	159 h	193 h	84 h	141 h	577 h	
% of time	28 %	33%	15%	24%		100%

fieldwork conducted over several years to explore the cultural gap between scientists and managers. In his study, biologists typically have technical backgrounds and work experience in university or private labs while "managers," who represent the business or marketing perspective, typically have MBA's and a background with other entrepreneurial start-ups or with venture capital firms. He explores how the professional training and career socialization of the molecular biologists and the business managers leads to very different "culture-worlds" and different ways of thinking about planning time and development time. Dubinskas' account has a similar theme to Dougherty's—that the technical and business people have different perspectives and the problem is less one of direct conflict over goals but rather that the groups talk past one another.

Recent work in technology management has also focused on the organizational system within which product development takes place. For example, Schmidt and Freeland [29] note that much of the work on project selection has been at the level of individual projects. They argue for studying the overall organizational context and the actual processes by which projects are selected and note that "the systems approach represents a fundamental shift in emphasis from 'decision events' toward 'decision processes.'" McGuinness [19] has also emphasized that product development should be viewed as "a system of social activities" and that "managers need to be less concerned with such things as formal checklists for idea screening than with the overall health and effectiveness of the social processes that make up the search system."

In summary, while there has been growing interest in decision processes and activities within engineering management, there have been few studies which have inductively explored in-depth the types of interactions that occur between R&D and marketing personnel. Many studies of development practices have used either mail surveys [9], [18] or interviews with managers in a range of firms [4], [5], [10], [17], [19], [22]. The research reported in this paper sought to understand the interactions between functional groups during product development. The paper begins with an overview of the research method and the processes by which decisions are reached. Next, the descriptive body of the paper presents engineering complaints about information they receive from marketing groups, followed by marketing's complaints concerning engineering. The paper concludes with a discussion assessing the implications of these observations on research on how marketing and R&D groups interact.

II. METHOD

Given my interest in the organizational processes and the cultural perspectives of engineers and marketing personnel, I chose to spend nine months on a full time basis observing the new product development activities within one firm in the computer systems industry. "Zytek" (a pseudonym) is an established supplier of computer systems, offering a full line of computing equipment, systems software, and a range of services. Zytek is reported to be an "engineering-driven" company and most marketing, field, and engineering people within Zytek generally agree that engineering has the most power in the firm, particularly in regard to new product decisions. Most of the VP's and senior managers have technical backgrounds and many have come up through the engineering ranks. Zytek had historically sold to technical customers but as Zytek grew in size, they increasingly sold their computers to managers in departments outside of MIS and engineering.

The fieldwork took place in 1988 and 1989 and I was provided with a "contractor badge" allowing access to Zytek facilities, an electronic mail account I could access from my PC at home, and was assigned to the "Low End Systems" group. I initially attended the weekly design review meetings for two different projects at differing stages of development and in engineering groups with differing track records of success (see "Hardware groups 1 and 2" in Fig. 1). Over the next few weeks, I attended meetings for these projects, set up interviews with the managers on my sponsor's staff, and read various documents and material that explained the product development process. I was given permission to set up meetings and interviews and I generally did this on my own, by phone, in person, and by electronic mail. I was able to get my name added to the e-mail distribution lists for various committees and was able to learn of upcoming meetings by checking my mail from home each evening. Over time I developed a fieldwork strategy of interviewing people and observing activities in a range of engineering, marketing, and sales groups, but always trying to relate the activities of these groups back to the specific projects I was tracking in engineering.

During the fieldwork I kept records of how I allocated my time. Of the 577 documented hours spent observing or interacting with people, I spent 33% of my time attending meetings, 28% in scheduled interviews, 24% in (unscheduled) informal discussions, and 15% attending formal presentations (see Table I). I attended 68 meetings including weekly design

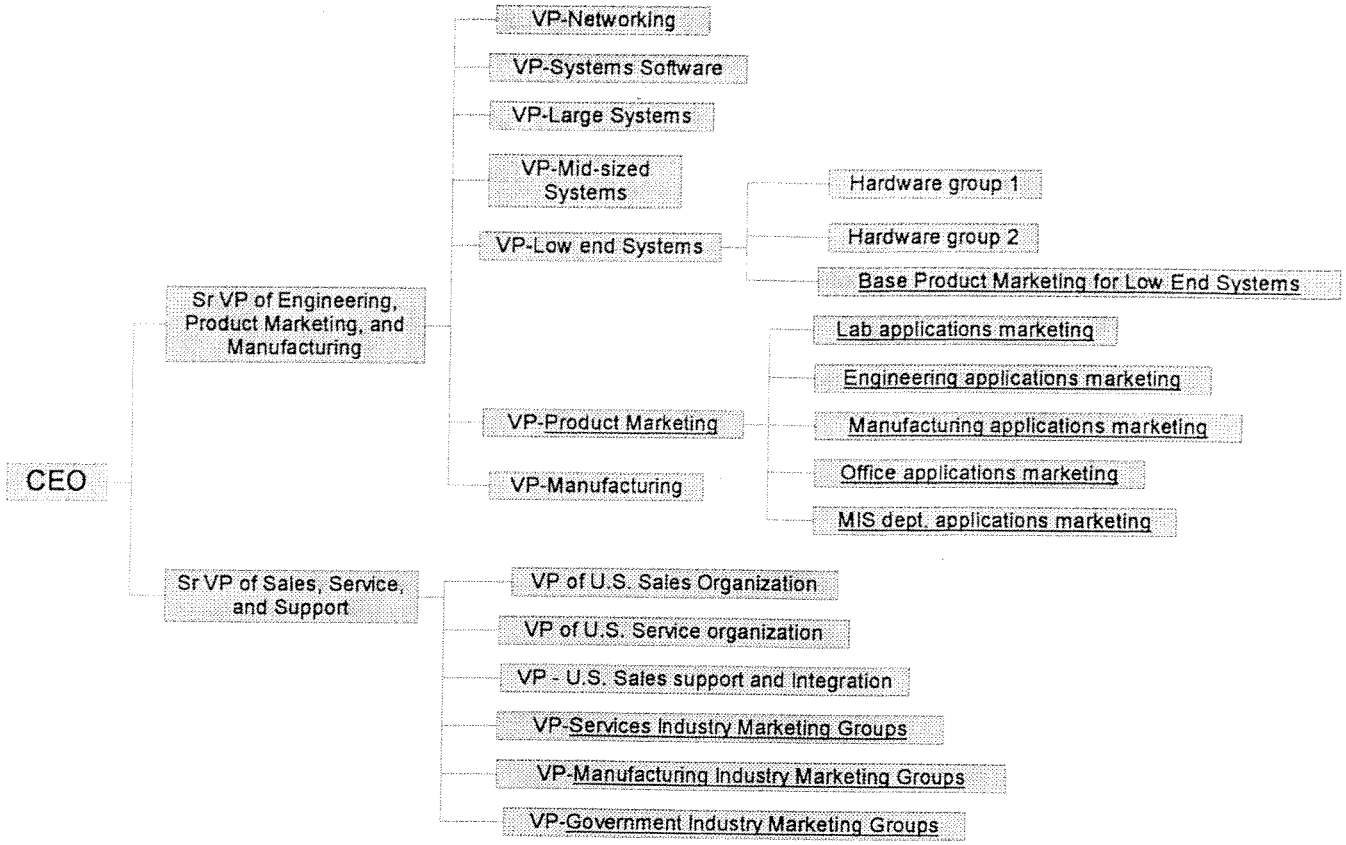

Fig. 1. Overview of Zytek Organization. Note that marketing groups are underlined. Not all groups in the organization are shown in this organizational chart.

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 review product and marketing plans. I had 144 formally scheduled interviews, during which I typically took handwritten notes. I usually did not take notes in informal discussions, since these occurred in places like the cafeteria, by dropping in on people's cubicles, or by informally talking with people after meetings ended. Presentations were different from group meetings in that they were typically one person addressing a large group and thus were less interactive than the meetings.

During the fieldwork, I kept detailed field notes, producing approximately 1600 pages of handwritten notes and 700 pages of single-spaced typed notes. I also acquired a large amount of material from Zytek ranging from product brochures and handouts from meetings I attended, to thousands of electronic mail messages and printouts from electronic bulletin boards.

After the completion of the fieldwork, all of the handwritten and typed field notes were systematically analyzed and categorized. The primary subheadings in the engineering and marketing sections of this paper reflect the categories of comments that were heard most frequently during the field work concerning problems of marketing and R&D in working with each other. In ethnographic terms, these are *emic* categories—those used by people in the field. In order to provide structure and analytic critique of these comments (my own *etic* perspective), I use two strategies. First, under each of the subheadings in the next two sections, I have inserted a commentary section which provides my own views and interpretations of the "native" comments. Secondly, in the discussion section, I suggest limitations to the traditional focus on integration and harmony in the relationship between marketing and R&D.

III. Overview of Organizational Structure and Product Development Process

New product development at Zytek is a highly iterative process, with customers on the one hand, technical capabilities on the other, and numerous mechanisms used to link the two. The merger of "possibilities" with "applications" is frequently achieved by engineering managers or product managers directly interacting with customers. Information from customer surveys is viewed as having limited usefulness, as is information received from marketing groups. The engineers claim that marketing people lack the expertise and the appropriate time horizon to make the "translations" from what customers are doing in their business, to what that means in terms of the technology. Their response is to seek out forums that allow interactive discussions directly with customers, allowing them to test out many different ideas.

Fig. 1 provides an overview of the Zytek organization. The VPs in engineering have a profit and loss statement and typically have a number of engineering group managers reporting to them along with a base product marketing (BPM) manager. People in BPM groups focus on the products produced within that engineering group and take responsibility for

producing the product-specific marketing literature and sales plans. Also within the engineering side of the company are the product marketing groups (PMG's) which focus on the applications the products are used for. In contrast to the BPM groups, the product marketing groups consider all of the hardware, software, services and support requirements for various types of applications such as engineering applications (e.g., CAD/CAM, fault analysis), office applications (e.g., database, word processing, desktop publishing), or manufacturing (e.g., factory information systems, robotics).

A third major set of marketing groups are the Industry marketing groups who report up through the field sales, service, and support side of the organization. While the number of industry marketing groups vary over time, they are broadly organized by the sectors of the economy (manufacturing, service, government). These groups are further broken down to specific sectors such as financial services, aerospace, telecommunications, state and local government, and automotive. The industry marketing groups are primarily responsible for working with the sales force in developing marketing and sales strategies for their respective industry sectors. They also may play a key role in identifying third party hardware and/or software needed for applications in the industry sector which are not provided by Zytek engineering groups.

Since each engineering group manager has a Profit and Loss statement, they are expected to understand their business. Most of the engineering group managers I interacted with did seem to have a substantial amount of interaction with customers, either through trips to the field or by meeting with or making presentations to customers who visited Zytek facilities. Other Zytek systems and processes tend to funnel customer input directly into engineering, frequently bypassing the marketing groups altogether. On several occasions I heard people who had transferred from marketing to product management positions in engineering say that they had more contact with customers in engineering than in marketing. Others noted that since engineering has most of the political power and makes most of the decisions around new products, the best way to influence engineering is to either be included in their organization or to use a label other than marketing or sales.

While there is value in having engineering groups directly interact with customers and make key decisions on product attributes, there are limits to this approach. Marketing groups claim that engineers tend to focus just on their piece of the system. Another limit of direct information is the lack of context and prioritization. Direct interaction does not address such questions as whether a given customer's needs are broad-based and whether the product should be optimized for a few market segments or should be more modular to address a broad range of market segments. With this background on the organizational structure, I now turn to complaints people in engineering have with the information they receive from marketing.

IV. Engineering Complaints About Information Received From Marketing

While textbooks call for firms to carefully study customers, to segment customers into relatively homogenous groups and to test new product concepts, the reality I found was that things were not so clear cut. Engineering tended to dominate decisions about new product specifications as well as the selection of new products, marketing had to exert influence in indirect ways, and the overall corporate culture was technology-focused with marketers being looked down upon. Interviews I had done with more than 30 people in a dozen other high-tech firms before beginning the fieldwork reported here suggest that Zytek is not atypical of high-tech firms. In this section, I present the most commonly heard complaints engineers have concerning the information they receive from marketing.

A. Customers Don't Know What They Want

The most frequent reason engineers give for not making more use of market research was some variation on the theme, "Customers don't know what they want." Frequently, people in engineering say that customers want "the past extended into the future." One manager phrased it, "Customers just extrapolate from current concepts and ideas they are familiar with." An engineer gave an example:

> "Customers typically can't visualize completely different approaches. A person using a teletype can't visualize the usefulness of a full screen monitor. They just want a faster, cheaper, quieter teletype. If you were to show them the interactive monitor, they wouldn't know what to do with it and might not like it."

On at least 15 occasions, people noted 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 large meeting of managers and it had diffused throughout the organization. In this speech he said:

> "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.' "

1) Commentary: The comment that "customers don't know what they want" was heard repeatedly, both in my fieldwork in Zytek and in other firms. To the extent that the technology is changing rapidly and customers value innovative new products over compatibility with existing products or processes, there may be some truth to the statement that they cannot articulate what they want in terms of the specifications that engineers desire. However, these comments are somewhat self-serving for engineers to make, since they provide justification for not listening to the marketing groups and gives them license to be "technology driven." When these comments come from the CEO (as in the quote above) and are continually reinforced by an engineering-driven organizational culture, they become self-reinforcing. The risk is that once an industry begins to mature and competitive advantage shifts from innovativeness to cost-effectiveness and lower cost distribution, firms such as

Zytek may be unable to change their organizational cultures and have engineers start listening to what customers want.

Some of the ways to address this limitation are to identify "lead users" [33] who are more familiar with the new technology, to use "information acceleration" to educate users up to a knowledge state they will be in when the product reaches the market [34], and to encourage interactive forums between people who understand potential customer applications and people who understand the technical capabilities. These interactive forums can consist of either contact by engineering personnel directly with customers (e.g., customer visits, focus groups, interactions at trade shows) or with intermediaries (e.g., consultants, distributors, marketing and sales personnel) who are familiar with customer business practices and potential applications.

B. Marketing Doesn't Have the Needed Expertise

Another factor making communication between engineering and marketing difficult is their varying levels of expertise and understanding of what is technically feasible. The engineers often 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." They say the marketing input is reflective of what customers are asking for today and based on what the competition is doing.

An example of marketing's perceived limitations is the ability to identify the design assumptions inherent in competitor's products. The image most engineers had of marketing was of "technical incompetents" that generated a lot of "fluff, hype," and paper. Engineers claim that a high level of expertise is needed to unravel the design assumptions made by competitors. For example, at one day long design session with 20 people in attendance (only one 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 design assumptions made by competitors. The analysis of competitor's approaches helps to generate new ideas, and with expertise from all the relevant groups present, it is possible to quickly make tradeoffs, discuss interdependencies, and rule out alternatives that are not technically feasible within the time horizon for the product. This generally is not possible with marketing people, since they do not have the same level of technical expertise as the engineers. Rather marketing people focus more on benchmarking performance levels (e.g., MIPS, vectors per second), feature and benefit claims, and pricing information.

1) Commentary: With the technology changing at a rapid rate, many engineers claimed even they found it difficult to stay abreast of what was technically feasible and the technical approaches adopted by the competition. Since it typically takes 18–36 months before leading edge technology shows up in products and since marketing groups spend most of their time working with products that either have been or are about to be introduced, it is inevitable that they will know less about the leading edge technology than engineering.

The varying levels of expertise between engineering and marketing is compounded by a self-selection bias. That is, the most technical people tend to take jobs in engineering rather than marketing—particularly in an engineering-driven firm where the power and rewards are perceived to be in engineering, not marketing. Much of what went under the "marketing" label in Zytek was the external, communication activities involved in introducing, positioning, and getting third party software for the waves of products continuously rolling out of engineering. In sum, there are structural reasons why marketing will know less about the state-of-the-art technology than engineering. However, this does not mean that they cannot be effective at providing information to engineering. It only implies that engineers should not expect detailed implementation and design trade-offs to be made by marketers. Rather, engineers should look to marketing for what they can provide—information on underlying customer needs, competitor actions, and general trends in the market.

C. Marketing's Time Horizon is Too Short

Another of the engineers' most frequent complaints about input from marketing is that they tend to provide information on what customers are saying today or what competitors are offering today. Since these products reflect design decisions made years earlier, the feedback is of limited usefulness. For example, one product manager said:

> "The marketing groups tend to have pretty short time horizons—3 to 6 months out. Thus, they don't tend to provide much input into the REAL design decisions which are made 12 to 24 months before introduction ... it's really hard to get them to come to the design meetings and have their say."

An engineering manager offered the following assessment:

> "The problem with Product Marketing and Industry Marketing is they only tell us what customers are telling us now—they're not looking out two years at what customers will want then ... they are reactive ... they have blinders on, see only their set of customers, and don't have the big systems perspective."

One design engineer spoke of the limited usefulness of the information received from customers:

> "The problem with asking customers what they want, is that the design cycles are significantly longer than the foresight of customers. I'm a customer for logic analyzers, and if you ask what I need in a logic analyzer two years from now—I don't know! I couldn't help other engineers design that product."

One product manager complained, "Marketing tends to think only in terms of concepts customers are already used to; they can't provide good advice about break-through types of products." Similarly, a Systems Task Force member mentioned "If you build what they want, you're always several years behind the times. You want to build what they're GOING to want." Finally, another Systems Task Force member commented on how he tries to get around the time horizon problem:

"Marketing doesn't have good info on competitors. I need to know where they'll be in three years. What are their strategic relationships? What are their technology directions? ... Marketing works too much on positioning the products ... they typically give me feedback on what the market needs, in terms of what today's customers are saying. I need it 18 to 30 months out."

1) Commentary: This "time horizon" complaint is related to the first one—"customers don't know what they want." The key difference is that the first is a claim that customers cannot express what they want while this one is a claim that marketing cannot translate what customers express in terms of today's competitive conditions into the level of information needed for the next generation of products. One of the factors that may prevent this translation is the second point above—the limited technical expertise of marketing. Engineers complain that people in marketing do not understand the technical capabilities and trends well enough to look beyond today's product implementations.

Possible ways to remedy this situation are to hire more technical people in marketing, transfer people between engineering and marketing, increase the amount of interaction between marketing and engineering, establish positions such as product or technology managers who are an integral part of the engineering organization, or encourage direct interaction between engineering managers and key customer accounts. Zytek tended to favor the latter two approaches which have the effect of reinforcing engineering's control over product decisions versus increasing the power and capabilities of the marketing groups. In sum, marketing's time horizon might have been too short because they had not been provided with the capabilities they needed to effectively translate expressed customer needs into next generation technology.

D. We Don't Have Time to Wait

One dominant aspect of life within the hardware engineering groups is the time pressures induced by the continual march of semiconductor technology down the "Price Performance" trend lines. The incessant pressure to "move on" leads to short time spans within which product decisions can be made and typically does not allow time for customized market research projects. Engineers often cite these time pressures as reasons that they do not have time to wait for input from the marketing groups. As an illustration of this pressure, in a videotaped presentation reviewing the development history of one project, the engineering manager for the project commented:

"The first priority on this project was time to market. The second priority was time to market. The third priority was time to market ... Time to market really drove the project ... you have to institutionalize time to market ... Get a stable spec quickly, and don't change it ... Throw a stake in the ground and leave it there ... if the juggernaut is rolling, people will have less time to try to kill it ... We managed to the schedule, not to budget."

This project turned out to be one of the most successful roducts in Zytek's history—thus reinforcing the myth that ngineers shouldn't wait around for marketing to decide on what to do. As a product approaches introduction, marketing and sales groups receive training on the products and strategy, invite customers to announcement events, reserve hotel rooms and announcement facilities, brief the consultants, press, and financial analysts, buy advertising space, and make other commitments that are hard to change without public embarrassment. These commitments make it difficult to slip the schedule, thus increasing the time pressure on engineering.

This dynamic environment leads to many complications. Customers complain of confusion and product obsolescence; account reps complain that it is impossible to keep up with so many new products; marketing people spend all their time with the logistics of "getting products out the door" and "training the field"; engineers "get burned out." One marketing manager commented on the difficulty customers face: "The products are coming every six months, the customer decision cycles are 10 months—it's a fundamental problem we've got." Another manager summarized, "It's tough when your technology cycle is shorter than your customer's decision making cycle."

1) Commentary: The statements above have to be taken with the caveat that there are hundreds of projects under development at any given time and specific projects often do not map into a single marketing group, but rather span many industries and applications. Often, the engineers were complaining about a specific marketing group trying to hold up development in order to make changes for its own market segment. In other cases, one specific marketing group might identify a limitation of a proposed design, but it might take weeks or months of lobbying to build enough consensus among the other marketing groups in order to get a change made. In the meantime, the engineers might have already made decisions and didn't want to revisit them later.

One of the central issues raised here is that the types of on-going market research done by the marketing groups may not directly relate to specific engineering groups or be in a form that is useful to the development team. For example, Zytek had a market research group of approximately 30 people which performed an annual mail survey of existing customers with several thousand replies being received. They additionally did dozens of custom projects on market trends and industry sector needs as well as research projects on specific products. However, given the hundreds of project development efforts underway in engineering and only a handful of *product-specific* market research projects it was rare for the internally collected market research information to correspond to a specific project. Additionally, formal market research was only a small part of the information collected on customer needs and market trends. Additional sources were purchased market research studies from firms such as IDC, Gartner Group, and Dataquest, information received from the sales forces, as well as on-going interactions between key customer accounts and personnel throughout Zytek. As will be discussed later, marketing groups were most concerned with understanding trends affecting their respective market segments and given the variety of ways of segmenting the market, the concerns of the marketing groups did not directly translate into the information engineering needed to make design decisions. It was very time intensive for engineering to collect the "market needs" from all the

possible marketing groups affected by their project and then make the trade-offs of optimizing the design for a few of these groups versus designing a modular system architecture that could be adapted to a wider variety of segments through value-added activities of marketing groups and third party external suppliers. The result was engineers often said they didn't have time to wait and instead tried to turn out "base platforms" which incorporated the state-of-the-art technology.

V. Marketing's Complaints About Engineering

With this background on the complaints engineers have of the information they receive from marketing, I now turn to marketing's view of engineering. Since these comments are organized around the categories that emerged from the systematic analysis of the field notes, many of marketing's comments do not directly address the issues raised by the engineers. However, as Dougherty [7] has pointed out, people in marketing and engineering have differing "thought worlds," see different sets of issues, and talk past each other more than they directly conflict with each other. Thus the categories below are more a synthesis of marketing complaints and reactions to what their role in product development was rather than a point-for-point reaction to engineering's complaints.

A. Engineers Lack Perspective

The single greatest complaint marketing people have with engineers is that the engineers are too detail-oriented and lack perspective. Many marketing people complain that engineers are fascinated by the technology, yet have little appreciation for what customers do with the products. "They turn out products looking for markets" is a common complaint. Others complain that engineering can be very insular and not open to new approaches; said one base product marketing person, "It's the Not Invented Here Syndrome." One woman in product marketing who had recently transferred out of engineering commented, "Engineers put their priority list together based on what they think will be fun to do. Engineers have a strange sense of fun."

Perhaps out of frustration, there is no lack of creativity in coming up with names to call the engineers. A few terms overheard include "tech-weenies," "pinheads," "tech-heads," "tech-nerds," "propeller heads," "techno-dweebs," "technoids," and the most frequently used, "techies." Some of the words used to criticize engineers are "narrow, "parochial," "insular," "literal," "rational," "focused," "technology driven," "analytic," and "social incompetents." One sales manager claimed that within engineering, "They're rewarded for analytic abilities, so the most analytic people rise to the top" while in sales, "empathy" and understanding of what customer are trying to do is required, and the "analytic" engineering mind set is unable to communicate with "empathetic" sales and marketing mind set.

Marketers also complain that engineers focus on specific components, leave gaps in the product line, and do not deliver the "solutions" that customers want. For example, one product marketing manager claimed, "They see their products as products in and of themselves, rather than as components in a larger system being sold to solve some problem or change the way a customer does business." One strategic planner in a base product marketing group spoke of this emphasis on "products:"

> "We spend so much time on the products—and then leave it up to marketing and sales to go do it—engineering washes their hands of it. But you have to communicate it, train people on it, differentiate it, have a marketing campaign to roll it out, and worry about all the other stuff—availability, distribution, third party software ... engineering builds devices and relies on separate groups to do their part. ... It's difficult to get all the pieces in place."

1) Commentary: Many researchers studying marketing/R&D interaction across different firms [7], [12], [20], [30] have reported similar complaints by marketing people. Within Zytek, these complaints revolve around both engineering's focus on technical details as well as a perceived lack of social skills of engineers. The fact that the Zytek culture and organizational structure gives engineers more power than marketers no doubt makes people in marketing envious and frustrated. However, in spite of the criticism, most people in marketing have a high level of respect for the engineers and their abilities and generally acknowledge that engineering produces good products.

B. Engineers Don't Appreciate Prior Customer Investments

People in marketing also complain of engineers being arrogant and ignoring the investments customers have already made in software, training, and peripherals for other vendor's equipment. Several marketing people talked of engineers being "belligerent" with customers and getting into arguments over the "best" technical approach. One industry marketing specialist provided an example:

> "Customers criticize us for being arrogant. They can't throw out their [*Competitor T*] investments. We aren't good at being nondisruptive ... we just lost a proposal at [*Bank X*]. They had the feeling Zytek wanted to get in and throw out [*T*] ... [*Bank Y*] has [*over £2 billion*] invested in [*T*]'s equipment. [*T's system architecture*] can't be replaced. One of the Zytek people doing a demo said they should replace it. The guy from [*Bank Y*] was a little upset. It's so typical of the engineering mind set—that our products are superior ... They very well may be, but they don't understand that they have to deal with the here and now of what customers have."

Marketing people often pointed to the market success of products that may not have had the most features, but were rather compatible with prior purchases. In many meetings, marketing people argued for being more concerned with how new products fit with customer work practices and less concerned with using the latest technology.

1) Commentary: Rogers [25] lists compatibility as one of the key factors which can affect the adoption of new innovations and Jackson [14] has focused on switching costs as a major factor affecting computer purchases. Marketing's complaint was that engineers underestimated the inertia of "the installed base" and thought customers would switch to leading

edge technology quicker than they typically did. I found that these complaints particularly came from the industry marketing groups that dealt with more mature, "commercial computing" environments. They argued that Zytek had historically sold to technical customers (scientists and engineers) who valued state-of-the-art technology and wanted the "latest and greatest technology." However, as Zytek increasingly penetrated commercial markets, there were a different set of customer needs. For industry segments where customers had built business processes around computer systems from competitors, it was impossible to penetrate these accounts without providing for a migration path or somehow reducing the switching costs.

C. Engineers Don't Appreciate the Diverse Market Segments We Represent

People in marketing often said that engineers ask very detailed questions, don't appreciate the varying customer needs between different market segments, and expect a consensus response from the marketing groups. One product marketing manager said:

> "Engineers have a very simplistic view of the world—what do customers need? Well it's not that simple. The world isn't homogeneous. [a lot of times] they ask us for is a prioritized list of needs from marketing—they want everyone in marketing to agree. The unanimous opinion of marketing. They don't realize the diverse sets of markets we represent."

Marketing input may be coming from not only the Base Product marketing group associated with an engineering group, but also from the five product marketing groups and the dozens of industry marketing groups (see Fig. 1). This organizational structure had evolved over time to serve the diverse information needs and differing customer needs of various groups both in the distribution channel (e.g., VAR's, OEM's, retail stores, systems integrators) and in customer accounts (e.g., MIS groups, departmental managers, senior managers, end users). While the product managers in engineering attempted to synthesize and make tradeoffs between the diverse marketing inputs, such a task was often impossible given the heterogeneity of the market segments represented.

One committee that sought to facilitate the 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. While 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. However, an important role was to provide a single forum where engineering groups could come and hear feedback from the various market segments that a product might be trying to reach.

1) Commentary: It seems that much of the tension between engineering and marketing arises over the level and type of information each wants from the other. Engineers must make very detailed design and implementation decisions and they go to marketing asking for help with these decisions. As Section IV of this paper indicates, the engineers generally feel that marketing doesn't provide the information they need. However, the marketing groups at Zytek do not deal with single, isolated products or with individual customer accounts, but rather with aggregate groups of each. Most engineers only see a small part of the world—their part of the system. In a similar way, most people in the field see only a small slice of customers—the account(s) they are assigned to. People in marketing deal with larger abstractions and attempt to "bridge the gap" between the hundreds of components and systems coming out of engineering and the set of customers within each of their respective market segments. However, because they deal with these abstractions, they seem to operate in a no man's land, where they typically don't know the technology as well as the engineers, nor do they know the "needs" of specific customers as well as the field sales personnel calling on those customers. As in Dougherty's field research [7], people in marketing have a difficult time connecting with engineering because of their differing "thought worlds." However, what is different between the firms in Dougherty's field research and Zytek, is engineering interacts not with a single marketing group but rather with many groups representing differing ways of segmenting the market.

D. Our Role is to Refine Technically Driven Ideas

Finally, many people in marketing argued that it was not appropriate for marketing people to tell engineers 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 chairwoman of the Marketing Advisory Board (the group which 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?"

While there were several groups scattered around Zytek that conduct market research studies on a full time basis, they were relatively small in relation to the number of people in other marketing and sales positions. One marketing manager mentioned that these studies are "just one data point:"

> "The quantitative methods and tools are just a footnote in the appendix. They aren't that important—the decisions and business plans are much more complex and are focused on a broad understanding of what customers could do with a given set of capabilities."

Others emphasized the usefulness of focus groups, given the rapid changes and dynamics of the computer industry and the confusion over terminology. For example, one product marketing manager said:

"The meaning of terms is different to people ... everyone wants 'open systems'—but just what are 'open systems?' Only 2% of the people really understand the issues ... it's very complex ... so surveys are pretty limited. That's why focus groups are so useful—to get at language and meaning. They allow you to move beyond the simplistic statements to a real probing of the issues."

Many of the focus groups were done by a group called the "Customer Information Group" which was not officially part of marketing, but rather reported directly to an engineering vice president. The head of this group was quite aware of the negative stigma associated with marketing ("we don't use the M-word around here") and said that they had shifted away from large scale surveys toward more focus groups in order to get a better understanding of what customers wanted.

1) Commentary: I was somewhat surprised that many of the marketing people argued for this "refinement" rather than "initiation" role for marketing. However, after my nine months of field work, I came to appreciate the logic of it. Most of the people in marketing spent the majority of their time on "outbound" marketing tasks—preparing for product introductions, doing demos, training the sales force, preparing merchandising material, and working with other various types of business partners such as third-party hardware and software firms, systems integrators, and value-added resellers. They realized they didn't know the technology as well as the engineers and claimed that they shouldn't be initiating the new products or providing all the detailed answers such as "telling engineers where to put the switches." Furthermore, the people with more experience with the firm appreciated that Zytek's development processes and corporate culture did not give the leading role to marketing for product development decisions. However, they did feel they had a significant role to play in providing reactions to the concepts put forth by engineering.

I found that there were differing views within engineering as to whether marketing's role should be primarily one of refining engineering-driven ideas. Some engineering managers had very close working relationships with their counterparts in marketing and looked to them to provide reactions on design ideas and stories and summaries on trends in the market. On the other hand, other engineering managers had more adversarial relationships with marketing groups and complained that marketing could not provide a stable spec for them. However, in general I believe that the top managers in both engineering and marketing thought the ideas should originate in engineering.

VI. Discussion

Since much of the literature on marketing/R&D interaction has acknowledged differing perspectives between the two groups [4], [7], [12], [20], [28], [30], the descriptive body of this paper is organized around the perspectives of people in engineering and marketing. Similar to other empirical studies of new product development practice in high-tech settings, my fieldwork found relatively little use of formal market research techniques [10], [16], [18], [19]. This is no doubt partially due to engineering-driven culture and the lack of power and status of marketing groups. However, one of the general themes that runs through the engineering complaints is that when technical capabilities are rapidly changing and when the technology is complex, customers may not anticipate what they can do with a given capability. Furthermore, information that passes through marketing and sales groups is often filtered and misinterpreted due to the technical complexity.

Some of these points have been made by prior research on product development in high-tech environments. For example, Von Hippel [33] has recognized the limitations to input from customers who do not have experience with a new type of product and he recommends identification of "lead users." An empirical example of using lead users to help design a new product is presented in Urban and Von Hippel [31]. Others have focused on the personality and translation problems between marketing and R&D. For example, Moenaert *et al.* [20] use a mail survey of 386 people to identify differing information styles of communication and identify four dimensions (relevance, novelty, comprehensiveness, and credibility) which affect the usefulness of the information. What this study adds to this prior research is a detailed description of problems marketing and R&D have in working with each other in one engineering-driven organization. While I am limited in my ability to generalize from these observations to other settings, I am able to use these observations to critique the existing literature on marketing and R&D interactions and to suggest directions for future research. I focus my discussion of the theoretical implications of this work on how the nature of the products produced by Zytek and the organizational structure prevented a dyadic interaction between marketing and R&D.

1) Modular Systems Prevent Dyadic Interaction between Marketing and R&D: Much of the prior work on marketing/R&D interactions [12], [13], [28] has implicitly assumed: 1) There is a dyadic relationship between one engineering group and one marketing group, 2) marketing has information that engineering needs and should represent the needs of customers to engineering, and 3) the problems are primarily ones of conflict, integration, or translation of customer needs to engineering specifications. However, computers are modular products which are customized and configured in different ways for different market segments and there are typically many marketing groups that an engineering group has to listen to. As Fig. 1 shows, in Zytek there were many marketing groups representing a variety of ways of segmenting the market.

While 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 five 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.

Within Zytek, these decisions of how modular and flexible to make a product were made within engineering. The annual R&D funding was allocated by a committee called the Systems Task Force and there were biweekly review meetings throughout the year between this committee and various engineering groups. A critical role of this committee was to plan and monitor compliance with an overall system architecture for Zytek's systems. Such an architecture helped ensure interconnectivity among the various systems and components under development within engineering.

There has been relatively little research exploring marketing/R&D interactions for such complex systems where multiple marketing groups interact with R&D project teams. However, Rothwell [26], [27] has pointed out some of these issues relating to modular products, economies of scope, and "robust designs." Additional research is needed to relate the design trade-offs between general purpose and specialized machines to organizational structure and communication processes. Do firms typically have a formalized system for collecting requirements of different market segments and analytically making trade-offs between the varying customer needs or is the chaotic, coalitional adhocracy seen within Zytek more common? Is a complex network organizational form more appropriate for dynamic, technology-driven environments with more systematic procedures appropriate in more stable environments? These and other questions relating organizational structure and processes to environmental conditions are in need of additional research.

VII. Summary

While single site participant observation studies are useful for inductively developing insights into issues such as organizational structure, culture, and decision making processes, follow-up studies are needed to test the generalizability of the findings. Two obvious questions that arise from this descriptive account are: 1) Do engineering groups have similar levels of power over product development decisions in other high-tech firms? 2) Is it appropriate for engineering to have control of product development decisions? Zytek is an engineering-driven firm producing modular systems and the nature of the interactions between marketing and R&D may be a function of this specific organizational context. Other computer firms give greater power and stature to marketing and specialize in narrower market segments than Zytek, thus it is probably not appropriate to generalize to all computer firms based on these observations. Additionally, this study does not attempt to assess organizational outcomes such as product development success or improved organizational performance. Future research is needed to assess both how generalizable these observations are and to assess the impact of various ways of structuring the marketing/R&D on organizational and product development performance.

In conclusion, this study has provided greater insight into problems in the interactions between marketing and R&D groups in an engineering-driven firm than has been provided in prior research. One of the key points made is that marketing groups may not have all of the information that engineers need and may not be structured in a way to easily help engineering make design decisions. Thus, some interaction directly between engineers and key customers may be desirable. However, marketing groups should help provide context and strategic prioritization for this direct input.

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