Management Issues for New Product Teams in High Technology Companies

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Developing successful new products is critical for organizations. Business experts, for example, note that the contribution which new products will make to sales growth is expected to increase by one-third during the 1980s while the portion of total company profits generated by new products is expected to increase by 50 percent over the next five years (Booz, Allen & Hamilton, 1982). The need for new product success is particularly important in high-technology industries. There is a push from both government and industry "not just to produce more technical innovation but to produce it more quickly and efficiently" (David, 1984, p. 57). The ability to rapidly develop new high-tech products has important implications for the entire country. Foreign policy strategy is ever more dependent upon advanced technology whether for a "star wars" defensive system or high-tech conventional weapons. In the private sector, international competition spurs the search for technological advances to provide growth in the economy. Although the United States currently holds a leadership position in some high technology industries, its lead is a narrow one that international competitors are working hard to erode (Chandler, 1984). As Dr. Edward E. David Jr. the President of Exxon Research and Engineering Company commented,

> "The strength of the competitive challenge is evident in virtually all the familiar measures: a declining U.S. share in technology-intensive trade, lower rates of productivity increase, and a steep decrease in patents by American companies at the same time that foreign companies (chiefly Japanese) have boosted their number of U.S. patents..." (1984, p. 59).

The growing importance of new products pose difficult challenges for management. Many current employment policies and management practices may

not be adequate to ensure that the organization has the appropriate human resources and management skills necessary to guarantee that new product ideas can be refined and brought into production. In order to understand how to best design employment policies to enhance new product development it is necessary to understand the process by which new ideas are developed into marketable products.

Within the computer industry, the key mechanism for product development is the new product team. Although known by a variety of names, this is the group of individuals who must cooperate to develop, design, test market, and prepare the new product for production. New product teams differ from most other groups that researchers have studied in that they are cross functional, face a variety of tasks and change in composition across time. Successful new product teams must be able to effectively obtain information and resources from others, both inside and outside the organization, process the information and resources internally, and use those inputs to create and gain acceptance of a viable product (Bergelman, 1983). Within an organization, a number of new product teams may be created and aborted early in the development process. Those groups that survive have potential access to large organizational resources and may shape the future of the organization (Kidder, 1981). The unique requirements of the new product team present special management challenges and require the development of unique employment policies. The purpose of this paper is: (1) to present a description of the new product development process and of the new product team's role in this process; and (2) to suggest how boundary management and building commitment can make this process more effective. The data for this paper are drawn from previous

research and from a set of wide ranging interviews with new product team managers in integrated circuit and computer companies.

The New Product Development Process

Research on product management has identified six phases of activities necessary to develop a new product and fit it into company strategy (Booz, Allen & Hamilton, 1982). These six phases include: idea generation, screening and evaluation, business analysis, development, testing and commercialization. Each phase describes a sequence of events that a product must move through in order to be introduced effectively. A major implication of this process is that the activities and focus of a new product team may change over the course of product development. The management activities and policies necessary to facilitate the teams performance therefore may have to change in response to the varying tasks required of the team.

Although this set of phases suggests a linear sequence of activity, in reality the process is not so straightforward (Frohman, 1978). Like some strategic decisions, new product development often proceeds incrementally (Quinn, 1982). The original product idea may be very general and only slowly become more and more specific. As information is collected and fed into the ongoing decision making process, a greater level of specificity is achieved (see Figure 1). As product development continues, the group actually may cycle back through earlier phases or ahead to future phases. For example, during the screening and evaluation stage there is often a rough prototype available to help in deciding whether to choose that product. In addition, in order to develop an accurate business plan,

commercialization costs need to be estimated. Those actually responsible for commercialization need to be notified early enough in the process so that manufacturing facilities are available. If the group waits until the testing phase is finished to do this, the product may well be late to market. It has been shown that there is a need to integrate technical and economic considerations early in the game, or large sums of money can be wasted on a product that is technically feasible but not commercially viable (Mansfield & Wagner, 1972). The process may cycle through several times, going through several hierarchical levels and numerous functional groups (Bergelman, 1983).

Insert Figure 1 About Here

Product development appears to be a messy, undirected process, however, two events serve to define or divide the process and to direct the new product team's activities. We refer to these events as crisis points, in that the group must meet certain critical goals or its viability as an entity is threatened. These crisis points pose particular challenges for the project team manager. If these goals are not achieved within a particular time period and up to particular specification, organizational support for the group and its product may be withdrawn and the group disbanded. The first of these crisis points usually occurs just prior to the major portion of the development phase and it involves the shift from a "possible" project to a "definite" project. During this shift the team moves from a recognition of potential feasibility to commitment to one new product idea. This entails movement from low-cost effort with minimal

organizational response to major capital investment and support from top management (Pessemier, 1977). By this time, the group should have a fairly clear specification of the product. If this is not the case, the group cannot be clear about what it is giving in return for organizational support, which can lead to over- or under-expectations for the product. In addition, the group cannot structure itself internally, because specific goals and schedules will not be in place.

The second crisis usually occurs somewhere during the testing phase. Here, the technological problems have been assessed, a prototype exists and has been tested. The crisis point consists of moving from team ownership of the product to more general organizational ownership. This is where other organizational groups are preparing for large-scale production and distribution of the product. This corresponds to what Quinn and Mueller (1972) would call a technology transfer point, where the emphasis moves from developing the technology to passing information, enthusiasm and authority to use that technology to other groups in the organization. The crisis will not be met if the group is either unwilling to relinquish the product or unwilling to continue to work on the product when it has passed into the hand of others (See Figure 1). As one manager put it, "Then we had this big fight. Manufacturing wanted to build it now and make repairs later, but engineering wanted to hold it. People were very upset. Manufacturing yanked its people off the team." Later, however, "Now we're helping to train the manufacturing people. The groups isn't meeting much, though, and people don't seem to know what to do now that the intensity is over."

These two crisis points divide the new product development process into three segments. These segments can be labeled idea generation, problem solving, and diffusion (Utterback, 1971). The third segment consists of those activities necessary to get the product successfully to market and to move the group members on to new projects.

Idea Generation Segment

It is during the idea generation segment that effective groups must collect large amounts of market, technical, and political information (Kanter, 1983; Maquis, 1969; Tushman, 1977). In order to develop ideas, screen them, and evaluate their economic feasibility, information from the external environment, top management, and other functional areas is necessary. In addition to technical and need-linking activities, understanding of the corporate tradition and management thinking is needed to know whether the product might be included in the corporate strategy (Bergelman, 1983). Gaining top management support and the cooperation of interdependent groups also is crucial. The project idea must be sold and the groundwork for future communication and commitment must be laid down. Bergelman in his study of internal corporate venturing (1983) describes this as "...necessary to demonstrate that what conventional corporate wisdom had classified as impossible was, in fact, possible" (p. 232). This requires scavenging for resources in order to demonstrate feasibility and creating early market interest in the product even though top management might see the product as still in the definitional stage (Bergelman, 1983).

In the high technology area, technological and market information play an extremely important role. Innovation occurs when new technology is

paired with a market need. However, technological change is rapid and competitors are often quite secretive about new products. Engineers are frequently out of touch with market needs and are not rewarded for cooperation with marketing. Thus, the dilemma here is how to get the product idea together and moving quickly while assuring that there is adequate support to build the product and that it is the right product to build.

Problem Solving Segment

It was during the problem solving segment that the team must specify the new product design well enough to set goals and schedules for the team. In order for this to be done inputs from external agents regarding their priorities and suggestions for the product design need to be halted. The more effective teams appear to be the ones that are able to get the inputs they need and then to consolidate this information and move on the action phase. Groups lose valuable time if they procrastinate about deciding on product specifications. Groups that continue to incorporate outside inputs continually change work goals and schedules so that group progress and motivation suffer. As one new product team manager put it, "They just couldn't decide which chip they were going to use. It was debated and changed and debated until the cost and time to delivery got out of control. We had to scrap the whole thing and most of that team left the company."

The group must be protected from this sort of input overload by making the group boundary less permeable. The team needs to spend its time on technical development; it is at this point that the group must transform the inputs into a finished product. Innovation and speed can be gained by

buffering against external interference and imposed organizational norms (Friedlander, 1984; Galbraith, 1982; Rogers, 1982). There are large costs to coordination and information gathering, so this activity must be kept to the minimum needed for group survival.

In high technology projects, it is during this phase that individual members become critical to project success. Technical work or product architecture is often concentrated in one person's head. Skills are often specialized rather than dispersed throughout a group. Individuals with these technical skills are in great demand in the public and private sector and turnover in high technology firms has been estimated to be higher than 25% for engineers and scientists (Allen, 1984). Loss of these individuals at this point in time can mean long delays or even the death of a project.

At this point in the project, the team often grows in size to accommodate all of the technical expertise and diverse skills needed for designing the product. This expanded team must be motivated and coordinated to do a task that is ambiguous, unpredictable, uncertain, and long (Quinn, 1979). For example, a new product engineer cannot always predict with certainty when a technological breakthrough will occur nor can the team leader know that the manufacturer of needed chips is going to go bankrupt. As well, unforeseeable delays may force the group to go way beyond previously agreed upon deadlines. The tasks are so unpredictable and complex, requiring the interdependence of so many individuals, that formal coordination and control mechanisms cannot fully direct all necessary work behavior. The key issue here is one of commitment. Commitment to the product development team so that turnover is minimized. Commitment to motivate individuals to fill in the gaps, to redo the

schedules when delays appear, to find a new chip when the former one cannot be manufactured or to stay overtime to find a bug that is holding everyone up. The dilemma here is that isolation and commitment may allow the group to work quickly and efficiently but it often makes the third segment of activity more difficult.

Diffusion Segment

It is during the diffusion segment that teams must transfer technical data as well as a sense of ownership to the groups that will manufacture and market the new product. The transfer of ownership of the new product may be difficult for the team. The nature of the second segment of the development process may have caused the team to have developed a very impermeable boundary. Although the isolation this boundary creates may be important in innovation, its existence and the cohesiveness that has developed in detrimental at this stage. The group must again shift its attention externally. The marketing people must be convinced to put resources into marketing this product, not others. Manufacturing needs to give this product careful attention or the group's efforts may be lost; the product may never be made in large quantities and shipped out the door.

As well, there are internal issues to deal with. There is danger of having too much or too little commitment from the group. The group that is over committed does not let go of the product and may delay or inhibit commercialization. Team members may resist turning over the product to others because they are too bound up in it. As well, frantic pace and the uniqueness of the team's environment in segment two may have created a situation members may not wish to leave. For example, one engineering

manager described team members in segment three as "lost" and out of touch with the rest of the organization. He himself admitted to tinkering with the product design longer than necessary in order to avoid administrative tasks long abandoned. In contrast, some team members may have tired of the project and moved on to other ventures. These individuals are not committed enough to transfer their product expertise to manufacturing. The dilemma here is how to keep people committed while making sure they are ready to move on to the next organizational task.

Coping With the Dilemmas: Boundary Management and Building Commitment

The coordination and management problems facing the new product team leader are often difficult to overcome. The employment issues of acquiring desired talent, developing people, and creating policies to maintain productivity and motivation are already difficult to manage in most high technology firms (Wilson, 1982). Overlaying these problems, the new product team manager must develop an ability to effectively manage the interactions of the team members and those outside the team. As well, the new product team manager must be able to develop team member's commitment to the new product, yet not let that commitment inhibit effective decision making or prevent the successful transfer of the product to other groups. It is to these problems of managing the new product team boundaries and team member commitments that we will now turn our attention.

Managing Team Boundaries

Despite the importance of groups and teams in organizations, research on group process is on the decline (Goodstein & Dovico, 1979). Compounding the problem of this research trend is the predominant focus of what research there is on the internal processes of short term groups with stable, clearly defined membership (Gladstein, 1984). Researchers have tended to study laboratory or T-groups and concentrated on internal decision making and communication patterns. Most of this research focused on processes inside the group and failed to consider how the group could manage its relationships with other groups.

Although relatively little research has examined how a group can most effectively manage its relations across its boundary, this is clearly an important concern for new product teams as the new product team must acquire information and resources from other groups and ultimately deliver a producable product to still other groups.

One set of studies that has focused on boundary spanning in groups examines the pattern of work-related information flow in R & D laboratories (e.g., Allen, 1984; Katz, 1982; Tushman, 1977, 1979). In general, these studies have found a relationship between the input of information by boundary spanners and group performance. For example, high-performing R & D project groups showed far greater communication with organizaitional colleagues outside the group than low-performing teams (Allen, 1984). In addition, communication followed a two-step process, with communication "stars" first getting the information from outside, then translating the information and transmitting it to the group (Tushman, 1979). Although

most of the group-level research on boundary spanning has been limited to studying how members bring information into the group, exchange theory would suggest that when a team is part of a system organized by an interconnecting web of relationships a broader conceptualization of boundary spanning is needed (Bagozzi, 1975).

Exchanges can be characterized by what is exchanged between social units as well as the patterns of exchange. Hence, boundary activity can be categorized by whether goods and services, affect and liking, information and ideas, and/or influence and power flow into or out of the group, and by whether group members or outsiders initial the exchange (Brinberg & Wood, 1983; Tichy & Fombrun, 1979). Figure 2 identifies four boundary spanning roles that are needed to handle flows of inputs and outputs. The same individual (e.g., group leader) may play each of these roles or they may be distributed among members. This broader categorization enables us to describe the set of activities needed to engage in social and economic exchanges necessary to accomplish interdependent tasks in environments with limited resources. In addition, this categorization takes into account not only the boundary activities that the group needs to initiate but also the reactive role that group members must play in response to external initiatives. In this paper the discussion will focus on how particular boundary roles help the group to handle the flow of information and resources (goods and services) necessary for product development.

Insert Figure 2 About Here

Boundary Roles

The scout brings information or resources needed by the group in across the boundary. These are the activities that have been traditionally associated with the boundary spanner. Examples of the kind of information the scout might collect include task-relevant information necessary for problem solution, political data about who supports or opposes the group's activities, and the extent of demand for the group's outputs. As well as collecting information, the scout procures other resources, such as equipment and training necessary for group functioning. When these resources are not given easily it is the scout who must negotiate to procure them. Examples of the scout role can be seen in the following remarks made by new product team managers we interviewed:

> "I would go around to the other groups to see what was going on. There was a great deal of coordination to take care of and this way I could make sure that components were ordered well enough in advance so that we could get the product out on time."

> "We have a kind of detector. She's very sensitive and works with the people interfaces not the technical part. She spends time with all the groups in manufacturing to detect problems so they can be dealt with quickly."

The ambassador role involves carrying information, resources, or other outputs that the group chooses to transmit to others. The ambassador represents the group to outsiders. Representation is the presentation of information by the group about itself to its surrounding environment for the purpose of shaping the beliefs and behavior of others (Adams, 1976, 1980). The ambassador develops and maintains channels of communication in order to explain the group's activities to powerful outsiders and to

persuade these outsiders that the group's activities are valuable and should be supported. These functions may involve getting others to commit themselves to, or share the goals of, the group (Kanter, 1983; Kotter, 1982). The following quotations illustrate the ambassador role:

> "I go down to where the project first hits and tell 'em what's coming down. I say that four things are coming, and this is the most critical. You can't always say rush, rush, rush. I stop in even when there's nothing urgent, to develop a relationship with those people. I send them minutes of our meetings and when the project gets closer I send them memos explaining what's required and asking what they need from us."

> "I'm like a cheerleader, trying to get those guys excited about our products. But I tickle our group too; I'm not going to carry over some half-baked ideas. They'd get tired of that real quickly."

The role that defines the permeability of the group's boundary and its openness to other groups is that of the sentry. The sentry polices the boundary by controlling the information and resources that external agents want to send into the group, acting as a filter deciding who can give input, how much of that input will be admitted, and when the flow of input must stop. The sentry protects the group by allowing it to work with minimal distraction. Often external groups try to communicate their priorities, interests, and demands. When this input is desired, the job of the sentry is to allow entry. When this information and other inputs are not desired, due to a a need for immediate action or to prevent information overload (Gladstein & Quinn, 1985; O'Reilly, 1983), the job of the sentry is to buffer the group (e.g., Thompson, 1967). The sentry absorbs external pressures, such as political tensions, on behalf of the group. An extreme form of buffering is to actually separate the group physically from the

rest of the organization. Examples of the sentry role are expressed as follows:

> "We needed to get input from engineering at the beginning. We didn't want to come up with some kind of Dr. Seuss machine that had to be redesigned later so we let the engineering people in."
>
> "Near the end I talked to the top management group a lot. I tried to protect the group from that kind of pressure though. It's like Tom West said, 'we won't pass on the garbage and the politics.'"

External individuals and groups may well be curious about group activities or products or envious of group resources. The guard monitors the information and resources that others request from the group and determines what the group will release in response to these demands. The guard role is reactive and requires judgment to determine if it is in the group's best interest to let information out of the group. One external agent may request some equipment and be denied, while another's request is granted because it has been traded for something more valuable to the group. Examples of the guard role can be seen in the following:

> "So we set up living quarters and moved the team away. That kind of intensity needed to be isolated. People kept coming over and saying, 'How's it going? What are you up to now?' This was at best distracting, at worst like being in a pressure cooker."
>
> "Near the end people started panicking. The top guys would come down and want to know if we were making progress. I told them they had to stop, that they were having a 'distracting and deleterious effect on the group.'"

These boundary roles are interrelated. The scout and sentry roles both deal with information that comes into the group. As such, both roles influence group member perceptions of the outside world, because they are likely to filter, consolidate, and interpret external inputs thereby

distorting them in some way. Similarly, ambassador and guard roles influence how external entities perceive the group. These roles determine what is said and the manner in which it is said to those outside the group. These roles may require a high degree of diplomacy to correctly communicate sensitive information and marketing skills to "sell" the group's position.

These roles all can be taken on by one individual or many different people can play the same role. As well, a sequence of boundary activities may contain elements of more than one role and different people may fill these roles at different times. For example, the group leader may assume all boundary activities or particular roles may be assigned to a particular individual. Roles may be combined, so that when one is in the position of ambassador, scouting also can be carried out. All group members may play the role of guard to keep certain information secret. Boundary management relates to performance to the extent that the appropriate type of boundary spanning is carried out. It is expected that high-performing groups will vary their boundary spanning activity with task and environmental demands. The team leader must ensure that these activities are successfully carried out.

Boundary Management and Product Team Performance

One means of coping with the dilemmas described earlier, and meeting task demands is to vary the amount and use of boundary activity in the group. For example, in the first segment (idea generation) when obtaining technical, market, and political information, and obtaining support from top management, interdependent groups and those allocating funds, the scout and ambassador roles should dominate. In the second segment (problem

solving) when partial isolation of the group is needed and distractions can be detrimental, sentry and guard roles should dominate. Finally, in the third segment (diffusion) when selling the project to outside groups and pushing others to make your product their number one priority, the ambassador role should dominate.

Thus, the team leader needs to do more than manage internal group processes. He/she needs to diagnose critical suppliers and customers in the organization and manage the exchange relationships with these external entities. This is done through the scout and ambassador roles. Cooperation and support are built early, and those who agree to cooperate are kept informed of group progress. Once they have a stake in the group's output, the need to be updated on progress. Friedlander and Scott (1981) found that work group activities were given more legitimization and were more likely to be implemented when there was a back-and-forth flow of ideas with top management. This liaison function is predicted to aid in integration and support from all interdependent groups (Friedlander, 1984). In addition, once a work or information channel is established, over time it tends to be used for other unrelated purposes (March & Simon, 1958) so that outsiders who are given information early may well reciprocate with assistance for the team. The ambassador must work to build voluntary coordination. This requires that he/she create in the other group a positive attitude toward coordination, a recognized need for coordination, knowledge of his/her group as a good potential partner, an assessment of his/her group as compatible, and a capacity for maintaining coordination links in both groups (Whetten, 1983).

The team leader must also diagnose critical blocks or distractions to the group. These distractions must be minimized through use of the sentry and guard roles. Support for these conclusions comes from a study in a number of engineering research institutes. The authors, Ryssina and Koroleva (1984) studied the relationship between roles and team performance. Although examining slightly different roles, their findings support having an active role profile and role differentiation that leads to closer scientific contacts and better cooperation in effective teams. The research indicated that the generator of ideas and gatekeeper (like scout) were of primary importance in early phases, then the teams move inward with the burden of activity falling on the leader and research technique specialist. Finally, the leader, specialist and interface manager become most important.

Roles will not always be taken on automatically. The team leader must assign these roles to group members and evaluate them on their performance in these roles. Role performance is also influenced by the organizational context. Organizational norms and rewards that support cooperation between functions will result in increased boundary role behavior while organizations that implicitly or explicitly support one function over another, e.g., engineering makes the decisions, will discourage boundary role behavior.

Managing Commitment in New Product Teams

A second process which is crucial in managing the new product team is the creation, maintenance and control of the team members' commitment to the project. The new product development process has many unforeseen

demands and pressures and as one manager we interviewed stated, "there isn't one project that hasn't gone through a stage where the members thought they had failed—where they thought it couldn't be done." Yet stories abound of product teams which have expended heroic effort despite apparent failure. Some of these have received wide publication (e.g., Kidder, 1981; the new book about Apple) and most managers we interviewed provided us with stories of similar effort within their own companies. The willingness on the part of product team members to work long hours, and in Quinn's (1979) words, become "fanatically committed" to the product's success may play an important role in the ultimate ability of the team to deliver the new product.

Commitment can be paradoxical however. While intense commitment may be important in motivating the product team, it may also have negative effects. Recent writings (c.f. Staw, 1982) have described how individuals become bound by their previous actions in such a way that they become committed to an unsuccessful strategy. For example, Staw (1976) showed how individuals who made a poor investment decision continued to invest resources in the failing activity to justify their previous investment decisions. This process of escalating commitment has been termed "entrapment" (Rubin & Brockner, 1975) or having "too much invested to quit" (Teger, 1980). In the environment in which the new product team operates, such entraping commitment may prevent the team from abandoning poor strategies or lead the team to ignore new information.

This then is the paradox of commitment. While escalation to a failing course of action is a real risk, it is not always clear whether a new product idea is "failing" and perhaps the only way to keep it from failing

is to work at it with a tremendous intensity. In other words, while escalating commitment can lead to failure, not having it can sometimes ensure failure.

Developing and Maintaining Commitment

Research studies and our interviews suggest that three factors which can influence the development of commitment are: (1) The nature of the vision of product success that is created; (2) How the decision making process within the team is managed; and (3) How others get signed on to the project.

Creating a Vision

The degree to which excitement and energy for a task develop is dependent in part upon the shared vision which guides the group. A strong, clear vision of the product or process can provide a sense of direction for both team members and outside groups (Martin & Siehl, 1982). Such visions can be developed through a number of factors including the vividness of the vision (Nisbett & Ross, 1980) the clarity and consistency of message (O'Reilly, 1983), the extent to which stories, myths, and language support the vision (e.g., Peters, 1978; Peters and Waterman, 1983; Pfeffer, 1981), and the extent to which the vision is linked to top level organization goals and rewards (Davis,). A strong and consistent vision can serve to direct the group members' energy and focus their information search and decision making. Strong visions are more likely to engender commitment than those visions which are less intense.

Strong visions can be general or specific in the image they present. A specific vision might spell out in great detail a process, product or goals to be achieved, while a general vision is more likely to specify a direction rather that a well defined notion of what the end product might look like. Two examples from out interviews can highlight this difference. In one company, the vision which developed within new product teams was to be "number one" in office automation by building the "most technically advanced", "high quality" product. Although general, this vision was strongly held within the teams. This vision became strong through policies including a strong quality control program and rewards for technical breakthroughs. The vision was supported by stories including one of a vice president who met with the team to say that the office automation market was necessary for survival. Another story circulated through the teams of how, at one site, a major competitors keyboards fell apart while a company supplied keyboard continued to work after someone inadvertantly stepped on it.

This general vision can be contrasted to another much more specific vision which developed in another company. This vision focused on the creation of a "missing link," a program designed to link a personal computer to a different company's mainframe. One way that this vision was strengthened and made salient to team members was through T-shirts distributed to the team. These T-shirts depicted the other company's computer with a stone-age user connected to the team's computer with a space-age user by a bolt of lightening called the missing link. A leap to the space age—where no man has gone before.

The Decision-Making Process

It is impossible to separate the process of gaining commitment from the on-going stream of decisions that are made as the original new product idea moves from the very general to the specific. Commitment and decision making are intertwined. The level of commitment of a team can affect the decisions which are made. Similarly, the process by which decisions are made can influence people's commitment to the decision.

In order to understand how commitment and decision making can interact in new product teams, it is useful to begin with an understanding of "why" decisions are made. Brunsson (1982) compares two models of decision making, decision rationality and action rationality. Decision rationality corresponds to most normative models of decision making whereby the goal of decision making is to make the "best" decision. Processes such as collecting all available information, specifying complete sets of alternatives, and ranking alternatives in terms of expected values are called for. Making good decisions requires avoiding such irrational processes as group think (Janis, 1982) or rigid responses to threat (Staw, Sandelands & Dutton, 1981).

Action rationality differs from decision rationality in that the aim may not be to arrive at the "best" decision in some abstract sense, but to involve people in the decision-making process so as to gain their input in molding the decision and build their commitment to it. The issue is less one of group effectiveness (whether what is being done should be done) and more one of efficiency--how decisions can best be carried out (Pfeffer & Salancik, 1978). Since the new project team manager is required to gain

not only the support of his or her own team but that of others outside of the team as well, action rationality can become an important tool for building commitment and support.

The steps followed to achieve action rationality (See Table 1) include (1) seeking information that solely bolsters particular alternatives, (2) viewing the group's decisions as more favorable than what is objectively warranted, and (3) making sub-optimal decisions to avoid conflict or to maintain group cohesiveness (O'Reilly, 1983). Under conditions of action rationality few alternatives should be analyzed. A narrow range of potential consequences should be used to choose among alternatives, and implementation issues should be dominant throughout the entire process (Brunsson, 1982; Gladstein and Quinn, 1984). The consideration of all the pros and cons of multiple alternatives is avoided because it could evoke dysfunctional uncertainty, while bolstering one or two, even before a mature consensus is reached, can be used to cement group support behind one feasible alternative. Feasibility and commitment in implementation should be important criteria for evaluating possible alternatives.

The paradox of commitment is illustrated by the choice of decision making strategy. The goal of action rational decision making is to build commitment, yet when individuals become committed to a course of action they are less likely to respond to new or changed information. A number of our interviewees described how a team or organization became so committed to product idea that work continued on it even after it became apparent that the technology was obsolete or that the market had disappeared. Despite the risks of a suboptional decision, the use of action rational decision methods can be valuable. For example, the engineer in one team

suggested using a design similar to one used by a particular competitor. The team leader would not let the suggestion be evaluated despite its technical elegance since it would sidetrack the group and since the President's current strategy was to more fully distinguish his company's product line from his competitor.

In general, those implementing the decision should be generally brought in early in the process since the relationship between participation and commitment is well documented (c.f. Bass, 1970; Coch and French, 1948; Hackman and Lawler, 1969). Those individuals in other areas and those lower down in the organization often have much better information about specifics. The new product team manager can simultaneously tap this information base and create initial enthusiasm through this early involvement. By getting these people to make proposals, develop plans and prototypes and think through their role in a sub-project, a decision can be half implemented before it is even finalized (often in a shorter time and with a lower cost) (Gladstein & Quinn, 1984).

In order to gain this commitment the group members may rationalize behavior, stereotype outsiders, create illusions of unanimity, and conform to internal norms (Brunsson, 1982; Janis, 1982). While there are many dangers inherent in this behavior, such as taking on too much, building expectations that are too high to be met, or working with very inaccurate models of the world, the behavior can also be useful. Engineers that believe they are making the best machine and running the horrible competition into the ground may work the extra six hours for the team, while without this belief they would not.

Insert Table 1 About Here

Getting Others Signed On

The willingness to continue an activity and increase the effort spent in it can be a function of the circumstances in which the behavior originally takes place. Commitment develops as individuals become bound to their previous actions (Kiesler and Sakamura, 1966). Once a person has made a decision or undertaken a task, implications for future actions may be developed. These circumstances in which the initial behavior takes place can be managed so that the individual may be strongly or weakly bound to a future course of action.

A number of factors can influence the extent to which engaging in an activity sets the person on a path toward future actions. Three of these factors are: (1) the amount of choice the individual felt he or she had in making the decision; (2) the visability of the initial action; (3) the extent to which the original activity can be revoked or denied. A substantial body of research has demonstrated that when individuals freely choose actions, they will engage in those activities with greater persistence and increased satisfaction. A number of experiments have demonstrated that when induced to make some initial voluntary compliance, people are likely to become bone marrow donors (Schwartz, 1970), to pay more for an automobile than planned (Cialdine et. al., 1978) or to assist in political campaigns (Kiesler et. al., 1971). In addition, when actions are made publically and when they cannot be easily revoked, increased

commitment is likely (Salancik, 1977). For example, O'Reilly and Caldwell (1981) show that individuals who make job choices which are not easy to revoke are more satisfied and committed to their jobs than those who can easily change their employment. A number of our interviewees described the importance of having engineers "choose" to serve on a team. As well, at least one mentioned the importance making it difficult for someone to leave the team once he or she had "signed up."

These ideas suggest that the circumstances under which individuals make initial commitments to the product team can shape the course of their future actions. By consciously managing these circumstances the new product team leader can produce strong commitment early or can slow down the commitment process.

Commitment and Product Team Performance

Developing individual commitment is important in new product team management. The nature of product development process often makes direct monitoring and control difficult. A shared commitment to a particular product or goal can reduce the need for more formal control. As well, a shared commitment can reduce the time the leader must spend providing direction to the group and free up the leader to spend more time managing relationships with other groups. A second advantage of individual commitment to the team is the potential for lower turnover and the possibility of quicker project completion (Stroh, 1981). However, commitment must be carefully managed. Too high a level of commitment can inhibit optimal decision making and, as our interviewees pointed out, make it difficult for the team to transfer "ownership" of the product to groups

which must produce and market it.

For the new product team leader, the process of managing commitment is one of balancing the appropriate level of team commitment to each segment of the product development process. The first segment of the product development process (idea generation) required the team leader to complete the formation of the team and to collect and process large amounts of information. The final outcome of this segment is a clear product plan and a fairly well defined set of specifications. In this segment, the team leader must begin to build member commitment to the product and the team, yet prevent that commitment from becoming too strong and too specific. During this first segment, the team leader is most likely to enhance the team's performance by providing a strong, general vision and managing the group's decision making process to ensure that decision rationality is maximized. These are important in order to allow the group to maintain flexibility and process divergent data. The team leader must prevent the team from prematurely closing off discussion and becoming too committed to a very specific idea. During this segment, it is important for the team leader to build support and commitment from other groups. These external commitments must be general in their nature and moderate as well. One of our interviewees described the importance of getting senior management initially supportive of a team and its leaders rather than committed to a specific set of product specifications. This interviewee argued that if outsiders form a commitment too early, the group may be forced to try to meet either impossible or suboptimal standards.

The optimal level of commitment changes dramatically during the second segment of new product development (problem solving). It is in this

segment that the development of commitment becomes most important. The problem solving segment can be characterized by progress in fits and starts. Delays may be common. It is at this time that intense personal commitment to the product idea can become most important. During this segment, a strong, specific vision can serve as a useful guide for the group. The increased use of action rationality in decision making can also become valuable. During the problem solving segment, the new product can not afford to reconsider major decisions or allow disagreements to dominate discussions. Our interviewees suggest that successful teams focus their energies during the problem solving and avoid "remaking" previous decisions. In contract, less successful teams continued to debate product specifications well into this segment. Increasing the publicness and irrevocability of decisions can be valuable in this segment to increase commitments.

The intense commitment which may facilitate the team's progress during the problem solving phase may limit the teams ability to cope with the challenges of the third segment, diffusion. Here commitment must be maintained but lessened as the product moves onward. At this point, commitment to new directions, ending ceremonies, time to decompress and to get reintegrated with the rest of the organization will help the overcommitted, while stressing earlier commitment procedures will help the undercommitted.

Summary

In this paper we have described and documented the new product development process. This process poses a difficult set of dilemmas with

which the new product manager must cope. The task is uncertain, ambiguous and unpredictable. Progress is determined not only by how well the team manages itself but also by how well the team can manage the myriad external relationships with outsiders. In high technology firms, the ever changing technology and market increase task uncertainty. Specialization increases the number of individuals involved in the process—both inside and outside the team. High turnover rates in the industry increase the probability of project failure due to losing critical individuals.

We have discussed two critical functions that help the group to cope with task dilemmas: boundary management and building commitment. The nature of these functions, like the nature of the process itself, must shift over time to meet the demands of the task. We predict that in the early stage the scout and ambassador roles help to assure that adequate external support for the product is forthcoming and that the "right" product is chosen. Decision rationality serves to get the product idea refined, while a general vision and the signing on process pulls the team together and gets members moving in the same general direction.

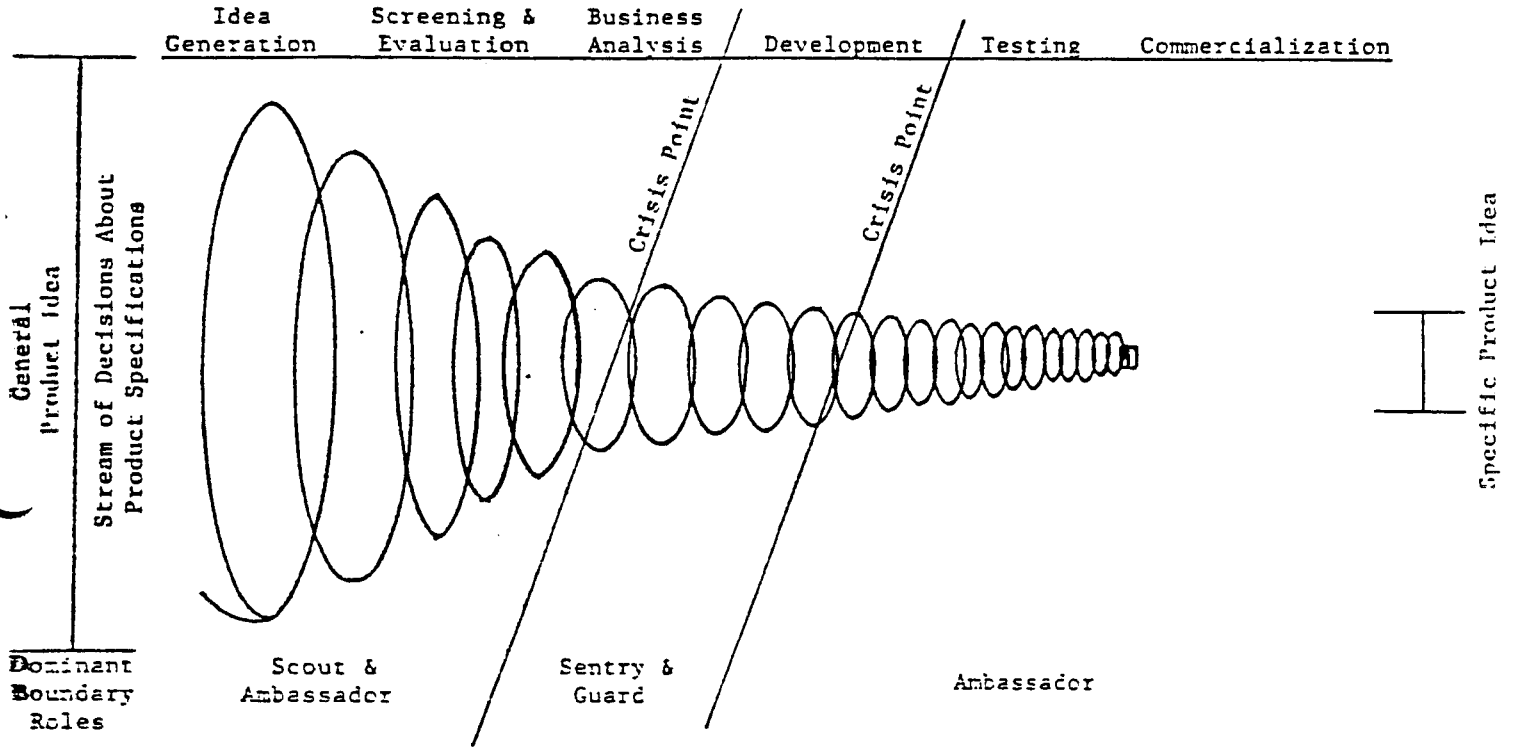
As the product idea gets refined and schedules are made up, the team expands. At this time the sentry and guard roles dominate so that the group can work on product development. Those who wish to change the product design and specs need to be kept away or progress could halt. At the same time the group members, many of whom are critical to the product development, must become committed to the product group. Turnover, low levels of work, and failure to meet deadlines when delays continue to appear, could mean death to a product. Action rationality, a clear specific vision and voluntary sign ons all help to produce this commitment.

As diffusion arrives the group shifts ownership to others. The ambassador role needs to come back forcefully to sell the product and ease the transfer to others. This is a time to develop commitment to the product from outsiders. Groups members need to help in the transition, but also need to move on new commitments.

In essence, the management of new product teams in high technology industries requires that we change some of our models of groups. Task accomplishment requires a constant set of transactions with the external environment, the group does not exist in a vacuum. The scout, ambassador, guard, and sentry roles and the organizational policies and practices that support these roles, assist in handling these transactions. Groups also do not have a fixed number of members who automatically do all the work that is required. In new product teams the work is also too uncertain to control via standard operating procedures and controls. To assure follow-through and low turnover, commitment to the team or the product is necessary.

FIGURE 1

Phases of New Product Development



Segment	Segment 1	Segment 2	Segment 3
	Idea Generation	Problem Solving	Diffusion

FIGURE 1

Phases of New Product Development

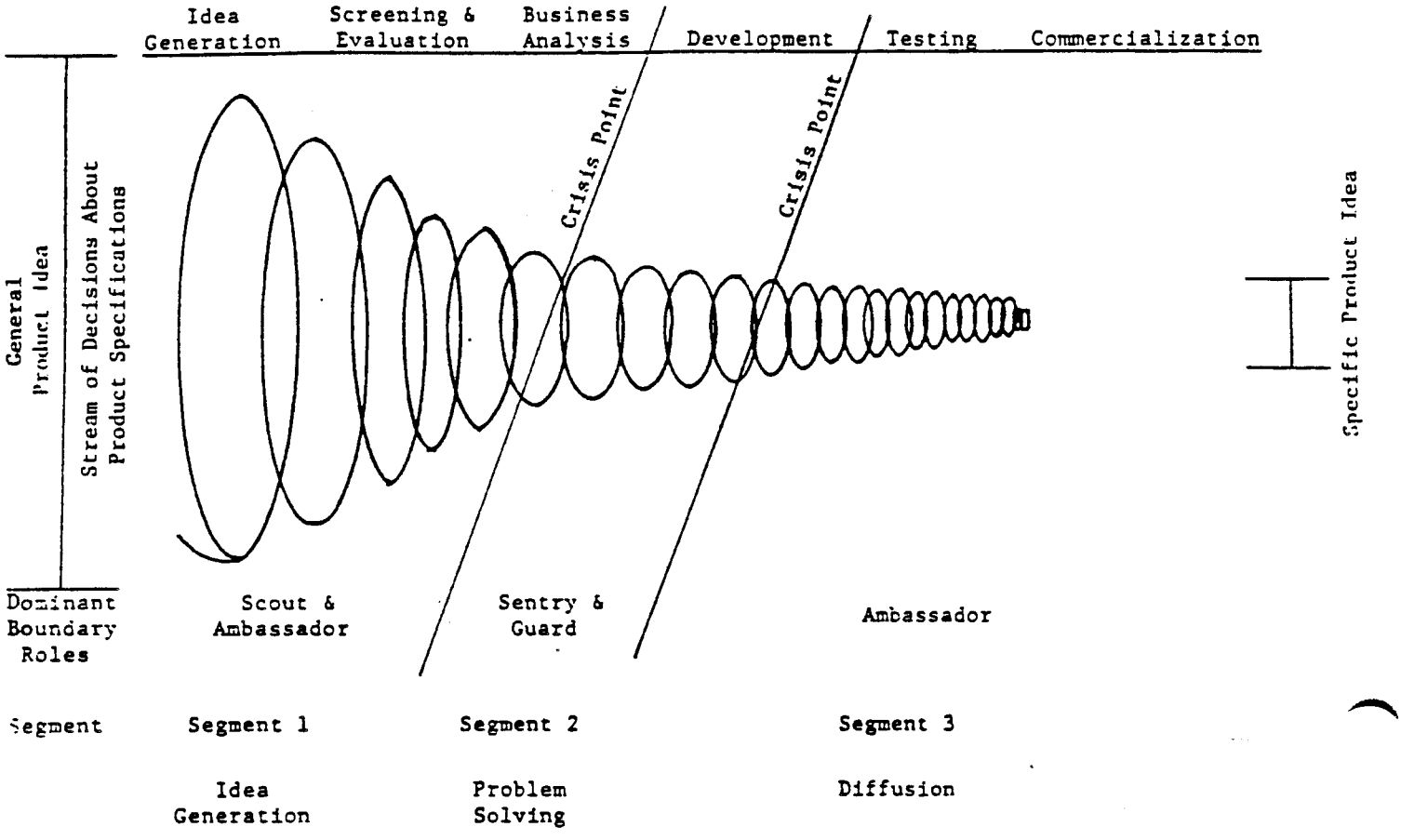


FIGURE 2

Boundary Roles in Groups

Who Initiates the Transaction	Direction of Information and Resource Flow: IN	Direction of Information and Resource Flow: OUT
Group	SCOUT	AMBASSADOR
External Agents	SENTRY	GUARD

TABLE 1

Principle Characteristics of Processes*

	DECISION RATIONALITY	ACTION RATIONALITY
Goals	Effectiveness	Efficiency
Group	Heterogeneous outlook	Homogeneous Outlook
Groupthink	Clear estimation of group Open minded	Overestimation of group Close minded rationalize behavior stereotype outsiders
	Diversity	Uniformity
Process	1) Thoroughly canvassing a wide range of policy alternatives	1) Look at only a small number of alternatives (1 to 2)
	2) Takes account of the full range of objectives to be fulfilled and the values implied by the choice	2) Use predicted consequences to evaluate alternatives, account for implementation
	3) Carefully weighing negative and positive consequences	3) Bolster alternatives with positive information
	4) Intensively searching for new information relevant for further evaluation	4) Search for new information that supports alternative desired
	5) Accounting for new information	5) Account for new information
	6) Reexamining positive and negative consequences of all known alternatives including those originally regarded as unacceptable	6) Readjust alternative to account for new information, do not go back to original alternatives left behind
	7) Providing detailed provisions for implementation	7) Continue to back chosen alternative and modify action and direction slowly over time

*These are intended to be indicative, not complete, definitions. Obviously overlaps occur between the two.