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# IMPROVING THE PROCESS OF PRODUCT INNOVATION

*Here's what 116 managers find wrong with the product innovation process and how they would go about fixing it.*

David H. Gobeli and Daniel J. Brown

*OVERVIEW: Innovation managers can improve every stage of the product innovation process (Discovery, Decision, Development, and Delivery) by applying the three guiding principles of total quality management: customer orientation, continual improvement and employee involvement. A survey of 116 innovation managers revealed that the most common problem in the innovation process at every stage is "inadequate resources." The guiding principles focus the respondents' suggestions for improvement of this and other problems: Survey customers to identify where to focus R&D efforts, redesign the key subprocesses such as project management, design activities and strategic planning, and involve employees at every stage of the innovation process. Employees can not only directly contribute to the innovation content, but can assist in improving the process of innovation so that fewer resources are wasted.*

Anyone familiar with the current management literature has heard of total quality management and how it is increasingly being applied to the process of product innovation itself. Reviewing just a few of the seminal works on quality management such as Deming (1), Juran (2), Crosby (3), Imai (4), or Feigenbaum (5), we noticed a consistent emphasis on three basic tenets. First, a customer orientation is essential. Second, continual improvement (including products, services and underlying processes such as the innovation process) is a way of life. And, third, those employees affected by changes must be included in improving the product, service or process.

These principles may sound like common sense by now, but as Tribus (6) warns, "American managers do not know how to increase the quality and productivity of the process they manage, especially the innovation process." This statement is certainly not true of all organizations, but even those who have already made a good start, such as Motorola (7), still continually seek improvements in such critical processes as innovation.

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The reader interested in the nuts and bolts of implementing total quality management in the innovation process might study Asahide and Kusamitsu (8), Gitlow (9) or Ishikawa (10) for detailed application of total quality tools, or Akao (11) for an in-depth discussion of quality function deployment. These are but a few of the good publications to help a firm apply quality concepts to product innovation.

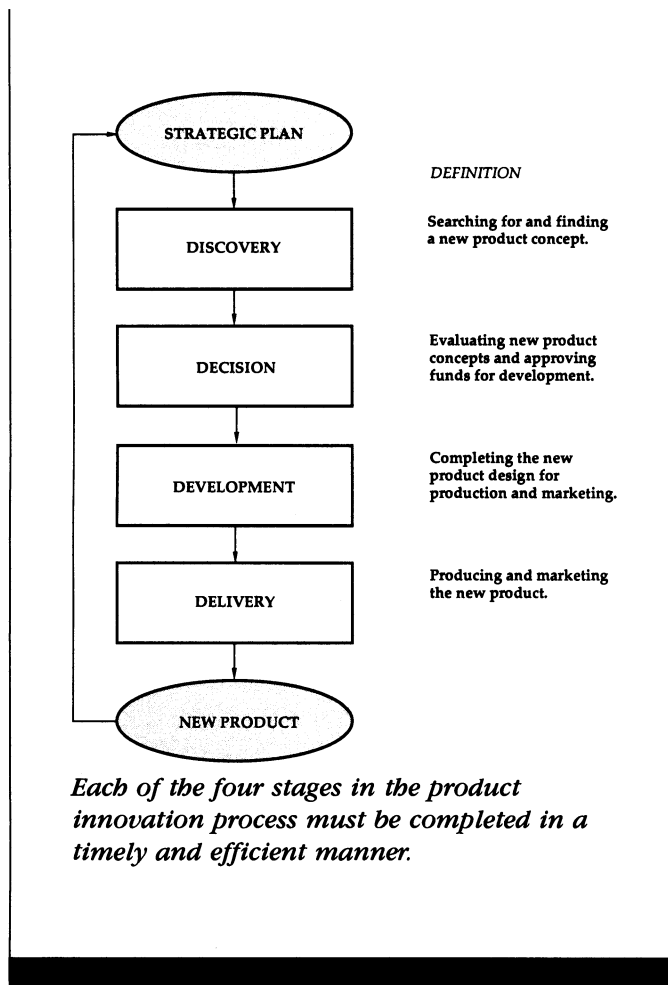
The purpose of this exploratory article is to share data from 116 successful, high-technology managers from firms in the Pacific Northwest about problems they experienced in product innovation, and solutions they thought would improve this vital process. The main objective here is to provide ideas for those trying to improve the innovation process, ideas to help identify what might be wrong and ideas to help find solutions. More specifically, this article first presents a description of the generic product innovation process, explains the study, shares the results, and concludes with implications for innovation managers. As will be seen, the results tie in closely with the three basic tenets of total quality management.

## The Product Innovation Process

Based on one author's own 15 years of industry experience as an innovation process manager, and recent experience implementing TQM in the R&D and production departments of a very successful high-technology firm, the generic Product Innovation Process (PIP) should appeal to most readers as representative of their own process. Of course, each organization adds its own twist to the process, but it probably follows these general steps.

The literature also contains other models, of course; probably the best known is that of Booz, Allen and Hamilton (12). Their model is more detailed, and could be valuable for those wanting to get more specific. The Booz, Allen and Hamilton model even provides a process performance measure: the number of ideas surviving each step of the process as they move from strategic planning to commercialization. Since only one in seven ideas reach the market, this illustrates again why the innovation process might be improved further.

The PIP illustrated on the next page contains four basic stages (Discovery, Decision, Development, and Delivery). Each stage is a critical step in the process, and each must be completed in a timely and efficient manner; collectively, the process must also contribute to products meeting customer performance requirements.



Of course, the four-stage process may be more complicated in practice, and may not always follow the sequence suggested in the model. For example, the Decision stage may lead to a “restart” back to Discovery to come up with a better product concept before any funding will be approved for development. Still, our survey was designed around these four stages, and the respondents seemed to have no problem understanding and relating to them. The real merit to clustering the innovation activities into four stages is to allow a common format for discussion of problems and solutions. Greater detail will probably be necessary to improve an actual firm’s innovation process. This model is, then, the framework for the following discussion.

### How the Study Was Conducted

The high-tech manufacturing firms participating in this mail survey were located in the directory “Advanced Technology in the Pacific Northwest” published annually by Quanix Data Services, Inc., of West Linn, Oregon. The responding firms are relatively successful new product innovators with an average 68 percent new product success rate. They are also successful when measured by market share change: 58 percent reported an increase in market share over the past year, while 23 percent maintained share, and only 15 percent lost market share. The firms tended to be small, with almost 61 percent having fewer than 100 employees. Only 16 percent had over 500 employees.

The 116 respondents, each from a different company, were all members of top management, and all were involved in new product innovation; they included presidents (27 percent), R&D executives (26 percent), marketing executives (25 percent) and operations executives (15 percent).

Survey respondents, after reviewing the generic PIP, were asked to identify, for their own firms, the most significant problems interfering with each stage of the process. Then they were asked to comment on the most effective techniques used for improving product innovation in their firms.

The actual responses were entered into computer files that were then coded and sorted according to the innovation stage. To further define problem areas, the responses were also coded and sorted according to five management categories: general management, resource management, marketing management, R&D management, operations management, and project management. Virtually all the comments easily fit into one of these categories which represent, in essence, subprocesses of the product innovation process. Resource management, of course, could be combined with general management (which we used if a comment had no particular functional focus), but the incidence of comments about inadequate resources was so overwhelming that we made this a separate category.

### What We Learned

A summary of the nature and incidences of problems is presented in matrix form as Table 1. To simplify the table, only problems with an incidence greater than 10 mentions are reported. Using this inclusion rule, no more than one major problem type appears in each cell of the matrix. For example, the general management category in the Discovery stage produced the problem type “unsupportive top management” which captured the essence of the Discovery comments by 26 executives.

From Table 1 it is clear that comments about resource management dominate this sample’s concerns in every stage of the product innovation process. Marketing management was second, mentioned half as frequently overall. General management issues followed in third place.

To provide more specific data, the results of the problems analysis and the general suggestions for improvement are reviewed below for each stage of the product innovation process. Table 2 summarizes the themes of these solutions according to the management category.

### Discovery Problems and Solutions

The Discovery stage was defined as searching for and finding an idea for a new product. In this stage, inadequate resources (resource management), not knowing the customer (marketing management) and unsupportive top management (general management)

were the major problem areas in order from most frequently mentioned.

**1. Inadequate resources.**—Time, money, people, and “other duties” were all frequently cited as the most significant problems that interfere with the discovery of good new product ideas. This shortage of resources was blamed on too much attention paid to current activities, which meant that key resource people were not free to pursue new ideas. “Present-versus-future resources” allocation conflicts appeared to be at the heart of the lack of resources for discovery. Or, as one respondent put it, current commitments reduce “think time.”

These managers did not really have clear suggestions about how to solve the inadequate resources problem, other than the implicit suggestion to reduce the focus on current products. To the extent that current products are essential for successful operations, the message here might be to apply total quality improvement concepts and improve the existing activities to make them more resource-efficient and thereby create more “think time.”

**2. Not knowing the customer.**—At the core of total quality, customer orientation is particularly important in successful innovation. Most comments here were about engineers not talking to customers. But comments about marketing people and management not understanding the market were also made. The overall theme appeared to be a lack of market research that left the organization unsure of what its users actually wanted. Simply “not listening” to the customer was also seen as a significant problem for some firms.

Not knowing the customer is bad news for total quality advocates, but these firms provided some examples of what to do to improve the situation. Comments included working directly with major accounts or key customers

***‘Force the technical people into exposure with current customers to allow them to see needs,’ stated one executive.***

using current products, studying lost-business reports, probing for needs of customers in regular customer contacts, and visiting the field.

One organization provides every sales person with a desk pad entitled “customer input” to aid in actively soliciting ideas for new products. In addition, respondents mentioned using members of the distribution channels to help solicit ideas. These modest techniques are quite straightforward; they reflect an active role in soliciting ideas from all sources.

Engineers received special consideration among these executives; they were sometimes sent to user sites to garner information. Several respondents described a process of “real marketing research: Both marketing and engineering staff should visit customers constantly.” One executive stated this even more strongly: “Force the technical people into exposure with current customers to allow them to see needs.”

**3. Unsupportive top management.**—Comments about top management centered on a lack of commitment to discovery, which showed up in such comments as “excessive retrospection on incremental benefits” and

**Table 1—Major Problems by Category and Stage**

Management Category	Nature and Incidence by Stage*				Overall Incidence
	Discovery	Decision	Development	Delivery**	
<b>Resources</b>	Inadequate (52)	Inadequate (39)	Inadequate (61)	Inadequate (81)	233 (41%)
<b>Marketing</b>	Not knowing customer (34)	Poor market research (31)		Poor strategy (51)	116 (21%)
<b>General</b>	Unsupportive top management (26)	Poor decision policies (33)	Poor planning and directing (16)	Poor planning (21)	96 (17%)
<b>R&amp;D</b>		Poor technical expertise (14)		Product problems (35)	49 (9%)
<b>Project</b>			Poor project process (44)		44 (8%)
<b>Operations</b>				Faulty process (25)	25 (4%)
<b>TOTAL</b>	112	117	121	213	563 (100%)

\* Only those problems mentioned by more than 10 respondents are included; no cell contained more than one major type of problem.

\*\* Includes responses to two questions, one on marketing and one on production.

“we have always done it that way” as well as a simple “lack of commitment.” Apparently, management sets the company norm about discovery, encouraging or stifling it; in other words, innovation can begin or not begin at the top.

How do managers in successful high-technology firms address these problems? They try to foster creativity among employees. In addition to normal brainstorming activities and encouraging open communication, some firms have resorted to “forced communication between different scientific disciplines” and even a “pizza lunch for new product-market opportunity discussions.” One firm used surveys of all employee groups in the company, from assemblers to the president, to show a commitment to discovery.

In these firms, top management shows support by making communication about new ideas happen. Many of the managers responding referred to the need for

***One-third of the firms required more than three months to make product funding decisions.***

management to encourage these discovery activities, and to “listen to all ideas, then discuss how they fit into company priorities.”

### Decision Problems and Solutions

The Decision process was defined as evaluating new product concepts and approving funds for development. The three most frequently mentioned major problems were inadequate resources (resource management), poor decision policies (general management) and poor market research (marketing management), in decreasing order.

**1. Inadequate resources.**—Limited resources were most commonly mentioned as interfering with the Decision stage. The comments here appeared to focus on the lack of enough engineering experts. Poor technical expertise was a related, major problem area, as seen in Table 1, but the lack of time, money and people to evaluate new ideas was also a common theme.

Some respondents pointed out that people were too busy with other activities to find time to adequately evaluate new ideas. One respondent summarized the problem as a “desire to consider a broad range of alternative business development directions with limited resources.” Focusing on fewer directions could allow for better results, not only in Decision, but in the subsequent Development and Delivery stages.

**2. Poor decision policies.**—An organization’s Decision process can interfere with innovation. The “technical background and bias of senior management” can actually be troublesome, as can “no clear process for decision-making.” And, there can be too many good new product ideas, which makes setting priorities difficult. The comments from the respondents generally show frustration with getting a decision made within a reasonable period of time.

A separate question, addressing the time required to make a new product decision, revealed that 46 percent of the sample firms made decisions in two months or less. Sixty-five percent claimed three months or less, so about one-third required more than three months to make product-funding decisions.

In a study of the cardiac pacing industry, Gobeli and Rudelius (13) found that innovative firms required two months, while less innovative firms sometimes required as long as two years to approve a new product development program. These data suggest that a company is likely to have problems with innovation if decisions cannot be made within a few months.

**Table 2—Suggested Solutions**

Management Category	Suggested Solutions
Resource Management	Focus better for improved use of resources. Other techniques listed here may also help this area.
Marketing Management	Talk to the customer. Involve engineers with the customer. Manage marketing activities better.
General Management	Set goals. Develop strategies to create new ideas. Commit resources for new ideas. Force decisions to happen. Clarify direction.
R&D Management	Use better project management. Increase marketing involvement. Obtain better resources.
Project Management	Provide clear leadership. Set priorities. Set clear and consistent goals. Provide adequate resources.
Operations Management	Manage inventories better. Involve operations people in project management. Use pilot builds and tests.

Respondents suggested that two ways to improve the Decision process are better strategic analysis and direction from management, and the integration of engineering perspectives. Strategic analysis and direction are provided by such techniques as new-product committees, "mini-proposals reviewed by a management planning committee," developing a mission, and top management reviews of all ideas on a regular basis.

The integration of marketing and engineering perspectives is accomplished in some firms with the same types of mechanisms already mentioned, but can also be done with a "joint commitment" or "joint responsibility" by requiring approval from the various functions, as well as by insistence on a consensus across functional areas. Project management with a product emphasis is another mechanism for improving decision effectiveness; one firm actually uses a "new product team" as a planning technique to evaluate ideas before making a recommendation to top management. These suggestions parallel the concepts of "concurrent engineering" as explained in more detail by Woodruff and Phillips (14).

**3. Poor market research.**—Over a quarter of the companies said they did not know their markets well enough to make informed decisions. Some claimed insufficient market research was done; others claimed the results were not utilized. But the most common complaint was worded simply as "not enough knowledge of the market." Many aimed this complaint at the engineers who did not bother to understand the market. Some even claimed "engineering egos" got in the way of effective market research.

Talking to the customer for help in evaluating ideas was frequently mentioned as an effective practice. Some actual techniques suggested were the use of an "expert" customer reference panel, focus groups, joint meeting of customers and decision-makers, reviews by the sales force, and customer surveys. The theme is actual and direct evaluation by potential customers in order to "better define ideas and demand."

### Development Problems and Solutions

The Development process was defined as completing the new product design for production and marketing. Inadequate resources was again the most frequently mentioned problem area, followed by poor project process (project management), then by poor planning and directing (general management).

**1. Inadequate resources.**—The inadequate resources complaints were aimed at insufficient or incompetent technical people, lack of time, and too few funds. In addition, several respondents mentioned lack of new technologies. A common theme was the excessive work load necessitated by multiple, on-going projects. In reading the more than 60 complaints about inadequate resources in the Development stage, one tempting conclusion is that engineers are simply working on too many projects at one time. Consequently, they sometimes are "pulled off a project to fix old or previous

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projects." Again, better focus on fewer projects and improving processes for handling older projects may be part of the solution to inadequate resources.

**2. Poor project process.**—Complaints covered most aspects of project management, including shortages of engineers and qualified project members or managers. (These resource complaints could be combined with the resources category above, but the complaints here were directly aimed at project management.) Competition for scarce resources was one of the other frequently mentioned problems. Another issue was poor cooperation between engineers and marketing even when resources were adequate.

Talking to the customer was again frequently mentioned as the way to improve product development; this is an indirect way of improving the use of resources through better focus and improved development processes. Firms accomplished this by having project members visit customers, having customers evaluate the design at various steps, and by generally making sure those doing the development have direct communication with potential users. Effective development appears to require a project team that talks to the customer (as opposed to talking to itself). In one respondent's words, "communication with the customer results in a product that serves the market."

Eighty-seven innovation executives suggested the use of effective project management techniques, from proper planning through documentation of results. This is the largest group of recommendations for improving the innovation process at any stage. Although the suggestions covered many aspects of project management, setting clear goals and defining clear responsibilities were dominant themes. One respondent summed this point up by recommending "good definition prior to design"; that is, execution of the Decision process leads to an improvement in Development.

Another strong theme among the recommendations for Development added up to concurrent engineering: the integration of functional areas, especially marketing, R&D and manufacturing. Some firms even involved top management in the design process. However, the relationship between marketing and engineering was touted as the most critical, and project management was a mechanism to integrate the two.

To resolve the dilemma of shared resources on multiple projects, one firm enforced a "strict focus on the highest priority project to get it past center." As soon as it was

moving by itself and making progress, they “allowed a multiproject environment again.”

**3. Poor management planning and direction.**—Development people do not like changes in priorities (unless they are the beneficiaries of the change), and that was the most common complaint against management. Another common complaint was expecting employees to work on too many projects. As one respondent commented, “Though assigned to one project, the engineer is constantly asked to do other things.” The theme is that top management does not always provide clear, consistent direction, and as a result, scarce resources are wasted by going off in the wrong direction.

To resolve these issues, top management must provide adequate direction through goal definition. They must help coordinate different functional groups toward a common end. They must also be active in the project, without interfering, by being supportive and providing direction to activities that supplement project activities.

### Delivery Problems and Solutions

The Delivery process was defined as producing and marketing the new product. The top three problem areas in Delivery were inadequate resources (again!), poor strategy (marketing management), and product problems (R&D management).

**1. Inadequate resources.**—As certain as death and taxes in everyday life, inadequate resources hound every stage of the innovation process, even in these successful firms. In Delivery, one respondent cited this problem as the “most significant problem that interferes with producing/marketing new products.” In addition to time, people and funds, however, delivery often suffers from lack of adequate manufacturing facilities and supplies. Incomplete documentation adds to the list of problems. Some firms cannot afford “proper tooling” and must suffer through “prototype delivery delays.” The manufacturing group must put the final product together, but they are not always given the resources to do it right.

The solutions might take the form of concurrent engineering to improve communication and ensure a better production process, as well as generally improved operations processes that are ready for new products. These steps might improve the resource situation, but most innovation managers would probably admit that production often bears the brunt of resource shortages, especially time.

**2. Poor strategy.**—Comments about marketing activities most often referred to the lack of a good marketing plan. The problematic aspects of the plan included poor targeting of a market, no strategy for distribution or advertising, and “getting the user to purchase” the products. The theme of these comments was that poor strategic planning led to marketing problems in delivery or, as one executive put it, the lack of a plan led people to “shoot from the hip about introductions and such.”

### Process Innovation Too

Although the research described in this article focuses on product innovation, the innovation framework also applies to process or operations innovations. However, when reviewing this framework with several production managers, they suggested that the fourth stage might be renamed “Deployment” rather than “Delivery.” This change reflects the fact that most process innovations are adopted by the innovating organization. With this adjustment, the process practitioners had no problem accepting the innovation process presented here.

In the event that a firm develops new processes to be used by other organizations, such a “turnkey” process might be dubbed a product by the developer. The adopting organization then deploys the innovation. Whatever the terms used, the innovation process remains similar; consequently, some of the possible problems and suggestions for improvement cited here for product innovations may well apply to process innovations.—D.H.G. and D.J.B.

Suggested techniques for improvement relate to more effective forecasting and better sales force training. To improve forecasting, some firms limit the product line, but most have simply learned how to use forecasting models and regularly update forecasts. To improve sales training, several firms have sales people present during final development and testing activities. One firm even cross-trained assemblers as sales people.

**3. Product problems.**—Problems with products, once they are on the market, were mentioned by several respondents. Related complaints were “design changes due to premature launch” and “constant revisions and delays.” The Achilles heel of manufacturing is frequent design change. The death blow is the defective product design or the “excellent prototype that is not manufacturable.” These are the most common complaints about the outputs of the engineering group. But, the very process of product innovation ensures these problems are not likely to disappear entirely.

The most commonly recommended solution to Delivery problems includes use of a project management team composed of marketing, R&D and manufacturing people (concurrent engineering again); the need to integrate these three perspectives extends from Development into Delivery. In fact, a separate question dealing with the extent to which marketing and manufacturing worked well together in the Delivery stage showed that those companies gaining market share had significantly better cooperation levels.

One firm even resorts to a three-phase process in which manufacturing and R&D first build the prototypes, then R&D and the factory refine the product until production is acceptable. Only then is the production turned over to the factory. Such techniques can ensure that products are ready for production.

Confirming product quality is extremely important. Analysis of another, separate question on the impact of defective products showed that companies losing market share had significantly greater product problems due to products not being ready. As one respondent put it: "Don't sell the wine 'til its time."

### What To Do

The first step toward improved management of the innovation process is to recognize that the process has problems, and to determine exactly what those problems are for a given firm. Then, customized solutions can be developed for each problem area. The exploratory research reported here helps to identify some possible malfunctions in the product innovation process, but it can only suggest possible solution ideas that others have tried in their own situations.

With this warning in mind, several possible conclusions from the respondents' comments can be developed. These are organized around the three basic tenets of total quality management presented at the beginning of this article. Indeed, the data from this study seem to make the most sense when seen through the lens of total quality management.

**1. Customer Orientation.**—Especially evident in the Discovery and Decision stages, but also receiving comments in every stage, the need for better relationships with customers is critical to improving the product innovation process. This includes involving the engineers so that they better understand the customer as they develop the product designs. It also includes better marketing research, and actually using the results of the marketing research.

**2. Continual Process Improvement.**—Our respondents criticized many subprocesses of the innovation process, but those of marketing research, project management, defect-free product design, actual manufacturing processes themselves, and even general processes like strategic planning all need improvement in many of these firms.

This need to improve all subprocesses may account for the complaints about inadequate resources that impact every stage of the innovation process. Indeed, "inadequate resources" was mentioned 233 times by the 116 innovation executives. Inefficient or ineffective processes do waste resources, as can be seen directly from Deming's "chain reaction" (1, p. 3), which shows the formula for how improving quality leads to better products and lower costs. If more resources are not forthcoming, better use of those resources is the only answer. Of course, good strategic and project planning are also critical in order to avoid inappropriate projects that would be wasteful, no matter how well executed.

**3. Total Employee Involvement.**—The data from this research are a strong endorsement for concurrent

***It is top management that is ultimately responsible for every stage of the product innovation process.***

engineering. Whether having engineers involved with marketing in studying the customer and defining the product, or having manufacturing people involved from the beginning to ensure the product can be produced, a greater emphasis on teams is one way of helping to improve all aspects of the production innovation process. Employee involvement can go beyond the creation of project teams, however, as shown by the firm that surveys all employees for innovation ideas.

Even top management should take an active role in clear strategic planning and support of innovation activities to make sure they happen. Although many engineers and other innovation operatives may not welcome top management making product decisions, they would most likely welcome a working environment conducive to product innovation. And, it is top management that is ultimately responsible for every stage of the product innovation process. The tools of total quality management can be a good way to begin improving the critical innovation process. ☺

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