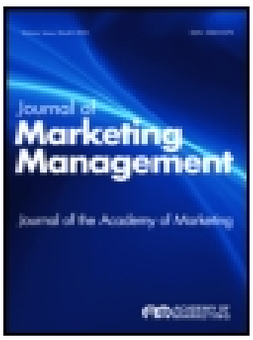

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The New Product Process: A Decision Guide for Management

Robert G. Cooper

This paper presents some of the findings of the latest study in the Project NewProd research series. It attempts to bridge the research-versus-practice gap by giving some advice on putting the findings into practice. The study looks at the characteristics of new research projects in an attempt to uncover what separates winners from losers. This paper takes the key findings from the research study and formulates them into a guide for systematic new product development, giving a practical aid to those involved in the new product development process.

INTRODUCTION

Product innovation has become a popular research topic in recent years. There have been studies into why new products fail, the ingredients of successful product innovation, and what separates winners from losers.[1]

The results of these studies make for interesting reading. But whether they have had a significant impact on management practice remains debatable. Consider this evidence:

—In 1964, the National Industrial Conference Board undertook a study of why new products fail. A similar study by the Board nearly 20 years later revealed an almost identical list of failure reasons (Hopkins 1980). How much have we learned in almost 20 years?

—New products continue to fail at an alarming rate, in spite of many studies that show us what makes for a successful new product. Recent studies show that the failure rates are similar to those reported years ago.[2]

—In spite of the call for the improvements in the way in which new product projects are carried out—better market analysis, more

[1] See references.

[2] See Crawford (1979). The one study that reports improved performance is the survey of management practice by Booz-Allen and Hamilton (1982). But there are obvious methodology and measurement questions concerning the original or benchmark study done in the 60s (Booz-Allen and Hamilton 1968, 1982).

marketing research, more consistent project evaluation, and more attention to marketing planning—recent studies show that many firms' new product processes still fail to include these vital activities (Cooper 1979b, Cooper and Kleinschmidt 1986, 1987a, 1987b, 1987c). Why hasn't management got the message?

Could the problem be one of translation: business researchers and academics produce interesting findings; but they fail to translate them into actionable guides for managers. Perhaps it is time that business researchers begin to focus more on transfer—on using the research results to develop approaches, guidelines and blueprints that can be applied at the new product project level. The objective is that these research-based blueprints will positively impact on the new product process—that is, on the way in which new products are conceived, developed and commercialised.

This article is one researcher's attempt to bridge the research-versus-practice gap. The aim is to translate some of our recent research findings on new industrial products into action steps that can and should be implemented as part of the new product process.

THE RESEARCH BASE

Before probing the management implications of our research, a brief background on the nature of the research is necessary in order to better understand the research results. The NewProd series of research studies have probed what separates successes from failure in industrial product innovation (Cooper 1979a, 1979b, 1980, 1982). The studies, begun in 1977, have typically looked at large samples of successful and unsuccessful new industrial products to determine what distinguishes successful innovations. The most recent NewProd study, undertaken in late 1985, involved a retrospective analysis of 203 industrial new products in 120 firms: 123 commercial successes and 80 failures (Cooper and Kleinschmidt 1986, 1987a, 1987b, 1987c). All 203 products had been launched into the market; commercial success or failure was judged in terms of a number of financial criteria.

The latest study looked at the characteristics of new product projects in an attempt to understand what separates winners from losers. A number of hypotheses were tested, including for example, the role of a strong market orientation and the importance of the pre-development phases of the new product project. The study also looked at the new product process in detail—that is, at the activities that were undertaken as the project moved from the idea stage through to launch. In particular, the focus was on what activities were undertaken, the quality of execution, and major gaps in the new product process. Although some of the research results have been previously reported (Cooper and Kleinschmidt 1986, 1987a, 1987b, 1987c), the current article goes beyond these research results, taking key findings

and fashioning them into a project or process guide for new product managers.

THE ROLE OF A FORMAL NEW PRODUCT PROCESS

A number of firms have adopted a formal new product process (Booz-Allen and Hamilton 1982). That is, they have implemented a systematic process for moving a new product project through the various stages from idea to launch. Such processes are typically characterised by stages, pre-specified activities, and evaluation points.

Does a process approach, although intuitively appealing, have any impact on performance? One study in the US finds that it does. The study concludes that new corporate practices, including implementing a systematic, step-wise new product process, improved the attrition and success rates of new products (Booz-Allen and Hamilton 1982). In our own studies, anecdotal evidence yields similar conclusions. For example, one firm in our sample spent about $1 million and 100 man years to design and implement a four-step new process. After 18 months in practice, the results are positive: fewer mistakes; shorter development cycles; and lower total project costs.

There are difficulties with direct measures of the merits of a new management practice, however. First, how does one objectively measure its impact on performance; and second, after spending one million dollars, it's hardly likely that management would confess that "the system doesn't work".

The NewProd research provides objective insights into the merits of adopting a formal, systematic new product process. Our evidence is indirect, but it has a consistent and undeniable theme: that a new product process decision guide promises significant payoffs. Consider the evidence:

—In the research, we looked at 13 key activities that often comprise the new product process. These activities are listed in Figure 1, but include familiar tasks such as initial screening, preliminary technical assessment, and pilot production runs. What stood out in a review of the 203 new product projects was how many times the key activities were missing altogether:

- In three-quarters of the projects, there was no market study or detailed market research undertaken at all.
- 77 per cent of the projects featured no test market or trial sell.
- 34 per cent of the projects omitted product testing with the customer; and
- 32 per cent did not even have a formal market launch.

Evaluations were also weak, with 65 per cent of projects lacking pre-

commercialisation business analysis[3], and 37 per cent failing to include a business/financial analysis prior to the product development stage.

—We define a "complete" new product process as one where all 13 activities were carried out. Very few projects—only 4 out of the 203—were complete; the typical or median project featured 9 of the 13 activities. But successful products had a much more complete process overall:

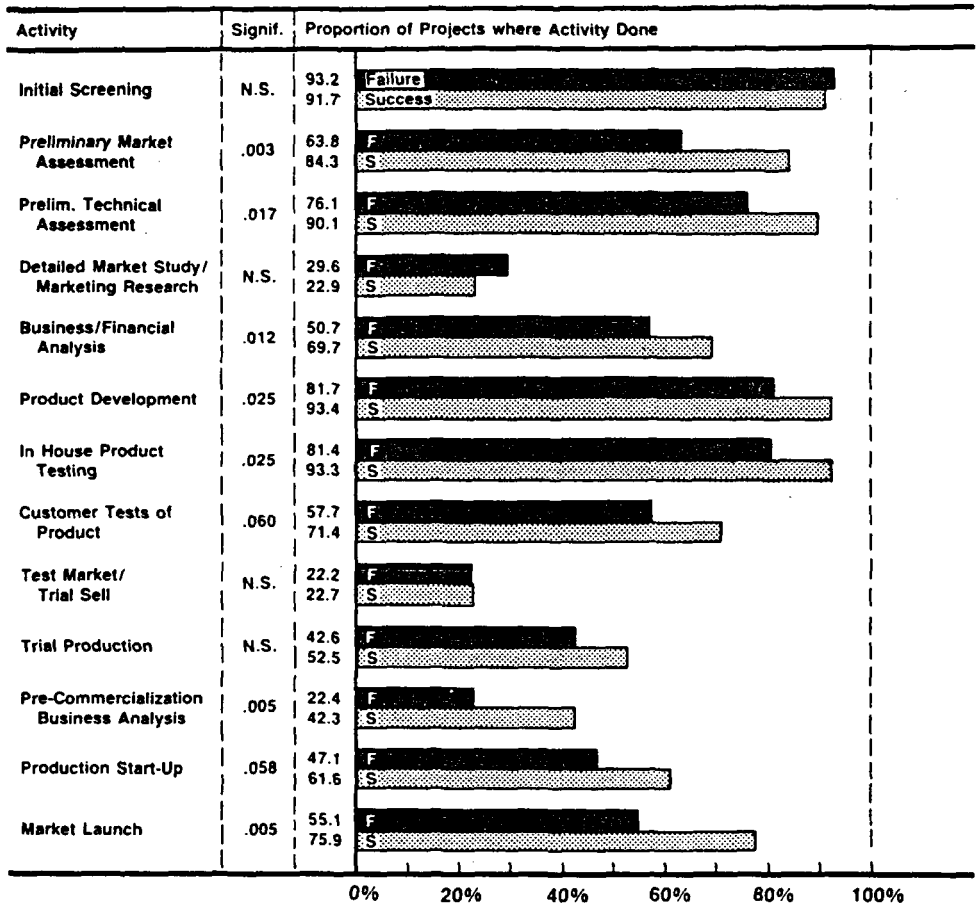
- 20 per cent more successes than failures had a preliminary market assessment carried out;
- 20 per cent more successes than failures had a pre-commercialisation business analysis undertaken;
- 21 per cent more successes than failures featured a formal market launch;
- 14 per cent more successes than failures had a preliminary technical assessment undertaken; and so on.

Figure 1 shows that these tendencies were true, regardless of the activity; in a successful project, there was a higher likelihood that a given activity was undertaken. None of the differences is huge; but they are significant and consistent. The point is that no one activity is pivotal; but as a group, these 13 activities have a pronounced impact on project outcomes. The message is clear: more complete projects are more successful; and the best way to increase the odds of failure is to skip over or delete two, three or more of the 13 activities in the process.

—How well the activities were undertaken was also investigated—the "quality of execution". Not surprisingly, how well the 13 activities were executed was strongly connected to product success and failure. We show the "quality of execution" measure for each of the 13 activities for successes versus failures in Figure 2. Here are some conclusions:

- For all 13 activities, successful products were characterised by much better execution. That is, where activities were properly carried out, there was a much higher likelihood of new product success. Quality of execution is critical.
- The weakest activities in the process—those most poorly executed and those which managers cited as needing improvement the most—were initial screening, the detailed market study or market research, and the preliminary market assessment study.
- The most pivotal activities—those where the differences between success and failure were the greatest—were the up-front or early activities in the new product process. That is, how well the pre-development steps were executed had the strongest impact on product success and failure.

[3]Pre-commercialisation business analysis and business/financial analysis are defined in the next section.



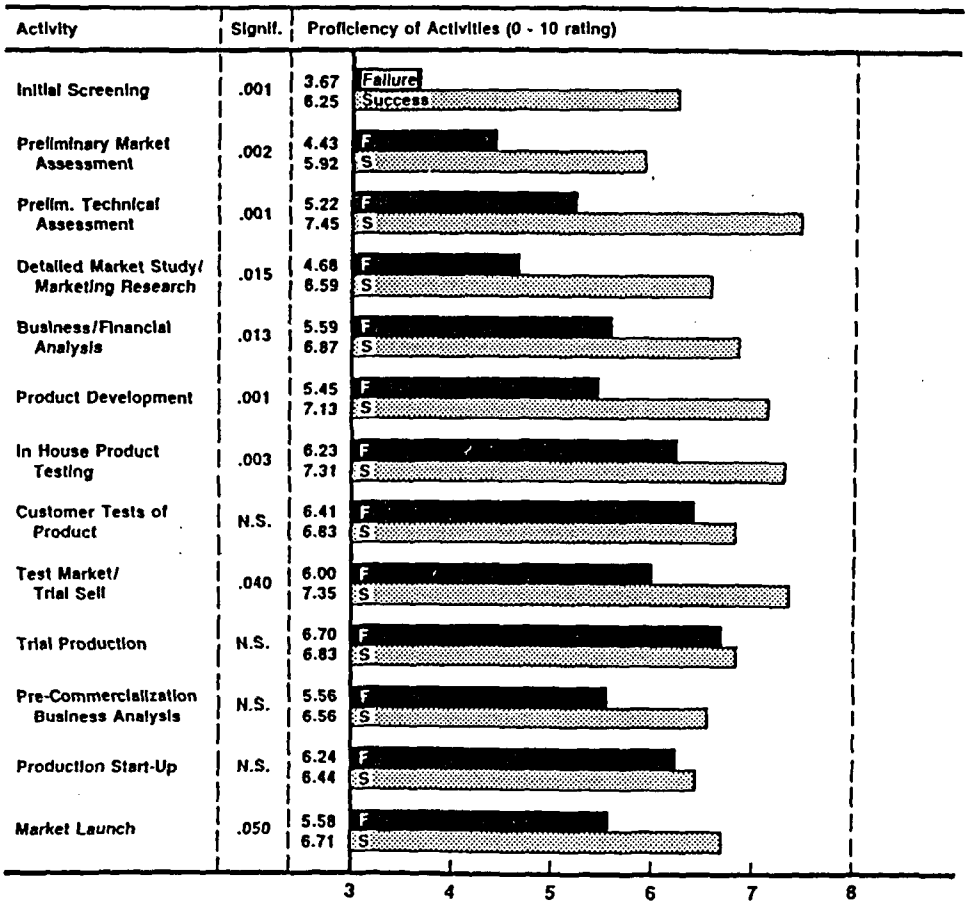
"Shaded bars show significant differences between successful and unsuccessful products. Signif. indicates level of significance, based on two-tail t-test

FIGURE 1 Frequency of activities: successful products versus failures.

What the research clearly reveals is a very strong connection between *process* and *outcomes*. Simply stated. . . .

1. The activities of the new product process—the quality of execution and whether they are carried out at all—have a dramatic impact on product success or failure.
2. There are serious gaps—omissions of steps, and poor quality of execution—in the new product process. These serious gaps are the rule rather than the exception. And they are strongly tied to product failures.

These research findings are the strongest evidence in support of the need for a more systematic approach to the way firms conceive, develop and launch new products. That is, a formal and systematic approach is required



NOTE: Shaded bars show significant differences between successful and unsuccessful products.
"Signif." indicates level of significance, based on two tail t-test.

FIGURE 2 Proficiencies of activities: success versus failure.

to guide and facilitate a new product project as it moves from the idea stage through to launch. Such a process should:

1. Focus on completeness: ensure that the key activities that should comprise a new product project are indeed carried out—no gaps; no omissions; a "complete" process,
2. Focus on quality: ensure that the execution of these activities is proficient; that is, build in controls and checks on the quality of execution,
3. Focus on the important: devote attention and resources to the pivotal and particularly weak steps in the new product process, notably the up-front and market oriented activities.

Later in the article we outline a skeleton of this new product process as a guide to management practice.

THE NEED FOR GATES

Most new product projects are unfit for commercialisation (Cooper 1986). More specifically, six out of seven projects that enter the process are cancelled or fail commercially (Booz-Allen and Hamilton 1982). In order to weed out poor projects early in the process, there is a clear need for project evaluation points or "gates"—points where GO/KILL/HOLD decisions are made on projects—throughout the entire new product process. Gates serve a second purpose as well: they are the check points to ensure the quality of execution of process activities.

Our research revealed that these evaluation points or gates are either missing or fairly ineptly handled in the majority of new product projects. We only looked at three possible gates in the new product process:

- Initial screening: the first decision to commit resources to a project.
- Business/financial analysis: a more in-depth analysis aimed at deciding whether the project should proceed to full scale development.
- Pre-commercialisation business analysis: a detailed business analysis, following product development, to decide whether to move to full production and market launch.

Figures 1 and 2 reveal some of the weaknesses in the three gates:

—Initial screening was rated the most weakly executed step of all 13 activities we considered.

—Over one-third of projects omitted the business/financial analysis evaluation prior to the product development stage. That is, they moved the project into product development without doing a business/financial analysis.

—Pre-commercialisation business analysis was undertaken in a minority of projects: 65 per cent of projects omitted this step.

When undertaken, initial screening was usually poorly handled. In only 11 per cent of the projects was this step undertaken in a proficient way—done by a screening committee or group, and based on a standardised list of screening criteria. The business/financial analysis, undertaken prior to product development, was typically a more formal gate, but it too was plagued by problems:

- In 14 per cent of the projects, management admitted to a superficial analysis—informal, "quick and dirty", rough guesses, etc.
- In 31 per cent of the cases, the evaluation ended at a cost and sales forecast; but there was no attempt at a profitability or return determination.
- In only 31 per cent of the projects did management undertake some form of a discounted cash flow analysis as a means to assessing profitability.

Pre-commercialisation business analysis was handled equally badly. Of the majority of firms undertaking such an analysis, only 35 per cent did a detailed financial analysis involving a profitability or return assessment. The great majority carried out only a partial analysis, such as a sales forecast or a cost review.

The results provide a glimpse of some significant weaknesses and holes in the way in which new product projects are controlled and evaluated. These project evaluation points—the GO/KILL/HOLD decision nodes—are clearly poorly executed in most firms, and omitted altogether in other areas.

One way of overcoming the problem is to build the new product process—the formal, systematic process suggested above—around a set of preset evaluation points or gates. These gates are analogous to quality control inspection points on a production assembly line. They serve to check on the quality and progress of the project. And like a production line with quality checks, the gates are preset at different points throughout the new product process. Some example of gates:

- Gate 1 is the initial screen. It is the first decision to commit resources to the project.
- Gate 3 is the pre-development business/financial analysis—the decision to move into product development.
- Gate N is the final gate—the pre-commercialisation gate—the decision to move to full production and market launch.

Similarly, like a quality control check in production, each gate has its own set of measures and criteria for passing the gate. These questions and hurdles deal with various facets of the project, including:

1. Does the project continue to make economic and business sense? In short, does it continue to meet or exceed our GP criteria?
2. Have the essential steps been completed—those steps or activities necessary to pass through the gate? Is the quality of execution of these activities adequate?
3. Is the project on time and on budget? Have the milestones been hit?
4. What steps or tasks need to be undertaken in the next phase or stage of the project? What milestones, dates and budgets should be attached to these tasks?

Each of the above global questions is broken down into a longer and more detailed list of questions that forms the basis of the measures used at each gate.

The output of the gate decision is one of three options:

KILL: if the answers to question 1 are negative.

GO: if the answers to questions 1 to 3 are positive.

HOLD: if the answer to question 2 is negative.

These gates serve to map and control the new product process. They signal a KILL decision in the event of a project whose economics become negative, where barriers to completion become insurmountable, or where the project is far over-budget and behind time. Gates prevent projects from moving ahead to the next stage until all critical activities have been completed, and the quality of execution is considered adequate. And most important, gates "chart the path forward": they determine what tasks and milestones lie ahead, and the budgets and time-frames for these tasks. In charting the path forward, gates pose the question, "what should we do?" rather than the too familiar question, "what should we have done?"

PARALLEL PROCESSING

One of the underlying drivers of product innovation is that product lives are becoming shorter and shorter (Booz-Allen and Hamilton 1982). But these shorter lives also place increasing time pressures on new product projects: the window of opportunity is limited; thus the product must be developed and commercialised quickly. Compression of the innovation process has become a major objective for many firms in product development.

The dilemma facing management is the conflict between the need for innovation compression on the one hand, and the desire to "do it right" on the other. The activities outlined in Figure 1 constitute a complete and somewhat idealised new product process. Each activity, properly undertaken, contributes to the success of the project, according to our research results. Conversely, electing to drop activities increases the odds of failure. Logic would dictate that many firms would elect the complete process. But less than 1 per cent of projects that we studied fit the ideal! In conversations with the managers we interviewed, some of the reasons for deviations from the ideal become apparent: no time and limited resources. In short, time pressures force many new product projects into a truncated process, with greatly increased odds of failure.

Parallel processing is one solution to the desire to have a complete and quality process, yet one which meets the time pressures of the firm. Traditionally, new product projects have been managed in a series approach—one task strung out after another in series. The analogy is that of a relay race[4]. The business manager initiates the race and runs with the baton for while, undertaking a business analysis. He or she then "hands off" the baton to the next runner, namely the R & D department. R & D runs with the project, eventually passing it to Manufacturing. And finally, Manufacturing hands the baton to Sales and Marketing for product launch. Phrases such as "project hand off" and "runs with the ball" were familiar phrases that managers used to describe projects in the firms where we interviewed.

[4]This relay race metaphor was described in a *Fortune* magazine article (Uttal 1987).

Astute observers note quickly that this traditional relay race or series approach to new product management is antiquated and inappropriate for the 80s and 90s. First, the elapsed time is too long when the process is designed as a series of tasks, strung out one after another. Second, some of the critical activities are overlooked, simply because only one runner or group is on the field at any one time. Finally, there is the problem of hand-offs, or more often, dropped hand-offs, as the project or baton moves from group to group.

Given the time pressures of projects coupled with the need for a complete and quality process, a more appropriate scheme is parallel processing. Here the analogy is a rugby football match (or rugger) (Uttal 1987). The team appears on the field. A scrum or huddle ensues; these scrums are the gates or GO/KILL decision points. The ball comes out of the scrum and the team moves down the field together; the players run in parallel, passing the ball back and forth across the field, yet always moving the ball down field towards the goal. After 25 yards or so, another scrum or gate takes place; and again the ball is moved down the field. This play or game plan is very different from that of a relay race.

The point of this rugby versus relay race metaphor is to demonstrate the advantages of paralleled processing versus a series approach to new products. With paralleled processing, more activities are undertaken in an elapsed period of time: three or four activities are done simultaneously and by different groups. Second, there is less chance of an activity being overlooked because of lack of time—the activity is done in parallel, not in series, and hence does not extend the total elapsed project time. Moreover, the activities are designed to feed each other—the picture of the ball being passed back and forth across the field. And finally, the entire new product process becomes multi-functional and multi-disciplinary: the whole team—marketing, R & D, engineering, manufacturing—is on the field together, participates in each play, and takes part in each gate or scrum.

A STRONG MARKET ORIENTATION

A strong market orientation is critical to new product success, according to most studies of product innovation. Our research concurs:

—Four of the five marketing activities that we studied as part of the new product process were strongly connected to one product success. The correlations between qualities of execution of these activities and new product success level were as high as 0.41 for the detailed market study. (Figure 2 shows how strongly the links between each market oriented activity and product outcomes were).

—We created an index that captured the degree of market orientation for each project (Cooper and Kleinschmidt 1987). This index measured how well the marketing activities were executed (if at all) over the

entire project. This marketing index was strongly and positively correlated to a number of new product performance measures, including meeting sales and projects objectives, relative sales and profits[5], short payback periods, and financial performance (Cooper and Kleinschmidt 1987). Indeed, of a number of hypothesised factors in new product success, a market orientation ranked strongly as a success factor.

—Sadly, a market orientation was missing in the majority of projects that we studied. In fact, the marketing activities were among the weakest rated activities of the entire new product process, as shown in Figure 2. The weakest marketing step was marketing research or the detailed market study; it was also the one activity which managers singled out as needing the greatest improvement.

The message is that market orientation—executing these marketing activities—must be built into the new product process as a matter of routine, rather than by exception. Marketing inputs play a decisive role from beginning to end of the project. The following activities should be an integral and natural facet of the new product process[6] (but they rarely are):

- Preliminary market assessment: an early, relatively inexpensive step designed to test the market attractiveness and market acceptance for the new product. Activities include focus groups, discussions with key customers, small sample phone surveys, etc.
- Market research for product design: an in-depth survey (usually personal interviews) to determine customer needs, wants, preferences and purchase choice criteria as an input to the design of the new product.
- Concept testing: a test of the proposed product with customers (either focus groups or larger sample surveys) to determine likely market acceptance. Note that the product is not yet developed, but a model or representation of the product is displayed to prospective users to gauge reaction and purchase intent.
- Competitive analysis: an assessment of competitors—their products, prices, costs, technologies, production capacities, and marketing strategies. In particular, this analysis should pinpoint areas of competitive weaknesses—notably product deficiencies—to provide clues to gaining a competitive advantage.
- User tests: tests of the sample or prototype product with users to verify the performance of the product at the customer's premises, and to gauge degree of customer liking or preference for the new product (preference tests).

[5]Relative sales and profits: the sales and profits performance of the new product relative to previous new product launches by the firm.

[6]Although the test market or trial sell may not be appropriate for all firms or all projects.

- Test market or trial sell: A mini-launch of the product in a limited geographic area or single sales territory. This is a test of all the elements of the marketing mix.
- Market launch: A proficient launch, based on a sound marketing plan, and backed by sufficient resources.

Concerns are often expressed regarding the *cost* of including these marketing activities—both monetary and time costs. The monetary expenditure is easily justified: properly undertaken, those market-oriented activities will more than pay for themselves by increasing the odds of new product success by a factor of almost three-to-one (Cooper 1980, 1986). The time cost—delay in the new product project—is more difficult to justify. But using the parallel processing approach outlined above, and in a fashion suggested later in this article, the total elapsed time of the project should not be materially affected by including these market-oriented activities. Finally, the time saved by "doing it right the first time", rather than having to recycle back and redo key steps, is a compelling argument for routinely including these steps.

MORE FOCUS ON THE UP-FRONT ACTIVITIES

The outcomes of new product projects are largely decided in the early stages of the new product process—in those steps that precede the actual development of the product. Ironically, most of the money and management time is devoted to the middle and back-end stages of the process, according to the managers we interviewed. Indeed, our research reveals that the up-front or pre-development activities receive little attention:

—There were serious gaps in most of the five up-front or pre-development activities, according to the results in Figure 1. No detailed up-front market study was done in 74 per cent of the projects; no financial/business analysis was done prior to development in 37 per cent of projects; and so on.

—The early or up-front steps tend to be poorly executed, as revealed in Figure 2. In fact, the weakest steps in the entire process occurred prior to development.

—These up-front activities are decisive to new product success. As Figure 2 reveals, the five up-front activities are all strongly linked to project outcomes. Additionally, an index of the quality of these pre-development activities was constructed: of nine key factors in success, the proficiency of these pre-development activities was the *number two* predictor of product outcomes (Cooper and Kleinschmidt 1987). Undertaking the up-front activities was strongly and positively correlated with 11 measures of product performance, including short

pay back periods, project profitability, meeting sales and profit objectives, relative sales and profits, market share in both domestic and foreign markets, and others.

There is more evidence. According to the Booz-Allen and Hamilton studies (1982), companies now spend more time and money on the pre-development activities, the average US firm spending about 20 per cent of the total innovation budget on steps that precede the development phase. Successful product developers spend more than the 20 per cent average, while Japanese firms spend even more.

The message from this facet of the research is that more time and resources must be devoted to the activities that precede the development of the product. These initial screening, analysis and definitional stages are critical to success. Managers must resist the temptation to skip over the up-front stages of a project, and move an ill-defined and poorly investigated project into the development phase. It is here where a disciplined, systematic new product process is required. Strong gates must be a facet of this process—gates which will halt projects from entering development until and unless those critical up-front stages have been completed.

A SYSTEMATIC PROCESS MODEL

We have made five main points in this article. Each is supported by the evidence from the NewProd research studies:

1. There is a need for a systematic new product process scheme to guide and facilitate the new product project from idea to launch.

   This process is one solution to correct the serious deficiencies that are common to many firms' new product efforts. These deficiencies and holes are glaring and pervasive, and sadly, they impact strongly and negatively on performance.

2. A system of evaluation points or gates is one method of controlling the new product process.

   These gates provide the quality control mechanism in the process. Before a project is allowed to proceed to the next phase, the gate ensures that the essential tasks are completed, that their execution is sound, and that the project still is a viable investment. The gate also charts the path forward for the next phase.

3. Parallel processing is an appropriate method for balancing the need of a complete and quality process with the desire for a speedier process.

   Parallel processing means undertaking a variety of tasks in parallel rather than in series. The result is a faster process; there are fewer temptations to delete key activities; activities feed and support each other; and a multi-functional process is the outcome.

4. Marketing activities must be an integral and essential part of the new product process.

A market orientation is missing in most industrial new product projects. Marketing activities are frequently omitted, and often poorly executed. Moreover, the quality of these marketing activities is closely linked to project success.

5. Up-front or pre-development activities are also crucial, and need to be built into the new product process in a consistent and systematic way.

The seeds of success or failure are sown in the first few steps of the new product process. Like the marketing activities, those activities that precede the development of the product—the screening, assessment and project definition steps— are typically weak in most firms, and at the same time, make all the difference between success and failure.

A logical outcome of the above observations and conclusions is a systematic new product process—the Stage-Gate Process—shown pictorially in Figure 3. The process involves a series of stages, each stage consisting of essential activities. A gate system is used to control the process, ensuring that appropriate tasks are completed in a quality fashion. Parallel processing is a feature of the process: marketing, technical and manufacturing activities proceed in parallel throughout the process. And the structure of the process in Figure 3 provides the necessary emphasis on the marketing and the up-front activities so critical to success.

The model or Stage-Gate Process shown in Figure 3 is a fairly generic one. Each firm will be required to develop its own version to suit its needs and industry. But the scheme in Figure 3 provides a skeleton, a concept, and starting point for such a tailored model.

There are six main stages and gates to the system. Each stage and gate is described briefly below:

Gate 1: Initial Screening

Initial screening is the first decision to commit resources to a project: the project is "born" at this point. Such screens are typically handled by a screening group. They are largely non-financial, and are based on a list of "must meet" and "should meet" qualitative criteria.

Stage 1: Assessment

This first and inexpensive step has the objective of determining the technical and marketplace merits of the product. A *preliminary market assessment* and *preliminary technical appraisal* are activities included in this stage.

Gate 2: Preliminary Assessment

This gate is essentially a repeat of Gate 1, but with evaluators armed with better market and technical information. Financial criteria can tentatively be introduced at this gate as well.

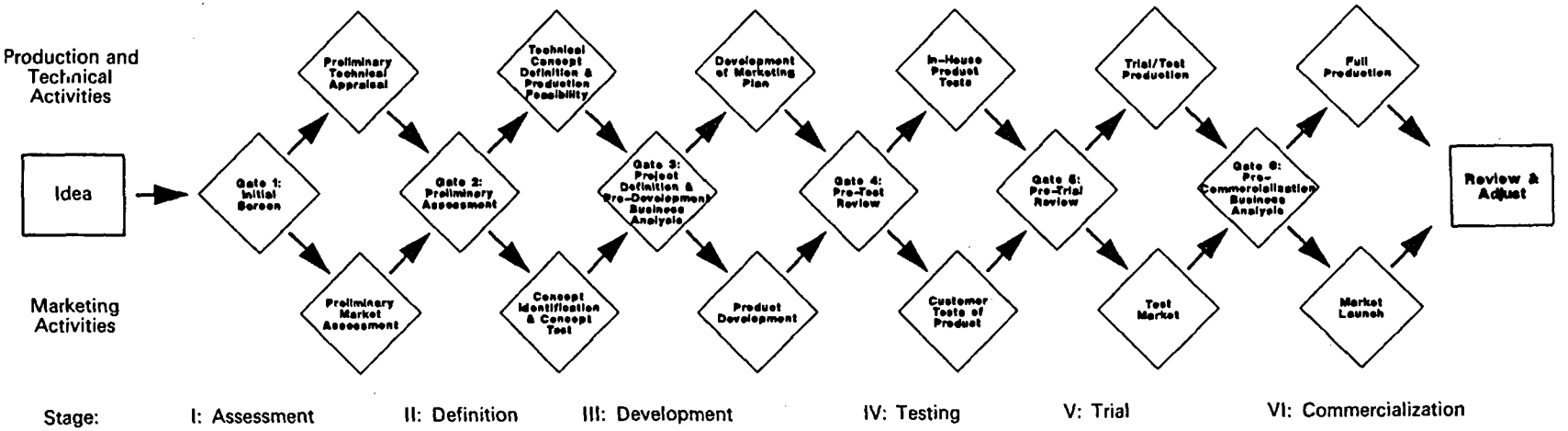


FIGURE 3 The State-Gate new product process, with six stages and gates.

Stage 2: Definition

The final stage prior to product development is where activities focus on defining the product requirements and design. Here, the market research activities listed previously—market research for product design, competitive analysis, and concept testing—are executed. In parallel, technical people translate customer wishes into technically feasible product concepts in the *technical concept generation* activity of this stage. Production feasibility is also an issue here.

Gate 3: Pre-Development Business Analysis

This is the final gate prior to product development, and a critical one. Financial analysis, involving a detailed profitability analysis, is one facet of this gate. A second facet concerns project definition or "protocol", as Crawford (1984) calls it. Agreement must be reached on a number of items before development can begin: the target market; the product concept; benefits to be delivered; positioning strategy; product features, and attributes; and even product specifications.

Stage 3: Development

Here the product development work is undertaken. Concurrently, the other elements of the marketing mix are formulated into a tentative marketing plan.

Gate 4: Pre-Test Review

Gate 4 opens the door to the back-end or post development stages. The first of these is product testing. This gate revisits the economic question—is the project still a good business venture—in the light of new information obtained during product development and the development of the marketing plan. This gate also serves as a quality control check on the development phase.

Stage 4: Testing

This stage includes activities designed to check on product quality to determine that the product functions properly, and also to assess potential users' reactions to the product under actual use conditions. In-house product tests (e.g. lab tests) and user or preference tests are usual activities in this stage.

Gate 5: Pre-Trial Review

This gate reviews the results of the lab and user tests. User results provide an indication of expected sales, and permit a more valid assessment of the products' economic prospects. If the lab and user tests are valid and positive, the project is ready to GO for Trial.

Stage 5: Trial

The trial stage verifies the economic and technical aspects of the project. A trial production run (pilot production) tests the production process and economics of production. A trial sell (or test market) provides a test for the marketing plan; that is, will the product sell? Note that Stage 5—Trial—may not be economically or technically feasible in all projects or companies, and could be a logical candidate for omission.

Gate 6: Pre-Commercialisation Business Analysis

This is the final gate before commercialisation—that is, the final point at which the project can still be killed. Profitability analysis obviously plays a major role in this decision to commercialise the project.

Stage 6: Commercialisation

This final stage involves gearing up for production and market launch. This stage should be followed by a post-commercialisation "review and adjust" step.

This Stage-Gate Process provides the framework for an effective new product process. In practice, the project leader drives the project from stage to stage, ever conscious of each up-coming gate. He or she is well aware of what questions will be asked, and what activities must be completed before the next gate review. The gate is "manned" by a review group—evaluators who are independent of the project—which has the authority to make GO/KILL/HOLD decisions. In effect, the members of this evaluator group are the keepers of the system—the essential quality control check points in the innovation process.

The basic benefits of the Stage-Gate Process are evident. The model puts discipline into a process which, in too many firms, is ad hoc and seriously deficient. The process is visible and relatively simple. What is required at each stage and gate is understood by all. The process provides a road map which facilitates (rather than impedes) the project, and better defines the project leader's job. The Stage-Gate Process also identifies key issues and potential killer variables early in the project, and forces the project team to address these issues well before the project enters the development phase. By building in key activities—the up-front activities and the market-oriented activities—the process promises a higher success rate for completed projects.

New product development will always be a high risk endeavour. This Stage-Gate Process—an attempt to incorporate our research findings into an actionable management tool—is one approach to managing risk in this vital field of product innovation.

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