

New Problems, New Solutions: Making Portfolio Management More Effective

Those businesses that implement a systematic process for managing their project portfolios clearly outperform the rest, ongoing research reveals.

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OVERVIEW: *Most companies' development portfolios suffer from: too many projects for the limited resources available; ineffective project prioritization; Go/Kill decisions made in the absence of solid information; and too many minor projects in the portfolio. The end result is poor performance: low-impact projects; too long to get to market; and higher-than-acceptable failure rates. Solutions are proposed based on the experiences of firms in the study. The first is to implement a systematic gating or Stage-Gate new product process, complete with tough Go/Kill decision points. Next, build in resource capacity analysis—a quantitative assessment of resource supply versus demand in your new product pipeline. A third solution is to develop a product innovation and technology strategy for your business to help guide the selection of the best projects. Finally, integrate portfolio management into your gating process using one of the two approaches utilized by leading companies in the study.*

There are two ways for a business to succeed at new products: *doing projects right*, and *doing the right projects*. Most new product prescriptions focus on the first route; for example, on effective project management, using cross-functional teams, or building in the voice of the customer. Portfolio management, the

topic of this article, focuses on the second route, namely, on doing the right projects.

Despite all the publicity about portfolio management, and the many portfolio methods proposed, managers have identified major problems and have raised serious concerns about the effectiveness of portfolio techniques. This article reports the results of continuing research into portfolio management practices (1,2). It highlights some of the problems, and offers some tentative solutions—solutions that have been witnessed in typical firms as they try to address the issue of picking the right projects (see “Research into Portfolio Management,” next page).

An Elusive Goal

Portfolio management is fundamental to successful new product development. Portfolio management is about resource allocation—how your business spends its capital and people resources, and which development projects it invests in. Portfolio management is also about project selection—ensuring that you have a steady stream of big new-product winners! And portfolio management is about strategy—it is one method by which you operationalize your business's strategy.

Recent years have witnessed a heightened interest in portfolio management, not only in the technical community but in the CEO's office as well. According to our recent survey of Industrial Research Institute member companies, portfolio management has gained prominence for a number of reasons (3):

- Financial—to maximize return on R&D and technology spending.
- To maintain the business's competitive position.
- To properly allocate scarce resources.
- To forge the link between project selection and business strategy.
- To achieve a stronger focus.
- To yield the right balance of projects and investments.
- To communicate project priorities both vertically and horizontally within the organization.

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- To provide greater objectivity in project selection.

The problem is that *effective* portfolio management has proven to be an elusive goal for many businesses. Management rated the effectiveness of their project selection and portfolio management methods, and the results are provocative (2) (Figure 1):

- Portfolio methods in use were given high marks for ensuring strategic alignment—that R&D spending and projects undertaken are consistent with the business's strategy.
- Portfolio methods also fared well in terms of selecting high value projects.
- But portfolio methods were rated much weaker in terms of: having the right number of projects (there are far too many projects in most business's portfolios); promoting timely completion of projects (there is gridlock in the pipeline); having the right balance of projects (too many minor, incremental projects).

Note the major significant differences in Figure 1 between the Best and Worst performers: clearly a number of companies are struggling with their portfolios, while a minority seem to have it right!

Why are managements so disappointed with their first attempts at portfolio management? More in-depth research has probed these issues, and has identified four main challenges or problem areas in portfolio management:

1. Resource balancing—Resource demands usually exceed supply, as management has difficulty balancing the resource needs of projects with resource availability.

2. Prioritizing projects against one another—Many projects look good, especially in their early days, and thus too many projects “pass the hurdles” and are added to the active list. Management seems to have difficulty discriminating between the Go, Kill and Hold projects.

3. Making Go/Kill decisions in the absence of solid information—The up-front homework is often substandard in projects, the result being that management is required to make significant investment decisions, often using very unreliable data. No wonder so many of its decisions are questionable!

4. Too many minor projects in the portfolio—There is an absence of major revenue generators and the kinds of projects that will yield significant technical, market and financial breakthroughs.

These four problems are clearly interlinked. For example, the inability to discriminate between projects invariably leads to a resource balancing problem. Insufficient resources on key projects in turn results in project teams short-cutting key activities. Cutting

Effective portfolio management has proven to be an elusive goal for many companies.

corners on projects results in poor information and difficulty in making sound Go/Kill decisions. Inadequate resources and poor information invariably lead to a tendency to do short-term, quick and simple projects. And so the portfolio problems continue, feeding one another in an endless downward spiral (Figure 2).

We now consider each of these challenges in detail:

1. Too Many Projects, Not Enough Resources

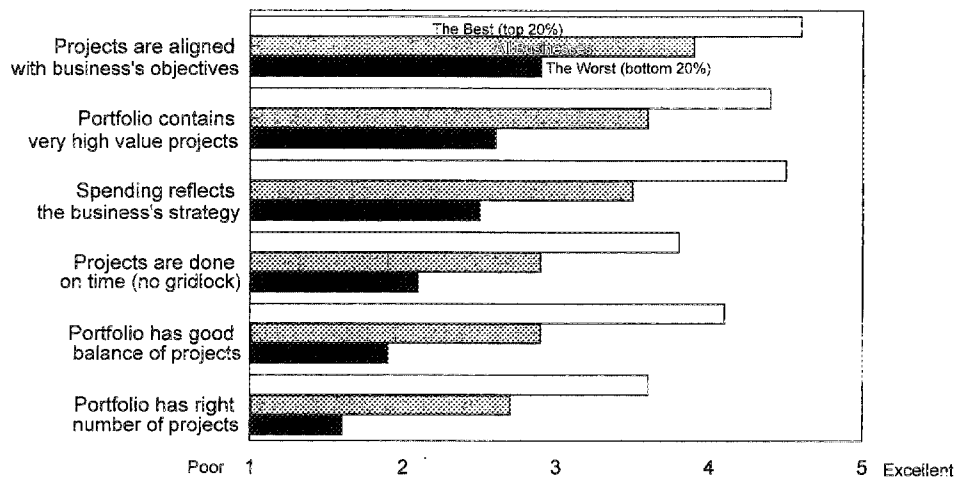
Pipeline gridlock plagues many business portfolios. There are simply too many projects and not enough resources to do them well. This is a universal complaint within product development groups. The demand for more new products than ever, coupled with corporate restructuring, has helped to create this resource crunch:

One frustrated new-product project leader at her company's technology conference exclaimed: “I don't deliberately set out to do a bad job. Yet, when you look at the job that the project leaders around here do, it's almost as though our goal is mediocrity. But that's not true . . . we're good project leaders, but we're being *set up for failure*. There simply isn't enough time and not enough people or the right people to do the job we'd like to do!”

Research into Portfolio Management

This article reports the findings of a continuing research investigation into portfolio management practices and performances, done in part with IRI member companies. Part I of the study looked at 35 leading firms' portfolio management approaches, and was reported in this journal (1). Part II considered a much larger sample of companies (205 businesses), and was able to correlate performance results versus methods used (2). Part III of the research, reported here, probes some of the difficulties uncovered in portfolio management, and what some companies are doing to address these difficulties.

The 30 companies in Part III were deliberately chosen, based on prior knowledge of their approaches and the fact that they were actively addressing portfolio management issues. Further, they are more representative of industry at large (typical companies, as opposed to Part I, which focused on leading firms only). The research is case study in nature (i.e., interviews with management in the firms).—R.G.C., S.J.E. and E.J.K.



Notes: 1) Businesses were categorized into three groups: Best, Worst and All; Best and Worst are top and bottom 20% in terms of their portfolio performance (2). 2) All differences between Best and Worst are significant at the 0.001 level. 3) Performance metrics are rank-ordered according to mean scores (highest mean scores at top of figure).

Figure 1.—Businesses' portfolio performance results are on average fairly good across six key metrics, but there are weaknesses in terms of too many projects, pipeline gridlock, and the right balance of projects. Also, there are major differences between the Best and Worst performers.

She went on to explain to senior management how insufficient resources and budget cuts coupled with too many projects were seriously compromising the way key projects were being executed. She was right! The point is: for positive results, *the resource commitment must be aligned with the business's new product objectives, strategy and processes* (4).

Lack of resources is part of the problem. The other part is the failure to allocate resources effectively. Here, portfolio tools and methods are partly at fault, along with a lack of will on the part of senior management to cut back the number of active projects—to say “no” to some worthwhile initiatives.

The fact is that most project selection and portfolio management methods do a poor job of *resource balancing*. Projects are evaluated; Go decisions are made, but resource implications are often not factored in. For example, one of the most popular methods for evaluating projects and making Go/Kill decisions is the use of financial models, such as NPV (2,5). More advanced versions introduce probabilities and uncertainties into the financial calculation. Management is presented with the NPV of the projects, along with probability distribution curves. These same models, while so elegant in their handling of financial estimates (revenues, costs, profits) are notably lacking in their handling of the resource constraint problem—resource availability is rarely part of the financial calculation.

The majority of project selection techniques are weak when it comes to making Go/Kill decisions or choosing the portfolio in the light of constrained resources. There is really no way to check that the required resources are

available when using most of these selection tools. Indeed, these selection tools consider individual projects one at a time and on their own merits, with little regard for the impact of one project on the next. Worse yet, people resources are assigned to projects but only later is it discovered that the same resources are committed to multiple projects and that some people are committed 150 percent of their time.

In one major beverage company, there were constant complaints that major bottlenecks were encountered in new product projects in the package development department. Only after a demand analysis was undertaken on a project-by-project basis was it discovered how heavily committed certain players were. Each project team member was assigned to projects (number of person-days each month). When the packaging department's time commitments were totaled across all active projects, it turned out that this three-person group had been committed to about 100 person-days each month—a 160-percent commitment. No wonder there were log jams in the process!

The results of too many projects in the pipeline are serious. Here are some of the negative effects we have observed:

- Time to market starts to suffer as projects end up in a queue waiting for people and resources to become available. A senior technology manager in one Xerox division, concerned about project timelines, undertook a quick survey. He picked a day at random, and sent an e-mail to every project leader in his division: “How much work got done on your project today?” The

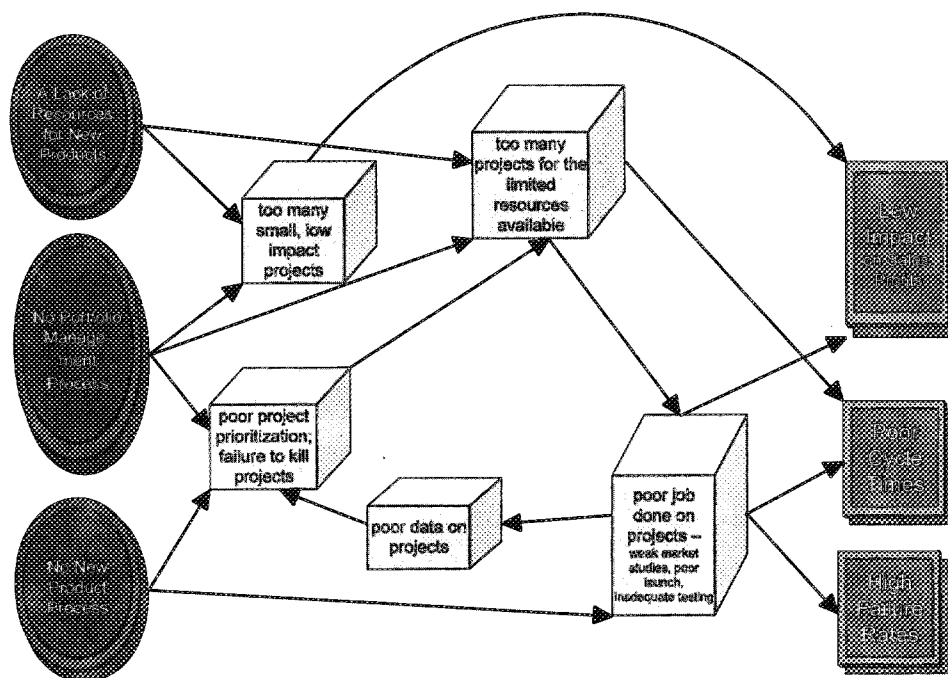


Figure 2.—Lack of resources, no portfolio management, and no new product process (left) are the root cause of many problems, which feed on one another, resulting in a downward spiral of negative effects and results.

shocking news: more than three-quarters of the projects had no work done on them at all! Subsequent follow-up revealed that a minority had legitimate reasons for inaction—waiting for equipment to be delivered, or for tests to be completed. But the great majority were simply in a queue, waiting for people to get around to doing something on them. His best guess was that he could have halved time to market for most projects simply by having fewer active projects underway, and thereby avoiding queues.

- People are spread very thinly across projects. With so many “balls in the air,” people start to cut corners and execute in haste. Key activities may be left out in the interest of being expedient and saving time. And quality of execution starts to suffer. The end result is higher failure rates and an inability to achieve the full potential of would-be winners.

One major chemical company undertook an audit of its new product practices and performance across its many businesses. One common conclusion, regardless of business unit, revealed a lack of good market knowledge and customer input in the typical new product project. A task force was set up to study why. Its conclusions: marketing people were so thinly spread across so many new product projects that they barely had time to oversee the launch of new products, let alone even think about doing market studies and solid market research.

- Quality of information on projects is also deficient. When the project team lacks the time to do a decent market study or a solid technical assessment, management is often forced to make continued investment decisions in the absence of solid information. Consequently, projects are approved that should be killed, and the portfolio suffers.

- Finally, with people spread so thinly across projects, and trying to cope with their “real jobs” too, stress levels go up and morale suffers. As a result, the team concept starts to break down (6).

2. Project Selection Methods Fail To Discriminate

Most project selection tools—scoring models and financial tools, for example—weigh the project against some hurdle or “minimum acceptable value.” In the case of NPV, for example, the NPV is calculated using a risk-adjusted cost of capital. If the NPV is positive, the acceptable hurdle rate is achieved, and the project is deemed a Pass.

The trouble is, lots of projects pass the hurdles. They are rated against objective criteria but then rarely force-ranked against one another. So there is little discrimination between projects—they are all Go’s!

An international banking organization had established a well-oiled new product process, complete with rigorous

Go/Kill decision points built in. These Go/Kill decisions were based in part on a scoring model and also on traditional profitability criteria. Unfortunately, many projects “passed” the hurdles at the gates, and so kept getting added to the active project list. As the list got longer, the resources became spread thinner and thinner! The gating method looked at projects, each on their own merits, but failed to distinguish the top-priority ones from the rest.

Forced-ranking of projects means making tough decisions: The result of this exercise is a prioritized list of projects, with the best ones at the top. Projects are listed until the business runs out of resources. Below that point, projects are put on hold or killed outright. But all too often these tough decisions are not made; as one executive put it, “No one likes to drown puppies in our business!”

This lack of discrimination among projects—where the best rise to the top of the list—is in part due to weaknesses in the particular selection tools used:

- NPV was designed for one-of decisions—for example, the decision to buy a new piece of equipment. But NPV was never meant for portfolio decisions, where multiple projects compete for the same resources. And ranking projects according to their NPVs does not yield the right portfolio either—the method ignores resource constraints. Finally, NPV calculations are always suspect in the early stages of a new product project. As one senior manager remarked, “What number do you want to hear? The project team always delivers the right number to get their project approved!”

- Scoring models are valuable decision aids for evaluating projects. But they too tend to rate projects against absolute criteria, rather than against each other. Admittedly, one might consider ranking projects according to their project scores. But again, the issues of resource constraints and “bang for buck” are ignored.

For example, one major financial institution developed a scoring model to rate projects. Four fairly typical criteria were used: strategic fit and importance, market attractiveness, competitive advantage, and magnitude of the profit opportunity. Projects were scored on these criteria by senior management on zero-to-ten scales; and the scores were added to yield a Program Attractiveness Score. Projects falling below a certain minimum score were discarded, and the remaining ones were rank-ordered according to the Attractiveness Score.

A review of the resulting three-page prioritized list of projects revealed an artifact of the ranking scheme. All the big-hit projects were on page 1 at the top of the list, and the small ones on page 3. But a closer review of the projects showed that many of these big-hit projects also consumed large resources, while some of the projects on pages 2 and 3 of the list, although having lower scores,

were also relatively inexpensive to do. The scoring model had missed the notion of *efficient* allocation of resources.

A final complaint about scoring models is that often they fail to discriminate well. They tend to yield middle-of-the-road scores—60 out of 100—which makes it difficult to spot the stars from the dogs. This is especially true when a large number of scoring criteria are used: high scores on some criteria cancel out low scores on others, and the result regresses towards the mean—a project score of 50 or 60 out of 100.

- Bubble diagrams, another popular tool for visualizing one’s portfolio, have the advantage of looking at all projects together. Figure 3 illustrates how resource requirements are displayed by the size of the bubbles or shapes (7). The problem is that bubble diagrams tend to be information displays only—a discussion tool—and do not generate a list of prioritized projects.

3. Go/Kill Decisions Without Solid Information

This issue was mentioned in the discussion of Problem 1 above, but it is so pervasive that we expand on it here. Here’s a typical case:

A major tool manufacturer has dozens of development projects underway at any one time. In order to help prioritize projects and make better Go/Kill decisions, management has implemented a “Go to Development” gate decision point. The project team is required to submit a business case, which includes estimates of market size, expected revenue and profits. These data are key inputs to the prioritization decision. The trouble is, these numbers are best guesses, often based on numbers pulled out of the air. Hence, management is lulled into believing that it is making rigorous Go/Kill decisions based on objective criteria; in reality, the numbers it is using to make these decisions are *pure fiction*.

Early in the life of a project, management must make some important Go/Kill and resource commitment decisions on specific projects. The dilemma is that the up-front homework is rarely done well enough to provide the quality of information that management needs to make sound decisions. For example, a study of over 500 projects in 300 firms revealed major weaknesses in the front end of projects: weak preliminary market assessments, barely adequate technical assessments, dismal market studies and marketing inputs, and deficient business analyses, on average (8). These are critical homework activities, yet in study after study, they are found wanting—the up-front homework simply does not get done well (9). Even worse, these activities are strongly linked to ultimate project outcomes. The greatest difference between winning products and losers lies in the quality of execution of the project’s homework activities.

Why is quality of execution of these early stage activities so pivotal to new product success? There are two reasons, we observe:

■ When the quality of this early stage work is better, an excellent foundation is laid for the project. Thus, subsequent activities are more proficiently executed—better product design, better testing, better launch and production start-up—and success rates rise (8,9). As an example, better up-front homework usually results in sharper customer input, which in turn means earlier, more accurate and more stable product definition. Note that unstable product specs is one of the major causes of long cycle times, while sharp, early product definition that is fact-based is strongly connected to product profitability (10).

■ When the early work is done better, market and technical information on the project is superior. Thus, management has the information it needs to select the winning projects (and to remove the dogs). The result is a much better portfolio of projects, and again higher success rates. For example, bad market information plagues many new product projects. Lacking good data on market size, expected revenue and pricing makes it difficult to undertake a reliable financial analysis. Indeed, one company's analysis of the accuracy of its financial analyses undertaken just prior to development revealed a 300-percent error in NPV estimates on average! Because so many firms rely on NPV numbers as the dominant decision criteria (2), such errors render the decision-making process a hit-and-miss exercise. One might be better off tossing a coin!

The overriding message here is that doing projects right will ultimately lead to better project selection decisions, hence higher odds of doing the right projects. "Right projects right" becomes the means to achieving the overall goal of a higher success rate:

4. Too Many Small Projects, Too Few Major Hits

The shortage of major hits or big breakthroughs in the portfolio is a problem common to many firms (Figure 2). Anecdotal evidence from our research suggests many reasons for this:

- A preoccupation with financial results and over-emphasis on shareholder value (financial evaluation techniques inevitably favor small, well-defined, fast projects over long-term, less-defined ones).
- Management impatience and its desire for some quick hits. One executive called this the Nike theory of management: "Just do it!"
- A lack of discipline: "Urgent things always take precedence over important things!" exclaimed a frustrated manager, annoyed with his business's preoccupation with quick-hit projects.

The greatest difference between winning projects and losers is in the quality of execution of the project's homework.

- The dynamic nature of markets and the competitive situation, making it difficult to predict the long term (and hence more difficult to predict and justify long-term projects).
- The difficulty in finding major revenue generators—markets are mature, and the opportunities for major breakthroughs just are not there, according to some people in certain industries.

Short-term projects (extensions, modifications, up-dates, fixes) are clearly important projects if the business wishes to remain competitive and keep its product line current. But if these projects consume almost all your development resources, the issue becomes one of balance. A certain proportion of your resources must be committed to bolder projects that promise breakthroughs, or to changing the basis of competition: genuine new products, platform developments, and even technology developments.

Part of the problem is the absence of a product innovation strategy that gives direction to the business's development efforts and spending priorities. With no strategy in place, tactics take over, and tactics favor the small, quick project. Another root cause is the lack of deployment decisions in the business. Many companies we interviewed did not consciously address the deployment or resource allocation decision across project types. For example, there was no attempt to set aside envelopes or "buckets" of money for different project types—major projects, long-term projects, technology developments versus shorter projects, extensions, modifications and fixes (11). With no conscious envelopes or buckets in place, every would-be project is thrown into the same bucket, and the results are predictable: the quick, short-term and well-defined extensions, modifications and fixes win out in the competition for resources, often to the longer-run detriment of the business.

First Things First

Fix the quality of information problem! No matter how elegant or sophisticated your portfolio selection and decision tools, if the information input is poor, then so will your decision-making be. As one manager exclaimed, "If we had spent as much effort improving the quality of information as we did on the software for our new portfolio model, we would have been further

The three axes are:
 X: Time to Launch date (a proxy for risk)
 Y: NPV (net present value \$000)
 Z: Probability of commercial success based on NewProd model [6]
 Projects are shown as spheres, cubes etc.
 The shapes denote degree of technological fit with company (spheres are high; cubes low).
 I-bars denote range of NPV, based on At Risk model (Monte Carlo simulation).

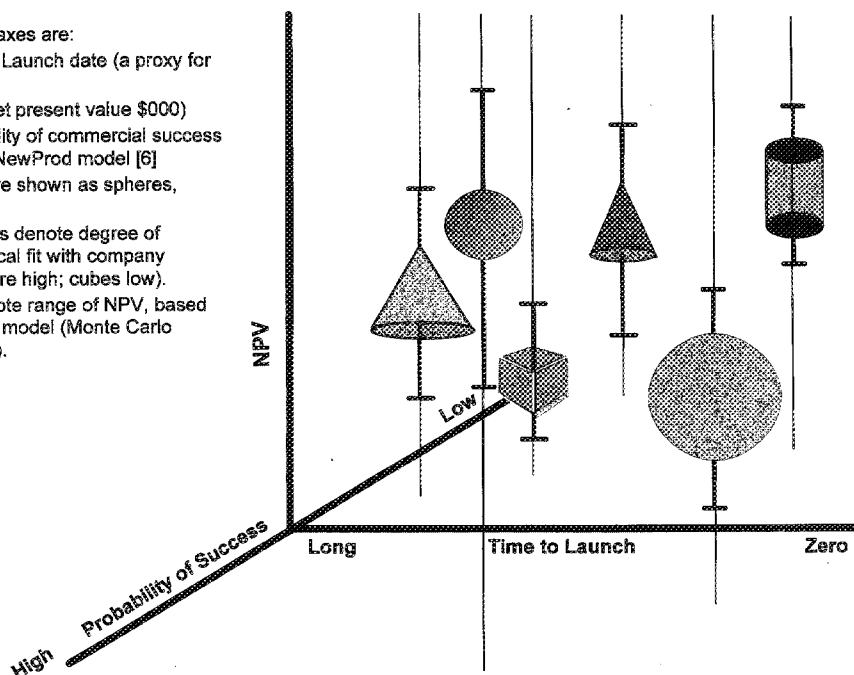


Figure 3.—The Risk-Reward bubble diagram, as used at Procter & Gamble, portrays projects in terms of NPV, commercial success probability, and time to launch (7).

ahead. The elegance of the model far exceeds the quality of the data inputs!"

How can your business strive for better quality information on its projects? Many companies have adopted a stage-and-gate approach to managing their new product projects in order to drive new products to market—see Figure 4 (12). Stage-Gate™ approaches are relatively common in industry today: an estimated 60 percent of U.S. product developers now employ a Stage-Gate method in their product development efforts (13).

Stage-Gate processes are instrumental in improving the quality of information generated in your projects:

- First, Stage-Gate methods define the key tasks, activities and accountabilities within each stage. Thus, in the typical Stage-Gate process, there is a heavy emphasis on the up-front or front-end of the new product process, and assurances that the market information activities are conducted in concert with the technical appraisals.

- Next, gating processes define the deliverables required for the gate decision: Every gate has a menu of deliverables—a list of information items that senior management needs in order to make effective Go/Kill decisions at each gate. Thus, project teams are well aware of what information they must deliver; these deliverables become the team's objectives.

- Finally, Stage-Gate methods specify the criteria against which each project is evaluated. Gatekeepers (the senior management) judge the project against a list of criteria, such as strategic fit, technical feasibility, market attractiveness, and competitive advantage. If the discussion that centers on each criterion results in shrugged shoulders and comments like, "we're not sure," this is a sure signal that the quality of information is sub-standard: the project is recycled to the previous stage rather than being allowed to progress.

Our benchmarking studies, which by now include more than 300 companies, reveal that businesses that boast such a new product process fare much better: higher success rates on launch (by 37.5 percent); meet new product sales objectives more often (88 percent better); and meet profit objectives more often (72.0 percent better) (14).

So, Step 1 is to overhaul your new product process: install a Stage-Gate™ process complete with defined stage activities that emphasize the up-front homework, a menu of deliverables for the key decision points or gates, and defined criteria at each gate against which the project is judged. Experience dictates that it is very difficult to implement portfolio management without an effective new product process, such as Stage-Gate, in place.

Introduce Resource Capacity Analysis

The problem of too many projects and too few resources can be partly resolved by undertaking a *resource capacity analysis*. This analysis attempts to quantify your projects' demand for resources (usually people, expressed as person-days of work) versus the availability of these resources. You can do this analysis in one of two ways (15):

1. *Do you have enough of the right resources to handle projects currently in your pipeline?*—Begin with your current list of active projects. Determine the resources required to complete them according to their timelines. Then look at the availability of resources. You usually find major gaps and hence potential bottlenecks. Finally, identify the key resource constraints—the departments, people or capabilities that you run out of first (see “Two Ways To Analyze Resource Capacity vs. Demand,” next page).

2. *Do you have enough resources to achieve your new product goals?*—Begin with your new-product goals. What percent of your business's sales will come from new products? Now, determine the resources required to achieve this goal. Again, you will likely find a major gap between demand based on your goals, and capacity available. It's time to make some tough choices about the realism of your goals or whether more resources are required (again, see “Two Ways” for details).

This capacity analysis is not a total solution. But it does provide information necessary to begin work on a solution. The experience in companies is that capacity analysis often:

- Detects far too many projects in the pipeline, resulting in an immediate prioritization and pruning effort—the result often is that half the projects are killed or put on hold!
- Causes senior management to rethink its goals (often new-product goals, such as percentage of sales by new

Stage-Gate methods are instrumental in improving the quality of information generated in your projects.

products, are based on wishful thinking or an unrealistic corporate dictum).

- Identifies departments or groups that are major bottlenecks in the innovation process, leading to decisions to increase or shift personnel.

Resource capacity analysis is a tactical move, but it is relatively straightforward, and provides real insights into the nature and magnitude of the resource constraint problem. So when looking at resources and resource allocation, this is a good place to begin. You cannot manage what you cannot measure!

Develop a PITS for Your Business

Developing a product innovation and technology strategy (PITS) for your businesses is one way to improve the balance of projects in the portfolio (16). Some would argue that such a strategy is necessary to ensure a reasonable balance between short-term, quick, small projects and major breakthroughs, and that if your portfolio has too many small projects consuming too many resources, then chances are it is because you lack an innovation strategy or have failed to operationalize one. *Strategy becomes real when you start spending money.* Thus, strategy guides the split in resources across project types—between short-term and long-term projects, between high-risk and low-risk initiatives, between new products and platform development versus extensions, up-dates and fixes.

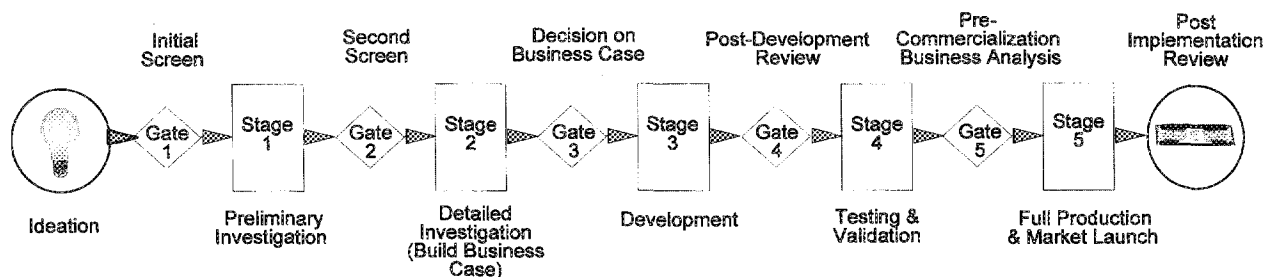


Figure 4.—The typical Stage-Gate™ new-product process has five stages, each preceded by a gate. Stages define best-practice activities and deliverables, while gates rely on visible criteria for Go/Kill decisions. An estimated 60 percent of product developers in the U.S. now employ a Stage-Gate process to guide development efforts (4).

Two Ways To Analyze Resource Capacity vs. Demand (18)

1. Demand Created by Your Active Projects

Determine demand.

- Begin with your current list of active development projects, prioritized from best to worst (use a scoring model to prioritize projects, or one of the financial approaches mentioned in the text). Develop a prioritized project list table.
- Then consider the detailed plan of action for each project (use a timeline software package, such as Microsoft Project).
- For each activity on the timeline, note the number of person-days of work (or work-months), and which group (or department) will do the work.
- Record these work-day requirements in the prioritized project list table—one column per department. In other columns, note the cumulative work-days by department.

What is your capacity?

- Next, look at the capacity available—how many work-days each department (or group) has available in total. (These work-days look at all people in that group or department, and what proportion of their time they have available for new products. Be sure to consider their “other jobs” in this determination; for example, the fact that a marketing group likely has 90 percent of its time consumed by day-to-day assignments).
- Then mark the point in your prioritized-list-of-projects table where you run out of resources—where demand exceeds capacity.

Results

You will likely learn three things from this exercise:

- You really do have too many projects, often by a factor of two or three.
- You can see which department or group is the constraining one.

- You also begin to question where some departments spend their time (and why such a small proportion is available to work on new products!).

2. Demand Generated by Your Business's New Product Goals

Determine demand

- Begin with your new product goals—what sales or percentage of sales you desire from new products.
- Translate these goals into numbers of major and minor new product launches annually.
- Then, using your attrition curve—how many Stage 1, Stage 2, Stage 3, etc. projects does it take to yield one successful launch?—determine the number of projects per year you need moving through each stage.
- Next, consider the work-days requirements in each stage, broken down by function or department. The numbers of projects per stage combined with the work-day requirements yield the demand—namely, the work-days and personnel requirements to achieve your business's new product goals, again by department.

What is your capacity?

- Now turn to availability—how many work-days are available per department (as per the second part of method 1 above).

Results

- Again you are likely to find a major gap between demand and capacity.
- At this point, you either modify your goals, making them a little more realistic, or make tough choices about adding resources or reassigning people in order to achieve your goals.

These two exercises can be done either with work-days (people \times days) or dollars as the measure of resources.—**R.G.C., S.J.E. and E.J.K.**

Your product innovation strategy should:

- Define the goals for your new product and development effort; for example, what percent of your business's sales will come from new products? What percent of profits or growth?
- Define arenas for focus—the key markets, technologies and product types that your development effort will focus on.
- Define deployment of resources—approximate splits in resources or spending across project types (platform developments, new products, extensions, fixes and up-dates), across markets, and across product types.

- Define the attack plan (or strategic stance) for development; for example, being the innovator (versus fast follower) in a given arena, or focusing on superior product performance versus best cost.

At Allied Signal, for example, senior management in each business unit first defines its business vision, goals and strategy. Then it translates this strategy into a spending split in technical resources across three project types: platform projects, new product projects and “other” (modifications, fixes, improvements). After the spending split is decided across project types, projects within each of the three categories are listed and ranked against one another. Different criteria are used to rank

the projects within each category—strategic criteria for platform developments, multiple criteria typical of a scoring model for new products, and financial criteria for “other.” In effect, three separate portfolios of projects are defined, and projects within one category or portfolio do not compete for resources against projects in another category. In this way, resource spending is forced to reflect the business’s strategy.

Integrating Portfolio Management

By putting a Stage-Gate process in place, you are taking the first step toward effective portfolio management. First, quality of information should improve. Second, the gates should at minimum kill poor projects, thereby improving the overall quality of the portfolio. Finally, a gating process engages senior management in the right way. Next, introducing resource capacity analysis is also a good step: you will have a much better understanding of resource needs, resource availabilities and potential bottlenecks.

Where Stage-Gate processes fall short is in project prioritization and resource balancing (Problems 1 and 2 above). That’s the role of portfolio management methods.

Portfolio management goes beyond mere project selection, and it is more than simply making tough Go/Kill decisions at gates. Portfolio management is a dynamic decision process whereby a business’s list of active new product (and R&D) projects is constantly up-dated and revised; new projects are evaluated, selected and prioritized; existing projects may be accelerated, killed or de-prioritized; and resources are allocated and re-allocated to the active projects (5).

A new-product process, such as Stage-Gate, is a step in the right direction, but is only a partial solution. Gating processes focus on individual projects, and evaluate each project on its own merits—they deal with the fingers. By contrast, portfolio management, by considering all projects together, looks at the fist!

Our research reveals a number of companies experimenting with different approaches to portfolio management. These attempts are quite new—portfolio methods have been in place for an average of three years—thus, the approaches are tentative (17). Virtually all the firms finding success here had already implemented a systematic new product process (above), and had designated one gate at the point where portfolio management kicks in. Typically this is Gate 2 (which precedes the Detailed Investigation stage in Figure 4) or Gate 3 (which opens the door to Development).

From this point on, however, there is divergence of opinion, with many different portfolio tools and techniques employed. Indeed, two broad portfolio

Where Stage-Gate processes fall short is in project prioritization and resource balancing.

approaches were observed in practice, and each has its own merits.

We present now a summary of the various portfolio tools used. Next, we outline the two fundamental approaches to portfolio management. Note that although the two approaches share some of the same tools, and on the surface look similar, each is fundamentally different from the other in terms of how it is put into practice.

Portfolio Tools

A variety of portfolio tools, charts and techniques are employed to assist in the review of all projects. Our research uncovered three goals of portfolio management, and different tools appear best suited to each of the goals (1, Part I). The three goals are:

Goal 1: Value Maximization—To allocate resources so as to maximize the value of the portfolio in terms of some business objective, such as profitability. Tools used to assess “project value” include:

- **NPV:** The project’s net present value (or some other financial metric) is determined and must exceed some minimum acceptable value. Projects can also be ranked by NPVs.
- **ECV:** This is a variant of NPV and introduces probabilities of technical and commercial success along with an incremental decision process (options pricing theory) (18).
- **Check lists:** A list of Yes/No questions is used to rate the project in check list format. A suitable pattern of scores (often the absence of definite “No’s”) signals a Pass decision.
- **Scoring model:** Decision makers rate the project on a number of questions that distinguish superior projects, typically on 1–5 or 0–10 scales. These ratings are added to yield a quantified Project Attractiveness Score, which must clear a minimum hurdle. This Score is a proxy for the “value of the project to the company,” but incorporates strategic, leverage and other considerations beyond just the financial measures.

The values of projects to the business are determined, and projects are ranked according to this “value” until there are no more resources.

Goal 2: Balance—To achieve a desired balance of projects in terms of a number of parameters: long-term

projects versus short-term ones; high-risk versus sure bets; and across various markets, technologies and project types.

Visual charts display balance in new-product project portfolios. These visual representations include portfolio maps or *bubble diagrams*, such as the risk-reward bubble diagram used at Procter & Gamble, plotting NPV, probability of success and time-to-market—Figure 3 (5). Other visuals include pie charts that show the breakdown in numbers of projects or spending by project types, product lines or markets (19).

Goal 3: Strategic Direction—To ensure that the final portfolio of projects reflects the business's strategy, that the breakdown of spending across projects, areas, markets, etc., mirrors the business's strategy, and that all projects are "on strategy."

The Strategic Buckets approach is used by some leading firms to ensure that portfolio spending mirrors their strategic priorities. Here, management pre-allocates funds to various "buckets": project types, markets, technologies, or product lines. These splits are based on strategic considerations (for example, Allied Signal splits development resources into three buckets: platform projects, new products and minor projects). Projects are categorized by bucket and then rank-ordered within a bucket. Thus, multiple lists or portfolios of projects are created, with each portfolio managed separately.

How are these various portfolio tools used in conjunction with a gating process? There are two fundamentally different approaches:

Approach 1: The Gates Dominate

Here, the philosophy is that if your gating or Stage-Gate process is working well, the portfolio will take care of itself. Therefore, make good decisions at the gates! The emphasis of this approach is on *sharpening gate decision-making* on individual projects.

In Approach 1, senior management or gatekeepers make Go/Kill decisions at gates on individual projects. Also at gates, the project is prioritized and resources allocated. Gates thus provide an in-depth review of projects, one project at a time, and project teams leave the gate meeting with committed resources—with a check in hand! This is a *real-time decision process*, with gates activated many times throughout the year. By contrast, the periodic Portfolio Review, held perhaps once or twice a year, serves largely as a check to ensure that real-time gate decisions are good ones.

This "gates dominate" approach is often used by companies that already have a Stage-Gate process in place, and one that is working well. They then add portfolio management to their gating process, almost as a complementary decision process. Our research found

this approach used most often in larger companies, in science-based industries, and where projects are lengthy (such as the chemical process industry).

Here's how it works: Projects proceed through the Stage-Gate process as portrayed in Figure 4. Projects are rated and scored at gates, usually by senior management, especially at more critical gates (Gate 3 and beyond in Figure 4).

To introduce portfolio management, gates become two-part decisions (Figure 5). The first part or half of the gate is a Pass-versus-Kill decision, where individual projects are evaluated using the financial, checklist and scoring model valuation tools described above.

The second half of the gate meeting involves *prioritization* of the project under discussion versus the other projects (Figure 5). In practice, this means making a Go-versus-Hold decision, and if Go, allocating resources to the project. A rank-ordered list of projects is displayed to compare the relative attractiveness of the project under discussion to the other Active and On Hold projects. Here, projects can be ranked on a financial criterion (for example, NPV or, better yet, the ECV) or on the Project Attractiveness Score derived from the scoring model.

Additionally, the impact of the proposed project on the total portfolio of projects is assessed. The question is: Does the new project under discussion improve the balance of projects (or detract from balance), and does the project improve the portfolio's strategic alignment? Bubble diagrams and pie charts are the tools used for visualizing balance and alignment, as outlined above.

Note how the gates dominate the decision process in this approach: Go/Kill, prioritization decisions and resource allocation decisions are made in real time, right at the gate meeting. But other projects are *not* discussed and reprioritized at the gate; only the project in question is given a relative priority level versus the rest.

What about looking at all projects together? That's the role of Portfolio Reviews. In this approach, the Portfolio Reviews serve largely as a *check that the gates are working well*. Senior management meets perhaps once or twice a year to review the portfolio of all projects:

- Is there the right balance of projects?
- The right mix?
- Are all projects strategically aligned (fit the business's strategy)?
- Are there the right priorities among projects?

If the gates are working, not too many decisions or major corrective actions should be required at the Portfolio Review. Some companies in our research indicated that they don't even look at individual projects

at the Portfolio Review but only consider projects in aggregate!

To recap, the gates are where the day-to-day decisions are made on projects in Approach 1. Gates focus on individual projects—one at a time—and are in-depth reviews. At gates, each project is evaluated and scored before moving on to the next stage—a real-time decision process. At gates, poor projects are spotted and weeded out, and good ones are identified and prioritized accordingly. Note that resource decisions—committing people and money to specific projects—are made right at these gate meetings. Thus, the gates become a two-part decision process, with projects evaluated on absolute criteria in the first part (Pass/Kill decisions in Figure 5), followed by a comparison with other active and on-hold projects in the second part (Go-versus-Hold decisions). These gate decision points are real-time decisions.

Portfolio Reviews, by contrast, are periodic meetings, held perhaps twice per year. They serve as a check on the portfolio, and oversee the gate decisions being made. If the gates are working well, the Portfolio Reviews are largely a rubber stamp.

Note that the portfolio reviewers and the senior gatekeepers are most often the same people within the business. The result of the gating process working in tandem with the Portfolio Reviews is an effective, harmonized Portfolio Management Process (Figure 6).

Approach 2: Portfolio Review Dominates

The philosophy of the second approach is that every project must compete against the others. A single decision on all projects replaces one of the gates in the gating process.

Here, the leadership team makes Go/Kill and prioritization decisions at the Portfolio Reviews, where *all projects* are up for auction and are considered on the table together. This Review occurs 2–4 times a year. The gates in the Stage-Gate process serve merely as checks on projects—ensuring that projects remain financially sound and are proceeding on schedule.

The result of this “portfolio review dominates” approach is a more dynamic, constantly changing portfolio of projects. The method may suit faster-paced companies, such as software and electronics firms, but it requires a much stronger commitment by senior management to the decision process, spending the time to look at all projects together and in depth several times a year.

Approach 2 uses many of the same portfolio tools and models described above, but in a different way. The result is a more dynamic portfolio of projects. In this approach, the project enters the portfolio process typically after the first stage (at Gate 2 in Figure 4) when data are available.

The main difference from Approach 1 is that early in the life of projects a combined Gate 2 and Portfolio decision

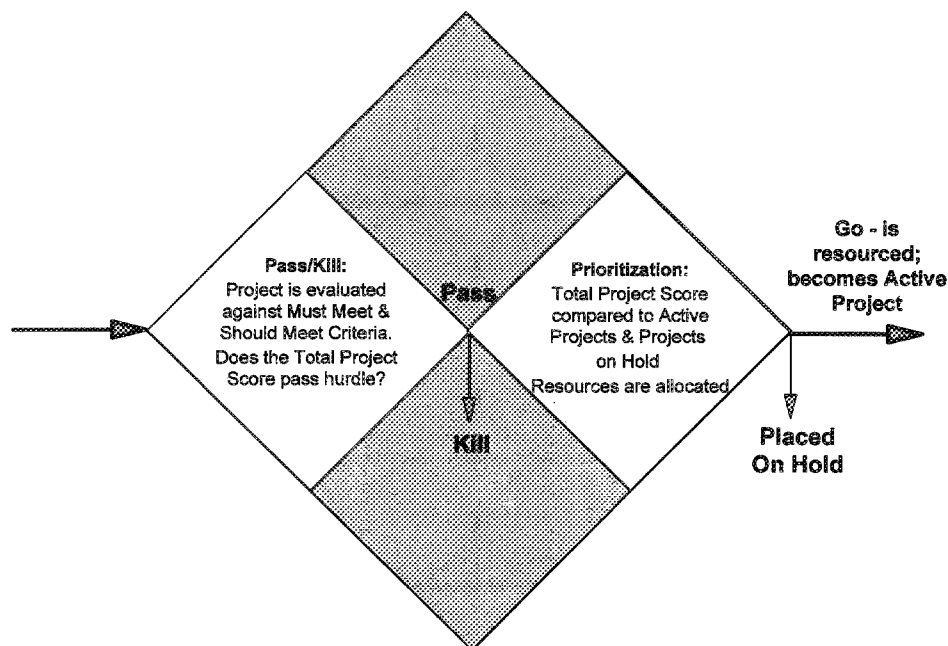


Figure 5.—Decisions at gates are a two-part process. The first part evaluates the project against a set of Must and Should Meet criteria—a Pass vs. Kill decision. In Part 2, the project is prioritized against other Active or On Hold projects.

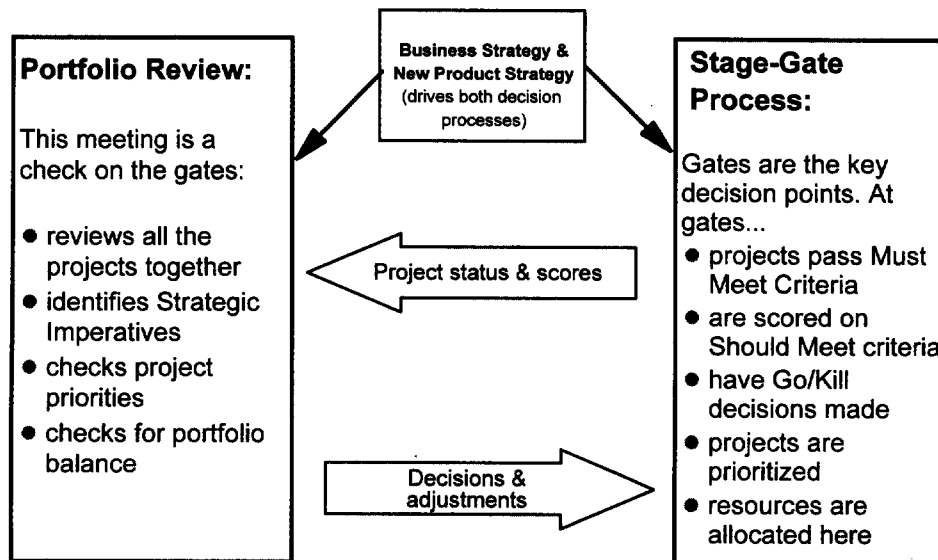


Figure 6.—Portfolio Approach 1 relies on a gating process (right) to make the key decisions. The Portfolio Review (left) serves as a check. Both decision processes are driven by strategy (top).

meeting takes place. All new Gate 2 projects, together with all projects past Gate 2, are reviewed and prioritized against one another. Every project at Gate 2 and beyond is thus in the auction, and all these projects are ranked against each other. Active projects, well along in their development, can be killed or reprioritized here, and resources are allocated here rather than at gates. This Portfolio/Gate 2 decision meeting takes place about four times a year.

The role of gates in Approach 2 is very different from Approach 1. Successive gates (after Gate 2) are merely check points or review points. They:

- Check that the project is on time, on course and on budget.
- Check quality of work done—the quality of deliverables.
- Check that the business case and project are still in good shape.

If No, the project could be killed at the gate, recycled to the previous stage, or flagged for the next Portfolio Review/Gate 2 meeting.

The major decisions, however, occur at the combined Gate 2/Portfolio decision point, which is a more extended, proactive meeting than Portfolio Reviews in Approach 1. And although this is a periodic process, it is almost real-time because this Portfolio/Gate 2 meeting is held every three months.

As an example, EXFO Engineering, a mid-sized entrepreneurial and very successful instrument manufacturer, has implemented both a Stage-Gate process and Portfolio Management Approach 2. Four times a year, the leadership team of this business, chaired by the CEO, evaluates the complete slate of new-product projects during their Portfolio Review meetings. Any project at or beyond Gate 2 is included in this prioritization exercise. Projects are rated according to the following criteria:

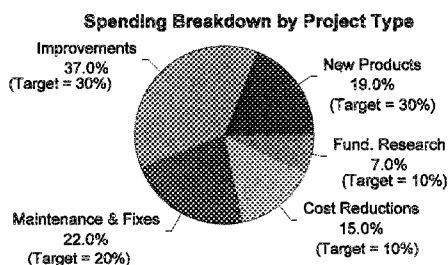
- Confidence in the project team and in their proposed costs, revenues and schedules.
- Revenues (times a commercial risk factor) versus expenses (development and commercialization costs, including a technical risk factor), over a two-year period.
- Match to the strategic plan (specific growth directions, with a weighting factor on each).
- Profitability index (return on investment).
- Availability of technical resources and commercial strengths.

Projects are then force-ranked against one another. The result is a prioritized list, with some projects placed on hold.

The format of this vital, quarterly Gate 2/Portfolio decision point is typically this: All Gate 2 and beyond projects are “on the table.” The portfolio managers (senior management) first identify the “Must Do” projects—the untouchables. These are projects that are

Prioritized Scored List of Active and On-Hold Projects

Project	Rank (Priority Level)	Total Project Score	Portfolio Balance Factor	Adjusted Total Project Score
Soye-44	1	80	1.10	88
Encapsulated	2	82	1.00	82
Legume N-2	3	70	1.10	77
Spread-Ease	4	75	1.00	75
Charcoal-Base	5	60	0.90	72
Projects on Hold				
N2-Fix	1	80	1.00	80**
Slow-Release	2	70	1.10	77*
Multi-Purpose	3	75	.80	68
etc.	etc.			



Risk-Reward Bubble Diagram

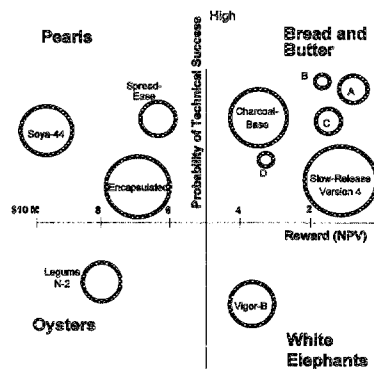


Figure 7.—In Portfolio Approach 2, at the end of the project ranking exercise, the resulting portfolio of projects is displayed on various charts. These charts enable management to check for portfolio balance and strategic alignment.

either well along and still good projects, or are strategic imperatives. Then, management votes on and identifies “Won’t Do’s,” which are killed outright.

Next, the projects in the middle are evaluated. There are different methods here:

- Some firms use the same criteria they use at gate meetings, and in some cases, the most recent gate 0–10 scores; that is, the Project Attractiveness Score from the gate meeting is used to rank-order the projects.
- Other managements re-score the projects right at the Portfolio/Gate 2 meeting (using a shorter list of criteria than the list found in the typical Scoring Model).
- Forced ranking on criteria is also used. Here management ranks the projects *against one another*—1 to *N*—on each criterion. Again, a handful of major criteria are used, such as those used by Kodak at its Portfolio Review (20):

- Strategic fit.
- Product leadership (product advantage).
- Probability of technical success.
- Market attractiveness (growth, margins).
- Value to the company (profitability based on NPV).

We recommend the forced ranking method because it yields better discrimination than a traditional scoring

model, forcing some projects to the top of the list and others to the bottom. One of the weaknesses of a scoring model, in contrast, is that projects tend to score middle-of-the-road—everything is 60 out of 100. But any of these three methods yields a list projects, rank-ordered according to objective scores. Projects are ranked until one runs out of resources. This ranked list is the first cut or *tentative portfolio*.

Following this, it is necessary to check for balance and strategic alignment: The proposed portfolio is displayed using some of the bubble diagrams and pie charts described above (summarized in Figure 7). The purpose here is to visualize the balance of the proposed portfolio and also to check for strategic alignment. If the tentative portfolio is poorly balanced or not strategically aligned, projects are removed from the list and other projects are bumped up. The process is repeated until balance and alignment are achieved.

To recap, the Portfolio/Gate 2 decision meeting is where the key decisions are made in Approach 2. The Portfolio Review is really a Gate 2 and Portfolio Review all-in-one, and held 2–4 times a year. It is here that the key Go/Kill decisions are made, and, consequently, is a senior management meeting. With all projects at or beyond Gate 2 on the table, the meeting:

- Spots Must Do and Won’t Do projects.
- Scores (forced ranking) the ones in the middle.

- Checks for balance and strategic alignment (using various portfolio charts and bubble diagrams).
- Decides the portfolio: which projects, what priorities, how much resources.

The gates serve mainly as a check. Projects are checked as they progress from stage to stage to ensure that they are on time, on budget and remain good projects. Kill decisions are still made at gates to weed out poor projects. Gates rely on criteria, and the scores at these gates are often used as inputs to the Portfolio meeting.

Approach 2 thus lashes together the two decision processes: the gating process and the Portfolio Review. Gate 2 is really the integrative decision point in the scheme, and the point where the two decision processes intersect (Figure 8).

Approach 2 has some advantages (and disadvantages) versus Approach 1. Management indicates that it is easier to prioritize projects when looking at all projects on the table together (rather than one at a time at real-time gates). Additionally, some people have difficulty with the two-part gate approach in Approach 1 and Figure 5; for example, how does one find resources for a good project when that is the only project being considered at the meeting? Finally, some managers like the notion that prioritization of all projects is redone regularly—no project is sacred!

There are also disadvantages to Approach 2, and areas in which Approach 1 is superior. Many managements believe that if projects are to be killed, then the project team should be there to defend the project (or at least to provide updated information), such as happens at an in-depth gate meeting. Another criticism is that Approach 2 requires a major time commitment from senior management; for example, senior management in the mid-sized firm in the instrument business cited above takes three days every quarter to conduct this Portfolio/Gate 2 decision meeting!

A final advantage of Approach 1 is that gate reviews provide a much more in-depth assessment than is ever possible when all the projects are considered at a single meeting.

Just Do It!

New-product portfolio management has become a vital concern, particularly among leading firms. For example, senior executives in top performing businesses consider new-product portfolio management to be “of critical importance” (2). Although a number of tools have been described that help to select projects and visualize a portfolio, the choice of tool may not be that critical; indeed, the best performers use an average of 2.4 tools each—no one tool can do it all!

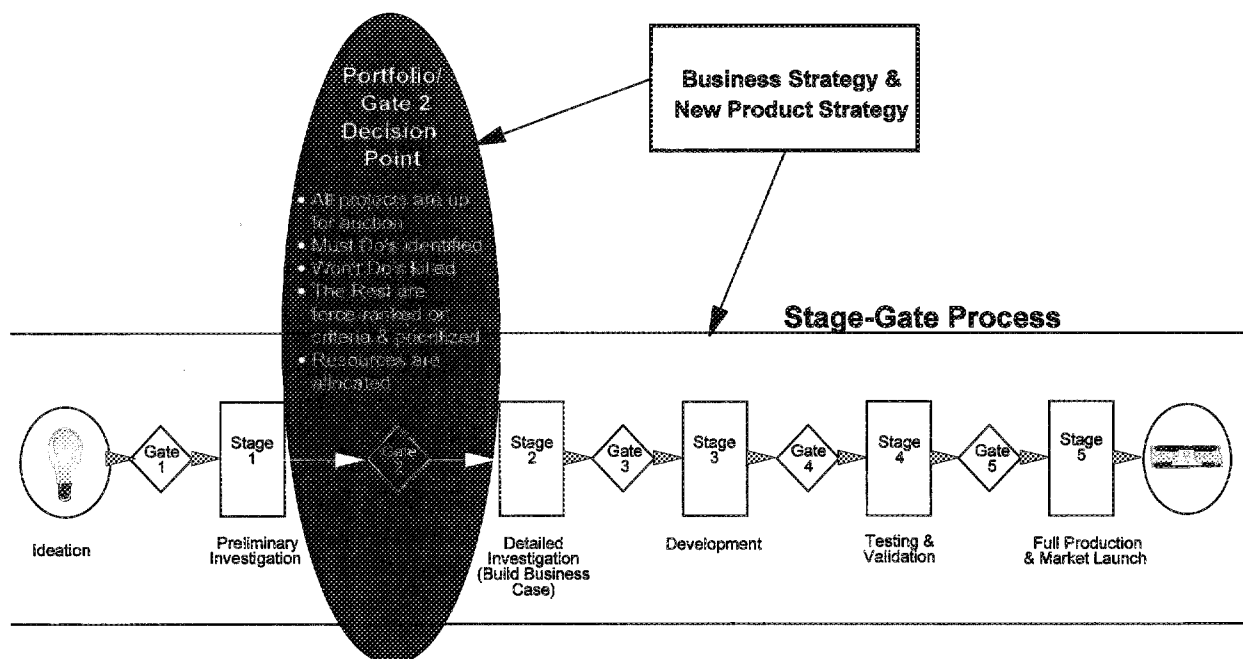


Figure 8.—In Portfolio Approach 2, portfolio management intersects with the new-product process (black oval). Projects are force-ranked against each other in this combined Portfolio/Gate 2 decision meeting. Prioritization is established, and resources are allocated here. Subsequent gates serve as checks.

Two different approaches to portfolio management—where the gates dominate, and where the Portfolio Review dominates—have also been outlined. Both have their merits, and both are recommended. Regardless of which portfolio method or which specific tools you favor, do move ahead: choose a method and implement it! Our research (2) shows clearly that those businesses that feature a systematic portfolio management process—regardless of the specific approach—outperform the rest. ④

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References and Notes

- Cooper, R. G., S. J. Edgett and E. J. Kleinschmidt. "Portfolio Management in New Product Development: Lessons From the Leaders—Part I." *Research • Technology Management*, Sept.–Oct. 1997, pp. 16–28; also: Cooper, R. G., S. J. Edgett and E. J. Kleinschmidt. "Portfolio Management in New Product Development: Lessons From the Leaders—Part II." *Research • Technology Management*, Nov.–Dec. 1997, pp. 43–52.
- A study of portfolio management practices and what results were achieved (IRI member companies). See: Cooper, R. G., S. J. Edgett and E. J. Kleinschmidt. "Best Practices for Managing R&D Portfolios." *Research • Technology Management*, July–Aug. 1998, pp. 20–33.
- Taken from: Cooper, R. G. *Product Leadership: Creating and Launching Superior New Products*. Reading, MA: Perseus Books, 1998, p. 189; and based on a study reported in: Cooper, R. G., S. J. Edgett and E. J. Kleinschmidt. "New product portfolio management: practices and performance." *Journal of Product Innovation Management*, 16, 4, July 1999, pp. 333–351.
- Example taken from: Cooper, R. G. "The invisible success factors in product innovation." *Journal of Product Innovation Management*, 16, 2, April 1999, pp. 115–133.
- Cooper, R. G., S. J. Edgett and E. J. Kleinschmidt. *Portfolio Management for New Products*. Reading, MA: Perseus Books, 1998.
- Also reported in: Crawford, C. M. "The hidden costs of accelerated product development." *Journal of Product Innovation Management*, 9, 3, Sept. 1992, pp. 188–199.
- See this and other examples of bubble diagrams in *Portfolio Management*, (5).
- New product success factors are reported in: Cooper, R. G. "New products: what separates the winners from the losers." In *PDMA Handbook for New Product Development*, ed. M. D. Rosenau Jr., New York, NY: John Wiley & Sons Inc, 1996.
- Success factors are defined in: Cooper, R. G. *Winning at New Products: Accelerating the Process from Idea to Launch*. Reading, MA: Perseus Books, 1993. Also, an excellent review of success/failure studies is: Montoya-Weiss, M. M. and R. J. Calantone. "Determinants of new product performance: a review and meta analysis." *Journal of Product Innovation Management*, 11, 5, Nov. 1994, pp. 397–417.
- Study reported in: Cooper, R. G. "Developing New Products on Time, In Time." *Research • Technology Management*, Sept.–Oct. 1995, pp. 49–57; and: Cooper, R. G. and E. J. Kleinschmidt, "Determinants of timeliness in new product development." *Journal of Product Innovation Management*, 11, 5, Nov. 1994, pp. 381–396.
- This strategic buckets method is described in *Portfolio Management* (5).
- Stage-Gate™ processes are described in *Winning at New Products* (9) and *Product Leadership* (3).
- Griffin, A. *Drivers of NPD Success: The 1997 PDMA Report* (Chicago, Product Development & Management Association) 1997.
- Benchmarking study in: Cooper, R. G. and E. J. Kleinschmidt. "Benchmarking firms' new product performance and practices." *Engineering Management Review*, 23, 3, Fall 1995, pp. 112–120.
- This resource capacity analysis method is taken from the article cited in (4).
- Cooper, R. G. "Product Innovation and Technology Strategy." *Research • Technology Management*, Jan.–Feb. 2000, pp. 38–40.
- As reported in the portfolio study cited in (2).
- For a discussion of Options Pricing Theory, see *Product Leadership* (3), and also: Faulkner, T. "Applying 'Options Thinking' to R&D Valuation." *Research • Technology Management*, May–June 1996, pp. 50–57.
- For a complete illustration of these various pie charts and bubble diagrams, see *Portfolio Management* (5); also the two articles in (1).
- Kodak's portfolio management approach is described in: Patton, E. "The strategic investment process: driving corporate vision through portfolio creation." *Proceedings: Product Portfolio Management: Balancing Resources with Opportunity*, The Management Roundtable, Boston, 1999.

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