



New Product Portfolio Management: Practices and Performance

Robert G. Cooper, Scott J. Edgett, and Elko J. Kleinschmidt

Effective portfolio management is vital to successful product innovation. Portfolio management is about making strategic choices—which markets, products, and technologies our business will invest in. It is about resource allocation—how you will spend your scarce engineering, R&D, and marketing resources. It focuses on project selection—on which new product or development projects you choose from the many opportunities you face. And it deals with balance—having the right balance between numbers of projects you do and the resources or capabilities you have available.

In this article, the authors reveal the findings of their extensive study of portfolio management in industry. This study, the first of its kind, reports the portfolio management practices and performance of 205 U.S. companies. Its overall objective was to gain insights into what portfolio methods companies use, whether they are satisfied with them, the performance results they achieve with the different approaches, and suggestions for others who are considering implementing portfolio management.

The research first assesses management's satisfaction with portfolio methods they employ and notes that some firms face major problems in portfolio management. Next, businesses are grouped or clustered into four groups according to management's view of portfolio management: Cowboys, Crossroads, Duds, and Benchmark businesses.

Various performance metrics are used to gauge the performance of the business's portfolio. The results reveal major differences between the best and the worst. Benchmark businesses are the top performers. Their new product portfolios consistently score the best in terms of performance—high-value projects, aligned with the business's strategy, the right balance of projects, and the right number of projects. The authors take a closer look at these benchmark businesses to determine what distinguishes their projects from the rest. Benchmark businesses employ a much more formal, explicit method to managing their portfolio of projects. They rely on clear, well-defined portfolio procedures, they consistently apply their portfolio method to all projects, and management buys into the approach.

The relative popularity of various portfolio methods—from financial methods to strategic approaches, bubble diagrams, and scoring approaches—are investi-

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gated. Not surprisingly, financial approaches are the most popular and dominate the portfolio decision. But what is surprising is the dubious results achieved via financial approaches. Again, benchmark businesses stand out from the rest: they place less emphasis on financial approaches and more on strategic methods, and they tend to use multiple methods more so than the rest. Strategic methods, along with scoring approaches, yield the best portfolios; financial methods yield poorer portfolio results.

The authors provide a number of recommendations and suggestions for anyone setting out to implement portfolio management in their business. © 1999 Elsevier Science Inc.

Introduction

A vital question in new product management is: How should the business most effectively invest its research and development (R&D) and new product resources?¹ That's what *portfolio management* is all about: resource allocation to achieve the business's new product and technology objectives.

Some firms restrict "portfolio management" to new and improved products, and platform projects with new product potential [16,18]. In contrast, other firms include virtually any Development project under the topic "portfolio management," such as process improvements, cost reductions, minor product improvements, customer projects, and so on. Thus, we tend to use terms such as "new product portfolio" or "R&D portfolio" interchangeably in this article.

BIOGRAPHICAL SKETCHES

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Much like a stock market portfolio manager, those senior executives who manage to optimize their R&D and marketing investments—to define the right new product strategy for the firm, select the winning new product projects, and achieve the ideal balance of projects—will win in the long run. This article presents some of the findings of an extensive investigation into how businesses manage their R&D and new product portfolios, how satisfied management is with their portfolio management practices, and the portfolio results achieved in these businesses.

What Is Portfolio Management?

"Portfolio analysis and planning will grow in the 1990s to become the powerful tool that business portfolio planning became in the 1970s and 1980s", according to Roussel et al. [19] in their widely read book, *Third Generation R&D*. Portfolio management and the prioritization of new product or R&D projects [19] is vital to successful business performance for many reasons:

- First, portfolio management is about making strategic choices. It is one route by which senior management operationalizes their business's strategy—the types of products, markets, and technologies management has chosen to attack, and the relative emphasis on each.
- Second, the new product and technology choices that management makes today determine what the business will look like 5 years out. An estimated 32% of firms' sales today come from new products introduced within the last 5 years [10].
- Third, portfolio management is about resource allocation—the allocation of scarce and vital R&D, engineering, marketing, and operations resources at a time when these resources are more stretched than ever.

- Finally, portfolio management deals with the critical issue of balancing resources available with the numbers of projects. Errors here—for example, trying to do too many projects for the limited resources available—results in longer cycle times, poor quality of execution, and underperforming new products.

Before charging into the topic of what portfolio techniques industry relies on, let's stand back and reflect on what portfolio management is. We *define portfolio management* formally as follows:

Portfolio management is a dynamic decision process, whereby a business's list of active new product (and R&D) projects is constantly updated and revised. In this process, new projects are evaluated, selected, and prioritized; existing projects may be accelerated, killed, or deprioritized; and resources are allocated and reallocated to the active projects. The portfolio decision process is characterized by uncertain and changing information, dynamic opportunities, multiple goals and strategic considerations, interdependence among projects, and multiple decision-makers and locations.

The portfolio decision process encompasses or overlaps a number of decision-making processes within the business, including periodic reviews of the total portfolio of all projects (looking at the entire set of projects, and comparing all projects against each other), making go/kill decisions on individual projects on an on-going basis (using gates or a *stage-gate* process), and developing a new product strategy for the business, complete with strategic resource allocation decisions.

R&D Portfolio Methods: A Checkered History

The original portfolio selection models of the 1960s and 1970s were highly mathematical, and they employed techniques such as linear, dynamic, and integer programming. The objective was to develop a portfolio of new and existing projects to maximize some objective function (for example, the expected profits) subject to a set of resource constraints. Anyone familiar with these programming techniques will immediately recognize the challenge that the mathematician and management scientist would have solving this portfolio problem. A good summary article on such methods is Jackson's [12] "Decision methods for selecting a portfolio of R&D projects."

Although conceptually appealing and perhaps the

most rigorous, mathematically based portfolio models see more visibility in text books and journal articles than in corporate offices. Studies done in North America and Europe show that managers have a great aversion to these mathematical techniques, and for good reason [1]. The major obstacle is the amount of data required: information on the financial results, resource needs timing, and probabilities of completion and success for all projects. Much of this information simply is not available, and, when it is, its reliability is suspect. Further, these mathematical portfolio approaches historically have provided inadequate treatment of risk and uncertainty; they are unable to handle multiple and interrelated criteria; and they generally fail to recognize interrelationships with respect to payoffs of combined utilization of resources. Finally, managers perceive such techniques to be too difficult to understand and use.

The portfolio management decision problem remains an important, albeit complex, one. Thus, recent years have witnessed the introduction or use of a number of other or new product portfolio methods. These include, for example:

- *Financial models and financial indices.* These range from ranking or selecting projects based on traditional net present value (NPV), internal rate of return (IRR), and payback methods through to various financial ratios (such as SDG's popular Productivity Index²) [2,15].
- *Probabilistic financial models.* These include Monte Carlo Simulation (for example, the add-on programs to various spreadsheets, such as *At Risk* and *Crystal Ball*); and decision trees (such as the expected commercial value (ECV) method) [20].
- *Options pricing theory.* This newer method, adopted by Kodak and others, treats each stage of the new product project much like purchasing an option on a future investment [9,14].
- *Strategic approaches.* Here, the selection of the portfolio of projects is largely driven by the strategy of the business. The business strategy decides the split of resources across different categories—for example, by types of projects, markets, or product lines—to create strategic buckets [5]. And strategic considerations dominate the decision to do (or not do) certain R&D or new product projects.

²Productivity Index: Probability-adjusted NPV divided by R&D costs remaining in the project (alternately, divided by the total costs remaining). Projects are rank ordered according to this index.

- *Scoring models and checklists.* Here, projects are rated and scored on a variety of qualitative questions (in some cases, the project score becomes the criterion for project prioritization) [11,19,21]. The questions or items often capture proven drivers of new product success such as product advantage, market attractiveness, synergy with the base business (leverages core competencies), familiarity, etc. [3,17].
- *Analytical hierarchy approaches.* These are decision tools based on paired comparisons of both projects and criteria. Models such as *Expert Choice* enable a team of managers to arrive at the preferred set of projects in a portfolio [22]. Voting software and hardware (for example, hand-held wireless voting machines linked to software and a video projector) permit the management team to input their choices quickly and visually.³
- *Behavioral approaches.* These are tools designed to bring managers to a consensus in terms of which projects to undertake, and include methods such as Delphi and Q-Sort [13,20]. They are particularly useful for the early gates, where only qualitative information is available.
- *Mapping approaches or bubble diagrams.* These are essentially extensions of the original Boston Consulting Group (BCG) portfolio models (stars, cash cows, dogs, wildcats) and the GE/McKinsey model, which were designed to allocate resources across the business units in a corporation. In new product mapping models, various parameters are plotted against each other in a bubble diagram format—plots such as Reward versus Probability-of-Success or Ease-of-Undertaking versus Project-Attractiveness [15,19].

Although the published literature over the past 30 years outlines many approaches for portfolio management and project selection, there is very little evidence regarding the *widespread transfer* of these techniques into management practice or whether these approaches have had positive results. Despite all the proposed solutions, a recent benchmarking study points to *project selection* and *project prioritization* as the *weakest facet* of all new product management activities [7,8]. In this benchmarking study, managements confessed to a lack of project prioritization, too many projects for the available resources, and minimal at-

tempts at portfolio management. So there appears to be a major gulf between theory and practice.

Further, although many prescriptions have been offered over the years, surprisingly little *empirical research* has probed the topic of portfolio management in industry. Numerous questions thus remain in the portfolio management area. For example, how do companies select the appropriate portfolio of new product investments? Do formal and explicit methods work better than informal, ad hoc approaches? How satisfied is management with the various approaches they use? And what portfolio results are businesses realizing?

The current research study seeks to address some of these questions regarding both the use and performance of portfolio management methods—questions that remain largely unanswered in the literature. The underlying goal of the investigation is to provide insights into how businesses manage their R&D and new product portfolios, and the results achieved. Specific objectives are as follows:

- to describe and characterize portfolio management and project prioritization methods used in industry,
- to determine the relative popularity of each method,
- to assess managements' perceptions of, and satisfaction with, alternate portfolio management methods,
- to characterize the portfolio methods used, and
- to determine portfolio results achieved.

How the Research Was Undertaken

Exploratory Work

An exploratory study was undertaken first to gain insights into industry's use of portfolio models. Leading firms were identified and in-depth interviews were conducted with management to better define what portfolio management is, to identify the types of portfolio management methods in use, to understand the principal goals that businesses are trying to achieve via portfolio management, and to determine how managers perceived these models and methods [4-6].

Conceptual Framework

Next, a conceptual framework was developed to help guide the current large sample study (Figure 1). The framework consists of six main sets or blocks of variables:

³See, for example, the system offered by the Saunders Consulting Group, Toronto, Canada, used in a number of businesses.

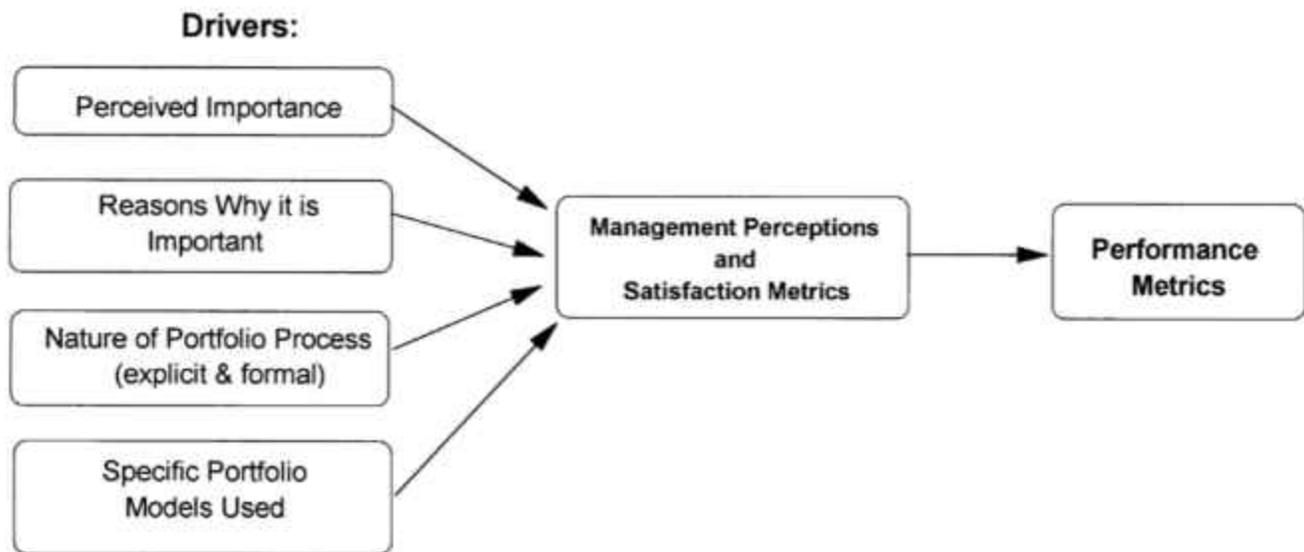


Figure 1. Portfolio conceptual framework.

1. *Performance metrics.* The framework postulates that management seeks certain ultimate performance goals from their portfolio management method. These performance goals or metrics were uncovered in the exploratory study and include items such as maximizing the portfolio's economic value, strategic alignment, and portfolio balance (more on these later). These performance goals are at the right side of Figure 1.
2. *Perception and satisfaction metrics.* There is also a set of interim or intermediate metrics and characteristics that captures how managers perceive their portfolio management tools (for example, decision effectiveness or user friendliness) and whether or not they are satisfied with the portfolio method they use (for example, whether or not they would recommend the method to others). Although not the ultimate goals of portfolio management, nonetheless they are highly desirable and very commonly discussed metrics, as uncovered in the exploratory study. They are shown in the middle of the conceptual framework of Figure 1.
3. *Drivers.* Finally, there are four sets of variables that are postulated to drive both sets of metrics outlined previously (again, these were tentatively identified in the exploratory study). These blocks of variables include:
 - how *important* portfolio management is perceived to be in the business.
 - the *reasons why* portfolio management may be important—why the business has adopted more formal approaches to portfolio management,

- the nature of the portfolio management methods used by the business—for example, how explicit and *formal* the method is,
- the *specific portfolio models* or tools used by the business—for example, financial methods versus mapping techniques versus scoring models or strategic approaches.

These four blocks of driver (or causal) variables are shown to the left of Figure 1.

The six blocks of variables outlined in this conceptual model in Figure 1 form the foundation for the study. A list of variables was constructed for each block, and these variables then were operationalized.

Data Collection

A detailed survey questionnaire was developed in concert with the IRI's Research on Research Committee. (The IRI or *Industrial Research Institute* is an association consisting largely of Chief Technology Officers of Fortune 500 companies in America.⁴) The questionnaire measured variables within each of the six blocks outlined in the conceptual framework, namely:

- how important portfolio management is thought to be, and the reasons why;
- the types of portfolio methods used by the business;
- management's perceptions of, and satisfaction with, the portfolio method(s) they use;

⁴Representing approximately 80% of R&D spending in the U.S.

- the performance of the business's portfolio management method;
- various characteristics—formality and explicitness—of the portfolio management approach employed; and, finally,
- general demographics (industry, business size, etc.).

Most of the questions were close-ended (i.e., require the respondent to check a box or circle a number), although some open-ended questions were included to solicit verbal comment. Many of the questions required ratings on 1–5 Likert-type scales. The questionnaire itself was carefully structured, exhaustively reviewed by a committee of industry experts from the IRI, pre-tested on eight businesses via personal interviews, and finalized.

A listing of businesses known to be active in product development in North America was prepared, including the IRI membership list as well as other private lists compiled by the authors. Although not the total population of all firms undertaking R&D and product development in the U.S., the list is a fairly representative one.

A respectable response rate of 25.8% was achieved from the mail survey, numbering 205 businesses. The breakdown of respondents by industry is as follows:

High technology	17.6%
Processed materials	8.3%
Industrial products	8.3%
Chemicals and advanced materials	28.3%
Health care products	6.3%
Consumer goods	12.2%
Others	19.0%

The corporations that took part in the survey are quite large, with average annual sales of \$6.74 billion (U.S.). Similarly, the size of the business studied within the corporation also was quite large, with average annual sales of \$1.89 billion. Note that the unit of analysis was a business, SBU, or division—a self contained business with its own R&D budget. The average R&D spending across the sample of businesses is 5.05% of sales, considerably higher than the U.S. national average.

There were no noticeable biases in the responding businesses⁵ versus those in the original mailing (i.e., the responses reflect the population). Additionally,

Note: we use the term "business" rather than company, because the completed questionnaires describe only a single business or SBU within a larger corporation.

there are no differences in the response patterns between IRI and non-IRI members; thus, the two samples are combined and results are presented together. Further, every effort was made to ensure that performance and satisfaction measures were objective ones: for example, multiple measures were used to heighten reliability; measures were reviewed by a panel of experts for their validity; and anchor phrases were used to improve consistency across respondents. Nonetheless, there is always the possibility of halo effects or "after-the-fact rationalization" in the case of retrospective research studies such as this.

Results: Management Perceptions and Satisfaction Level

Management's satisfaction with the portfolio management methods they are using was one of the prime areas of interest in the current study—for example, the perceived effectiveness, efficiency, realism, and user friendliness of their portfolio approaches (the middle box in Figure 1). Management perceptions and satisfaction levels were captured on nine different metrics (Figure 2).

On average, managements appears to be *only marginally satisfied* with their portfolio management approaches. Note the mid-range, middle-of-the-road scores achieved in Figure 2. The most positive facets of the portfolio management methods include:

- the portfolio management process used *fits the management's decision-making style*, and
- the method is perceived as being *effective* (i.e., makes the right decisions).

These elements are the best, but still the mean scores achieved here point to much room for improvement. The remainder of Figure 2 reveals much more disturbing results. On average:

- The portfolio method used is not particularly efficient (somewhat laborious and wastes time);
- It is not especially realistic in capturing key facets of the decision problem;
- The method is not particularly user friendly and easy to use; and
- It is not well understood by senior management.

The three lowest scoring items in Figure 2 are noteworthy. On average, businesses do not rate their portfolio methods as excellent (rather, a mid-range, fairly mediocre rating is given); their method is not really used to make go/kill decisions on projects; nor

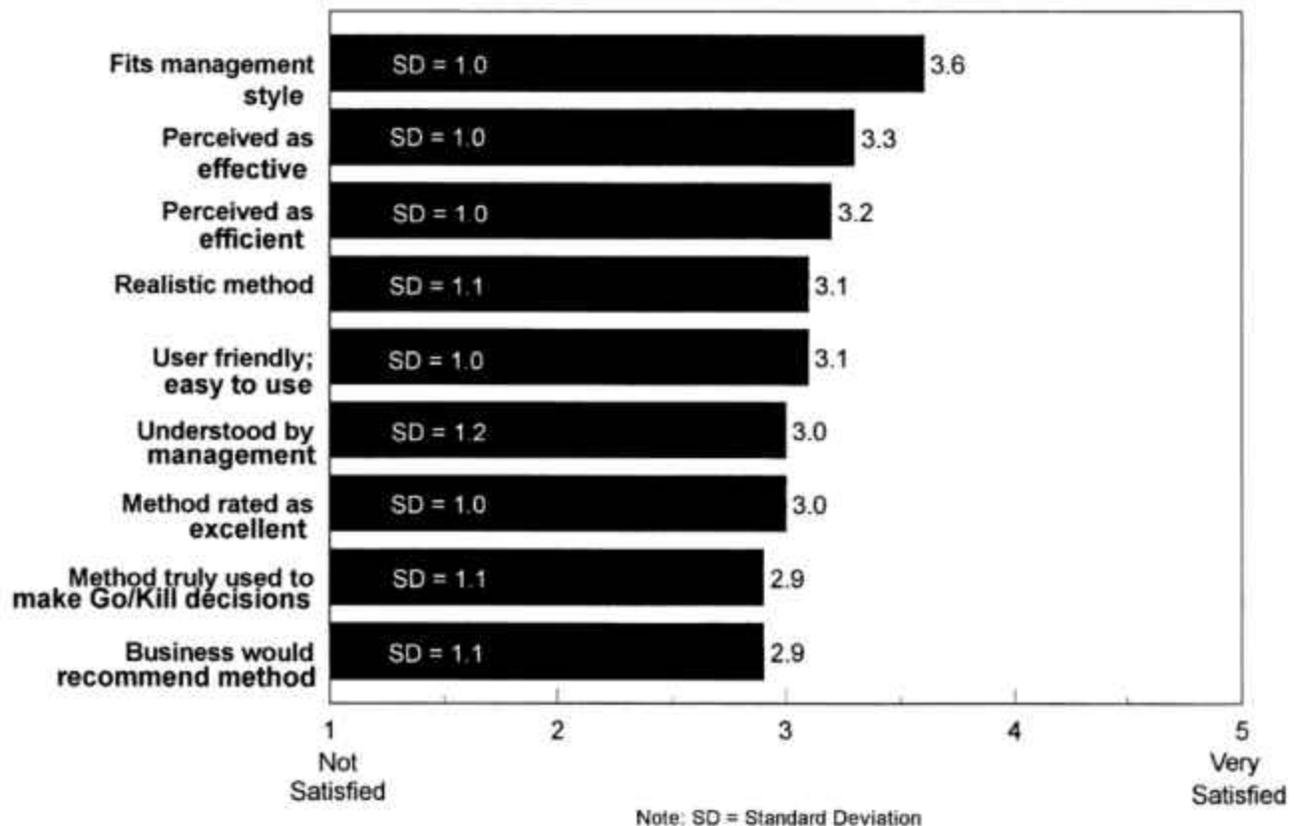


Figure 2. Perceptions and satisfaction with the portfolio management method.

do they strongly recommend their portfolio approach to others . . . all in all, not a strong endorsement of currently used portfolio approaches!

A large spread in satisfaction responses exists between businesses, however (see the standard deviations in Figure 2). This range or spread in responses underscores the *substantial differences in satisfaction*; for example, about 10% or fewer businesses and their managements are *very pleased* with their portfolio management approach (a score of 5 out of 5 on the six metrics), but *the great majority are not*. For example, almost one-third of businesses surveyed rate their portfolio management approach as anything but excellent (a score of 1 or 2 on the five-point scale); and more than one-third would clearly not recommend their approach to others! Major improvements to portfolio management methods and their application are clearly needed in the case of many businesses.

Mapping the Satisfaction Scores

Not surprisingly, these nine satisfaction metrics or variables are intercorrelated, some in a strong fashion.

Thus, factor analysis was undertaken to identify the underlying dimensions or themes—the main dimensions of management satisfaction and perception of their portfolio management methods.⁶ Two main factors emerged from the factor analysis; these two factors capture well the original nine satisfaction metrics or variables and have face validity. Figure 3 shows the satisfaction map, with the two factors as the X and Y dimensions, and factor loadings on these two dimensions or factors portrayed as vectors. Five of the nine satisfaction metrics or variables had loadings in excess of 0.7 on at least one factor, and all had loadings of more than 0.5, thus permitting a straightforward interpretation of the two factors.

The two factors are:

Factor 1: overall quality rating, consisting of:

- The portfolio method is realistic, capturing key facets of the decision problem;

⁶ Principal component factor analysis; SPSSX routine; varimax rotation. The two-factor solution was chosen based on eigenvalues >1.0 and the Scree test.

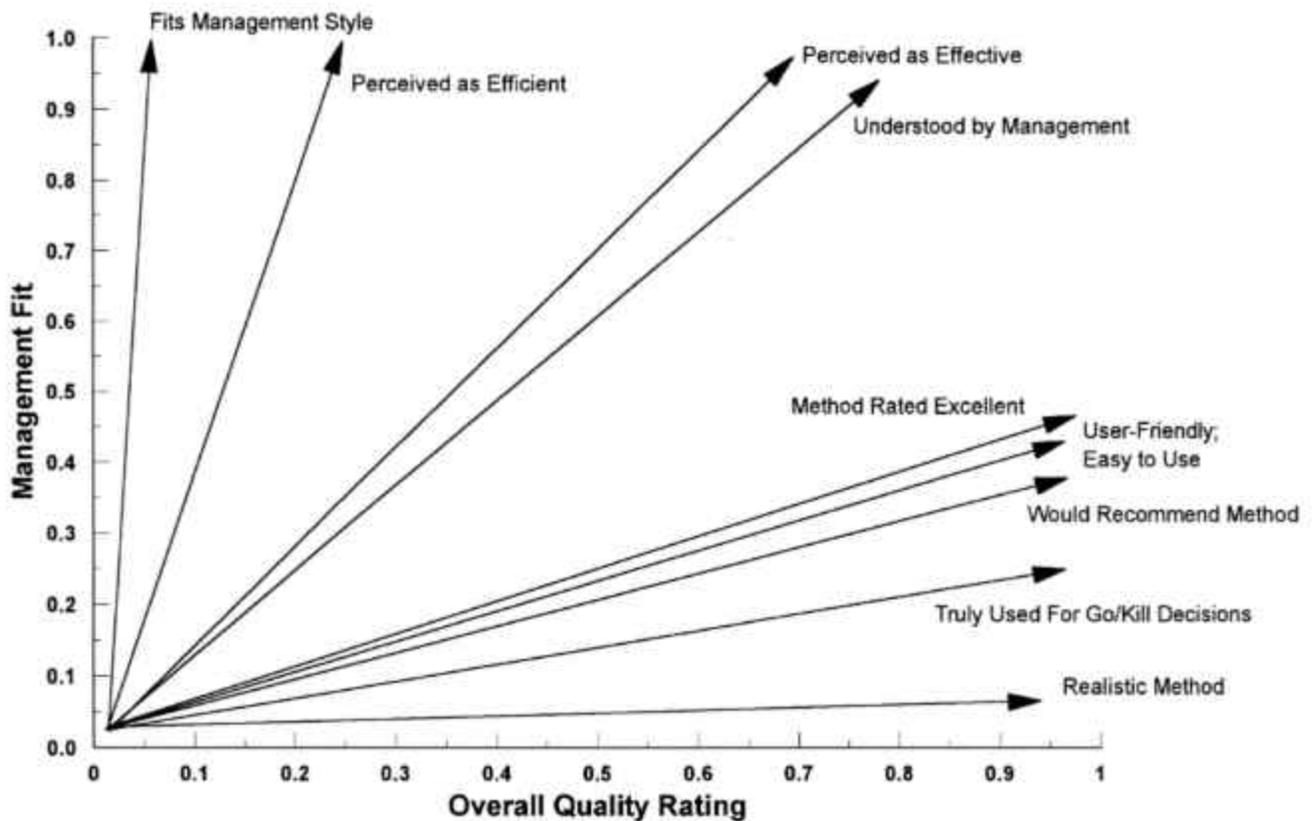


Figure 3. Satisfaction map: loadings of factors on dimensions of satisfaction and management perception of portfolio management methods.

- Management would highly recommend their portfolio method to others;
- The method is rated as excellent by management;
- The portfolio method is truly used to make go/kill decisions on projects;
- The method is user friendly;
- The portfolio method is understood by management (also loads on factor 2 following); and
- Management believes the method to be effective—makes the right decisions (also loads on factor 2).

Factor 2: management fit, consisting of:

- The portfolio method fits management's decision-making style;
- Management rates the method to be efficient—is not laborious and does not waste time;
- They see it as effective (makes the right decisions; also loads on factor 1); and
- The method is understood by management (again, loads on factor 1).

Four Types or Clusters of Businesses

As might be expected, the 205 businesses are scattered across Figure 3, the X–Y map generated by the two factors as axes. A review of the map reveals that logical clusters of businesses exist, however—for example, businesses with high quality and high management fit portfolio methods versus those with much poorer methods. Thus, it was of interest to identify these different clusters, search for differences between them, and, in so doing, gain more insights into the portfolio management methods and performance.

Cluster analysis was used to define these logical groupings of businesses in terms of these two dimensions of management perception.⁷ Four clusters of businesses were identified (Figure 4). This clustering solution was validated by undertaking multiple dis-

The clustering routine used was SPSS for Windows, Release 6.0, K-Means Cluster Analysis. The four-cluster solution was elected based on both discrimination and parsimony. This solution yielded the highest between-group explanation based on ANOVAs of cluster membership versus the original two factors; and it produced a reasonable distribution of cases across clusters.

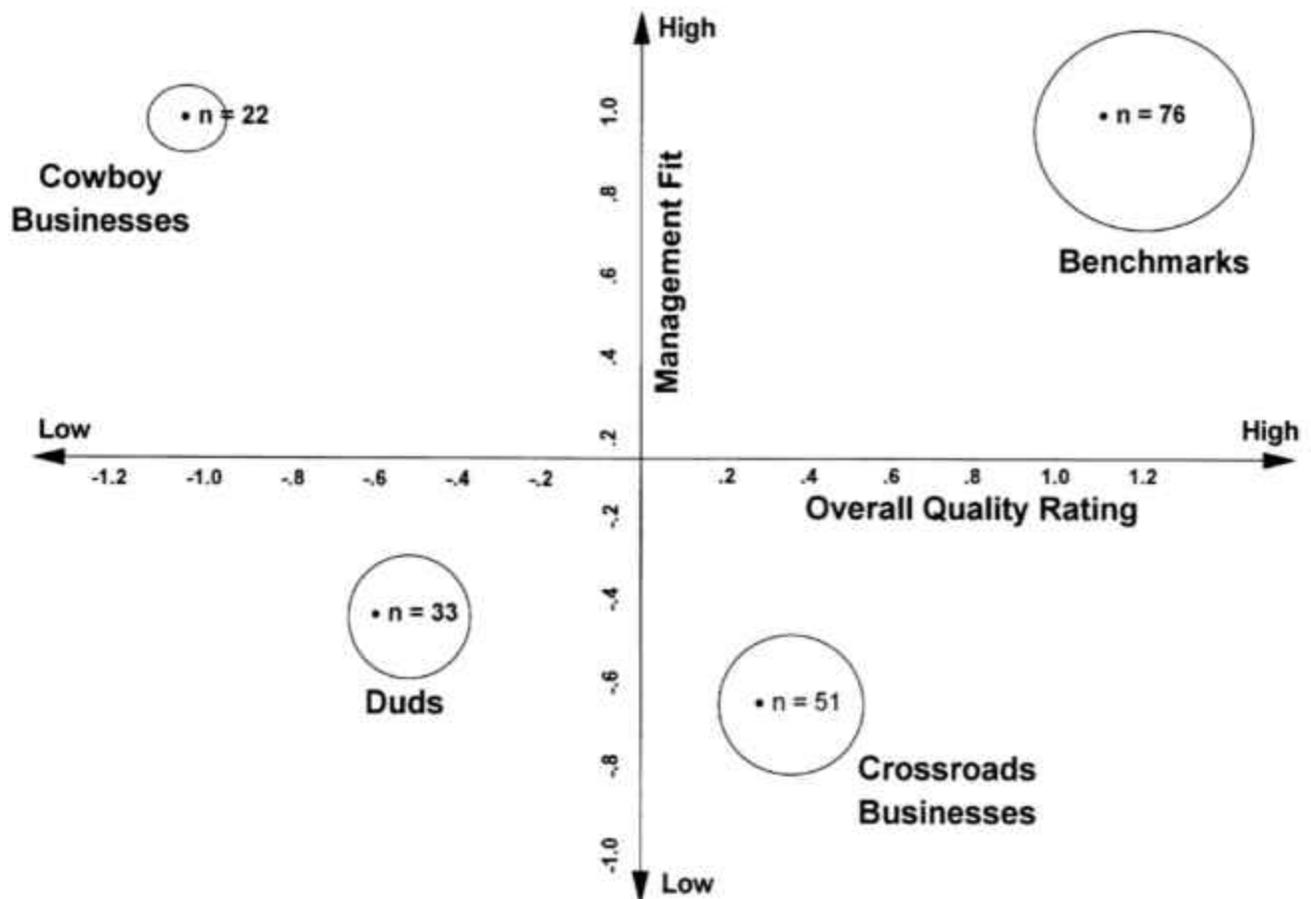


Figure 4. Factor map displaying the four-cluster solution.

criminant analysis of cluster membership versus the original nine variables used in the factor analysis. The validation results were very positive, with 94.0% of the businesses correctly classified. Additionally, the SPSS macro routine DISCLASS was used to validate the cluster solution (this is a jackknife-like unbiased classification method). Here, 93.4% of the cases were correctly classified, again suggesting that the four cluster solution is quite robust.

The four clusters identified in the cluster analysis were next characterized and labeled. Analyses of variance (ANOVAs) of cluster membership versus the original nine variables in the factor analysis yielded many strong and statistically significant differences between clusters (Table 1). These ANOVAs, along with Duncan Multiple Range tests, led to the following descriptions of the four clusters (refer to Figure 4 and Table 1):

Cowboy Businesses: These businesses shoot from the hip when it comes to project selection and portfolio management. They are in the upper left

quadrant in Figure 4. They rely on a very poor-quality portfolio model or approach (as we shall see later, actually not much of a model or system at all!), but an approach that suits management very well. For example, as shown in Table 1, cowboy businesses indicate that their portfolio approach is the opposite of excellent, the lowest of all businesses; nor would they recommend their approach to others, again the lowest of all four business clusters. Moreover, their portfolio model, such as it is, is a rather simplistic one (the least realistic of all clusters) and fails to capture important elements of the decision situation. On the positive side, management likes the approach: they view the portfolio method as efficient (the best of the four clusters), and it certainly fits management's decision-making style (tied for best). Cowboys are the smallest cluster of businesses on the satisfaction map, representing only 12.1% of the sample. We call these businesses cowboys simply because they have no real port-

Table 1. Management Perceptions and Satisfaction with Portfolio Management Methods

Measures of Management Perception and Satisfaction	Cowboys (1)	Crossroads (2)	Duds (3)	Benchmarks (4)	Duncan Multiple Range Test*
It is a realistic method	1.68	3.45	2.24	3.78	4 > 1,2,3; 2 > 1,3; 3 > 1
Would recommend method to others	1.63	3.03	1.96	3.72	4 > 1,2,3; 2 > 1,3
Rate method as excellent	2.00	2.88	2.30	3.78	4 > 1,2,3; 2 > 1,3
Truly used to make go/kill decisions	2.13	2.96	2.12	3.55	4 > 1,2,3; 2 > 1,3
It is user friendly	2.59	3.15	2.51	3.56	4 > 1,2,3; 2 > 1,3
Fit management's decision-making style	4.09	2.78	3.27	4.13	1,4 > 2,3; 3 > 2
It is efficient	3.86	2.52	2.57	3.82	4 > 1,2; 1 > 2,3
It is effective	3.27	2.94	2.57	4.01	4 > 2,3; 3 > 2
Method is understood by management	2.54	2.49	2.21	3.97	4 > 1,2,3

* Duncan Multiple Range Test, significant at $p = .05$.

Mean perception/satisfaction scores on 1-5 scale, where 5 = high and 1 = low.

To be read as "It is a realistic method" the Benchmarks were significantly different from the Cowboys, Crossroads and Duds, whereas the Crossroads were significantly different from the Cowboys and Duds, and finally the Cowboys were significantly different from the Duds.

folio approach, they know it, and they like it that way!

Crossroads Businesses: These businesses are the opposite of cowboy businesses and are found in the lower right quadrant in Figure 4. They employ a highly recommended, excellently rated, and very realistic portfolio method. But they are at a crossroads in the sense that management has yet to fully embrace the method—it is perceived not to fit management's style (the lowest of all four clusters); it is not perceived by management to be particularly efficient or effective; and the method is not well understood by management. We call these businesses crossroads, simply because they face choices: they employ an apparently proficient approach to portfolio management, yet there is some resistance to the method by management, a situation that must be corrected. Crossroads businesses account for 28.0% of the sample; hence they are a fairly substantial group.

Duds: Dud businesses are what the name implies... bad on all fronts. Of the four groups of businesses, they fare the worst in terms of the perceived effectiveness of their method and its lack of fit with management's decision style. Moreover, their portfolio approach is perceived by management to be inefficient—wastes time (tied for worst). Additionally, these businesses rate their portfolio approach as unrealistic, not used by management, and not user friendly. Finally, dud businesses do not recommend their approach to others, and they rate it far from excellent. Fortunately, dud businesses are a relatively small group, representing only 18.1% of the sample.

Benchmarks: Benchmarks are the "good" businesses—the ones held up as benchmarks or standards against which to compare oneself and/or to emulate. They fare remarkably well across the board. Their portfolio method scores the best in terms of quality; it is rated the most realistic of all businesses; it comes highly recommended and is rated as excellent (the best of all businesses); it is used by management to make go/kill decisions; and it is user friendly—the best of all four clusters (Table 1). The method also fits management well: it is perceived by management to be very effective (highest of all clusters) and is well understood by management; and benchmark businesses' portfolio approaches fit management's style and are perceived to be efficient in use (they do not waste time), tied for best across the four groups. Benchmark businesses are also the largest cluster, representing 41.8% of the sample, thereby demonstrating that effective, quality portfolio approaches are not an elusive goal attained by a small minority of businesses. Note, however, that the sample of firms is biased toward leading R&D firms in America, which also might explain, in part, the large size of the benchmark cluster.

Portfolio Performance of the Four Types

What are the various performance results achieved by the four types of businesses? Portfolio performance was measured on six metrics, based largely on the performance goals identified during the exploratory study (the far right box of Figure 1). These six per-

formance goals for portfolio management are as follows:

- having the right number of projects in the portfolio for the resources available,
- avoiding pipeline gridlock in the portfolio—undertaking projects on time and in a time-efficient manner,
- having a portfolio of high-value projects (or maximizing the value of the portfolio)—profitable, high-return projects with solid commercial prospects,
- having a balanced portfolio—long term versus short term, high risk versus low risk, and across markets and technologies,
- having a portfolio of projects that are aligned with the business’s strategy, and
- having a portfolio whose spending breakdown mirrors the business’s strategy and strategic priorities.

Portfolio performance gauged on these six metrics is very clearly and strongly linked to managements’ perception and satisfaction with their portfolio tools. Figure 5 shows the same two-factor map as before, but this time with the six performance metrics shown as

vectors (the X and Y coordinates of each vector are the correlation coefficients between each performance metric and the two perception factors; thus, the length and direction of each vector denote the loadings).

Table 2 shows how the sample of businesses did overall when gauged on these six metrics and specifically how each of the four clusters of businesses performed:

1. Not surprisingly, the benchmark businesses score top marks in terms of performance, significantly better than any of the other three clusters and on all six performance metrics (based on ANOVAs and Duncan range tests; see Table 2). Specifically . . .
 - Benchmark firms end up with a portfolio of *very-high-value projects*—profitable, high-return projects with solid commercial prospects, the best of all four clusters;
 - Strategically, these businesses’ portfolios are also the best—projects in benchmark businesses’ portfolios are *aligned with the business strategy* and objectives, while the *spending breakdown* across

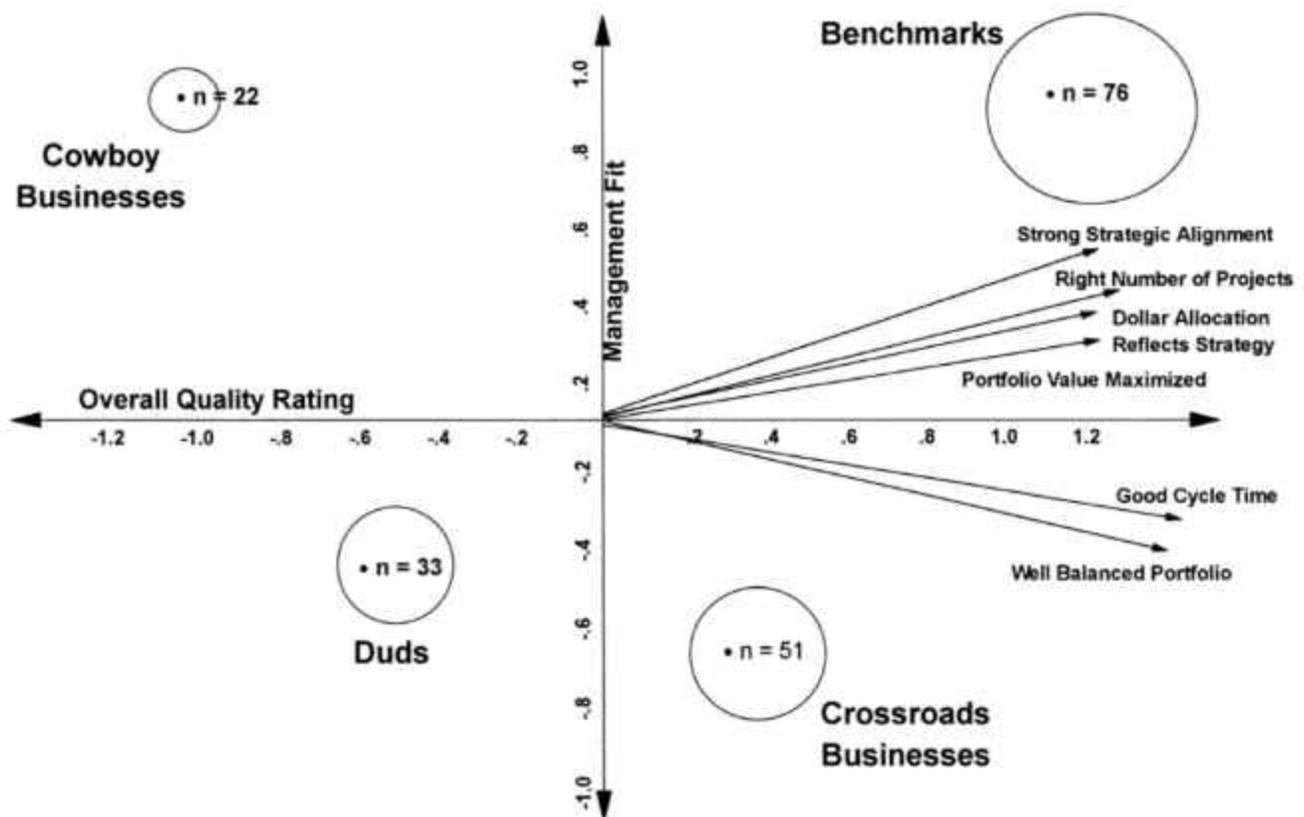


Figure 5. Two-factor map with performance metrics displayed as vectors.

Table 2. Performance Results Achieved by Portfolios of the Four Business Types

Portfolio Performance Measure or Metric	Cowboys	Crossroads	Duds	Benchmarks
The right number of projects for the resources available	2.36-	2.69+	2.09-	3.15++
No gridlock in the portfolio—projects done on time	2.66-	2.96+	2.40-	3.30++
Portfolio contains high-value projects—profitable, high-return, solid commercial prospects	3.18-	3.60+	3.03-	3.93++
Portfolio has an excellent balance of projects (long term versus short term, risk, etc.)	1.95--	3.02+	2.48-	3.41++
Projects are aligned with the business's strategy	3.50-	3.77-	3.40-	4.27++
Spending breakdown of projects in portfolio reflects the business's strategy	2.95-	3.32-	3.06-	4.10++

Mean performance scores on 1-5 scale, where 5 = high and 1 = low.

The four clusters of businesses have significantly different portfolio performance results on all six performance metrics (ANOVAs significant at the .0001 level). Based on Duncan Multiple Range Test ($p < .05$).

++ Indicates top performance (or tied for top) on that metric; + indicates second best; -- indicates worse performance (or tied for worst); - indicates second worst.

projects in these portfolios *mirrors the business strategy*;

- The portfolio has an *excellent balance of projects* in terms of long term versus short term, high risk versus low risk, across markets and technologies, and so on; and
- These benchmark businesses portfolios contain an *appropriate number of projects*—there are the right number of projects given the businesses resources; as a result, projects are done on time (no portfolio or pipeline gridlock).

All in all, this is a very enviable portfolio performance.

2. In contrast, the dud businesses—those with a poor-quality portfolio method and that management perceived as not well suited to them—do not perform well at all. They achieve poor portfolio performance on the six metrics shown in Table 2. Similarly, cowboys perform poorly and in particular achieve a very poor balance of projects.
3. Crossroads businesses, surprisingly, perform well: that is, they fare second best, next to benchmark businesses, but still significantly lower.

The message is that where a business is located on the perception/satisfaction map is very closely tied to the ultimate performance of the portfolio, and in the expected way. Second, certain businesses, namely, those we labeled benchmarks, are the clear winners in terms of portfolio performance results. Their practices and approaches merit a closer look. Next, using a high-quality portfolio method and one that fits management's style seem to be the two key dimensions that drive portfolio performance. But the most impor-

tant of these is using a highly rated method, whereas management fit, although connected to performance, does not have near the same impact. This last conclusion is based on the loadings of performance metrics in Figure 5 and the fact that crossroad businesses, although relying on portfolio methods that lack management fit, still perform quite well.

Characteristics of the Portfolio Method Employed

What types of portfolio approaches are used by the benchmark businesses—the ones that achieve such positive portfolio performance? And how are these methods different than the other three clusters of businesses? Various characteristics of the portfolio methods used were measured (left boxes in Figure 1), and their impact was assessed.

What stands out in an analysis of the various characteristics of portfolio methods used is that benchmark businesses use much *more formal and explicit portfolio approaches* than do the other firms. Table 3 shows the large and statistically significant differences between business clusters, and in particular, how benchmark businesses are distinguished from the rest in terms of their portfolio practices:

- Benchmark businesses have an *established, explicit method* for portfolio management, much more so than for other businesses. Cowboys and dud businesses rate very low here.
- Benchmark businesses use *much more formal approaches* to portfolio management; cowboy businesses use the least formal, indeed almost no process at all!

Table 3. Explicitness and Formality of the Portfolio Management Methods Used by the Five Clusters of Businesses

Measures of Satisfaction and Management Perception	Cowboys	Crossroads	Duds	Benchmarks
Established, explicit method	2.22--	3.45+	2.93-	3.86++
Formality of method	2.20--	3.48+	3.16+	3.16+
Method has clearly defined rules and procedures	1.90--	3.21+	2.63-	3.50+
Method is consistently applied to all appropriate projects	1.77-	3.00+	2.24-	3.43++
All projects are considered together (e.g., compares them against each other)	2.09-	3.00+	2.39-	3.53++
Management buys into the portfolio management method (e.g., via actions)	2.18-	3.15+	2.69-	3.82++

Mean values on 1-5 scale, where 5 = high and 1 = low.

The four clusters of businesses are significantly different in terms of these six measures of the satisfaction and perceptions of the portfolio method used (ANOVAs significant at the .0001 level). Based on Duncan Multiple Range Test ($p < .05$).

++ Indicates top score (or tied for top) on that characteristic; + indicates second highest score; -- indicates lowest score (or tied for lowest); - indicates second lowest score.

- Portfolio methods used by benchmarks feature *very clear and well-defined rules and procedures* for portfolio management. Cowboy businesses rate dismally here.
- Benchmarks *consistently apply their portfolio method*, for example, to *all* appropriate projects; cowboys score also very low here, followed by dud businesses.
- The portfolio method used by benchmark businesses treats all projects as a portfolio—*considers all projects together* and compares them against each other.
- Finally, management *buys into* the portfolio methods used at benchmark businesses much more so.

The message is this: A formal, explicit portfolio management method yields better portfolio results ...much better than an informal, undefined process. There is now solid evidence that senior management must adopt and embrace portfolio management as a management principle. Such explicit portfolio methods should have clear and well-defined rules and procedures (for example, how projects will be selected and prioritized, how resources will be allocated, etc). Effective portfolio management methods should be consistently applied across all appropriate projects, treat all projects together (comparing them against each other), and management must buy into the process.

What Specific Portfolio Techniques Are Used?

Popularity of the Methods

No one portfolio method has a monopoly in the field of portfolio management. Virtually every business in

the survey uses multiple methods or techniques for portfolio management. These techniques, in rank order of popularity, are as follows:

- *Financial methods*, where profitability, return, payback, or economic value of the project is determined, and projects are judged and rank ordered on this criterion: 77.3% of businesses use this approach.
- *Business strategy methods*, where the business's strategy is the basis for allocating money for different types of projects. For example, having decided strategy, different buckets or envelopes of money for different project types are established, and projects are rank ordered within buckets [6]: 64.8% of businesses use a strategic approach.
- *Bubble diagrams*, where projects are plotted on an X-Y portfolio map (the X-Y axes are various dimensions of interest, such as reward versus probability of success [19]): 40.6% of businesses employ bubble diagrams.
- *Scoring models*, where projects are rated or scored on a number of criteria on scales, then the ratings are added to yield a project score (this score then becomes the basis for making prioritizing or go/kill decisions): 37.9% of businesses employ scoring models for portfolio management.
- *Checklists*, where projects are evaluated via a list of yes/no questions (and each project must achieve all or a certain percentage of "yes" answers): only 20.9% of businesses use checklists for project selection and portfolio management.

The percentages cited add up to well over 100% (241.5%), suggesting that, on average, the typical business relies on about 2.4 different portfolio man-

agement methods. Using multiple methods—the notion of a hybrid approach to portfolio management—appears to be the right answer, however. Cowboy businesses, for example, rely on the fewest number of portfolio methods (on average, 1.8 methods per business), significantly less than benchmark businesses (2.5 methods) and crossroads firms (2.6 methods).

Multiple Methods: Popularity by Cluster

The combinations of portfolio methods that yield the best results were investigated. Table 4 shows the results. Here:

- The majority of both benchmark businesses (56.6%) and crossroads firms (54.9%) use both a *strategic* and a *financial approach* for portfolio management (significantly more so). In contrast, only 36.4% of cowboys uses these two methods together.
- A *strategic approach* combined with a *bubble diagram* is the portfolio combination relied on by significantly more benchmark and crossroads businesses (28.9% and 33.3%, respectively).
- Significantly more benchmark businesses rely on *three portfolio methods in conjunction*—a *financial method*, a *strategic approach*, and a *scoring model* (21.1% of benchmarks). The other three clusters of businesses do so much less frequently.

The Link Between Dominant Method Used and Portfolio Performance

Because of the multiple methods used by businesses, it proves difficult to discern a relationship between *any one portfolio technique employed* and the four clusters of firms, and ultimately the link to portfolio performance results. In an attempt to overcome this problem, managers were asked to indicate which method was the *dominant method used*. Figure 6 shows the breakdown. Not surprisingly, the most dominant method is

the financial approach (40.4% of businesses), followed by strategic approaches and scoring models. But no significant differences were uncovered in use of a specific dominant method by the four clusters. However, there was a distinct link between ultimate performance results and which portfolio method was dominant (Table 5):

- Financial methods of portfolio management (e.g., using a financial measure or index to rate and rank projects) yield the *poorest performance results* when gauged on three important metrics: poor value projects in the portfolio, too many projects for the resources available, and projects not done on time (gridlock in the portfolio).
- In contrast, strategic approaches (letting the business's strategy decide resource allocation and even choice of projects) perform the best (significantly so) on these same three metrics: project value, number of projects, and time to market.
- Scoring models produce positive performance and fare the best (significantly so) in terms of yielding a portfolio containing high-value projects—profitable, high-return projects with solid economic prospects (statistically tied with strategic approaches, but even a little better).

It is ironic that financial models, presumably chosen to select higher-return, higher-profit projects, yield precisely the opposite—a portfolio with the worst economic value. Financial approaches fare the worse on 5 of 6 of the portfolio performance metrics shown in Table 5. Scoring models and strategic approaches do very well, yielding the best or second best results on 5 of the 6 performance metrics. Finally, bubble diagrams perform moderately well on some performance metrics, but excel in terms of yielding a balanced portfolio (tied for best) and strategic alignment (best, but not significantly so).

Table 4. Impact of Combined Portfolio Methods on Clusters

Methods Combined	Cowboys	Crossroads	Duds	Benchmarks	Duncan Multiple Range Test*
Strategic and financial	36.4%	54.9%	45.5%	56.6%	Benchmarks > Cowboys
Strategic and bubble diagrams	17.3%	33.3%	12.1%	28.9%	Crossroads and Benchmarks > Duds
Strategic, financial, and scoring model	13.6%	15.7%	18.2%	21.1%	Benchmarks > Duds, Cowboys, and Crossroads

To be read as: Cowboys use a combined strategic and financial portfolio method 36.4% of the time.

* Significant differences between clusters based on ANOVAs and Duncan Multiple Range Tests ($p = .05$).

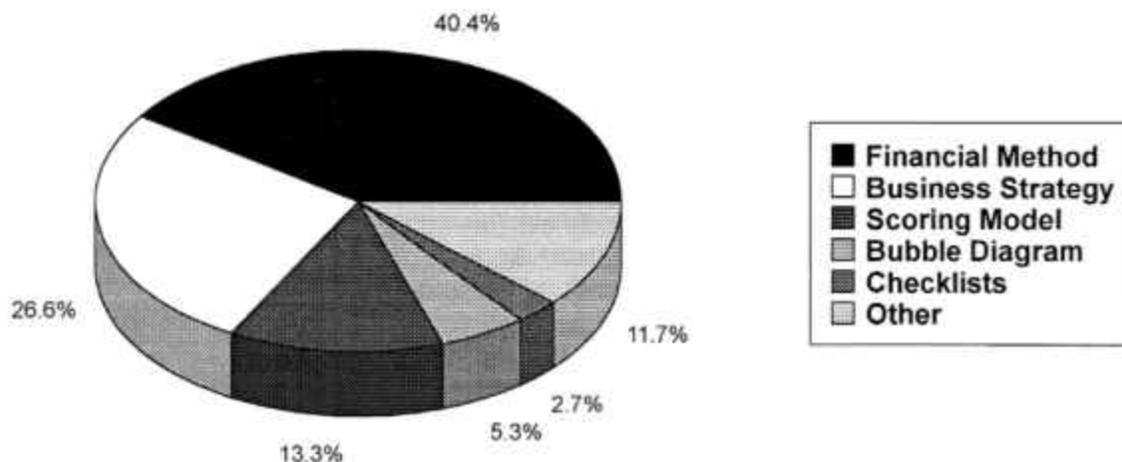


Figure 6. Dominant portfolio method employed.

Importance of Portfolio Methods

Although portfolio management recently has been heralded as one of the most important facets of management leadership [19], it is clear that not every senior manager has received the message. How important portfolio management was perceived to be by various senior managements was gauged in the study. The results are provocative.

Portfolio management is a critical task in the business, at least according to the majority of senior managements. Table 6 provides the mean importance scores for the four clusters of businesses, broken down by executive function. Not surprisingly, senior managements in technology (CTOs, VPs of R&D, etc.) give portfolio management the highest importance ratings of all functions; they are followed by senior management overall and then by corporate executives (all three management groups score in excess of 4 of 5, where 5 = critically important). Note that both marketing/sales management and operations/production management rate portfolio management as less

important. The fact that marketing/sales senior people are not perceived to have bought into the concept and importance of portfolio management represents a potential deficiency in the widespread acceptance and implementation of portfolio management, especially given the vital role that marketing/sales resources play in the business's total new product effort.

Here again, benchmark businesses are distinguished from the rest. Portfolio management is accorded much greater importance in benchmark businesses than in the other businesses (Table 6). This is true across the board, regardless of the functional area. Crossroads businesses come second: in these businesses, senior management and technology management view portfolio management as vital. In contrast, corporate executives and senior management in cowboy businesses place very little importance on portfolio management (the lowest of all four clusters), whereas technology management, marketing/sales management, and operations/production managements in dud businesses see portfolio management as relatively unimportant.

Table 5. Relationships Between Dominant Methods and Portfolio Performance

Performance Metric	Financial Methods	Strategic Methods	Scoring Model	Bubble Diagrams	Methods That Are Better
Projects are aligned with business's objectives	3.74	4.08	3.95	4.11	—
Portfolio contains very-high-value projects	3.37	3.77	3.82	3.70	Scoring and Strategic > Financial
Spending reflects the business's strategy	3.50	3.72	3.59	3.00	—
Projects are done on time—no gridlock	2.79	3.22	3.13	2.90	Strategic > Financial
Portfolio has good balance of projects	2.80	3.08	3.20	3.20	—
Portfolio has right number of projects	2.50	2.93	2.70	2.50	Strategic > Financial

Ratings are 1-5 mean scores for each method, when used as dominant portfolio method where, 1 = poor and 5 = excellent. Checklist methods are used too infrequently to include here. Last column is based on Duncan Multiple Range Test ($p = .05$).

Table 6. Importance of Portfolio Management by Functional Area

Perceived Importance of Portfolio Management by	Cowboys (1)	Crossroads (2)	Duds (3)	Benchmarks (4)	Mean Value	Significance (ANOVA)
Corporate executives	3.00	3.57	3.34	3.73	3.52	4 > 1 (.05)
Senior management in the business	3.04	3.96	3.45	3.90	3.74	2, 4 > 1, 3 (.001)
Technology management (e.g., CTOs, VPs, R&D)	3.80	4.21	3.78	4.25	4.10	4 > 3 (.05)
Marketing/sales management (e.g., VP marketing)	2.76	3.15	2.72	3.25	3.07	4 > 3 (.10)
Operations/production management (e.g., VP operations)	2.23	2.66	2.21	2.75	2.56	4 > 3 (.05)

Mean importance values on 1-5 scale; where 5 = critical importance and 1 = not too important.

The message is that the *importance that management accords portfolio management* is directly related to the end result—to the explicitness and formality of the portfolio management process, to management's perception and satisfaction with the outcome, and even to the performance of the portfolio itself.

Some of the reasons why portfolio management is thought to be important were gauged. Table 7 shows the results overall and then broken down by the four clusters of businesses. The top four reasons are virtually tied in importance:

- *Competitive position*, because portfolio management and project selection are vital to maintaining the business's competitive position.
- *Efficient resource allocation*, because development resources—people, time, and money—are very scarce, and the business does not want to waste these on the wrong projects.

- *Strategic*, because project selection is closely linked to the business's strategy.
- *Focus*, because the business wants to be focused—not do too many projects for the limited resources available.

When it comes to a breakdown of these reasons by business cluster, again the familiar pattern is evident. Benchmark businesses score higher than the rest on 5 of the 6 reasons for the importance of portfolio management. In particular, benchmark businesses are significantly higher than the other three clusters on the strategic dimension—portfolio management is linked to strategy, and tied for highest on another three elements (Table 7). Crossroads businesses are in second place on most elements of importance. Only on one dimension—strategy begins when you start spending money—are there no significant difference between clusters.

Table 7. Reasons Why Portfolio Management is Important Linked to Cluster Membership

Reasons Why Portfolio Management Is Important	Cowboys (1)	Crossroads (2)	Duds (3)	Benchmarks (4)	Mean Value	Significance (ANOVA)
Project selection is closely linked to business strategy	3.54	4.07	3.78	4.42	4.10	4, 2 > 1, 3 (.0001)
Strategy begins when you start spending money—resource allocation is how strategy is implemented	3.31	3.58	3.21	3.61	3.49	NS
Project selection is important to maintaining our competitive position	3.95	4.43	4.03	4.44	4.30	4, 2 > 1, 3 (.01)
We want to be focused—not do too many projects for the resources we have available	3.50	4.31	3.75	4.21	4.07	4, 2 > 1, 3 (.002)
Our new product resources are very scarce, and we do not want to waste them on the wrong projects	3.81	4.33	3.84	4.32	4.18	4, 2 > 1, 3 (.02)
It is important to have the right balance of projects	3.04	4.00	3.54	4.00	3.80	4, 2 > 1, 3 (.001)

Mean importance values on 1-5 scale, where 5 = a major reason and 1 = not a reason.

The four clusters of businesses are significantly different in terms of (5 of the 6 reasons) why management thinks that portfolio management is important. Based on Duncan Multiple Range Tests ($p < .05$).

Conclusions and Implications for Management

The research has identified which portfolio management methods are used and their relative popularities. Financial models are used most often, both overall and as the dominant method, but they *do not yield* the best results. They produce portfolios with poor-value projects, too many projects for the resources available, and gridlock in the pipeline. Strategic approaches followed by scoring models are next in popularity; they tend to produce much better portfolios in terms of the various performance metrics.

Four clusters of businesses were identified in terms of where they were located on a perception/satisfaction map. These are as follows:

- *Benchmarks*, a large group of businesses (41.8% of the businesses), whose portfolio methods are rated as high quality and they fit management well.
- *Cowboy businesses*, which rely on an informal (or no) method to select their portfolio—shoot from the hip—but this fits management's style well.
- *Crossroads businesses*, which employ a well-rated, high-quality portfolio approach, but it does not seem to fit management well . . . management sees it as inefficient and ineffective, and really does not understand the method.
- *Duds* rate their portfolio approach poor on just about every metric.

Benchmark firms are worth taking a much closer look at. After all, they are the ones to emulate. Management scores their portfolio approaches better than the other businesses; they rate the portfolio methods as excellent and would recommend them to others; the methods are more realistic; they are really used to make go/kill decisions; and they are user friendly. Additionally, the methods are perceived by management to be both effective and efficient, and the methods are well understood by management. The good news continues: benchmark businesses also achieve the best portfolio results. Their portfolios have the best value projects (economic value to the firm) and achieve the best strategic alignment (projects fit the business's strategy, and spending mirrors strategic priorities). Their portfolios are rated best in terms of balance of projects, and there is the right number of projects for the resources . . . no gridlock. All in all, these benchmark businesses are to be admired for proficient portfolio management.

What distinguishes these benchmark businesses from the rest?

- First, managements in benchmark companies view portfolio management as *very important*. This is true across the board regardless of functional area, with benchmark businesses scoring significantly higher than other and lower performing businesses.
- Second, benchmark businesses have an *established, explicit, and formal method* for portfolio management. The method they use features very clear and *well-defined rules* and procedures for portfolio management; these businesses *consistently apply* their portfolio methods to all appropriate projects, they treat *all projects together* as a portfolio, and, finally, *management buys into* the method. In contrast, lower performing businesses tended to lack an explicit, formal, well-defined, consistently applied portfolio method.
- Third, benchmarks tend to use *multiple portfolio methods* more so than other and lower performing businesses. Note that, on average, all businesses use multiple methods, but benchmarks do so even more: strategic and financial approaches; strategic approaches combined with bubble diagrams; and financial, strategic, and scoring models together.

One more conclusion: the quality of the portfolio method appears to have much more impact on performance results than whether or not the method fits management's style. Recall that two underlying dimensions were uncovered that define the perception/satisfaction map; however, one of these, namely, quality of the portfolio method, dominated. The message is this: if you have implemented a solid, high-quality portfolio process but continue to see management resistance, do not give up. This situation yield relative positive results, even if top management does not totally buy into the process. Obviously the best situation is where the process fits management (there is buy in) *and* the portfolio method is a high-quality one. But second best is having a good portfolio process—the location occupied by crossroads businesses.

Here are some possible *management actions* that emerge from the research results.

First, try to assess where your business might be located on the perception/satisfaction map (Figure 4). Imagine that your business had taken part in the study, and rate yourself on the nine questions in Figures 2 and 3 to determine your location.

If you are located in the enviable top right quadrant in Figure 3, along with benchmark businesses, you can

take some pride in your portfolio approach. If you are typical, chances are that, besides having a high-quality portfolio method and one that fits management well, your portfolio results are very positive. For example, your portfolio should contain . . .

- high economic value projects (high return on investment, solid NPVs, and good financial prospects),
- the right balance of projects (long term versus short term, high risk versus low risk, and so on), and
- projects that are strategically aligned with your business's strategy.

Moreover, your portfolio should . . .

- have a spending breakdown that reflects strategic priorities of your business,
- have the right number of projects for your limited resources, and
- be free from pipeline gridlock—projects done on time.

Second, if you are not one of these envied benchmark firms, then take steps to move toward that quadrant. Here are some specific actions you should consider:

1. Recognize that portfolio management is vital to new product success. And challenge your business's leadership team to recognize its importance too. If your senior people have not yet heard the message, emphasize the importance of portfolio management for the reasons highlighted by managements in our study (and which were outlined in this article), namely: Portfolio management is critical because . . .

- portfolio management and picking the right new product projects is vital to maintaining your business's competitive position,
- efficient resource allocation is essential (your resources are scarce and must be devoted to the right projects; you cannot afford to dissipate them on the wrong projects),
- project selection is closely linked to your business's strategy, and
- your business must be focused—not do too many projects for the resources you have available.

2. Move toward a formal, articulated, explicit, and consistently applied portfolio management approach in your business. The mere fact that com-

panies with formal portfolio methods seem to do better—regardless of the method—is encouraging. At least recognizing the need for formal portfolio management appears to be a step in the right direction.

3. Next, as you design your portfolio management process, recall the intermediate metrics—the perception and satisfaction ones—that were so strongly linked to ultimate performance. For example, strive for a portfolio management method that is a high-quality, proficient method and, at the same time, fits the management style of your business. That is, strive for a method that scores well on the following items:

- is realistic—captures key facets of the decision situation,
- is truly used to make go/kill decisions on projects, and
- is effective—yields the right decisions,

and, at the same time . . .

- is user friendly,
- is efficient—does not waste time,
- is easily understood by management, and
- fits management's decision-making style.

This is a difficult balancing act, according to managers interviewed: Finding one method that rates well on all seven of these characteristics is a challenge!

4. Thus, consider multiple portfolio methods—a hybrid approach. No one method seems to provide the universal answer here. Benchmark firms employed almost three methods per business, on average. Our results suggest a combination of:

- *Financial methods*, such as using NPV, IRR, or the Productivity Index. We suggest a financial approach, not that it yields the best results, but simply because it is so popular (and someone at the top of your organization is certain to demand that projects be rank ordered according to financial value to the corporation!).
- *Strategic approaches*, where the business's strategy determines buckets of money or resources for different types of projects, and projects are selected because of their strategic importance. We recommend such an approach partly because it makes intuitive sense, partly because it yields positive results, and also because the method is quite popular.

- *Scoring models*, where all projects are rated on multiple criteria, and projects are ranked according to the resulting project scores. This approach is less popular but yields surprisingly good performance results, especially in terms of producing a portfolio of high-value projects. You cannot ignore a scoring model approach!
- *Bubble diagrams*, where projects are plotted on X-Y plots on a variety of parameters. These methods we recommend because they produce good results in terms of portfolio balance and strategic alignment. Besides, a picture is worth a thousand words.

Effective portfolio management in new product and R&D management remains an elusive goal. Witness the less than enthusiastic ratings that management accord their portfolio approaches. But portfolio management is essential to winning at new products. Without an effective portfolio management process in place, the business suffers many evils: poor-quality projects, too many short-term and lower-risk projects, too many projects for the resources at hand, ultimately resulting in pipeline gridlock, and an investment portfolio that does not mirror the strategic priorities of the business. Thus, the quest for the right portfolio management method must continue: the stakes are too high and the challenge is too important to ignore.

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