Measuring the Performance of the Innovation Process

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When executives examine how smart their innovation processes are, the soul-searching involves questions of effectiveness, efficiency, and risk. How does the company's record of success in innovation stand up against competitors'? Does the company achieve an adequate return on its investments in technology? Is the company's innovation process sufficiently under control to improve the predictability of results?

Traditional financial performance measures and cost accounting systems do not provide the answers for four reasons:

• They often fail to recognize that innovation is a creative process that does not lend itself to tidy routine checks.

• They seldom provide the yardsticks specific to each stage in the innovation chain, from fundamental research to incremental development.

• They frequently consist of lagging indicators, such as market share, whereas management of future-oriented R&D needs leading indicators.

• They tend to be either too aggregated to be of much operational value or too narrowly focused on individual functions, such as engineering, to fairly measure the performance of the innovation process as a whole.

Managers need a measurement system that allows them to steer the entire innovation process, from blue-sky idea to marketable product. The system should also reveal the root causes of any under-performance, so that managers can determine how to change the way the innovation process is managed. In order to achieve that objective, managers should not only use the right measures, but use those measures correctly.

We have found that smart innovators use the right measures correctly by adhering to six principles:

• Establish a partnership between business and R&D.

• Link the performance indicators to your strategy.

• Apply a spectrum of performance indicators.

• Interpret and adjust the performance indicators continuously.

• Learn from and act upon the performance measurements.

• Combine calendar-driven measurements with event-driven reviews.

A Partnership Between Business and R&D

Smart innovators realize that performance measurement can never be a surrogate for an effective interface between business and R&D. Companies that lack such an interface often resort to performance measures to „set matters straight." R&D hopes that performance measures will justify its invaluable initiatives, while business hopes that performance measures will make R&D justify its outrageous spending.

In these cases, the quest for measures hides a fundamental lack of communication between business and R&D. As a substitute for an effective interface, performance measurements will be self-defeating. Managers will play the numbers (not hard to do in technology), pointless debate over interpretation will prevail, and business will still not be convinced of the value of R&D.

As discussed extensively in the recent book on *Third-Generation R&D*,[1] smart innovators foster communication, create a common language, and set joint objectives between business and R&D. They abandon the judge-advocate relationship in favor of a spirit of partnership. And they use performance measures for making choices, tracking progress, and learning together.

Hewlett-Packard, for example, has a backlog of innovation ideas that compete for staffing. Inevitably, only the best ideas pass the evaluation stage and get staffed, while the others are discarded. *Yet* the company measures the quality of the discarded ideas so as to gauge its entrepreneurial vitality and foster partnership.

Link to Strategy

Smart innovators do not select performance indicators at random; they link them to their strategy. Indicators should reflect the company's goals and ambitions so that the company can track how effectively it pursues its strategic objectives.

For example, if the company's product strategy calls for rapid product renewal, a meaningful indicator might be the percentage of sales derived from products introduced to the market within a set number of years. At Hewlett-Packard, more than 60 percent of sales is derived from products introduced during the last three years. The

corresponding numbers at 3M are 30 percent and four years; at Baxter International, 34 percent and five years; at Emerson Electric, 20 percent and five years.

If the company's product strategy centers around after-sales service, a key measure is design for serviceability. In the elevator business, for example, where service income compensates for low margins on original equipment sales, maintenance and repair are most efficient when there are only a few product models. Therefore, indicators that measure design modularity and commonality are much more useful than those that encourage product novelty and diversity.

In a desperate attempt to acquire quantitative yardsticks, companies may be tempted to copy performance indicators wholesale from another industry or company. This is not only meaningless but also dangerous, as inappropriate indicators may steer behavior in directions contrary to the companies' objectives.

A Spectrum of Indicators

Smart innovators do not use one indicator for all purposes, but a spectrum of indicators that reflect the complexity and importance of technology and innovation. A client of ours, a large chemical company, recently hired as head of its Central Research Division a controller who came from the life insurance industry. When we began working with him to develop a performance indicator system, he was determined to have a single super-formula that would tell him how Research was doing. Subsequent discussions with Research and its customers, namely the company's business units, convinced him to abandon his draft super-formula in favor of a much more meaningful balanced scorecard with a spectrum of indicators.

As shown in Exhibit 1, smart innovators broaden the spectrum of performance indicators in four dimensions.

Incremental R&D and Fundamental R&D. Smart innovators measure not only how clever they are at exploiting existing knowledge (incremental R&D) but also how well they create knowledge that is new to the company or even to the world (fundamental R&D). Measuring the effectiveness of incremental R&D is relatively easy: you just compare actual performance with objectives such as product cost, project budget, percentage of components carried over from a previous design, and market penetration speed.

Indicators for fundamental R&D should measure how effectively the company broadens or deepens its technological capability. Some companies set up a „trade balance sheet" that accounts for the license exports from and imports into their fundamental R&D center, be it with other parts of the company or third parties. Other companies, such as the pharmaceuticals company Merck, use financial option analysis to evaluate returns on long-term strategic projects with a high degree of uncertainty and staged funding.

Single Projects and Project Portfolios. Smart innovators measure the effectiveness not only of single development projects but also of the project portfolio as a whole. Single project indicators track how individual projects perform in terms of development lead-time, number of late engineering changes, product call-rate after launch, or other operational aspects.

Project portfolio indicators show how effectively the portfolio of R&D projects supports the business strategy and how balanced the portfolio is in terms of expected reward, technological or commercial uncertainty, or time to market. A client of ours in the steel industry systematically evaluates the „springboard" potential of each proposed R&D project. Even if a project would not merit start-up on its own, it may be worth doing if it provides a platform for other projects in the portfolio.

Portfolio indicators can also show how well the portfolio of new project ideas is managed. One indicator that helps Hewlett-Packard measure the efficiency of its pipeline opportunity is „project team change-over waste": the cost of time and resources spent between the end of the previous project and the point at which all team members are again fully engaged in value-adding activity.

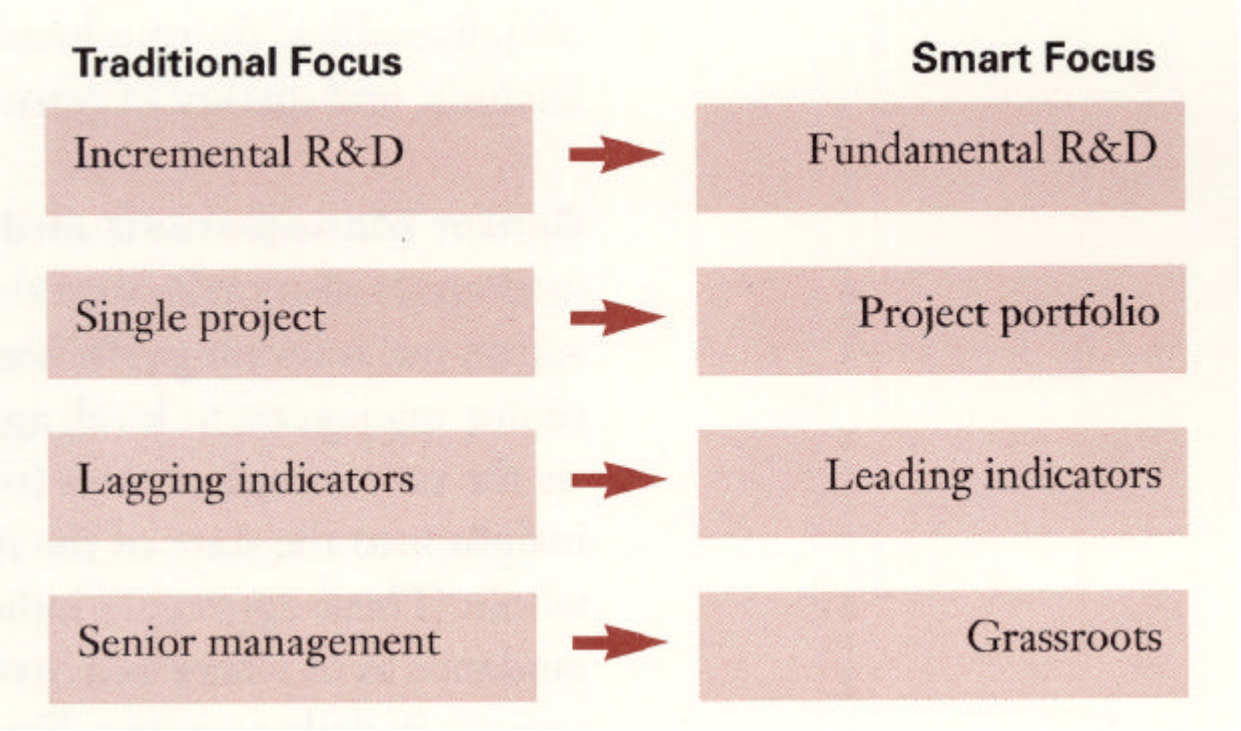
Lagging and Leading Indicators. Smart innovators assess how well the money devoted to innovation has been spent. For this after-the-fact evaluation, they use lagging indicators such as development cycle-time, initial product quality, warranty costs, first-year sales volume, and billable research hours. These end-of-process indicators enable them to track progress over time, to benchmark performance, and to identify symptoms of an underperforming innovation process.

However, smart innovators also realize that lagging indicators do not give early-warning signals, highlight root causes, or enable corrective action. „Technology and business are necessarily out of phase in the cycle of things," said one participant at a recent Arthur D. Little colloquium. „Technology vision is hard because when a business is performing well, it's based on a technology from yesterday. There's a mismatch. The seeds of destruction are planted at the top of success. History is often the worst enemy in charting the future."

Therefore, smart innovators add leading in-process indicators that measure, for example, anticipated break-even time, quality of planning, conformance to best-practice, time spent with customers, timeliness of deliverables, thoroughness of early engineering analysis, and quality of resources.

Exhibit 1

Spectrum of Performance Indicators



Senior Management and Grassroots. Smart innovators also make sure that all levels in the organization use relevant performance indicators. At the senior management level, aggregate indicators, such as the percentage of sales from new products, provide insight into the state of the innovation process as a whole. These aggregate indicators, however, offer little guidance as to where and how to improve the innovation process in daily activities. For this, grassroots indicators, such as the lead time for obtaining prototype parts, are required. Furthermore, smart innovators link the indicators at the various levels logically together into a pyramid, so that priorities set at the top steer behavior at the bottom and good performance at the bottom percolates up to the top (Exhibit 2).

Interpretation and Adjustment

Once a spectrum of performance indicators linked to the company's strategy is in place, measurement and tracking can start. However, smart innovators do not apply the indicator system mechanically. They use it flexibly and allow for interpretation and continuous adjustment. Some of the guidelines they follow are:

• Set „stretched" yet realistic targets for each performance indicator. Stretched targets usually generate first despair and then anger. The acid test of their realism is whether the anger subsequently is transformed into resoluteness. Once that hurdle is cleared, teamwork, extraordinary creativity, and, ultimately, success follow naturally.

• Tune the measurement frequency to the rate of change in the process. Too high a frequency creates indicator fatigue from lack of variability; too low a frequency lets threats and opportunities slip by unnoticed – or be noticed too late. Similarly, adjust the targets and measurement scale to the improvements that occur. Show how targets change and performance improves over time.

• Hold people accountable for indicator performance insofar as they can influence the score. A pyramid of performance indicators, as discussed before, can be very effective. Furthermore, while rewarding good performance, consider team as well as individual rewards; consider rewards for process owners and coaches as well as for functional managers.

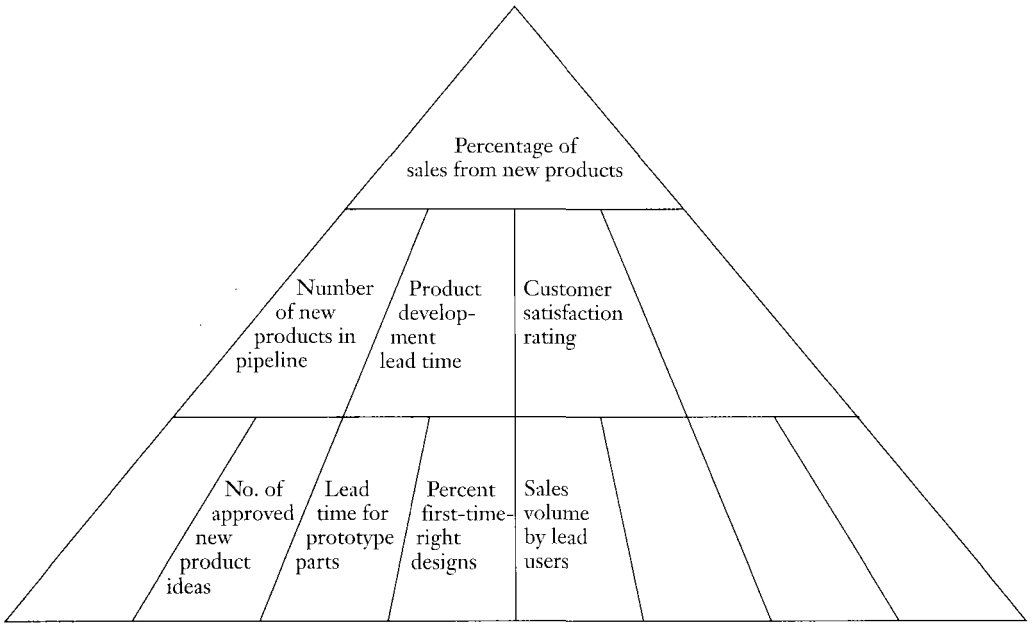
Learning and Acting

Corning uses its „Million Dollar Club" to identify systematically which research projects undertaken seven years earlier are now producing at least $1 million annually in revenue. It investigates and learns from projects both in and outside of the club. Smart innovators like Corning realize that performance measurement is worthless unless it accelerates learning. It makes sense to measure performance only when it triggers understanding and

eliminates the drivers of under-performance.

Exhibit 2

Pyramid of Performance Indicators



Suppose, for example, that a manager is worried about the erratic lead-time performance of his or her development projects. In some periods, most projects finish within the planned schedule; in other periods, a large number of projects finish well beyond plan (Exhibit 3). A more thorough look reveals a correlation between complexity and performance. As soon as the average number of projects on which engineers work simultaneously rises above a certain level, coordination problems and long mental set-up times throw the innovation process into unmanageable chaos.

The manager can envisage several courses of action to remedy the performance problem. In the medium term, he or she can reduce the average number of projects on which engineers work by reallocating and focusing each of the engineers on fewer projects, by hiring temporary staff, or by cutting the number of projects. In the long term, the manager can improve the organization's resilience – i.e., move the curve to the right – for example, through better project planning, management, and control.

Event-Driven Reviews

Performance indicators provide managers with periodic scores on the effectiveness and efficiency of the innovation process. They enable managers to track progress, for example, in rejuvenating their product range, staying within development budgets, and reducing time-to-market.

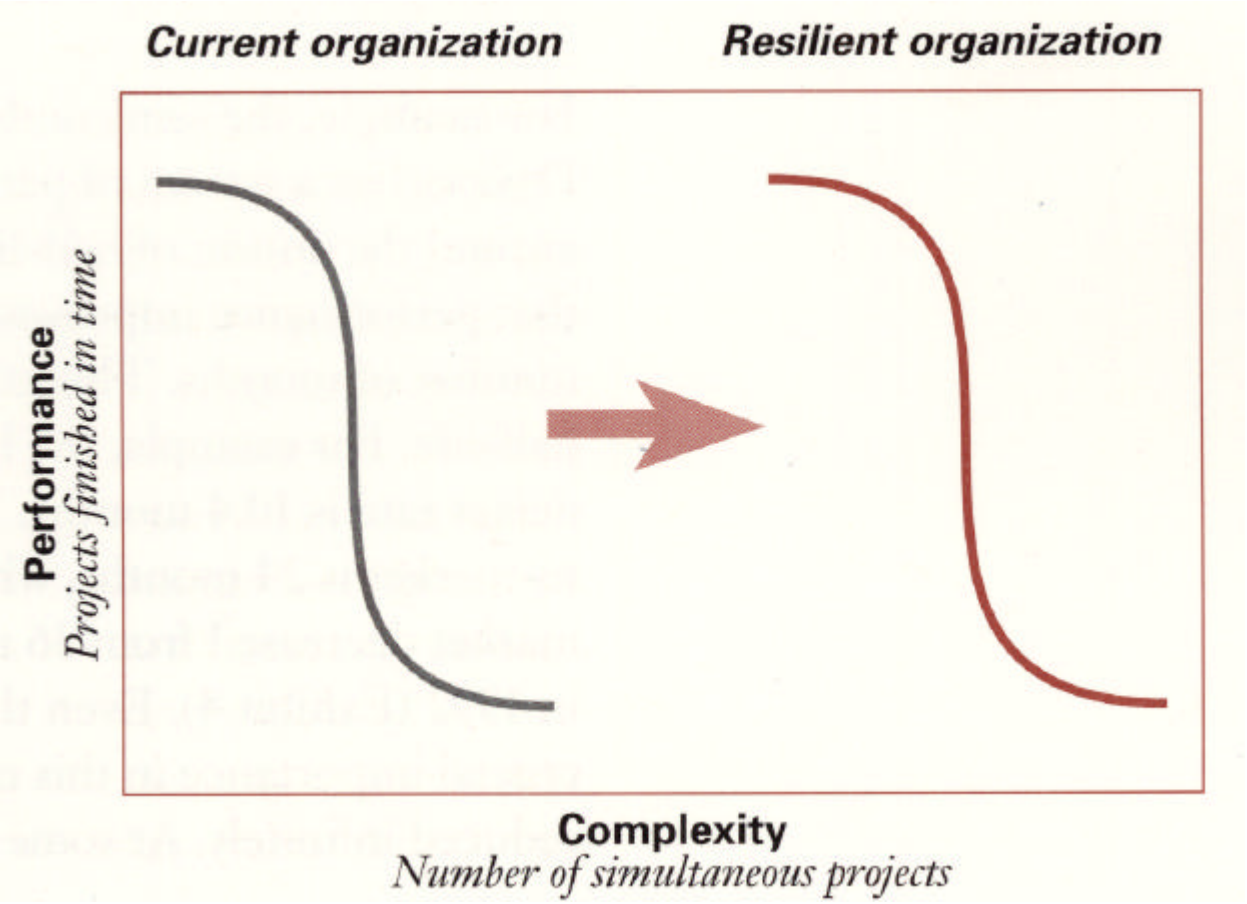
Smart innovators complement these calendar-driven measurements with event-driven reviews. Event-driven reviews, which are *ad hoc*, are in-depth audits of certain aspects of the innovation process. One example is a post-mortem analysis of a just-completed development project.

The reason for conducting event-driven reviews is that performance indicators are the manifestation of innovation priorities and concerns that were considered important at the time of their design. As performance on these indicators improves over time, it becomes increasingly difficult to keep improving at the same rate. The complacent manager will be satisfied to stay at the achieved performance level. The foolhardy manager will make inordinately expensive efforts to go one step further.

Both complacency and foolhardiness are inappropriate. It is likely that by the time performance levels stabilize at targeted levels, innovation priorities will or should have changed and, therefore, that new performance indicators are required. Event-driven reviews enable you to identify these better-suited indicators.

Exhibit 3

Example of Cause-Effect Performance Indicators



For example, the semiconductor company Analog Devices has a system of performance indicators built around the notion of half-life. The company has found that performance improves by 50 percent every set number of months. This constant period is called the half-life. For example, the half-life of the product defect rate is 10.4 months. The half-life goal for time-to-market is 24 months, which means that time-to-market decreased from 36 months in 1987 to 6 months in 1992 (Exhibit 4). Even though time-to-market is of crucial importance in this cutthroat industry, it can't be reduced infinitely. At some point, the company needs to revise its competitive priorities and focus on something else, such as product innovation. When it does, the performance indicators should follow.

Arthur D. Little has designed a kit of audit tools that help managers change the way the innovation process is managed and adapt the corresponding performance indicators. We distinguish three levels of tools, based on the impact they have on the organization. Which package of audit tools is applied in any particular situation depends on the objectives and focus of the review (Exhibit 5).

Level-1 Tools. A level-1 tool reveals the organization's perception and consensus about where the innovation process needs improvement. It holds up a mirror to the organization and opens its eyes to the need for change, often in dramatic ways. An example of a level-1 tool is the Marketing/R&D-interface survey. This questionnaire probes the quality of the interface between marketing and R&D people at various stages of the innovation process. For example, how are the two groups involved in developing the company's product strategy, in generating new product ideas, in setting advanced development priorities, or in specifying new products?

To see clearly where and how to change, level-2 and level-3 tools should also be used.

Level-2 Tools. A level-2 tool yields a rating of the company's practices in the innovation process against best practice. An example is the best-practice scale, a grid that defines performance levels on a scale from „barely acceptable" to „world-class" for each of some 50 aspects of the product creation process. For example, the tool helps determine what it means to be world-class in project planning, in using design rules, in assessing customer needs, and in establishing product cycle-plans. Where a level-2 tool reveals that the company's current practice deviates strongly from best practice, the company should undertake in-depth investigation and action. Level-2

tools can reveal opportunities for dramatically improving the performance of the innovation process.

Exhibit 4

Half-life of Time-to-Market

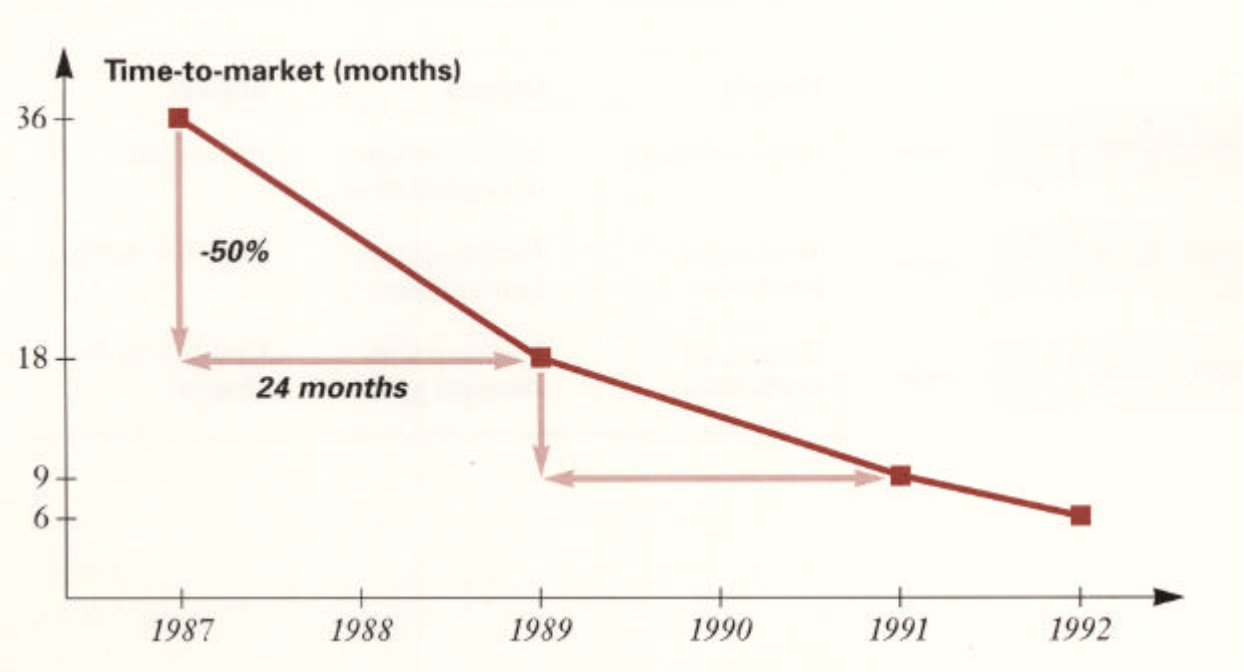


Exhibit 5

Tools for Event-Driven Reviews

	Vehicle	Output	Impact
Level-1 tools →	Questionnaires	Mirror-image of organization	Eye-opener
Level-2 tools →	Structured interviews	Rating against best practice	Case for change
Level-3 tools →	Structured workshops	Variance with strategic goals	Conditions for change

Level-3 Tools. An example of a level-3 tool is product dissection, the systematic physical analysis of the company's and key competitors' products. In the case of an assembled product, product dissection provides benchmarks and detailed insights into cost structures, design capabilities, and opportunities for design improvements. Because these analyses are done cross-functionally and look at the root causes of under-performance, they can effectively create widespread acceptance of the need for change.

Learning to Measure, and Measuring to Learn

The saying „what gets measured gets done" is only partly true. Purposeful action comes about only when communication channels are open and when the spectrum of performance indicators is compatible with the technology and innovation priorities that the company has chosen to pursue. Continuous interpretation, learning, and adjustment are necessary to make sure that the scores on the performance indicators stimulate innovation in a direction that reinforces the company's competitive position.

[1] Third Generation R&D: Managing the Link to Corporate Strategy, Philip A. Roussel, Kamal N. Saad, Tamara J. Erickson, Harvard Business School Press, 1991

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