

Third-Generation R&D Management

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In the decades ahead, competition will grow increasingly international and will focus increasingly on technological strengths. Financial and physical resources, work skills, and technology are highly mobile. The firms that succeed in global competition will be those that employ technology to maintain an edge in product quality and innovation, an advantage in production and marketing productivity, and responsiveness to market interests. This success in turn depends on each firm's skill in managing its research and development effort.

Despite the crucial importance of R&D, our research has revealed that R&D organizations are rarely integrated spiritually or strategically as full and equal partners in the business enterprises whose prosperity they are intended to serve. This article suggests a philosophy and set of practices that can help ensure that R&D's contribution to a firm's competitive advantage will continue and grow.

From Hope to Project Management

Some companies are still managing R&D in what we define as the first-generation mode: they hire good people, provide them with the best facilities money can buy, have them work in a „creative“ – possibly remote – setting, leave them alone, and hope they produce commercially viable results. This construct can be called „the strategy of hope.“

Editor's note: This article is derived from Third Generation R&D: Managing the Link to Corporate Strategy, by Philip A. Rousssel, Kamal N. Saad, and Tamara J. Erickson, Harvard Business School Press, Boston, 1991.

Through the 1950s and the early 1960s, the strategy of hope produced results. Most industries enjoyed substantial growth and healthy profits. But times have changed. Many once-revolutionary technologies are approaching their full potential. What once were innovative, cutting-edge products are now commodities. In industry after industry, demand growth has slowed or disappeared, and heightened competitive intensity has put severe pressure on profitability. Inevitably, management expects larger contributions from R&D.

Today, top executives recognize that they often possess insufficient insight into R&D – and therefore insufficient intuition in this area – to base their companies' R&D on hope alone. In the past decade or two, many companies have adopted second-generation R&D management practices – practices that are distinctly more systematic and more specifically attuned to business needs. Second-generation R&D management recognizes the discrete project nature of research and development. It seeks to quantify the cost and benefits of individual projects and to monitor progress against project objectives.

But even in the second-generation mode, operations tend to manage R&D on a project-by-project basis, rather than managing the aggregate of all projects. Although each individual project may have merit, the collection, or portfolio, of projects may or may not be strategically adequate. Managers working in this mode find it difficult to establish priorities among projects within each business, across businesses, and for the corporation as a whole.

Third-Generation R&D Management

Some companies are now moving to a mode of R&D management that is both purposeful and strategic. In this third-generation R&D, general managers and R&D managers work as partners to pool their insights in deciding what to do and why and when to do it, given the needs of each business and of the corporation. They realistically assess costs, benefits, and risk/reward, and they balance these variables within a portfolio of R&D activity that best fulfills the purposes of the corporation as a whole (Exhibit 1).

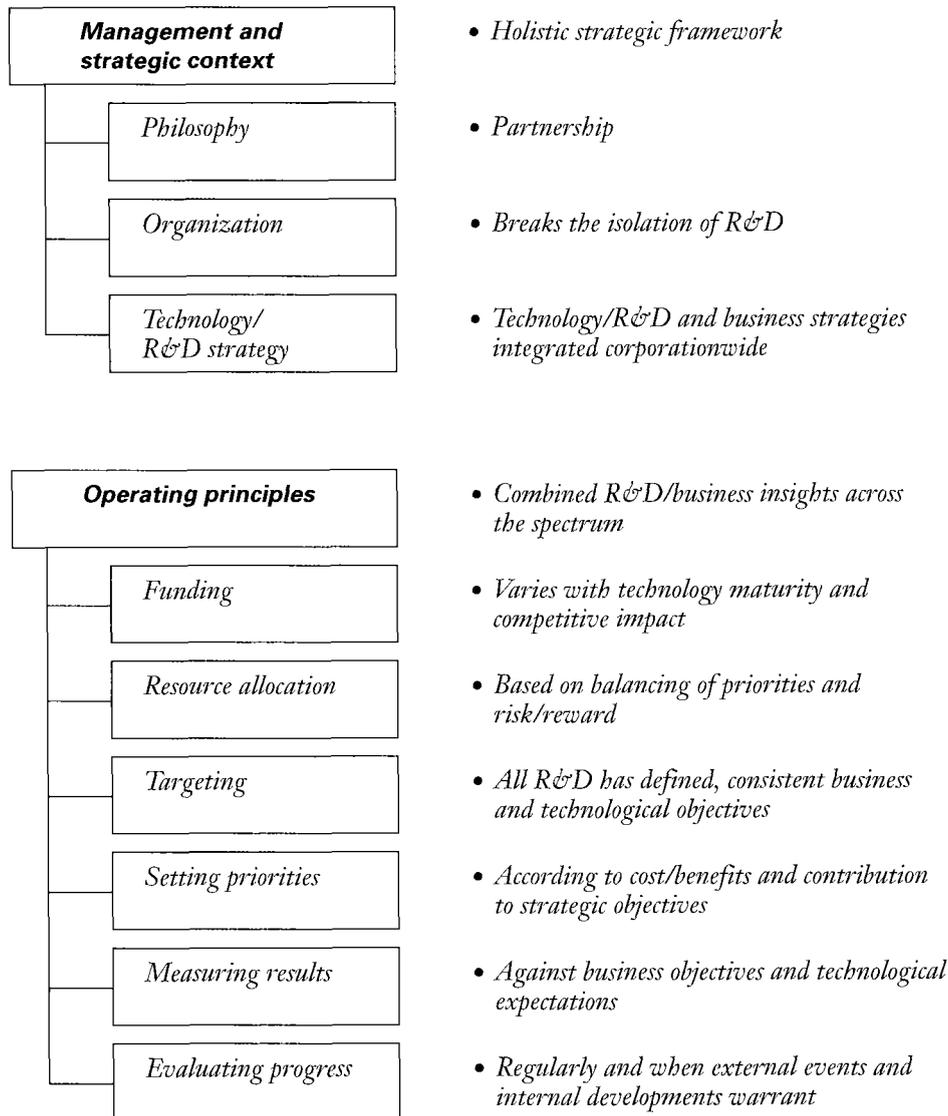
Third-generation R&D management is not a mechanical model that lets managers plug in variables and come up with decisions. Rather, it is a conceptual model that fosters productive working relationships and shared insights – a true partnership that forms the basis of judgments about what R&D to do and not do, now and in the medium- and longer-term future in a particular corporate environment.

In short, companies working in the third-generation take a holistic view of the full range of their R&D activities. They organize their R&D in a way that integrates R&D with the rest of the company in order to promote the spirit of partnership between R&D managers and their general or functional management counterparts.

By concentrating scarce resources and rare skills, these companies organize to promote sharing where it matters. They exploit technological synergies by integrating their R&D and technology plans across businesses and across the corporation, by coordinating plan execution, and by sharing experiences and information among distribution centers. They design their communication networks to ensure a continuum across the R&D spectrum and forward to the market. They believe in the matrix as a powerful way of managing R&D, and they seek to make project managers full partners with their R&D line-manager counterparts.

Exhibit 1

Characteristics of Third-Generation R&D Management



These companies work to formulate integrated corporate/business/R&D/technology strategies that take into account synergies and trade-offs between projects across businesses and corporate programs, particularly when technologies are shared by different parts of the corporation. And they select targets by setting their fundamental research in a business context, confident that providing researchers with a sense of business purpose is a motivating factor and need not be inimical to creativity.

Seven Key Practices

How can CEOs and R&D managers assure themselves that their organizations are developing and institutionalizing practices consistent with third-generation management? Our experience suggests that seven key practices will help manage the process effectively:

- A common vocabulary for describing R&D projects and their objectives, allowing rigorous communication
- A process that jointly develops clearly articulated, mutually agreed-upon, strategically evaluated project objectives, with clearly defined results
- A process for setting priorities and allocating scarce resources – capable of change in response to market, strategic, technological, and competitive developments
- A backlog of ideas

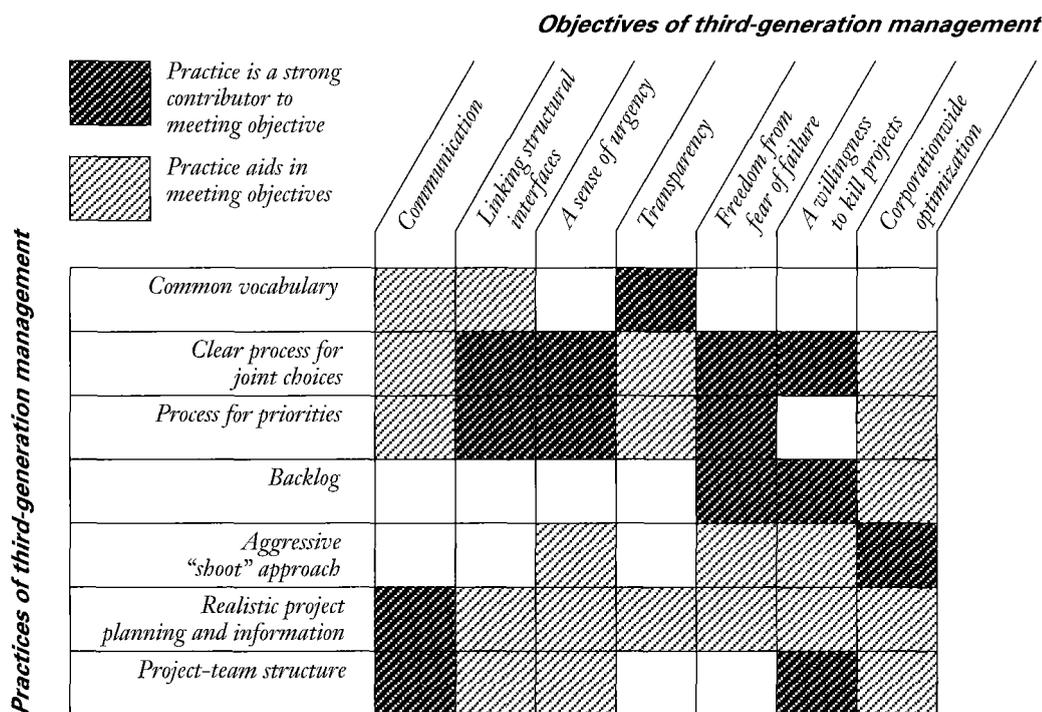
- An aggressive approach to project design that addresses most significant technical uncertainties as early as possible
- A practical approach to individual project planning, reporting, measurement, and control, aided by appropriate information systems
- An appropriate project-team structure, composition, and authority – the professional management of complex projects – along with appropriate integrative mechanisms

As shown in Exhibit 2, each practice plays an important role in helping an organization achieve the objectives of third-generation management.

A Common Vocabulary. The marketing vice president of the Haber Food Ingredients Division is frustrated. Months ago his competitors introduced a new salad dressing that, frankly, tastes great. To compete successfully, he needs a new salad dressing that will taste better and cost less to manufacture. But his discussions with R&D seem to be going nowhere.

Once again, he reads a report from R&D. It describes in detail an intense effort to develop a new emulsifier system. The report talks about how close R&D is to achieving progress on an emulsifier system. Nowhere does it talk about salad dressing.

Exhibit 2 Managing for Results



The frustration experienced by Haber's marketing vice president is not uncommon. Often R&D thinks of its goals – and describes them – simply in terms of demonstrating the feasibility of technological systems or approaches. Business, however, thinks in terms of products, markets, and financial goals. In the minds of the Haber R&D staff, success with the emulsifier will significantly improve the taste of salad dressings and reduce manufacturing costs. But R&D's reports in no way connect the realities of the emulsifier project with the flavor and cost expectations of the marketing vice president.

Another way to think about the problem is that R&D often communicates data, while the marketing vice president needs information in the way that Peter Drucker defines it as „data endowed with relevance and purpose.“¹

A key component of successful communication in third-generation companies is the ability to express R&D objectives and business objectives in a common language. That language needs to describe the technical means

and relate them to the business ends in terms acceptable and clear to both technologists and business people.

Objectives, Priorities, and Resources. Movement from a sound strategy through successful implementation – by project, by multiproject business, by multi-business division, and across the corporation – requires an iterative process for setting priorities and allocating resources in light of business and corporate objectives.

Technical strategies are translated into specific programs that go through a portfolio review process (described in the book from which this article is derived). The portfolio review sets priorities among the projects and allows subsequent resource planning, including detailed staffing requirements, to be developed.

The projected resource needs feed into a project management system that, as one of its outputs, provides status reports on the programs feeding back into the next year's technology planning and strategic planning cycle. Outlining the integrated process in this way allows everyone in the company to understand the process, the need for well-considered trade-offs within R&D objectives, the rationale for difficult decisions, and the fit of individuals and individual organizations within the whole. The process must not be seen to produce winners and losers. The corporation as a whole is the only winner, and the process encourages buy-in and support (or, at least, acceptance) by business and R&D participants.

A Backlog of Ideas. People are more inclined to say „enough is enough“ and go on to the next project when the next project is clearly defined, clearly attractive, and only awaiting resources. A useful tool to encourage organizations to kill projects and avoid the lingering death that can drain corporate resources is to create a backlog of attractive pending projects.

One company has a policy of always having 25 percent more work defined than its resources can support. The company feels that such a policy maintains a healthy R&D balance. The backlog is used by management: (1) as a test to ensure that the most attractive projects are supported and (2) to encourage among researchers receptivity to project termination in the knowledge that important alternative projects await them.

Aggressive Project Design. Project design must address most significant technical uncertainties as early as possible. In other words, management must be willing to „stand 'em up and shoot.“ One company faced a fascinating challenge. A new technology, developed somewhat accidentally in its R&D laboratory, had a wide range of potential applications, all of which were outside the current scope of the corporation. Over the course of its development efforts, the company asked for help in assessing the market potential and technological and competitive challenges facing the products that would result.

An early assessment described a large number of possible applications as well as the great uncertainty associated with any estimates of market size in view of the fact that none of the products had actually been tested. Several years later, little of significance had been added to the knowledge of market potential. The number of possible applications to which this fascinating technology could be applied was still vast, the potential revenues were still enormous, but uncertainty about any market estimates was significant.

Over the years, the company had invested in significant technical development. It had dealt with a number of thorny issues surrounding the compound's manufacturability and stability, and it had succeeded in producing a compound with extraordinary shelf life. But the technical work had failed to deal with the fundamental issues affecting the technology's commercial potential. In effect, the company had avoided subjecting the program to the toughest test – it had not pushed it up to the wall and pulled the trigger.

R&D and business management must be pushed to maximize the quality of the information developed through R&D investment, allowing decisions to be made as early as possible about the make-or-break issues in the product-development cycle. The sought-after results must be defined in such a way that if the critical demands fail to be satisfied, the fatal blow will be recognized as early and as inexpensively as possible.

Planning, Reporting, and Controlling. Managing for results in the third-generation mode requires realistic projections of time, cost, and manpower needs. To ensure sound business results and to avoid compromising its future credibility, R&D's business partners must be equally demanding – and demanded of. They must provide the best information about markets, competitive dynamics, rates of environmental change, costs, and uncertainties surrounding market entry – the full commercial half of the success equation.

Controlling requires decision-oriented information for line, project, and top management. Project plans are prepared jointly by the project manager, the department heads of the line organizations, and the internal customer. These plans include the commercial and scientific objectives of the project, its constituent individual activities, timing, costs, and, critically, milestones. These plans are the basis for comparison between actual and planned performance and for company-wide, multiproject planning.

The tracking of performance against the project plan is often aided by visual displays of the project's flow. Pert and Gantt charts are frequently used tools, too well treated in other literature to be discussed in detail here. Though potentially useful, they tend to portray R&D as a disciplined, orderly, exactly forecastable process,

which of course it is not. R&D is never precise. Good management incorporates in the project plan the assumptions for success that must be tested and the uncertainties that characterize creative work, then allows flexibility for timely plan revisions.

Appropriate Project Teams. Many R&D projects are complex enough to justify a formal project-management system designed to cope flexibly with change, unanticipated challenges, and complex interorganizational interfaces. In those situations, traditional, departmentalized thinking has to be changed to an interdisciplinary project orientation. Our work with clients, as well as a study done by R. Katz and T. J. Allen on 86 R&D teams² shows clear improvements in tying R&D objectives to business strategy when R&D projects are undertaken in a multidisciplinary, output-oriented fashion.

Third-generation management thinks about and practices project management as part of a holistic management system that works across business units, operating companies, divisions, and the corporation as a whole. Third-generation project management could never be captured by a software package; it demands an understanding of and a sensitivity to the other key practices discussed in this article.

There is no assurance of success, but to encourage its probability, third-generation management considers project management and managing the interactions of multiple projects as a constructive overlay on the existing organizational structure, not as a competitor to it. The project manager and team provide crucial input to both the results to be expected and the resource-management processes: the technological objective, work plan, resource requirements, and cost/benefit and risk/reward assessments. The project manager and team also require and obtain crucial information from the business system: the business purpose/objective and priority, market requirements, market potential and market uncertainty, state-of-the-art information on relevant external technologies, and resource availability over time. In obtaining and providing these inputs, the project manager and team deal with an increasing number of people both inside and outside the company.

In practice, the word „project“ is commonly reserved for sizable clusters of activities with a clear beginning and a clear end; smaller activities or groups of activities are often referred to as tasks that do not need full project-management treatment. A „pure“ project organization, with a task-force structure, is typically used in exceptional cases involving large resources.

All project participants are transferred from their original department to the project team for the duration of the project. Administratively, functionally, and organizationally, each member reports to the project management (a reporting structure that may lead to reorientation problems in functional departments at the end of a project). The great chemical company Hoechst, for example, makes these total transfers to a project when a new business unit is likely to evolve from the work.

For most projects, however, the matrix organization is optimal. People working on the project team stay hierarchically within their departments. In addition, the function of project manager is introduced. The project manager is disconnected from his or her original department and derives authority from well-established and visible linkages with senior R&D and business management.

During introduction of the matrix, clear rules of the game must be established between project and line managers. This can be done by means of a functional diagram that describes the tasks, responsibilities, and authorities of the project manager, each member of the team, and the line managers to whom the team members continue to report.

For all types of projects, a clearly defined client relationship is indispensable. The client's task is to define what and when, review progress and provide feedback, and fund the project.

Furthermore, the success of a project must be defined in terms of the ideal profile of the product or process to be developed. Success will always have multiple parameters. They must be ranked by relative importance: those that are „killers“ – meaning the project must be stopped if they cannot be achieved – must be clearly understood up front by all concerned.

While the transition to third-generation R&D management entails significant change, its characteristics are elementary and the process needn't be daunting. All it requires is management will, intelligence, and commitment. The rewards are well worth the effort.

¹ Peter Drucker, „The Coming of the New Corporation,“ Harvard Business Review (January-February 1988), pp. 45-53.

² R. Katz and T. J. Allen, „Project Performance and the Locus of Influence in the R&D Matrix,“ Academy of Management Journal, vol. 28, no. 1 (March 1985), pp. 67-87.

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