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Managing the "Unmanageable"

Radical Innovation

ORVIDAS

Managing the "Unmanageable"

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AT A GLANCE

Manufacturing companies have had impressive success in boosting product development by following rigid processes. Yet this approach has made it harder for them to develop the breakthrough products that draw a significant share of profits and growth over the long term.

A Bias Toward Learning and Agility

The main elements of the prevailing approach to innovation since the 1980s—processes, tools, and KPIs—undermine radical innovation: they bias the organization toward linear, predictable, and isolated tasks. In order to promote creativity while enforcing discipline, companies need to govern according to a broader range of criteria that include learning that doesn't fit initial expectations.

Reorienting for Radical Innovation

A good first step involves reflecting on the organization's capabilities for radical projects along the five key domains: processes, methods and tools, KPIs and decision making, organization structure, and teaming and collaboration.

I N RECENT DECADES, ONE of management's objectives has been to add discipline to innovation. Companies have greatly improved the efficiency of new-product development, and managers have been able to draw on a variety of processes, methods, and tools to maximize the return on their R&D investment.

Unfortunately, these advances have had the unintended consequence of discouraging radical innovation: technical breakthroughs that render existing products obsolete or that create new markets altogether. In this report, we look at products—not services or business model innovation. Unlike incremental innovation, radical innovation involves a great deal of uncertainty—the very quality that is not tolerated by most management techniques.

As a result of this intolerance for uncertainty, companies have been undertaking less and less radical innovation. A recent study by the Product Development and Management Association found that radical innovation accounted for only 10 percent of an average company's innovation portfolio, down from 21 percent in 1990. As the new productivity measures gained traction, managers naturally gravitated to projects that succeeded under the new constraints. More and more, breakthrough projects with high failure rates and less predictability lost out when investment priorities were set.
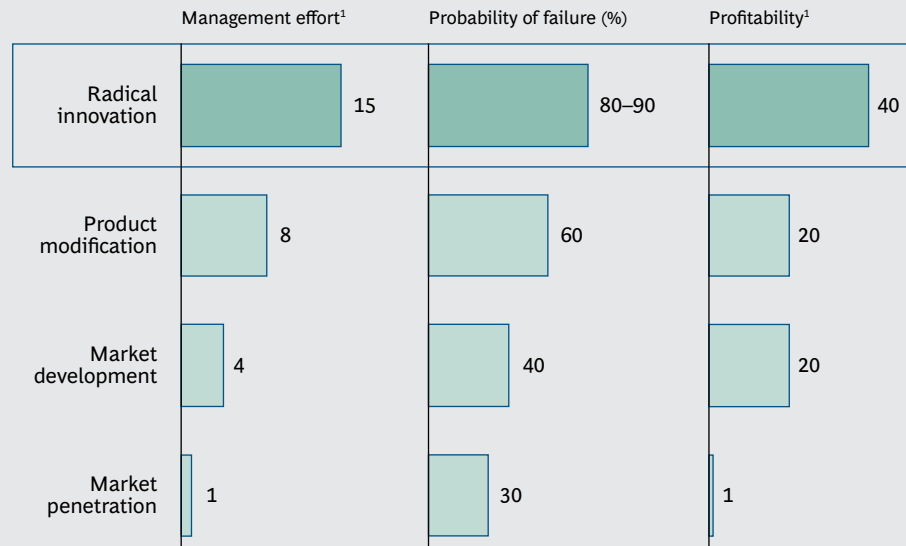
Breakthroughs are an important source of competitive advantage. Although incremental improvements help maximize returns on existing investments, radical innovations are vital to long-term growth and profitability. While challenging to carry off, they can deliver great value. (See Exhibit 1.) Radical innovations are essential for progress in society at large. Fortunately, there is a way to bring order and efficiency even to highly uncertain projects.

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Balancing Flexibility and Discipline

It's easy for managers to focus on short- or medium-term results and to shy away from radical innovation. A superficial look at past advances supports the widespread opinion that success depends heavily on chance. Corning's optical-fiber work, for example, didn't start out in the 1970s as a telecommunications product. It led to commercial success a decade later, following a highly opportunistic path that built on outside events and unrelated internal projects. The process also involved several failures, including attempts at video telephony and broadcast local-area networks. Optical fibers are now a vital conduit of the world economy. But if Corning had been subject to today's development regimes, managers would have

EXHIBIT 1 | Radical Innovations Are Challenging but Rewarding

	Management effort[1]	Probability of failure (%)	Profitability[1]
Radical innovation	15	80–90	40
Product modification	8	60	20
Market development	4	40	20
Market penetration	1	30	1

Sources: Product Development and Management Association (PDMA); BCG experience.
Note: These statistics are based on a 2012 PDMA survey of more than 400 product-development practitioners worldwide.
[1]Management effort and profitability are indexed to market penetration.

shelved the project long before serendipity and creativity had had the opportunity to influence the ultimate development path.

Instead of patiently pursuing projects, many companies have effectively decided to outsource radical innovation. They monitor startups and other entrepreneurial ventures for big advances, which they then commercialize through licensing or outright acquisition. In many instances, this makes their long-term strategy dependent on the advances of others. And because of the acquisition or licensing premiums that they need to pay, there are limits to the value that they can capture through innovation.

Another approach is to set up separate, highly autonomous organizations with minimal supervision. The idea is to imitate startups and to free teams from the usual corporate constraints. While the intentions are good, many of these efforts suffer from the worst of both worlds. Their autonomy means that they usually lack management efficiency, and they often lose out in budget allocations after the first year or two because they are isolated politically from the larger company.

There is, however, a way to control destiny without completely throwing out the rules and imitating a high-risk startup. Managers can still have rules, but they need to use a different rule book. We have drawn on extensive experience with major innovators, as well as academic research, to discover which management techniques correlate with success. We learned not only why conventional R&D management discourages major advances but also how managers can reduce risk and promote efficiency without squelching creativity.

To do that, managers need to shift their mindset away from *predicting* the course of projects. Instead they should focus on *governing* the project to manage risk and keep potential losses within an acceptable range. They can provide essential discipline while enabling the flexibility that radical innovation requires. This takes extra effort and adaptable management, but the payoff is enormous.

Why Conventional R&D Management Fails

The techniques of systematic management have brought enormous gains to business and the economy. By articulating goals, planning the major steps, assigning accountability, and monitoring results over time, companies have greatly boosted efficiency in almost every aspect of what they do. As companies began to get serious about innovation in recent decades, they followed this approach—with impressive success. Skeptics who thought innovation could never be managed were proved wrong. Productivity jumped while companies produced a stream of solid improvements in the marketplace.

In practice, this meant managers established project goals and laid out a sequence of stages, each with clearly defined criteria for allowing a project to continue. Regular reviews averted big surprises and kept projects moving along the normal budgetary process, ensuring a rational allocation of resources. These techniques have worked well in the stable and predictable environments common to incremental innovation. But when it comes to radical projects, these efficiency-oriented practices enforce a number of biases that can undermine even the most promising ideas.

We can learn about these biases by reviewing the attempts of a real company (which we have dubbed NewPro for this report) to carry out radical innovation. For many years, the company had been using the same approach with all new projects, regardless of how much the envisioned product differed from current offerings. For a typical radical project, the project manager started by applying a traditional gate-focused process.

Gate-focused processes chart a strongly linear path: development followed by prototyping, testing, and commercialization. In theory, these processes bring some flexibility for iterations or recursions that allow for concept testing or technology development. But NewPro's project manager discouraged such changes midstream because these would force changes to the timeline and the budget. As a result, when the NewPro team learned about a potential problem late in the testing phase, there was neither budget nor time to research a promising fix. The gated process had become something of a straitjacket. Given the inherent uncertainty of a typical radical-innovation project, it is usually essential for successful teams to conduct research in parallel with product development, leading to a zigzag process with the sort of side activities that would have frustrated NewPro's project manager.

The project manager further structured the project by strictly separating work on technical matters from the commercial side of the product. However, many radical-innovation projects get much of their value by integrating these efforts. Both technical and commercial areas can be highly uncertain, and developments in one area can greatly affect the other.

When it comes to radical projects, efficiency-oriented practices enforce a number of biases that can undermine even the most promising ideas.

In addition to this functional isolation, the NewPro work stayed largely internal. The project manager discouraged ties with external developers and potential customers whose participation might have slowed the project or added complexity. This isolation prevented the team from gaining vital information and insights into both technology and markets, which could have helped reduce uncertainty to manageable levels.

Along with the gated process, NewPro's project manager used a number of tools to propel the project forward. Total-quality-management applications for R&D worked to boost productivity by establishing a narrow set of goals for project managers. Failure mode and effect analysis helped predict where things could go wrong. But they also limited options and closed off investigations of promising alternatives to established ways of doing things. NewPro's project manager was naturally eager to pin things down so that he could plug in his usual tools. But radical innovations are never fully conceived when the project is initiated. To unfold, they depend on numerous small discoveries and adjustments—many of them requiring an open, patient, and creative mindset—along the way.

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A vital component of a gated governance process is a series of predefined, structured progress meetings. This by itself is not a problem for radical innovation. But NewPro's manager tended to zero in on the two areas easiest to assess—tangible near-term gains in the project and the project's measures of productivity—making it difficult to justify the experimentation and side projects that could germinate into breakthroughs and project refinements. NewPro's team members took their cues from the project manager and inevitably focused their attention on maintaining the project's forward momentum. Furthermore, the regular check-ins generated seemingly positive feedback that reinforced the initial preference for tangible results. The manager saw more output and greater predictability, which convinced him that the team was on the right track, and he came to expect more of the same. Work on everything but the incremental improvements was abandoned as the team was stuck in a vicious circle of preparing for the next stage-gate meeting.

Reinforcing all of these tendencies was the team's own natural response to novelty, which the manager never worked to counter. Rather than stopping to reflect on puzzling phenomena they encountered, team members would channel information into their preexisting images and goals. They extrapolated the status quo instead of imagining new possibilities. They ignored data that contradicted what they already knew even when the old knowledge was weak. Yet successful radical innovation requires openness and curiosity.

Similarly, the project manager understandably preferred to minimize risk. But taking on risk should not mean fatalistic acceptance. Especially in terms of innovations that could respond to an acute need in the marketplace, the project team might have reached out to customers and suppliers to gain commitments to share the risk of the development process effectively.

All of these problems—linear project management, isolation of technical and commercial development, minimization of outside contacts, efficiency-oriented tools, focus on tangible gains, and the human tendency to resist novelty—came together to

limit NewPro's ability to innovate. The final product was close to the original design and lacked most of the novelty for end users that a more patient, curious, and flexible project team would have developed along the way. (See Exhibit 2.)

EXHIBIT 2 | What Causes a Company's Radical-Innovation Projects to Fail?

Root causes of failure of radical-innovation projects

Values
- Aiming to predict the unpredictable
- Avoiding risk rather than controlling it

Processes and tools
- Rigidly following a gate-focused, sequential management process
- Applying highly structured tools developed for incremental innovation
- Emphasizing KPIs for near-term gains and process efficiency over learning
- Extrapolating existing data rather than thinking out of the box

Interaction
- Little collaboration with colleagues beyond the product team
- Little exchange with outsiders to learn about markets and technology
- No attention to acquiring advance commitments from stakeholders to reduce risk

Many companies do not carefully differentiate between radical- and incremental-innovation projects

Source: BCG project experience.

This company's experience typifies the majority of companies that invest in product development. In our experience, we've seen that they treat all development projects the same, with a single organization and uniform guidelines, regardless of the type of innovation. They get what their processes are designed to deliver—better incremental innovation—and fail to achieve radical success and truly breakthrough products. If they do see that their focus on productivity is limiting their results, they are not sure how to manage a more flexible approach.

In our study of companies that have succeeded at radical innovation, we've rarely seen teams that follow conventional management practices. We believe they've dropped this conventional approach not from careful consideration of an alternative but simply because their teams' strong entrepreneurial spirit drives them to break free from the rule book. Individual efforts can succeed in this way, but we are convinced that companies can achieve more and better radical innovation by adopting a modified management discipline that balances risk and reward.

Making Radical Innovation Work

A different kind of innovation needs a different—yet systematic—management approach. The high level of ambiguity in the path forward, as well as uncertainty in
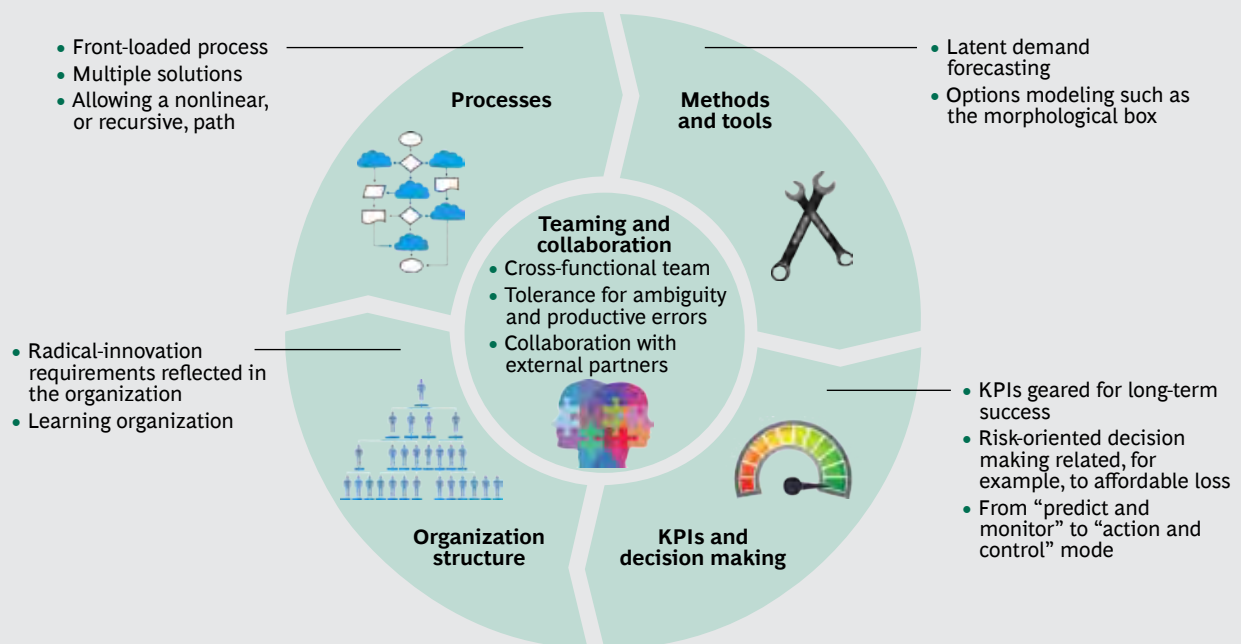
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technology or markets, requires managers to shift their expectations. Rather than focusing on predictability, they can focus on governance, especially around risk management, and on containing potential losses at an acceptable level.

Before the start of any project, management needs to clarify whether the product development plan will follow a radical or conventional approach. Products that involve both new technology and a new market are certainly radical, but categorizing those that involve only new technology or a new market will require judgment. Leaders need to factor in their organization's innovation expertise. Most breakthrough products that are truly new to the world benefit from a radical approach even if they are being developed for well-understood customer segments and familiar markets or marketing channels.

From there, the planning work can begin. We can illustrate the approach to radical innovation by looking at the five key domains involved in product development. (See Exhibit 3.)

Processes. Instead of following a linear, fairly stable path, project managers need to think in two time frames. When a project kicks off, the team needs access to sufficient resources to launch the work and start the design phase. The near-term project plan should be defined in detail and should include a clear articulation of the anticipated risks that will require management. Except for this initial phase, however, the project manager should leave the project plan open and flexible, allowing the team to adapt to the information learned and results generated by its

Exhibit 3 | BCG's Radical-Innovation Wheel Covers the Five Key Domains

- Front-loaded process
- Multiple solutions
- Allowing a nonlinear, or recursive, path

Processes

- Latent demand forecasting
- Options modeling such as the morphological box

Methods and tools

Teaming and collaboration
- Cross-functional team
- Tolerance for ambiguity and productive errors
- Collaboration with external partners

- Radical-innovation requirements reflected in the organization
- Learning organization

- KPIs geared for long-term success
- Risk-oriented decision making related, for example, to affordable loss
- From "predict and monitor" to "action and control" mode

Organization structure

KPIs and decision making

Source: BCG project experience.

early work. This approach includes the expectation that team members will initially pursue multiple solutions and will discontinue certain work streams as they learn and adapt to new information. In this way, the project can respond to emerging customer needs and refined product requirements.

The project manager focuses on determining which concrete investments to make at the start of each phase of the project rather than aiming for specified outcomes. Each phase requires a fresh management decision about resources—a decision based not on initial expectations but on the prospects currently at hand.

Teams need the foundation of strong project and resource management, but managers emphasize a different set of concerns. Rather than press teams to follow a carefully charted progression, they acknowledge contingencies and urge teams to consider multiple options. This approach requires a project manager who is comfortable being "directionally correct" and recognizes that until much later in the effort, any detailed project plan will be "precisely wrong."

Because teams have flexibility, they can quickly shift direction, responding to new information and avoiding wasteful efforts that follow through on a plan set from on high. This flexibility also facilitates a focus on continually "de-risking" the project. In many cases, a team follows multiple paths simultaneously, adapting to emerging circumstances that could never have been predicted at the start of the project. Accountability is associated not with having met a clearly established project plan. Rather the concern is whether at each phase, the overall project still looks promising on a risk-reward basis.

Methods and Tools. Instead of narrowing the field of vision and action, radical innovation demands that teams expand their horizon. They can do this with options modeling such as the morphological box, which forces a team to consider alternative solutions. These methods can encourage cross-functional teaming and more agile product development—especially in conjunction with rapid prototyping—to get early results on functionality. Similarly, tools such as quality function deployment can overcome developers' preconceptions and tightly link customer preferences to the design of a product.

Developers can also free their minds with creativity tools. Structured ideation activities, such as "thinking in new boxes" and TRIZ, get people imagining new forms and connections—with enough discipline to avoid unproductive brainstorming.[1] All such tools help the team get beyond preconceived notions about what the product "should" look like or do.

KPIs and Decision Making. Instead of focusing on tangible results, project managers can look at a wider set of accomplishments, however unexpected. In conventional innovation, managers treat all discoveries and solutions that don't fit within the existing plan as waste. By contrast, when Corning's optical-fiber team unexpectedly demonstrated that the fiber enabled video telephony, it won a new round of support.

Radical project managers still pay attention to what they can control, especially where the project stands relative to the project's affordable loss—the acceptable

This approach requires a project manager who is comfortable being "directionally correct" and recognizes that any detailed project plan will be "precisely wrong."

downside risk. They can tolerate a team's lack of progress on some dimensions but not its exceeding budget authority in spending. Other important KPIs can involve the commitment of stakeholders vital to making these complex projects work and progressively increasing the risk-adjusted value of the product by reducing uncertainties.

Organization Structure. The goal is an organization that is free of conventional management structures yet is integrated with headquarters closely enough to keep the funding flowing over time. One way to accomplish this is to divide the R&D function into two clearly separate units: one for incremental and the other for radical projects. It is also helpful if each radical project has the strong sponsorship of a high-level executive.

Radical efforts work best in organizations geared toward learning. Teams need to be open and agile enough to shift as they learn more about the imagined product and the likely market. Organizations that thrive on execution can achieve radical innovation, but they need extra management encouragement that supports people taking time to probe and learn.

Teaming and Collaboration. Because they don't focus on efficiency and predictability, radical projects can embrace the greater learning and flexibility from cross-functional teams, especially those that bring together technical and commercial people. This is harder to achieve than it might seem: the iterations in radical innovation can be fast-paced and unpredictable, so the teams need to be nimble. Yet the benefits often involve not just expanded options but also access to much-needed resources.

> Because they don't focus on efficiency and predictability, radical projects can embrace the greater learning and flexibility from cross-functional teams.

These benefits of cross-functional teaming are old news in R&D circles, but radical teams need more than just an easier time crossing internal silos. They must also be able to traverse company boundaries and collaborate with external partners—not just R&D partners but also the potential customers and vendors themselves. Both can, in many cases, be additional sources of funding and expertise.

The approaches and processes of radical teams are different from those of their incremental counterparts. Members need to be far more tolerant of ambiguity, which can slow the work but can also point the way to important discoveries. Radical teams work with less structure and must cope with greater uncertainty, but they know that mistaken paths can still provide vital insights. Because radical teams have less direct guidance from a detailed project plan, they need empowered leaders ready to make fact-based decisions and to call for management review as needed.

Taking Control of Radical Innovation

Companies don't need to be passive about radical innovation, simply waiting for outside forces to reduce uncertainty. The teams themselves can work to create realities that have never been seen before. Precisely because individual or organizational action is decisive, companies can manage the inherent risks involved with radical innovation. Individual actions and capabilities can drive the process.

For example, management at a midsize European photo-technology company realized in the early years of this century that the company needed to step up its innovation efforts in order to thrive in the new era of digital photography. At the time, the company was a world leader in photomechanical and optical equipment for professional users. But it aimed to gain a sizable share of the emerging demand for printing technology in industrial applications such as ceramics and furniture.

When initial efforts to develop industrial printers yielded suboptimal solutions for customers, the company overhauled its processes for major projects. Instead of a sequential process with resources committed throughout, it invested heavily at the start in generating and learning about potential solutions. These included commercial as well as technical possibilities, and the work revealed multiple distinct markets for the new printers. As a result, development teams discovered early in the process that different kinds of customers needed different product options. By including marketing managers on the teams from the beginning, developers were able to adjust their designs for such elements as printheads, inks, and conveyors to fit each kind of customer's manufacturing workflow.

The new approach sacrificed predictability and efficiency for learning and flexibility. Unlike the earlier development regime that would quickly focus on a single approach, the teams drove forward multiple options related to technological and marketplace demands. But the extra investment paid off: customers embraced the new equipment, sales grew more than 10 percent annually, and the company established a strong reputation in the digital-printing market.

Likewise, a large U.S. manufacturer of industrial goods, with $3 billion in annual revenues, was using a gate-focused process for developing new products. After studying its latest failed attempt at radical innovation, the company realized that the gates were too rigid and linear to support this kind of project. The revelation led to a bifurcated structure for radical innovation, separating the front-end work of building and testing options from the rest of development. Only after the teams had learned enough to reduce the options to a manageable level did the company shift toward a more traditional project-management approach.

Another midsize European equipment manufacturer worked to optimize four of the five domains. Organizationally, it separated radical from incremental projects and gave the former a distinct structure. Radical projects benefitted as well from redefined processes, especially in encouraging a more recursive path that allowed learning from failures and acknowledged new insights. Individual projects were now means based—that is, centered on the extent of resources required to give the company a good chance at success—rather than progress based.

All of these changes led the company to devise a set of more suitable KPIs for the radical-innovation projects. Those were oriented more to resources, such as budgetary outlays and time expended, than to outputs.

Finally, in terms of how teams operate, the company moved toward a culture of open innovation. It imitated successful examples such as Procter & Gamble, whose "connect and develop" attitude has reduced final product cost while improving

The company's revelation led to a bifurcated structure for radical innovation, separating the front-end work of building and testing options from the rest of development.

design and marketing. Far from bogging its teams down in complexity, open innovation has helped the company double its success rate for innovation while boosting R&D productivity by 60 percent.

Exhibit 4 illustrates the variety of ways to support radical innovation in each of the five domains.

Reorienting for Radical Innovation

"What you measure is what you manage," says the old adage, and that's certainly true of innovation. Most companies have increasingly managed for R&D productivity, maximizing their short-term return on R&D investment—at the cost of undermining riskier projects essential for long-term success. They have worked on predictability, not the ability to learn and adjust.

That's understandable, but even the most cost-conscious organization can reorient itself. A good way to start is with an assessment tool based on our analysis. Structured along the five domains, the assessment tool prompts a company to identify potential areas for improvement and prepare the organization for a different kind of project. By attending to all five domains together, a company can adopt a holistic approach to radical innovation that is customized to its situation. (See Exhibit 5.)

EXHIBIT 4 | Five Approaches for Raising the Success Rate of Radical Innovation

Processes
- Allow changes in project specifications, recursions, iterations, and side paths by employing flexible, nonlinear processes
- Leave room for individual ideas and experimentation instead of applying strict process-management techniques

Methods and tools
- Assess the likely degree of innovativeness upfront in order to choose the right approach
- Identify required capabilities and experiences as early as possible
- Gather commitments from stakeholders that add capabilities

KPIs and decision making
- Control radical-innovation projects along specific KPIs such as budgets
- Encourage risk taking
- Enable clear and quick decision making

Organization structure
- Clearly differentiate between radical- and incremental-R&D processes
- Allow for internal and external collaborations through open organization structures
- Set radical innovation as a top-management priority
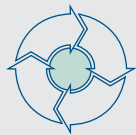
Teaming and collaboration
- Promote openness and collaboration with internal and external partners
- Ensure availability of required resources
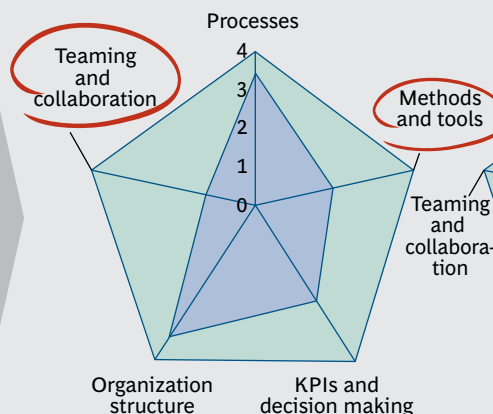
Source: BCG project experience.

Exhibit 5 | BCG's Readiness Assessment: A Well-Established Basis for Optimizing the Capabilities for Radical Innovation

BCG assessment

The assessment enables a quick overview of key areas for improvement along five dimensions

Result example 1: an equipment manufacturer

The company has adequate structures and processes in place, yet, significantly, it lacks teaming and collaboration (for example, there are no external links and no stakeholder commitments)

Result example 2: an automotive supplier
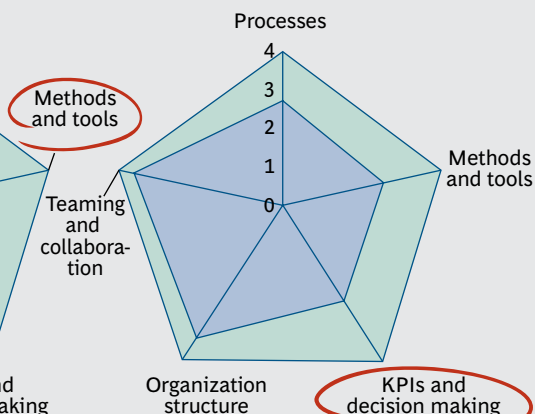
The company is very strong in cross-functional collaboration, but it is weak in drawing conclusions and making decisions (that is, it has no decision guidelines and uses the same KPIs for both incremental and radical projects)

The objective is a holistic yet focused optimization for enabling the organization to deliver radical innovation

Source: BCG project experience.

These measures provide a disciplined way for management to ask, "How flexible are our development processes? Do our decision structures recognize advances in understanding as well as more tangible gains? How well do our project teams integrate technical and commercial concerns?"

Together, these measures point the way to achieving both rigorous management and creativity. We have offered a framework that can enable companies to move from the conventional prediction-based approach to one oriented to ongoing governance. Radical innovation comes from motivated individuals who collaborate within their organizations and with outside partners. Governance allows flexibility to support the serendipity and creativity necessary for success, as well as managing the overall risk to the company. As organizations learn how to carry out this balancing act, they will start to seek out radical innovation rather than avoiding it.

NOTE
1. See Luc de Brabandere and Alan Ivy, *Thinking in New Boxes: Five Essential Steps to Spark the Next Big Idea,* New York: Random House, 2013. TRIZ, a Russian acronym for "theory of inventive problem solving," aims to systematically generate breakthrough solutions by applying patterns derived from empirical analysis of successful innovation. For more information, see Genrich Altshuller, *And Suddenly the Inventor Appeared: TRIZ, the Theory of Inventive Problem Solving,* Technical Innovation Center, 1992–1996.

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