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Research Paper

The drivers of success in new-product development

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ABSTRACT

Why are some new products so successful and some companies outstanding performers in new-product development? The article identifies success factors from numerous research studies into NPD (new-product development) performance in industry. Three categories of success drivers have been defined. First, success drivers, that explain the success of individual new-product projects, are more tactical: They capture the characteristics of new product projects, such as certain executional best practices (building in voice-of-customer; doing the front-end homework; and adopting a global orientation for the project), and well as the nature of the product itself (a compelling value proposition, for example). A second category is drivers of success at the business level: They include organizational and strategic factors, such as the business's innovation strategy and how the firm makes its R&D investment decisions; how it organizes for NPD; climate and culture; and leadership The third category of success divers identified is the systems and methods the firm has in place for managing NPD, for example gating systems, Agile development approaches, and ideation methods. The details of each of these 20 success drivers, along with their managerial implications, are outlined in the article.

1. In search of the success

What are the factors that underlie new-product success? And why are some new products so successful and some companies such outstanding performers in product development? The answer is complex, and certainly elusive for many – witness the high failure rates of new products and the poor innovation performance in industry: About 40% of new products are estimated to fail at launch, even after all the development and testing work; out of every 7 to 10 new-product concepts, only one is a commercial success; and only 13% of firms report that their total new product efforts achieve their annual profit objectives (Cooper, 2017b; Cooper, Edgett, & Kleinschmidt, 2004). Wide variances exist around these and other performance statistics, however, with the best performers doing dramatically better than the rest. This begs the question…why?

2. The scope and focus of this article

The current article and review is based largely on data from the world of physical or manufactured new products (NPD). While new service development (NSD) and software development are obviously important sectors, the fact that in the U.S. manufacturers account for 70% of R&D spending, means that NPD (physical products) is very much a vital area (NSF, National Science Foundation, 2014). Some of the success factors or drivers, and some of the best practices, outlined in the current article also have applicability to these other two sectors, namely to software and service developments; but not all do, nor are the relative impacts quite the same.

Note that results are obtained from studies of both B2B and B2C firms, and across many industries within each category. While the methods, approaches, and tools used for the conception, development, testing, and launch of B2B and B2C products differ, there is no hard and consistent evidence that the main success factors are significantly different by industry or sector. For example, it's important to have an innovation strategy, do solid voice-of-customer research, and put together effective cross-functional teams, regardless of the industry one is in. In short, the factors that make new products successful are fairly universal across industries.

The article identifies success factors from numerous research studies into NPD (new-product development) performance in industry. The impetus for this current article was a look back at two articles on this topic written thirty years ago which appeared in this journal, and which have been widely cited over the years – it is time for an update (Cooper, 1988; Cooper & Kleinschmidt, 1987). Some of the most revealing investigations on success drivers have been the large-sample quantitative studies of winning versus failed new products (for reviews, see Cooper, 2018, 2017a, 2013a; Montoya-Weiss & Calantone, 1994). This long series of product studies began with Project SAPPHO in the early 1970s, followed by the NewProd series of studies, and the Stanford Innovation Project, and subsequently, studies in countries outside of North America and Europe (Mishra, Kim, & Lee, 1996; Song & Parry, 1996). Additionally, several large benchmarking studies of best practices within firms have provided other insights into how to succeed at product innovation (APQC, 2003; Cooper & Edgett, 2012).

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Table 1
Success drivers of individual new-product projects.
Source: Cooper (2013a, 2017b, 2018).

1.	USP: A unique superior product – a differentiated product that delivers unique benefits and a compelling value proposition to the customer or user
2.	VoC: Building in the voice-of-the-customer – market-driven and customer-focused NPD
3.	Pre-work: Doing the homework and front-end loading – due diligence, done before Development gets underway
4.	Definition: Sharp and early product definition to avoid scope creep and unstable specs, leading to higher success rates and faster to market
5.	Iterations: Iterative or spiral development – build, test, obtain feedback, and revise – and putting something in front of the customer early and often, to get the product right
6.	Global orientation: The world product – a global or "glocal" product concept (global platform, locally tailored) targeted at international markets (as opposed to the product designed to meet home-country needs)
7.	Launch: A well-conceived, properly executed launch – a solid, properly resourced marketing plan is at the heart of an effective launch

Twenty success drivers have been singled out in this article. Each of these drivers has been cited in several notable studies, and/or are now found in handbooks on product-development management. For reading convenience, these 20 drivers are arbitrarily divided into three categories (although some drivers cut across categories):

1. Success drivers of individual new product projects: These are tactical and capture the characteristics of the new-product project or the product itself (see Table 1).
2. Drivers of success for the business, including organizational and strategic factors such as: the business's innovation strategy and how it makes its R&D investment decisions; climate and culture; leadership; and how the firm organizes for NPD (see Table 2).
3. The systems and methods that the firm has in place for managing NPD (see Table 3).

3. Success drivers of individual new-product projects

Why do so many new products fail and why do some succeed? And is there a pattern? Seven drivers of success at the development-project level have been identified by the research (Table 1).

3.1. Unique superior products

Delivering differentiated products with unique benefits and a compelling value proposition for the customer and/or user distinguishes new product winners from losers more often than any other single factor. Such superior products have five times the success rate, over four times the market share, and four times the profitability of "me too," copycat, reactive and ho-hum products with few differentiated characteristics (APQC, 2003; Cooper, 2013a, 2017b, 2018; McNally, Cavusgil, & Calantone, 2010).

What do superior products have in common? Winning products:

- are superior to competing products in terms of meeting users' needs, offer unique features not available in competitive products, or solve a problem the customer has with competitive products;
- feature good value for money for the customer, reduce the customer's total costs (high value-in-use), and boast excellent price/performance characteristics;
- provide excellent product quality relative to competitors' products (in terms of how the user measures quality); and
- offer product benefits or attributes that are highly visible and easily perceived as useful by the customer.

The term "product superiority" used here relates to innovativeness, but defined from an external perspective, that is, new to the market, new to the world (rather than from an internal perceptive, namely new to the firm), consistent with the definitions of "innovativeness" by Garcia and Calantone (2002). One further note is that innovativeness alone is not necessarily the key: A product might be "new and novel" in the eyes of the customer – the first of its kind, never been seen before – yet deliver little of benefit to that customer, hence is not superior in meeting needs. The satellite phone is a case in point – clearly novel, but few new benefits to the majority of potential users, hence a dud when compared to cell (mobile) phones.

Note also that "product" is broadly defined here. It includes not only the evident or physical product, but also the "extended product" – the entire bundle of benefits associated with the product, including the system supporting the product, product service, and technical support, as well as the product's image or branding. Further, product meaningfulness concerns the benefits that users receive from buying and using a new product, whereas product superiority captures the extent to which a new product outperforms competing products (Rijsdijk, Langerak, & Jan, 2011).

3.2. Market-driven products and voice-of-the-customer (VoC) built in

A thorough understanding of customers' needs and wants, the competitive situation, and the nature of the market, is an essential component of new product success (Cooper, 2013a, 2017b, 2018). This tenet is supported by virtually every study of product success factors. Conversely, failure to adopt a strong market orientation in product innovation, unwillingness to undertake the needed market assessments, and leaving the customer out of product development spell disaster. These culprits are found in almost every study about why new products fail.

Sadly, a strong market orientation is missing in the majority of firms' new product projects. Detailed market studies are frequently omitted from new product projects. In general, marketing activities are

Table 2
Drivers of success for businesses – organizational & strategic factors.
Source: Cooper (2013a, 2017b, 2018).

1.	Innovation strategy: A product innovation and technology strategy to focus the business on the best strategic arenas and provide direction for ideation, product roadmaps, and resource allocation
2.	Focus: Doing fewer development projects (relative to resources available), better projects, and getting the right mix of projects by adopting systematic portfolio management
3.	Leveraging core competencies: Step-out development projects, which take the business into new and unfamiliar markets and technologies, lead to higher failure rates
4.	Targeting attractive markets: Certain elements of market attractiveness – market size, growth, and the competitive situation – useful as project selection criteria
5.	Resources available: Innovation resources, both quantity (people, money), and quality (the right people) in place
6.	Teams: Effective cross-functional teams to reduce time-to-market
7.	Climate: The right climate and culture – one that supports and fosters innovation activities – one of the strongest discriminators between successful innovating firms and the rest
8.	Leadership: Top management supporting and leading the innovation effector at every opportunity

Table 3
The right systems, processes and methodologies.

1.	Gating systems: A multistage, gated disciplined idea-to-launch system, such as Stage-Gate (as opposed to an ad hoc approach or no system at all), now used by most top-performing B2B firms in NPD
2.	Accelerating development: Many good ways to accelerate development projects, but not at the expense of quality of execution.
3.	Agile: Agile methods from the software development world built into traditional gating systems to yield agility, adaptive response to changing requirements, and faster to market
4.	Generating breakthrough ideas: Effective ideation to feed the innovation funnel
5.	Execution: Quality of execution of certain key tasks in the innovation process, from idea through launch

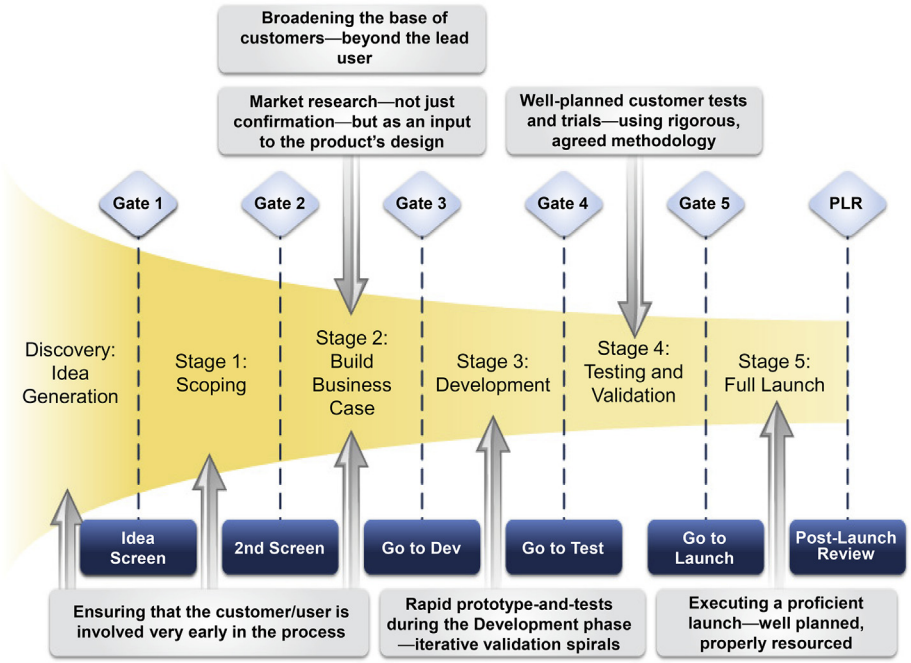

Fig. 1. A Strong Customer Focus Means Key Actions from Beginning to End in the Innovation Process.
Source: Cooper (2017b).

the most poorly executed activities of the entire new product process, rated far below corresponding technical (engineering, design, R&D) activities. Moreover, relatively few resources are spent on marketing actions (except for the launch), accounting for less than 20% of total project costs.

A market focus should prevail throughout the entire new product project (Griffin & Hauser, 1996) – see Fig. 1:

- Idea generation: The best ideas come from customers. Market-oriented idea generation activities, such as focus groups and VoC research (ethnography and site visits) to determine unmet needs or problems, lead to superior ideas (Cooper & Dreher, 2010). Robust ideas also come from innovative users and web-based customer inputs (open innovation).
- Product design: Customer inputs have a vital role in the design of the product, determining the product's requirements and specifications. Often, market research, when done at all, is done too late – simply as an after-the-fact check after the product design has already been decided. But market research must be used as an input to the design decisions, starting with a user needs-and-wants study (VoC research).
- Before pushing ahead with development: Best performers[1] test the product concept with the customer by presenting a representation of the product – via models, mock-ups, "protocepts,"[2] computer-aided design (CAD) drawings, and even virtual prototypes – and gauging the customer's liking and purchase intent. It's much cheaper to test and learn before development begins than to develop the product and then begin customer testing.
- Throughout the entire project: Customer inputs shouldn't cease at the completion of the pre-development market studies. Seeking customer inputs and testing concepts or designs with the user is very much an iterative process. By bringing the customer into the process to view facets of the product via a series of rapid prototypes-and-tests, customer tests of working models, and field trials, the developer verifies all assumptions about the winning product design.

3.3. Pre-development work – the homework

Homework is critical to winning. Studies reveal that the steps preceding the actual development of the product make the difference between winning and losing – the "game is won or lost in the first five plays." (Cooper, 2013a, 2017b, 2018; Edgett, 2011). Successful firms spend about twice as much time and money as unsuccessful firms on these vital front-end activities:

- preliminary market assessment – a quick market study to assess

[1] The terms "best performers" and "top performers" used throughout generally capture the top 20% of firms in terms of their NPD results. A number of metrics are typically used to gauge results in the studies cited, including percentage of sales from new products; return-on-investment of R&D efforts; NP success rates (such as proportion of new products hitting their sales and profit targets); on time performance; and so on.

[2] "Protocept": Something between a "concept representation" and a working product prototype ready for field trials or beta tests.

market potential and desired product attributes;
- preliminary technical assessment – the first technical appraisal of the project, assessing technical feasibility and identifying technical risks;
- detailed market study, market research and VoC research (described above);
- detailed technical assessment – in-depth technical appraisal, establishing proof of concept, intellectual property issues resolution, and an operations or source-of-supply assessment; and
- business and financial analysis just before the investment decision to go to full-scale development.

Another issue is the balance within the homework phase. Best performers strike an appropriate balance between market/business-oriented tasks and technical tasks. Worst performers tend to push ahead on the technical side and pay lip-service to marketing and business issues during the early phases of the project.

"More homework means longer development times" is a frequently voiced complaint. However, research shows that homework pays for itself in improved success rates and actually reduces development times:

1. A much higher likelihood of product failure results if the homework is omitted.
2. Better project definition, the result of sound homework, speeds up the development process. Poorly defined projects with vague targets and moving goalposts incur time slippage as they enter the Development stage.
3. Given the inevitable product design evolution that occurs during the life of a project, ideally most of these design changes should be made early, when they are less costly to correct. Pre-development homework anticipates these changes and encourages their occurrence earlier in the process.

As Toyota's new products handbook (Morgan, 2005) recommends, "Front-end load the project." That is, undertake a higher proportion of the project's work in the early stages and ensure that no significant project moves into the Development stage without the key market-facing and technical homework actions listed above.

3.4. Sharp, early, and fact-based product definition

Two of the worst time wasters are project scope creep and unstable product specs. Scope creep means that the definition of the project constantly changes. The project might begin as a single-customer initiative, then be targeted at multiple users, and finally end up being a platform for a new family of products. Unstable product specs means that the product definition – product requirements and specifications – keeps changing throughout the Development stage. Thus, the technical people chase elusive development targets – moving goalposts – and take forever to get to the goal (Cooper, 2013a, 2017b).

Sharp, early, and fact-based product definition during the homework phase is a solution. How well the product are defined before the Development stage begins is a major success factor, impacting positively on both profitability and reduced time to market. This definition includes:

- the project's scope;
- the target market;
- the product concept and the benefits to be delivered to the user (including the value proposition);
- the positioning strategy (including the target price); and
- the product's features, attributes, requirements, and high-level specifications (Cooper, 2017b).

Unless this product definition is in place and fact-based, the odds of failure increase:

1. Building in a definition step forces more attention on the front-end homework, a key success driver.
2. The definition serves as a communication tool: all functional areas have a clear definition of the product.
3. This definition provides clear objectives for the development (technical) team members, so they can move more quickly to their objective.

3.5. Iterative, spiral development – build, test, feedback, and revise

Spiral or iterative development is the way fast-paced project teams handle the dynamic information process with fluid, changing information. Spiral development helps the team get the product definition and product right, in spite of the fact that some information is fluid and even unreliable when the team moves into the Development stage, particularly in rapidly changing markets.

Many businesses use too rigid and linear a process for product development. The project team diligently visits customers in the pre-development stages and determines customer requirements as best they can. Front-end work is properly done, the product specs are determined, and the product definition is fixed. Then development begins.

The world moves too fast today, however, to make a stable and rigid product definition always possible. Often customers are not clear on what they wanted (or needed), so it's difficult to get an accurate product definition prior to development. As Steve Jobs, never a proponent of traditional market research, famously said, "People don't know what they want until you show it to them" (Isaacson, 2011, p. 567). And sometimes requirements simply change in the time that passes between the beginning and end of development, and thus the original product definition is no longer valid. The result is a cycle back to development to rethink the product's design.

Smart project teams and businesses have made the idea-to-launch system much more adaptive and make adjustments on the fly through spiral or iterative development (Cooper, 2017b). These firms build in a series of deliberate iterative steps whereby successive versions of the product are shown to the customer to seek feedback and verification, as shown via the spiral arrows in Fig. 2. Each iteration consists of:

- Build: Build something to show the customer – a representation of the product, such as computer-generated graphics, a simulation. a virtual-reality prototype, a protocept, a rapid prototype, a crude working model, an early beta version, a pretotype, or an MVP[3]… each version closer to the final product.
- Test: Test each version of the product with the customer.
- Feedback: Gather feedback on that version of the product from the customer or user – what they like (or don't like), and what value they see.
- Revise: Reset your thinking about the value proposition, benefits sought, and the product's design based on the feedback, and move to the next iteration (Cooper, 2014).

This spiral approach promotes experimentation, encouraging project teams to fail often, fail fast, and fail cheaply. Not only do iterations or spirals reduce market uncertainties, they also can be used to reduce technical uncertainties by seeking technical solutions in an experimental, iterative fashion. Moreover, there is strong evidence that this spiral, iterative development is both feasible and works: 44.8% of best-performing businesses practice these "build-test-feedback-and-revise" iterations with customers (but only 26.3% of firms on average do)

[3] MVP or minimum viable product: a feature-limited product that can actually be sold and thus generate revenue; more common in start-up and high-tech businesses (Ries, 2011).

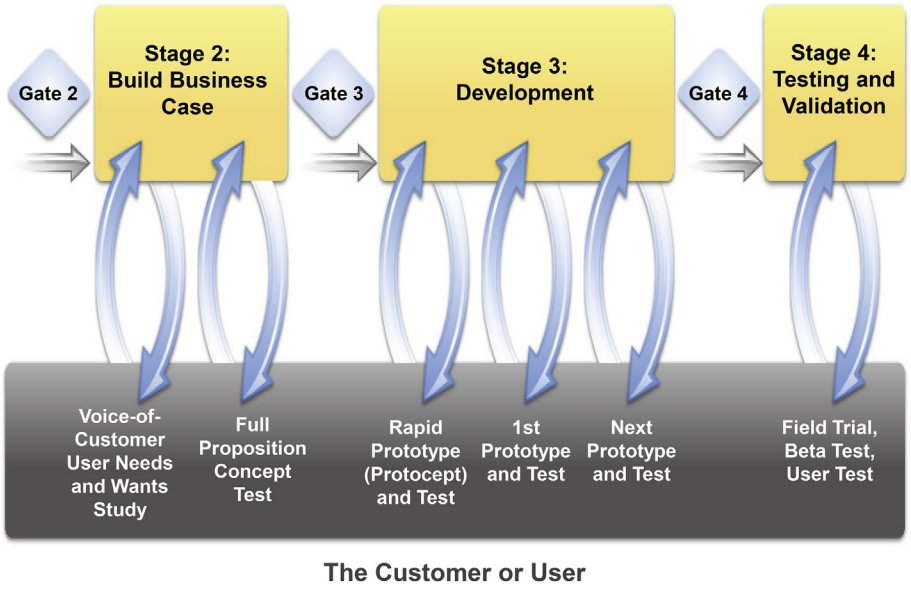

Fig. 2. Spiral Development—A Series of "Build-Test-Feedback-Revise" Iterations with Customers/Users—Gets the Product Right with No Time Wasted. Source: Cooper (2017b).

(Cooper, 2012). And a study of leading B2B European manufacturers revealed that, on average, between 3 and 4.5 versions of the product were presented to validate the design with customers through the Development and Testing stages, while product ideation-and-design contractors, such as IDEO, iterated on average 15 times with the customer per project (Sandmeier, Morrison, & Gassmann, 2010).

3.6. The world product – a global orientation

Corporate growth and profitability depend on a global business strategy married to product innovation. In global markets, product development plays a primary role in achieving a sustainable competitive advantage (Kleinschmidt, de Brentani, & Salome, 2007). And multinational firms that take a global approach to new-product development outperform those that concentrate their R&D spending on their home market (de Brentani & Kleinschmidt, 2004; de Brentani, Kleinschmidt, & Salomo, 2010; The Economist, 2008; Kleinschmidt et al., 2007). International products designed for and targeted at world and nearest neighbor export markets are the best-performing new products. By contrast, products designed for only the domestic market, and later adjusted and sold to nearest neighbor export markets, fare much worse. The magnitude of the differences between international new products and domestic products is striking: 2 or 3:1 on various performance gauges.

The management implications of these and other studies is that globalization of markets demands a global innovation culture and a global innovation strategy (de Brentani & Kleinschmidt, 2015). To define the new product's market as domestic and a few nearby convenient countries severely limits market opportunities. For maximum success in product innovation, the objective must be to design for the world and market to the world. Sadly, this international dimension is often overlooked or, if included, is handled late in the development process or as a side issue.

This global orientation translates into defining the market as international and designing products to meet international requirements, not just domestic ones. The result is either a global product (one version for the entire world) or a "glocal product" (one development effort, one basic product or platform, but several product variants of it to satisfy different international regions). A global orientation also means undertaking VoC research, concept testing, and product testing in multiple countries rather than just the domestic market, and tailored launch plans in multiple countries. It also means employing a global project team with team members in multiple countries – only one new product project team in five is reported to be a global development team (de Brentani et al., 2010; Kleinschmidt et al., 2007).

3.7. Planning and resourcing the launch

"Build a better mousetrap and the world will beat a path to your door," said Emerson. But Emerson was a poet, not a businessman; not only must the product be superior, but it also must be launched, marketed, and supported in a proficient manner. A quality launch is strongly linked to new product profitability, and effective after-sales service is central to the successful launch of the new product (Di Benedetto, 1999; Montoya-Weiss & Calantone, 1994; Song & Parry, 1996).

Good new products don't sell themselves, and the launch should not be treated as an afterthought to be handled late in the project. A well-integrated and properly targeted launch is the result of a finely tuned marketing plan, proficiently executed. The launch must be properly resourced in terms of both people and funds; too often, an otherwise great new product fails to achieve its sales goals simply because of an under-resourced launch. And those who will execute the launch – the sales force, technical support people, and other front-line personnel – should be engaged in the development of the market launch plan and therefore should be members of the project team. This ensures valuable input and insight into the design of the launch effort, availability of resources when needed, and buy-in by those who must execute the launch – elements critical to a successful launch (Hultink & Atuahene-Gima, 2000).

4. Drivers of success for businesses: organizational and strategic factors

Why are some businesses so much more successful at product innovation than others? Huge differences in product development productivity exist between the best and worst firms (Arthur D. Little, 2005). The top 25% of firms have 12 times the productivity in NPD, realizing a huge $39 in new product sales per R&D dollar spent, while the bottom 25% of firms achieve only $3.3. We continue to explore the theme "drivers of success," but focus on the business – see Table 2.

4.1. A product innovation and technology strategy for the business

A product innovation and technology strategy for this business charts the way for NPD, and having a new product strategy is strongly linked to positive performance (APQC, 2003; Cooper, 2011; Song, Im, van der Bij, & Song, 2011). The ingredients of such a strategy with the strongest positive impact on performance include (Cooper & Edgett, 2010):

- Clearly defined product innovation goals and objectives: for example, specifying what percentage of the business's sales or growth will come from new products.
- The role of product innovation in achieving the overall businesses goals, to link the product innovation goals to the business's overall goals.
- Strategic arenas defined – areas of strategic focus on which to concentrate new product efforts. The goal is to select strategic arenas rich with opportunities for innovation – those that will generate the business's future engines of growth (Cooper, 2011, 2017b). The great majority of businesses do designate strategic arenas – markets, product areas, industry sectors, or technologies – but evidence suggests that many are focused on traditional and sterile areas that fail to yield the needed opportunities (Cooper, 2005).
- A product roadmap in place, which maps out a series of planned development initiatives over time, often five to seven years into the future. A roadmap is simply management's view of how to get to where they want to be or to achieve their desired objective (Albright & Kappel, 2003; McMillan, 2003) and provides placemarks for specific future development projects.

4.2. Focus and sharp project selection decisions – portfolio management

Most companies suffer from too many projects, often the wrong projects, and not enough resources to mount an effective or timely effort on each (Cooper, 2011, 2013a; Cooper & Edgett, 2002, 2006). This stems from a lack of adequate project evaluation and prioritization, with negative results:

- First, scarce and valuable resources are wasted on poor projects.
- Second, the truly deserving projects don't receive the resources they need, and so the good projects, starved for resources, move at a crawl, or just don't get done.

The desire to cull out bad projects, coupled with the need to focus limited resources on the best projects, means that tough Go or Kill and prioritization decisions must be made. This results in sharper focus, higher success rates, and shorter times to market. Project evaluations, however, are consistently cited as being poorly handled or non-existent: Decisions involve the wrong people from the wrong functional areas; no consistent criteria exist to screen or rank projects; and there is no will to kill projects, so that projects are allowed to develop a "life of their own."

Smart firms have built in "tough gates with teeth" (Cooper, 2009). The result is better focus: fewer but better development initiatives. They have redesigned their idea-to-launch systems and created a funneling process that successively weeds out poor projects. The use of visible Go/Kill criteria at these gates improves decision effectiveness, such as list of screening criteria in a scorecard format, namely a scoring model (Cooper & Edgett, 2006; Cooper, Edgett, & Kleinschmidt, 2002a, 2002b).

Selecting high-value new product projects is only part of the task, however. Other portfolio goals are selecting the right mix and balance of projects in the development portfolio, and ensuring strategic alignment in the portfolio: that the business's spending on product innovation mirrors its strategic priorities. Many businesses have moved to more formal portfolio management systems to help allocate resources effectively and to prioritize new product projects (Cooper et al., 2002a, 2002b). In order to ensure the right mix and balance of development projects, some leading firms have adopted "Strategic Buckets", earmarking buckets of resources targeted at different project types or different strategic arenas (Cooper, 2013b, 2017b).

4.3. Leveraging core competencies – synergy and familiarity

"Attack from a position of strength" may be an old adage, but it applies to new product management. When synergy with the base business is lacking, new products fare poorly on average (Cooper, 2013a, 2017b; Montoya-Weiss & Calantone, 1994; Song & Parry, 1996). Synergy, or leverage, is a familiar term, but exactly how does it translate in the context of new products? Synergy means having a strong fit between the needs of the new product project and the resources, competencies, and experience of the firm in terms of:

- R&D or technology resources (ideally the new product should leverage the business's existing technology competencies);
- marketing, sales force and distribution (channel) resources;
- branding, image and marketing communications and promotional assets;
- manufacturing, operations or source-of-supply capabilities and resources;
- technical support and customer service resources; and
- management capabilities.

These six synergy or leverage ingredients become important checklist items in a scoring model to prioritize new product projects. If the "leverage score" is low, then there must be other compelling reasons to proceed with the project. Leverage is not essential, but it does improve the odds of winning.

"Familiarity" is a parallel concept and has its basis in the popular Roberts's familiarity matrix (Roberts & Berry, 1985). Some new product projects take the company into unfamiliar territory – a product category new to the firm; new customers with unfamiliar needs; unfamiliar technology; new sales force, channels and servicing requirements; or an unfamiliar manufacturing process. And the business often pays the price: Step-out projects are riskier and have higher failure rates due to lack of experience, knowledge, skills, and resources.

The negative impact here is not as strong as for most success drivers, however. New and unfamiliar territory certainly results in lower success rates and profitability on average, but the success rates are not dramatically lower. The message is this: Sometimes it is necessary to venture into new and unfamiliar markets, technologies, or manufacturing processes and areas where leverage may be limited (e.g., some key skills or resources are missing). Success rates will suffer, but the pay-offs may be worth the cost.

Further, for such step-out projects, strategies such as collaborative development and open innovation may help the developer acquire the necessary and missing resources, skills, and knowledge (Chesbrough, 2006; Docherty, 2006). Indeed resources from partner firms – from customers, other developer-firms, and even suppliers – may also have a positive impact on other success factors, such as effective cross-functional teams (team members available from the partner), voice-of-customer work, and effective launches.

Early and extensive supplier involvement in NPD projects has the potential to improve development effectiveness and efficiency (Johnsen, 2009). Often the developing firm's suppliers can provide necessary but missing resources, skills and capacities. For example, the supplier may possess technology essential for the development of the new product and share it with their customer; and a suppliers production capabilities may also be used to advantage to supply key components or ingredients. These resources from suppliers must be considered among the total set of "resource collections" available to the

project (Håkansson & Waluszewski, 2002). Suppliers may even be willing to share new products ideas with customers (Wagner, 2012).

Partnering does pose risks, however: Open innovation arrangements and collaborative developments are not always a "win win" situation for both parties. Conflicts and misalignments can occur due to misunderstandings, cultural differences, and even a lack of trust. Additionally, there is no strong evidence to suggest that partnering or collaborative NPD projects are more successful than those done alone (although some evidence exists that the project may not have been done at all were it not for the partnership). (Campbell & Cooper, 1999; Håkansson & Waluszewski, 2002).

4.4. Targeting attractive markets

Market attractiveness is an important strategic variable and plays a role in notable strategy models such as Porter's "five forces" model and the two-dimensional GE-McKinsey map or business portfolio grid. Market attractiveness is also important for new products: New products targeted at more attractive markets are more successful (Cooper, 2013a, 2017b; Montoya-Weiss & Calantone, 1994; Song & Parry, 1996). Thus, market attractiveness should be considered in project selection and scoring models.

There are two dimensions to market attractiveness:

- Market potential: Positive market environments, namely, large and growing markets with large long-term potential and where the purchase is important to the customer.
- Competitive situation: Negative markets characterized by intense price competition and low margins and competitors with strong products, capable competitive sales forces, channel systems, and support service.

Both elements of market attractiveness – market potential and competitive situation – impact new product fortunes and both should be considered as criteria for project selection and prioritization.

4.5. The resources in place

Too many projects suffer from a lack of time and financial commitment. The predictable result is much higher failure rates (APQC, 2003; Cooper, 2017b). As the quest for profits has intensified, companies often have responded by restructuring and cost-cutting – doing more with less – and so resources are limited. Also, many firms try to do too many projects for the resources available: an inability to say "no" to mediocre development projects or to kill bad ones. The resulting resource crunch takes its toll and is the root cause for much of what ails product development: a lack of VoC; inadequate front-end homework; ineffective launches; and overemphasis on simple, fast, and cheap projects (Cooper & Edgett, 2003).

Best-practice companies commit the necessary resources to new products, much more so than most firms. While new product resources are limited across the board – with less than 30% of businesses indicating that they have sufficient NPD resources in four key functional areas – the best performers appear to be much better resourced (APQC, 2003; Cooper & Edgett, 2003). Equally important, these resources are focused and dedicated, with project team members not multi-tasking (not working on too many projects or tasks). Indeed, about half of the best performers have a dedicated product innovation group whose full-time job is to work on new product projects.

4.6. Effective cross-functional teams

Product innovation is very much a team effort. Do a post-mortem on any bungled new product project and invariably you'll find each functional area doing its own piece of the project with very little communication between functional areas (a fiefdom mentality) and no real commitment of team members to the project. Many studies concur that the way the project team is organized and functions strongly influences project outcomes (Cooper, 2011, 2013a, 2017b; Nakata & Im, 2010; Valle & Avella, 2003). Best performers organize their new product project teams as follows:

- Every significant new product project has a clearly assigned project team: people who are part of the project and do work for it. And the project team is cross-functional with team members from R&D, Sales, Marketing, and Operations, a practice now embraced by the majority of businesses. Team members are not just representatives of their functions, but rather true members of the project team, shedding their functional loyalties and working together to a common goal.
- The project team remains on the project from beginning to end, not just for a short period or a single phase. Almost half of businesses use this "end-to-end" team approach and it is particularly evident among the best performers.
- There is a clearly identified project leader – a team member who is in charge and responsible for driving the project, much like the captain of a football team. The project leader is responsible for the project from idea to launch, carrying the project right through the process and not just for one or a few stages.
- A central shared-information system for project team members is in place: an IT system that permits sharing of project information and allows project team members to work effectively together, across functions, locations, and even countries.
- Project teams are accountable for their project's end result – for example, for ensuring that projects meet profit, revenue targets, and time targets. Team accountability is a key best practice, separating the best from the worst performers.

Product development must be run as a multidisciplinary, cross-functional effort. While the ingredients of good organizational design should be familiar, surprisingly many businesses have yet to get the message.

4.7. The right environment – climate and culture

A positive climate for innovation is one of the top three success factors that distinguishes top-performing businesses in new product development, with a huge impact on performance results. Such a climate has been found to have many attributes, including (APQC, 2003; Cooper, 2011, 2013a; Edgett, 2011):

- senior management strongly and passionately supporting innovation in the business;
- "intrepreneurs" (internal entrepreneurs) and risk-taking behavior encouraged;
- senior management not afraid to invest in the occasional risky project;
- new product successes rewarded or recognized (and failures not punished);
- team efforts recognized rather than individuals;
- senior managers refraining from micro-managing projects and second-guessing the project team;
- open project review meetings with senior people (the entire project team participates);
- idea generators recognized or rewarded;
- time allowed for creative people to work on projects of their own free choice (projects on-the-side); and
- employing skunk works and allowing some unofficial projects (projects done "outside the system").

Most businesses are quite weak on almost all of these elements of a positive climate, with typically less than one-third of businesses

employing any one of these practices. Best performers embrace these practices much more so.

4.8. Top management support

Top management's main role is to set the stage for product innovation, to be a behind-the-scenes facilitator and much less an actor front and center (APQC, 2003; Cooper, 2011, 2013a; Edgett, 2011). In best-performing businesses, senior management makes a long-term commitment to product innovation as a source of growth. It develops a vision, objectives, and a strategy for product innovation. It makes available the necessary resources for product development and ensures that they aren't diverted to more immediate needs in times of shortage. And senior management commits to a disciplined idea-to-launch system to drive products to market. Most important, senior management is engaged in the new product process, reviewing projects, making timely and firm Go/Kill decisions, and if Go, making resource commitments to project teams. And management empowers project teams and supports committed champions by acting as mentors, facilitators, "godfathers," or sponsors of project leaders and teams.

5. The right systems and processes

The tactics, systems, methods, and procedures that businesses put in place, and how well they are executed, often hold the key to new-product success. For example, today there is much excitement in the business community about new Agile development methodologies from the software world being built into the development of B2B manufactured products, as well as "open innovation", success drivers both listed in Table 3.

5.1. A multistage, disciplined idea-to-launch system

A systematic idea-to-launch methodology, such as a Stage-Gate® system,[4] is the solution many companies have adopted in order to overcome the deficiencies that plague new product efforts (Cooper, 2013a, 2017b, 2018; Edgett, 2011; Griffin, 1997; Lynn, Skov, & Abel, 1999; Menke, 1997). Stage-Gate systems are simply roadmaps or "playbooks" for successfully and efficiently driving new products from idea to launch. An APQC benchmarking study revealed that 88% of US businesses employ such a process, and identified the stage-and-gate process as one of the strongest best practices, employed by almost every best-performing business (Cooper & Edgett, 2012). The payoffs of such processes have been frequently reported: improved teamwork; less recycling and rework; improved success rates; earlier detection of failures; a better launch; and even shorter cycle times.

The goal of a robust idea-to-launch system is to integrate the best practices outlined above into a single model. A typical gating system for major projects, as shown in Fig. 1, breaks the innovation process into five or six stages (Cooper, 2013a, 2017b). Preceding each stage in Fig. 1 is a gate. These gates are the quality control checkpoints in the system: At each gate, the project team meets with senior management, the gatekeepers, to seek approval and resources for their project for the next stage. The gates thus open the door for the project to proceed and commit the necessary resources – people and funds – to the project team.

Gating systems have evolved over the years and now include new practices such as (Cooper, 2008, 2014, 2017b):

- A scalable process – for example, Lite and XPress versions of Stage-Gate for lower-risk and smaller projects (see Fig. 3), and even different versions of Stage-Gate to handle different types of development projects, such as Stage-Gate-TD for technology platform developments (Ajamian & Koen, 2002; Cooper, 2003).
- A leaner idea-to-launch system – removing all waste and building in continuous improvement – by utilizing value stream analysis borrowed from the field of "lean manufacturing".
- Adapting the system to accommodate open innovation (Grölund, Rönneberg, & Frishammar, 2010).
- Integration with the total Product Life Cycle management – from idea all the way through product exit many years later.
- An adaptive and iterative process – for example, by using iterative or spiral development (above).
- An automated idea-to-launch system, via software solutions that handle everything including idea management, navigating the development process, portfolio management, and resource management.

5.2. Speed – but not at the expense of quality of execution

Speed offers the competitive advantage of being first on the market, namely "first mover advantage". Speed means less likelihood that the market situation has changed. And speed results in a quicker realization of profits. Therefore, the goal of reducing the development cycle time is admirable.

Note, however, that speed is only an interim objective, the ultimate goal being profitability. While studies reveal that speed and profitability are connected, the relationship is anything but one to one (Griffin, 2002). Further, there is a dark side to the emphasis on speed (Crawford, 1992). Often the methods used to reduce development time yield precisely the opposite effect and in many cases are very costly: They are at odds with sound management practices. The objective remains successful products, not a series of fast failures. Additionally, overemphasis on speed has led to trivialization of product development in some firms – too many product modifications and line extensions that can be done quickly, but result in a shortage of truly innovative products (Cooper, 2005).

Sound principles that project teams embrace in order to reduce time-to-market, some highlighted above, include the following (Cooper, 2014):

- Doing the front-end homework and developing early and fact-based product definition saves time downstream.
- Building in quality-of-execution at every stage of the project: The best way to save time is by avoiding having to cycle back and do it a second time.
- Employing effective cross-functional teams: "Rip apart a badly developed project and you will unfailingly find 75 percent of slippage attributable to "siloing" (sending memos up and down vertical organizational "silos" or "stovepipes" for decisions) and sequential problem solving" (Peters, 1988).
- Using parallel processing (undertaking tasks concurrently, such as concurrent engineering), and even overlapping stages – moving long lead-time forward, and moving ahead with partial information. The relay race, sequential, or series approach to product development is antiquated and inappropriate for today's fast-paced projects.
- Using spiral or iterative development: These build-test-feedback-revise iterations get the product right earlier and make needed adjustments long before formal product testing begin.
- Prioritizing and focusing in order to undertake fewer projects with higher value. By concentrating resources on the truly deserving projects, not only will the work be done better, it will be done faster.
- Utilizing an Agile approach, which yields both time-to-market reduction and increased NPD productivity (Cooper & Sommer, 2016a, 2016b) – next section.

[4] Stage-Gate® is a registered trademark of the author, of R.G. Cooper & Associates Inc., and of Stage-Gate International Inc. in various countries.

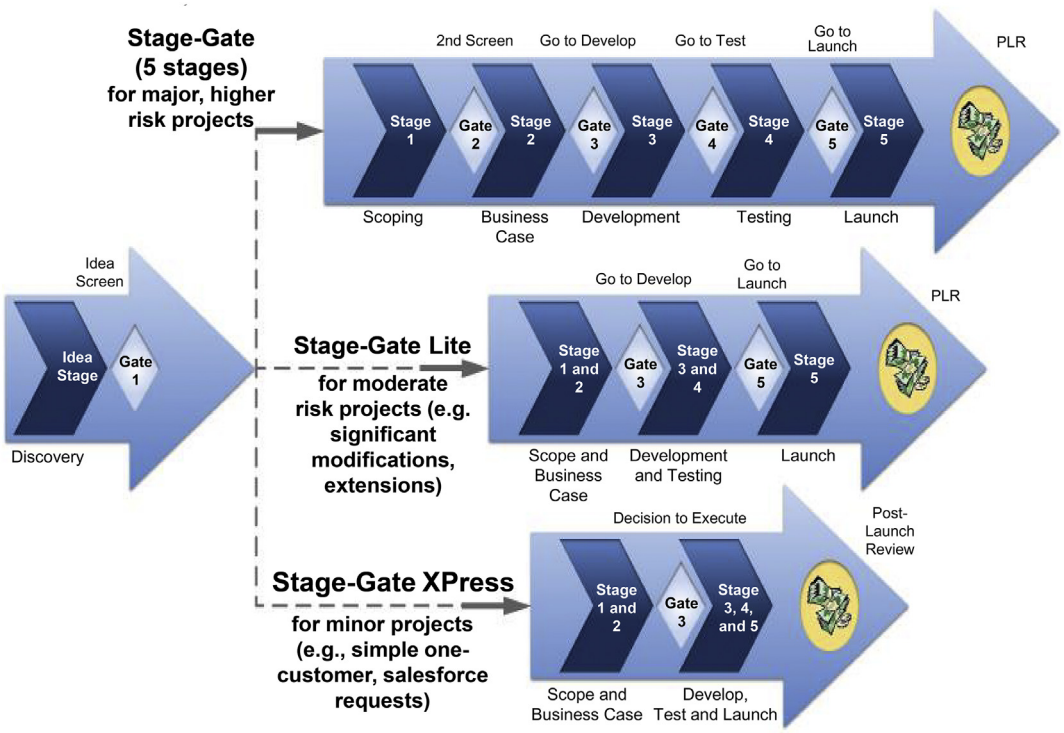

Fig. 3. Stage-Gate Is Context Based and Scalable—One Size Does Not Fit All. Source: Cooper (2017b).

5.3. Building agile into traditional B2B gating systems

Agile software development is a group of software development methodologies based on iterative and incremental development, where requirements and software solutions evolve through collaboration between self-organizing, cross-functional teams. Agile promotes adaptive planning, evolutionary development and delivery; utilizes a time-boxed iterative approach; and encourages rapid and flexible response to change. The Agile Manifesto introduced the term in 2001 (Beck et al., 2001).

In the Scrum version of Agile, a software development project consists of a number of iterations called sprints, which are time-boxed and very short, typically 2–4 weeks. Each sprint produces a working product (executable software code that works) that can be demonstrated to stakeholders. An iteration may not add enough functionality to warrant a market release, but the goal is to have a potentially available release at the end of each sprint; multiple sprints are usually required to release a product or new features.

Larger software developers with existing development systems began integrating Agile into their traditional gated development processes with considerable success (Karlström & Runeson, 2005, 2006): The two systems dovetailed nicely. More recently, manufacturers of physical products (hardware), especially B2B firms, have successfully built elements of this Agile methodology into their traditional gating models (Ovesen & Sommer, 2015; Sommer, Hedegaard, Dukovska-Popovska, & Steger-Jensen, 2015). Agile is most often initially employed in two stages, namely, Development and Testing in Fig. 4, via a series of 2–4 week sprints; with experience, manufacturing firms also apply Agile to the entire idea-to-launch process to create a true Agile-Stage-Gate hybrid model (Cooper, 2016; Cooper & Sommer, 2016a, 2016b). Sprints begin with a sprint planning meeting; daily scrums (project team meetings) are held during the sprint, facilitated by a scrum master; and each sprint ends with a product demo (to management and customers) and a sprint retrospect.

A few adjustments must be made when applying Agile to B2B physical products. When contrasted to software development, hardware development is usually not as divisible (it is usually not possible to have anything that actually functions within a few weeks, as in the software world). Thus, a sprint does not build a working product, but a product version somewhere between a "virtual product" through to a "ready-to-trial prototype" – something to show the customer to seek feedback, much as was described in spiral development above (Cooper, 2014). At the end of every 2–4 week sprint, however, the team must deliver something tangible that can be demo'd (see the IMM article by Cooper & Sommer, 2016b).

The advantages of Agile-Stage-Gate are speed (sprints are time-boxed with no relaxation of the timeline); dedicated teams (team members are usually 100% dedicated to the one project); much better communication within the team (via daily scrums and a dedicated team residing in one location); and constant customer feedback with strategic pivots (revisions), if needed (Sommer et al., 2015). Early adopters of this new hybrid Agile-Stage-Gate system report positive results, but implementation challenges do exist, to which many firms have found solutions (Cooper & Sommer, 2016b, 2018).

5.4. Effective ideation

Great ideas are the foundation for great new products. Thus, increasingly more attention is being devoted to the "fuzzy front-end" of the innovation process. Idea generation and idea handling are key components. Studies indicate that although internal methods of ideation (e.g., using one's own employees) are the most popular, they are not the most effective, on average (Cooper & Edgett, 2008). Voice-of-customer methods generally are rated the most effective for generating breakthrough ideas and many firms build VoC into the earliest stages of their idea-to-launch systems to generate great ideas (Cooper & Dreher, 2010):

- Customer visit teams – typically a cross-functional team of 2–3 people undertaking a systematic visitation program with key purchase influencers in a limited number of representative customers.
- Lead user analysis – identifying leading or innovative users (ahead

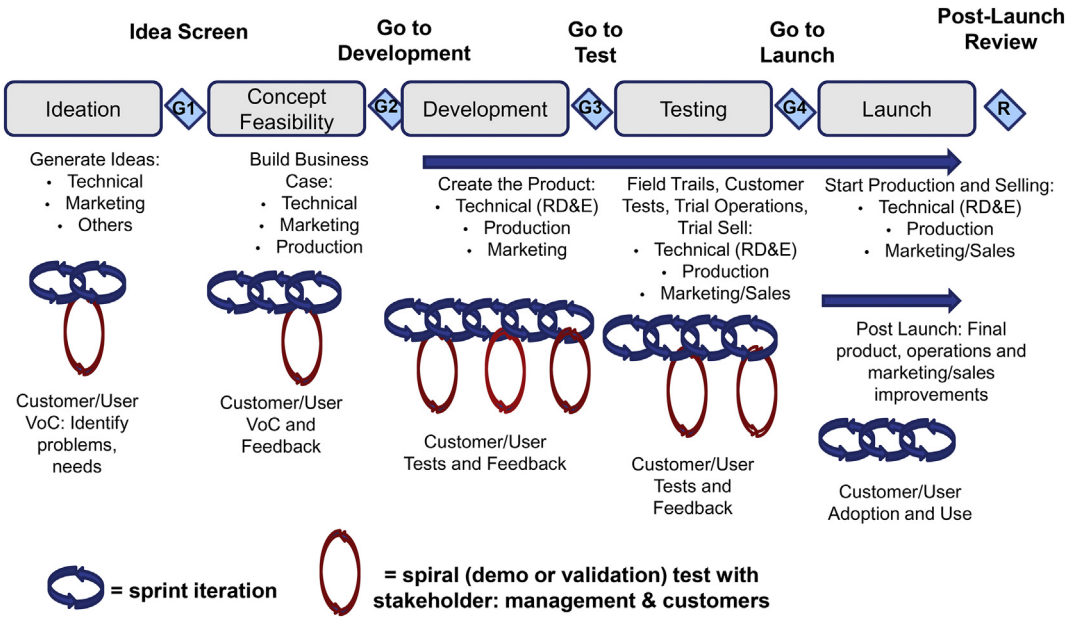

Fig. 4. A Typical Five-Stage, Five-Gate System, with Agile Built into Each of the Stages—an Agile-Stage-Gate Hybrid Model.
Source: Cooper (2017b).

of the wave) and working with them (typically in workshop format) to develop new product concepts (Lilien, Morrison, Searls, Sonnack, & von Hippel, 2002; von Hippel, Ogawa, & de Jong, 2011).

- Ethnography – camping out with customers to observe behaviors (cultural anthropology), and in so doing, understanding their unspoken, unmet and often unknown needs.
- Focus groups – with groups of customers (often consumers) to identify problems, desires, needs, and wants.
- Design thinking, whereby users' needs are understood through VoC (for example, ethnography) and a series of product versions are immediately tested with users (Brown, 2008).

Many commercially important products are initially thought of and even prototyped by users rather than by suppliers (Lilien et al., 2002; von Hippel, Thomke, & Sonnack, 1999). Such products tend to be developed by "lead users" – innovative companies, organizations, or individuals that are well ahead of market trends and even have needs that go far beyond the average user. The challenge is to track down lead users, who are by definition rare – those who are ahead of the wave.

Customer focused innovation has received much attention in recent years, and has been made possible in part because of IT and Internet tools. Here, customers or users are invited to help the product developer design the next new product, and in so doing, provide many ideas for significant product improvements (von Hippel et al., 2011). Indeed consumers were found to be 2.4 times more efficient at developing significant innovations than producers, and much more prolific and efficient product developers when the field is in its early stages (Hienerth, von Hippel, & Jensen, 2012).

Strategic methods also are positively rated and include exploiting disruptive technologies (Christensen, 2000) and peripheral visioning (Day & Schoemaker, 2005). "Open innovation" – looking outside one's company – is another valuable source of new product ideas (Chesbrough, 2006; Docherty, 2006). Through open innovation, the developer obtains knowledge and resources from sources external to the company: ideas for new products; IP and outsourced development work; marketing and launch resources; and even licensed products ready to sell. But most firms are not well positioned to solicit or handle outside ideas and IP. Engaging suppliers in the fuzzy front end of the development project provides ideas to the developer, as well as technical insights: A strong positive relationship exists between supplier integration in the fuzzy front end and NPD project performance (Wagner, 2012). Thus, it is important to adapt the firm's processes and systems for open innovation in order to encourage the inclusion of ideas, IP, R&D work, and even fully developed products from outside the firm (Docherty, 2006; Grölund et al., 2010).

5.5. *Quality of execution*

"Do it right the first time" is an old adage, referring to the fact that poor quality-of-execution usually results in much waste by having to go back to fix things. Sadly, quality-of-execution is notably lacking in many new product projects. Beginning decades ago, the causes of new product failure were identified, and revealed serious deficiencies in the way new product projects were executed: a lack of market research, poorly implemented launches, weak business cases, and so on. One early study of new product failures showed that market research was poorly done in 73% of projects, product launches were weak in 54%, and product testing deficient in 49% of the product failures studied.

The front-end of the innovation process tends to be where most of the weaknesses occur (APQC, 2003; Cooper, 2017b). For example, only 18% of firms consistently execute the VoC (market research) well; 27% carry out the concept tests well; and only 26% undertake the business analysis well. What really stands out in the research is how much better the top performing businesses execute on every task in a typical new product project – better by as much as 4:1.

The management implications are clear. First, quality-of-execution really does make a difference in new-product performance. Second, it is notably lacking in too many firms, too many projects, and across too many key tasks. Third, the weakest areas are the front-end (pre-development) and the business and marketing related tasks (technical tasks are much stronger). Quality can be built into any process, whether it is a manufacturing process or an innovation process, and top firms promote quality of execution in new-product projects: a project team with capable and trained people; dedicated team members with time available to do a quality job; management mentoring and support; a clear innovation process with useful guidelines for the project team; and quality checks or "gates" during the project that ask "are we doing this project right?"

6. Looking ahead

Philosopher and statesman Edmund Burke once said, “Those who don't know history are destined to repeat it.” Thirty years of research focusing on past successes and failures has led to many more insights about new-product best practices and success drivers than we had when my early articles on the topic first appeared in IMM.

Today, however, product developers face many new challenges: The world is faster, more global, less predictable, and more ambiguous than it was when those early articles were written. And there have been many new practices introduced to NPD since then in order to deal with these challenges: practices such as Agile development (for physical products), design thinking for ideation, open innovation, lean product development, lean startup, and others, whose impacts have not yet been thoroughly investigated. And so research into new-product success drivers and novel NPD practices must continue, simply because product innovation is so important to business prosperity, and yet the keys to success still remain quite elusive.

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