



## Wiley Public Health Emergency Collection

Public Health Emergency COVID-19 Initiative

[J Prod Innov Manage](#). 2021 Mar; 38(2): 221–232.

PMCID: PMC8014561

Published online 2021 Apr 22. doi: [10.1111/jpim.12565](https://doi.org/10.1111/jpim.12565)

PMID: [33821086](https://pubmed.ncbi.nlm.nih.gov/33821086/)

### Accelerating innovation: Some lessons from the pandemic

[Robert G. Cooper](#)<sup>1, 2 \*</sup>

Guest Editor (s): Jelena Spanjol and Charles H. Noble

▶ [Author information](#) ▶ [Copyright and License information](#) [Disclaimer](#)

#### Abstract

[Go to:](#) ▶

The Pandemic taught us that accelerated new-product development is more important than ever, and provided examples of firms developing breakthrough products in record time. Five approaches to accelerated development are outlined here: The first two deal with adequately resourcing new-product projects, namely the use of focused teams; and effective portfolio management to prioritize projects and reallocate resources. Newer digital tools are outlined that speed new-products developments. Finally, two development methods are described that move development projects faster: Lean development and Agile development. Accelerated development also has hidden costs: undertaking less innovative projects and cutting too many corners. Although important, the topic is under-researched, and the limited research has yielded inconclusive results about acceleration's expected benefits.

**Keywords:** accelerated innovation, accelerated new-product development, Agile development, Agile-Stage-Gate, portfolio management, Stage-gate

**Link to National Institute of Health website Library – copy of article:**

[Accelerating innovation: Some lessons from the pandemic - PMC](#)

**Link to publisher (Wiley) and full article (free access due to Pandemic):**

[Accelerating innovation: Some lessons from the pandemic - Cooper - 2021 - Journal of Product Innovation Management - Wiley Online Library](#)

**The full article by Robert G. Cooper follows...**

[J Prod Innov Manage](#). 2021 Mar; 38(2): 221–232.

Published online 2021 Apr 22. doi: [10.1111/jpim.12565](https://doi.org/10.1111/jpim.12565)

PMCID: PMC8014561

PMID: [33821086](https://pubmed.ncbi.nlm.nih.gov/33821086/)

## Accelerating innovation: Some lessons from the pandemic

[Robert G. Cooper](#)<sup>1, 2 \*</sup>

Guest Editor (s): Jelena Spanjol and Charles H. Noble

▶ [Author information](#) ▶ [Copyright and License information](#) [Disclaimer](#)

### Practitioner Points

- The Pandemic has focused the spotlight on the need for accelerated product innovation, and also revealed ways to get to market faster that are generally applicable.
- Focused project teams coupled with effective portfolio management – fewer projects but better projects – increases resources on projects to maximize speed.
- New digital tools – from Virtual Reality to AI – can both enhance and accelerate new-product projects.
- Lean Development removes waste and inefficiencies in the idea-to-launch process through value stream mapping.
- Managers should also overlap stages in their new-product process and move key decision points forward to minimize the impact of long lead-time tasks.
- Agile methods borrowed from the software world can be built into more traditional gating processes to yield increased productivity and faster development times.

## 1. HOW TO ACCELERATE NPD

The goal of developing a COVID-19 vaccine in record time has shone the spotlight on the need for accelerated product development. A number of articles and books have been written over the years on the topic, and some research has been done to investigate the various acceleration methods and their impacts. In spite of the research and publications, however, the quest for accelerated innovation has proved elusive—many firms continue to plod along at development much as they have for

years—and also many questions about the “how's and why's” of accelerated innovation remain unanswered. Indeed, a comprehensive review of accelerated product development concludes that “the performance implications of shortening NPD cycle time are still not fully understood.” (Katrin et al., [2013](#)).

The pandemic heightened interest in accelerated development, as we watched as pharmaceutical companies moved quickly to develop vaccines at unheard-of speeds. But they were not alone: Other firms—perhaps less spectacularly—also responded at high speed (Cooper, [2020](#)). Corning Glass, a long-time innovator in the field of glass and ceramics, leveraged their glass-ceramic technology to create a virus-fighting anti-microbial innovation, Guardiant®, glass-ceramic particles that enable coatings to kill COVID-19 on painted surfaces. Another is Heron Gruppe, the Austrian producer of production automation equipment, who used their IT skills to develop SAFEDI or “safe distance control,” a very precise COVID-19 detection system for use on the production floor. SnapCab, a manufacturer of portable glass-and-aluminum privacy pods for use as meeting rooms for the open office, quickly pivoted, developing and launching a medical testing pod, a mini home-office pod, and the “God Pod” for private meetings in a church. And Marelli, an Italian-based automotive components maker, quickly developed its new virus-killing cabin air-filter for shared-use vehicles, such as taxis and ambulances (Weissler, [2020](#)).

Exemplary stories perhaps, but they prove the point that when needed, *firms can respond quickly and pivot with innovations*. The trouble is that just doing what is already being done, but working harder and faster, will not yield the desired result. A recent *Forbes* article about pandemic pivots points out that: “It takes an accelerated innovation process with a redesigned rather than a merely time-wise compressed innovation journey.” (Mayer, [2020](#)) Thus, the need is to *re-think the firm's innovation process and methods*—moving to new approaches and a re-designed process. Here, are five practices that can be built into a new or re-invented innovation process in order to get new products to market faster.

[Go to:](#)

## 2. FOCUSED PROJECT TEAMS

---

The most frequently cited challenge in new-product portfolio management is *too many development projects in the pipeline* (Cooper & Sommer, [2020](#); Dalton, [2016](#);

Edgett, [2013](#); Thomke & Reinertsen, [2012](#)). Portfolio managers are “normally concerned and overwhelmed with issues like the prioritization of projects and the continuous distribution of personnel from the different projects to overcome the urgent crises.” (Amaral & Araújo, [2009](#)) The result is that people resources are spread too thinly across too many projects, so that every project, even the important ones, are under-resourced (Elonen & Artto, [2003](#)). The lack of needed resources is one of the fundamental reasons why projects take so long to get to market, and is also blamed for shortcuts taken to save time and effort, that later come back and haunt the project team (Cooper et al., [2004](#)).

Benchmarking studies show that top-performing businesses are considerably more focused than others, with dedicated resources for product innovation: Half the top businesses use *dedicated teams for projects*, and more than half have fully dedicated product-innovation groups that only work on new products (Cooper et al., [2004](#)). Consider this example, *Project Lightspeed*:

*On a Friday in late January 2020, Dr. Ugur Sahin, received an email with news about a deadly new coronavirus in China (Pancevski & Hopkins, [2020](#)). The following Monday, the scientist and CEO of biotech firm BioNTech SE in Mainz, Germany, summoned his board to announce that the company would start work on a COVID-19 vaccine. To accomplish this task in record speed, BioNTech staff was divided into two dedicated teams working seven-days per week (separate teams to avoid transmission). BioNTech had later partnered with Pfizer; and by early December, just 10.5 months after the project start, the new vaccine, perhaps the most significant product development in recent times, was ready for roll-out: the first COVID-19 vaccine approved in the developed world (on December 9 in Canada and shortly after in the USA).*

While a 100% dedicated team is ideal for maximum speed, this is not always practical for many manufacturers. For example, there are waiting times in such projects (waiting for equipment arrival or test results), so team members work on other projects; and team members often have other important duties. Thus, to ensure time commitment to the project, an appropriate model for most product-developers is to deploy a “focused team”—not quite 100% dedicated as in the BioNTech or Agile developments, but almost; that is, to use a *mostly dedicated team* with some core team members devoting the majority (60%–75%) of their time to the project. Some firms, such as Tetra Pak, a global packaging company, limit the number of “other projects” per team member to one or two, so that for core team members, this new-product project is really their principal job. Thus, the core team

is protected from outside disruptions that divert their attention from the project (Cooper & Fürst, [2020a](#)).

[Go to:](#)

### 3. FEWER PROJECTS, BETTER PROJECTS!

---

The development of the Moderna vaccine at warp speed has taught us that given unlimited resources, time-to-market can be cut dramatically. (Moderna received \$2.5 billion in funding from the U.S. government) (Clouse, [2020](#)). But most firms do not have access to such unlimited resources, but at least they can *avoid the opposite situation*: under-resourcing projects to the point where they move at a crawl. Effective *portfolio management* is one solution to getting focused on the right development projects, and *right number* of projects. Here, are some ways (Cooper et al., [2004](#)):

#### 3.1. Prioritizing projects at regular portfolio reviews

At these reviews, senior management goes through the list of active development projects, checks that there is the right mix and balance, but most important, does a *forced ranking of projects*: 1 to N. Resources per project are then added down the list. When the resource limit is reached, a line is drawn: Those projects below the line are killed or put on-hold, and their resources are re-allocated to the better projects above the line. The goal is to do *fewer projects but better projects*, resource them properly, and get them done!

*Example: ABC Company, a manufacturer of baby-care products near Vienna, had too many active projects in their portfolio. At the portfolio review, the CEO complained that new-product projects were taking too long, including his two “executive sponsored” projects. The portfolio manager produced a list of the 16 active projects—Table 1—which we ranked from best to worst using both the Project Attractiveness Score (based on a scorecard method) and the Productivity Index, both shown in Table Table1.1. Also shown is the full-time equivalent people (FTEs) needed to get the project done on time, and the current resource allocation (FTEs).*

#### TABLE 1

*Forced ranking of projects at a quarterly portfolio review*

<b>Project name</b>	<b>Current resources (FTEs)</b>	<b>Project attractiveness score/100</b>	<b>Productivity Index</b>	<b>New ranking</b>	<b>Required resources (FTEs)</b>	<b>Resources after ranking</b>	<b>Cumulative resources</b>
Ambo	0.5	88.1%	340	1	3.0	3.0	3.0
Mama	0.1	85.2%	318	2	3.0	3.0	6.0
Thermo	1.0	86.0%	300	3	3.0	2.0	8.0
Pump	12.0	79.2%	265	4	12.0	12.0	20.0
Retro	2.5	74.0%	250	5	5.0	3.0	23.0
Soother-2	0.5	77.6%	223	6	4.0	3.0	Resource (26.0)
<i>Primo</i>	<i>0.2</i>	<i>72.2%</i>	<i>211</i>	<i>7</i>	<i>3.0</i>	<i>0.0</i>	<i>limit 26.0</i>
<i>Dental-A</i>	<i>5.2</i>	<i>70.0%</i>	<i>190</i>	<i>8</i>	<i>5.2</i>	<i>0.0</i>	<i>26.0</i>
<i>Cup-Hold</i>	<i>1.4</i>	<i>72.4%</i>	<i>186</i>	<i>9</i>	<i>2.0</i>	<i>0.0</i>	<i>26.0</i>
<i>Toddler-BR</i>	<i>0.2</i>	<i>74.5%</i>	<i>199</i>	<i>10</i>	<i>2.0</i>	<i>0.0</i>	<i>26.0</i>
<i>Dental-B</i>	<i>0.2</i>	<i>68.1%</i>	<i>203</i>	<i>11</i>	<i>3.0</i>	<i>0.0</i>	<i>26.0</i>
<i>Cup-Warm</i>	<i>0.1</i>	<i>68.0%</i>	<i>200</i>	<i>12</i>	<i>3.5</i>	<i>0.0</i>	<i>26.0</i>
<i>Baby-Sit</i>	<i>0.5</i>	<i>67.6%</i>	<i>191</i>	<i>13</i>	<i>4.5</i>	<i>0.0</i>	<i>26.0</i>
<i>Inset</i>	<i>1.0</i>	<i>65.5%</i>	<i>187</i>	<i>14</i>	<i>4.0</i>	<i>0.0</i>	<i>26.0</i>
<i>Baby-BR</i>	<i>0.2</i>	<i>61.0%</i>	<i>192</i>	<i>15</i>	<i>2.0</i>	<i>0.0</i>	<i>26.0</i>
<i>Situ</i>	<i>0.4</i>	<i>64.1%</i>	<i>150</i>	<i>16</i>	<i>1.5</i>	<i>0.0</i>	<i>26.0</i>
Total	26.0				60.7	26.0	

[Open in a separate window](#)

*Notes*

*“Current resources” are what project is currently receiving, that is, FTEs (technical people) now working on the project. “Required sources” is what the Project Leader had requested at the previous gate in order to get the project done reasonably on time, FTEs. “Resources After Ranking” are the resources the project ended up*

with as a result of the current Portfolio Review decisions. Projects below the line (in italics) were put on hold: 10 of the 16 original projects. There are 26 FTE technical people available.

*Almost all projects were under-resourced (actual versus needed resources), with some projects having less than one-half of an FTE assigned; and the two exec-sponsored projects were consuming 66% of the resources. The total resource requirements for all 16 projects was 2.3 times the 26 FTEs available! After ranking the projects and adding up resources per project (final column), the resource limit was reached after the sixth project. Thus, 10 of the 16 projects were put on hold, and their resources re-allocated to the top six projects. As a result, besides one exec-sponsored project, the other five top priority projects saw their resources increased by a factor of 3.0, and could now be accelerated. A simple procedure, but very effective.*

### 3.2. Productivity index

Ranking projects by their NPVs or some similar profit metric is *not the way to prioritize* development projects. The result is a *sub-optimal list* of projects. Instead, the Productivity Index is an effective way to prioritize projects when there are *constrained resources*, which is usually the case (the method is based on the theory of constraints) (Matheson et al., [1994](#)). The Productivity Index is simply the value of the project divided by the constraining resource, usually person-days or dollars. It gauges what value is added for every additional unit of scarce resource—person-days or dollars—that is spent on the project:

$$\text{Productivity Index} = \frac{\text{Output}}{\text{Input}} = \frac{\text{Project NPV}}{\text{Dollars remaining to be spent}} \text{ or}$$
$$\frac{\text{Project NPV}}{\text{Person-days needed to complete the project}}$$

In practice, one simply takes the NPV from the project's Business Case, and divides by the person-days or dollars that must be spent in order to complete the project; and then one rank-orders the projects by this index until out of resources, as in the example above. Note that sunk costs are not relevant to this prioritization model, only the “go forward costs” are counted.

Ranking projects by this Productivity Index is one way to cull out the lower “bang for buck” projects—they fall to the bottom of the ranking list. Done correctly, this method *maximizes the value of the development portfolio for a given resource level*.

### 3.3. Qualitative scoring models

Numerous factors have been shown to correlate strongly with new-product success and profitability (Cooper, [2013](#), [2019](#)). As a result, research-based scoring models have been developed that *predict new-product outcomes reasonably well*, as high as 83% accurately, pre-Development (Bronnenberg & Engelen, [1988](#)). Many of the models were initially developed privately within corporations, but in recent years, more are found in the public domain (Cooper, [1985](#)). Seven proven criteria for such a scoring model include:

- Strategic fit and importance.
- Product advantage—unique superior product with a compelling value proposition.
- Market attractiveness—large, growing, low competitive intensity.
- Ability to leverage the firm's core competencies in the new project.
- Likelihood of technical success—size of technical gap, technical complexity.
- Potential for financial reward.
- Risk level (negative)—investment versus reward, uncertainty of key assumptions.

At the gate meeting, following presentation of the project by the project team, senior management (the gatekeepers), independently of each other, score the project on the criteria, 0–10, using a scorecard. Gatekeepers' scores are displayed on the screen, and major differences are debated. A decision is then reached, and if “Go,” the resources are committed.

Such models are often better predictors of new-product outcomes than are financial models, which are traditionally unreliable.<sup>1</sup> And the transparent decision process that scoring models enable produces a fruitful discussion, and usually results in more thoughtful Go/Kill decisions.

[Go to:](#)

## 4. DIGITAL TOOLS TO ACCELERATE KNOWLEDGE GENERATION

---

Numerous digital tools are available to accelerate the product-development process (Cooper & Fürst, [2020b](#)). A recent survey of 200 firms reveals that they expect their investments in digital product development to increase their efficiency and performance by 19% over the next 5 years; and also expect to *reduce time-to-market* by 17% (Geissbauer et al., [2019](#)).

Newer technologies have made prototype development easier, faster, and less expensive. Rapid prototyping based on 3D printing was the precursor of these new prototyping tools; a rapid prototype could be used not only to test technical facets of the product's design, but also to seek customer feedback and validation for the proposed new product. Rapid prototyping, now much cheaper and more ubiquitous, partially solves the number one reason for new-product failure, namely the lack of understanding of customers' needs. As Steve Jobs, never a proponent of traditional market research, famously said "People do not know what they want until you show it to them." (Isaacson, [2011](#)) Rapid prototyping makes this possible. And today, 3D printing has gone beyond just prototypes: Finished products are now being 3D printed. For example, more than a third of the components in GE's new advanced turboprop engine are made by 3D printing (Sheynin & Bovalino, [2017](#)).

Other digital testing technologies are being used in a similar way. Simulations not only test new products technically, but also allow customer-testing of a product that does not yet exist. For example, Volvo Construction evaluates new truck designs before a working prototype is built using a real-time simulator, not unlike a flight simulator.<sup>2</sup> And Alphabets' (Google's) self-driving car, Waymo, logged 10 billion miles, all done by simulation (Etherington, [2019](#)). In a similar vein, developers create a digital twin (or virtual prototype) of the new product—a virtual or digital replica. Sensors collect real-time data from the physical item, which is used to operate the digital duplicate, allowing it to be understood, analyzed, or optimized.

More recently, Virtual and Augmented Realities are being used to test early versions of products, long before the real product is developed. VR and AR can be used to simulate the user's environment so that test-customers can try the product, not just in a lab, but in its intended setting. For example, in the development of FedEx's new drop-box, an early prototype was first developed from cardboard (Termini, [2018](#)). With potential users fitted with VR goggles, developers were able to allow users to

see and use the prototype in a variety of environments, for example, at their own homes.

AI is also beginning to be used to predict the outcomes of different technical solutions—for example, molecules—thus accelerating the choice of the right technical solution. For example, medical chemists must guess which compounds might make good medicines; thus they synthesize and test countless variants, and most are failures. The same is true for material science—coming up with a new molecule for a material. Much of this innovation thus involves making predictions based on data (Rotman, [2018](#)). But AI and machine learning uses real-world data and analysis to predict outcomes, faster, and cheaper than traditional lab-testing methods. For example, the design or “invention” of a new product can be accelerated by machine learning to select the right molecule and hence help to create new materials for solar panels or batteries.

The pharmaceutical industry has recognized the power of AI: “The step-wise serial process of R&D will change to be hyper-iterative and integrated, so that real-world information coming back from development will, in real time, change the research being conducted.” (Mishcon & Robinson, [2019](#)) Companies such as Amgen, Pfizer, Novartis, Sanofi, GlaxoSmithKline, and Merck now have partnerships with AI firms to discover new drug candidates for a range of diseases. For example, machine-learning systems and computational analyses played an important role in the COVID-19 vaccine quest, helping researchers understand the virus, and predict which of its components would provoke an immune response (Waltz, [2020](#)).

[Go to:](#)

## 5. LEAN DEVELOPMENT

---

Many firms’ new-product processes have become bureaucratic and slow. *Value stream analysis* is a well-known Lean-Six-Sigma methodology, designed to remove waste and inefficiencies from business processes; it has seen widespread success in factory-floor settings. But the Lean method can also be applied to new-product development, specifically to *remove waste* and to make the idea-to-launch system more efficient (Fiore, [2005](#)). Removing unneeded tasks, cutting the preparation of too-many PPT presentations, and deleting work that adds no value all save time. And re-designing the process to overlap tasks, namely *parallel processing*—starting

one task or stage before the preceding one is 100% complete—can save time too (as the COVID-19 vaccine developers did, with a “rolling approval process” in the United States; Figure [Figure 1](#) shows this accelerated five-stage process) (U.S. Government Accountability Office, [2020](#)). Other ways to cut cycle time that a value stream analysis may identify are to *move some of the key decision points forward*—for example, the decision to purchase production equipment (acquiring equipment is often a long lead-time item). Making this decision before the field trials are completed is risky, but a cost-benefit analysis often reveals that the payoffs of a faster launch through rapid manufacturing are worth the risk.

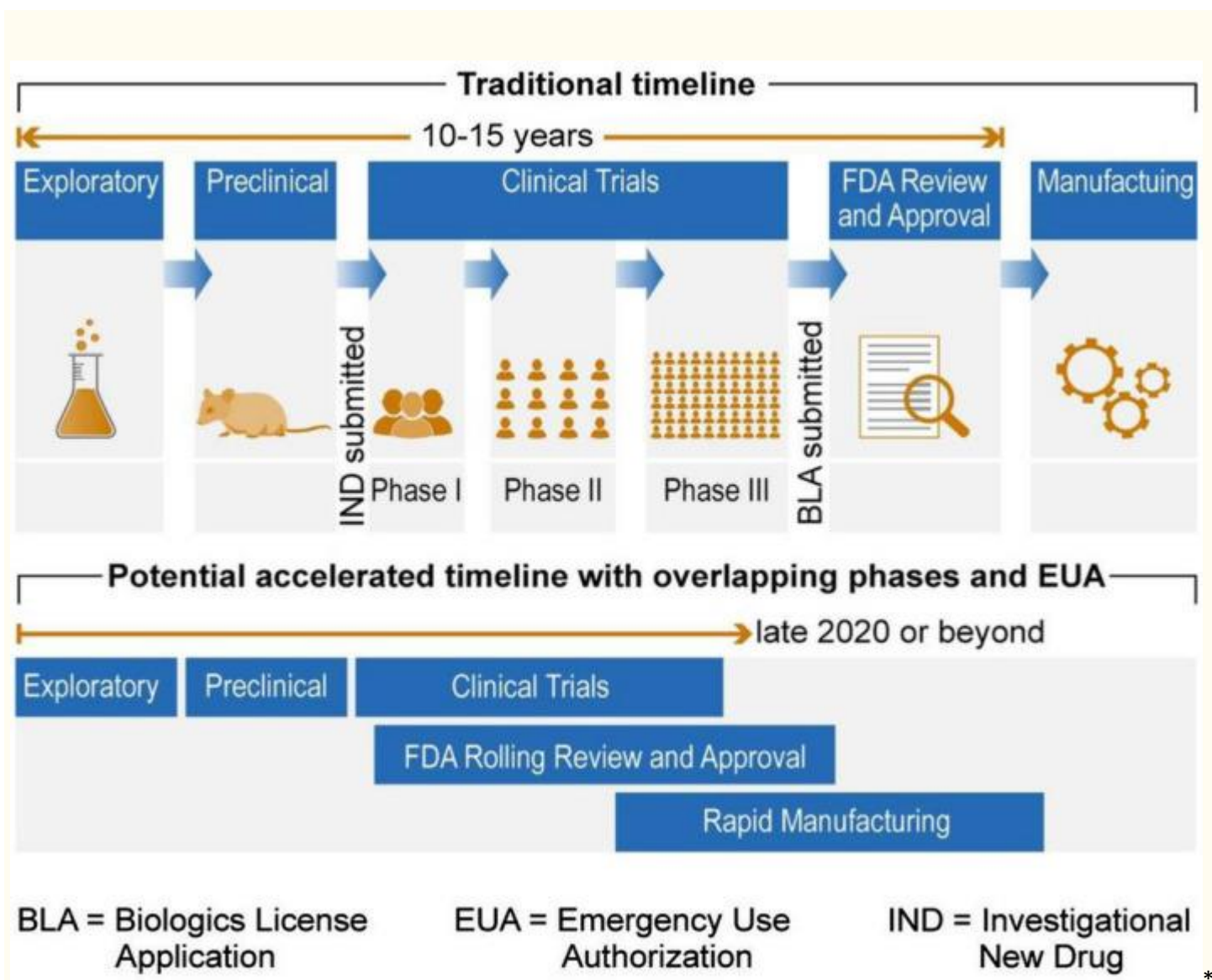
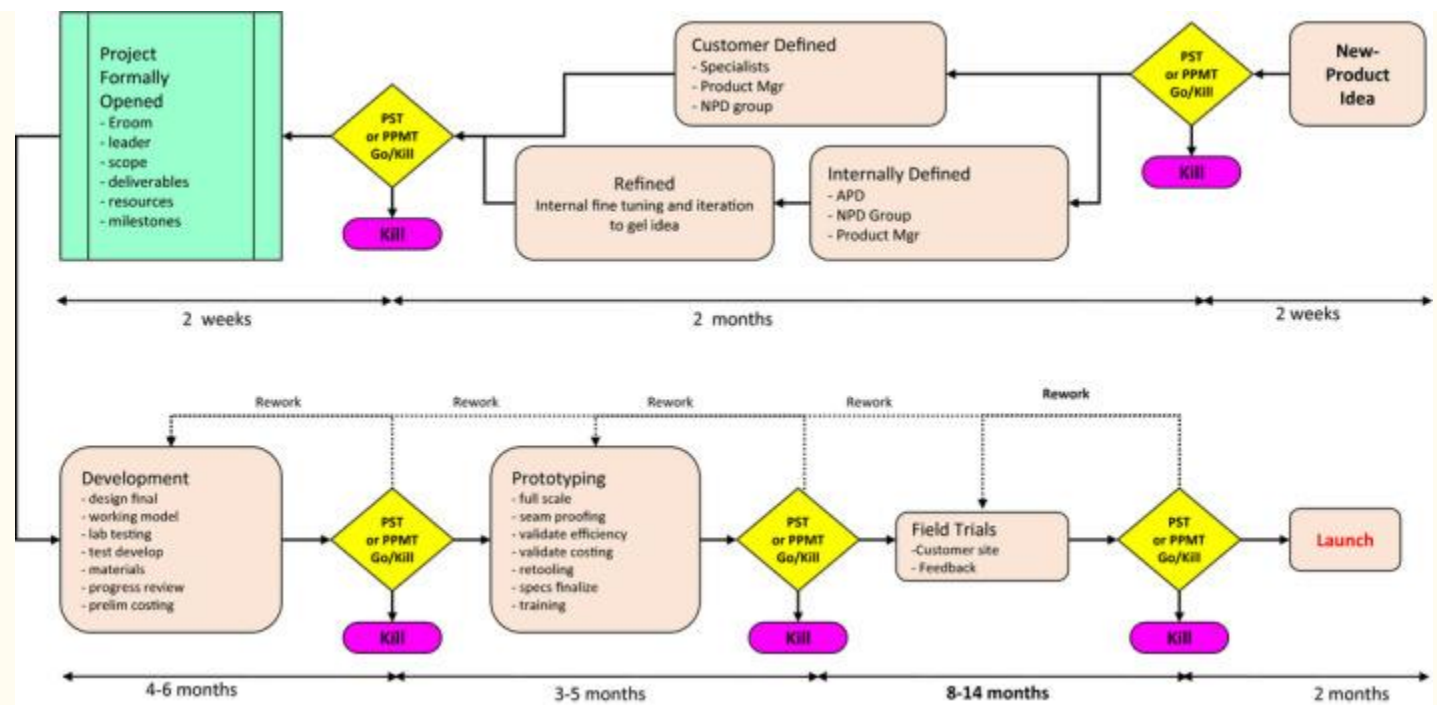


FIGURE 1

In practice, in *value stream analysis*, a task force of knowledgeable product-developers maps the current idea-to-launch process for a typical project in the business—every step, activity, procedure, and decision point. Then they walk through the process and identify all work that adds no value, and also tasks that take too long.<sup>3</sup> Problem-solving methods are employed to eliminate the sources of delay or to shorten lengthy tasks or steps. For example, Danfoss, the Danish controls company, undertook such a Lean exercise, and over a 3-year period, and *cut the cycle time* for major projects from *development-approval through to launch by half*—a remarkable acceleration of the process at relatively little cost. (Jørgensen, [2018](#)) Perhaps not coincidentally, this Lean approach is consistent with Agile principles, which value simplicity, defined as “the art of maximizing the amount of work not done.”

*Example: AK produces a key component used in a large piece of production equipment in the paper industry. Although the development process seemed fairly straightforward, projects were taking much longer than they should have. A small task force of project leaders undertook a value stream analysis exercise: They mapped out the entire process, idea to launch, for a typical major project on a long sheet of paper along a wall, about 10 meters in length: every activity, step, and decision point. An abbreviated version of their 10-meter map is in [Figure 2.2](#). Then the task force went through the map, step by step, and eliminated tasks that were not needed and worked to reduce the time of lengthy tasks.*



**FIGURE 2**

The value stream map for a typical major project in the example company.

The longest task in Figure [Figure22](#) is the field trials, 8-14 months, sometimes with several recycles, thus up to three years for field trials! The task force then used root cause analysis (a fishbone diagram) to identity the main causes of this. Over a dozen causes were identified, including that the customer had to shut down their production in order to do a field trial, at some cost; and often the field trial failed due to lack of prior technical testing, resulting in recycles. For each of the dozen causes, the task force, with other invited experts, brainstormed and arrived at numerous solutions. The result was a significant reduction in the field trial times, and the elimination of recycles.

[Go to:](#)

## 6. AGILE DEVELOPMENT

Agile Development methods were developed in the 1990s in the software world to deal with projects facing uncertain and changing information. While a number of different Agile methods were proposed, the Agile field finally came together in 2001

as a set of principles outlined in the *Agile Manifesto*, (Beck et al., [2001](#)) complete with *development methodologies* with clear rules (Schwaber & Sutherland, [2017](#)).

Agile is incremental and iterative, a series of build-test-and-revise iterations; it is adaptive and evolutionary—the product definition and project plan change as the project moves forward; it emphasizes frequent and fast delivery of results (e.g., product versions), in rhythmic takt time; and it is based on self-managed project teams.

Agile (the Scrum method, the most popular) works like this for software development: Agile breaks the development process into a series of short, iterative, and incremental time-boxed *sprints*, each typically about 2 weeks long. At the beginning of each sprint, the development team holds a *sprint planning meeting* to agree on sprint goals and create a task plan for the sprint. Once the sprint is underway, the team meets every morning—their *daily stand-ups or scrums*—to ensure that work is on course, share information, and solve problems. At the end of each sprint, software increments, potentially releasable, are *demonstrated to stakeholders*, both management and customers. Finally, the team meets in a *retrospective meeting* to review how they can improve the way they work and execute the next sprint better. The team then plans the next sprint based on customer and management feedback.

In Agile development, the team is *dedicated 100%* to the one project and *co-located physically*. Agile defines new roles—the Scrum Master and Product Owner, but no traditional project leader or project manager. The method is also very visual, with tools such as the burndown chart, Kanban chart, and sprint backlog visibly displayed in the team room.

Although Agile Development has its roots in the software industry where it has become widely accepted, firms that produce physical products have benefited from Agile Development methods in recent years (Cooper & Sommer, [2016](#)). What leading manufacturers have done is *to build Agile project management methods into the stages* of their traditional gating process, replacing the more rigid project management methods such as Gantt charts, timelines, and milestones. (Cooper & Fürst, [2020a](#)) A typical gated model with Agile built in is shown in Figure [Figure3.3](#). By integrating Agile methods with traditional gating models, leading firms such as Honeywell, GE, and LEGO have dramatically reduced time to market as well as getting the product right. (Cooper & Sommer, [2018](#)).

Example: Chamberlain, a manufacturer of remote-controlled devices (garage door and commercial gate openers) moved to its hybrid model, Agile within Stage-Gate, in 2013. They were one of the first in North America. The company had used a traditional stage-and-gate process for product development for years, but an ever-larger percentage of each new-product project entailed software development for Smartphone connectivity. Thus, the conflict: Stage-Gate or Agile?

The solution was to introduce the concept of “Agile within Stage-Gate”, whereby the firm uses Agile sprints and scrums for both physical and IT development, and in doing so, improved development efforts considerably across all groups and all project types (Cooper & Sommer, 2018). Agile is employed in the development and testing stages of their Stage-Gate system: Each stage is divided into a series of sprints, each lasting exactly three weeks. Project teams have 100% dedicated team members for each project; but given that dedicated teams are not feasible for every project, the firm only uses this Agile-Stage-Gate approach for about 20% of their projects, specifically the larger, major revenue generator projects. After seven years using the system, the firm estimates “a 20% to 30% cycle time reduction because there is much less ‘redo’ in projects now”, as well as improvements in productivity.

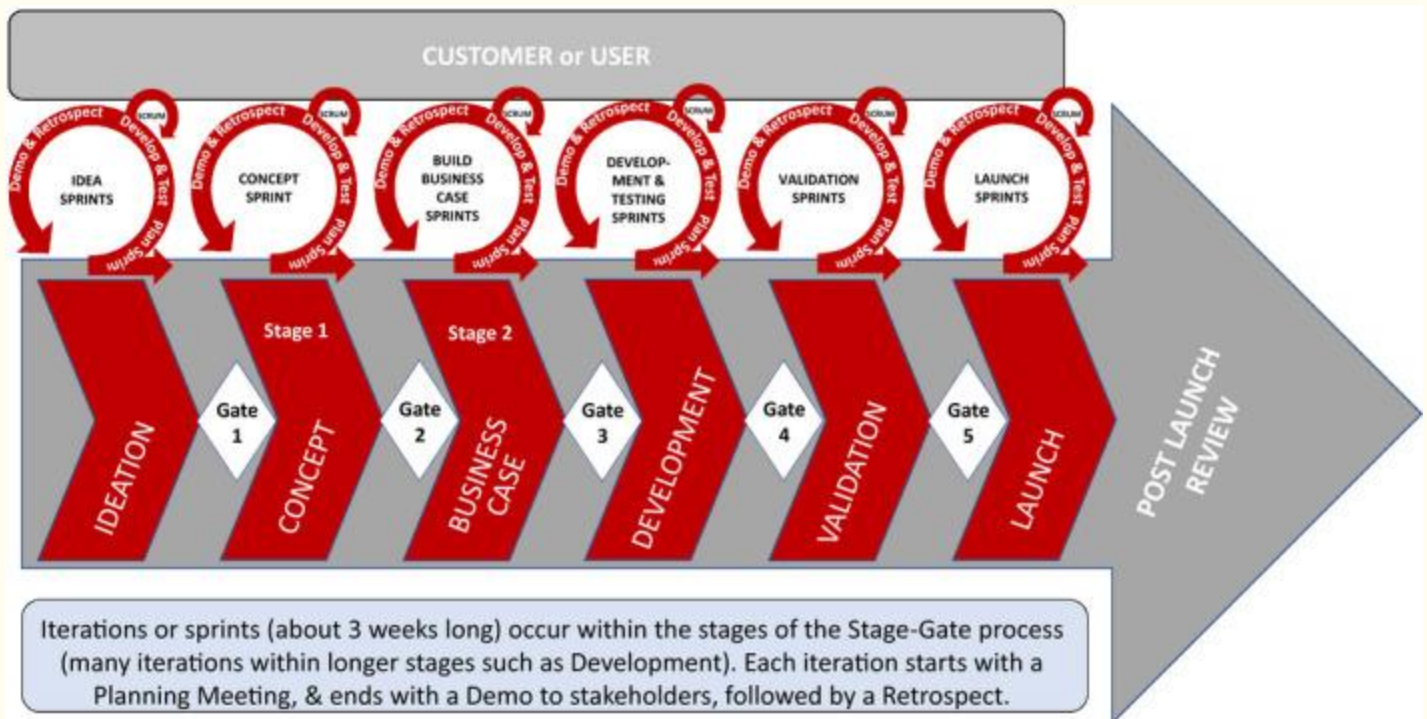


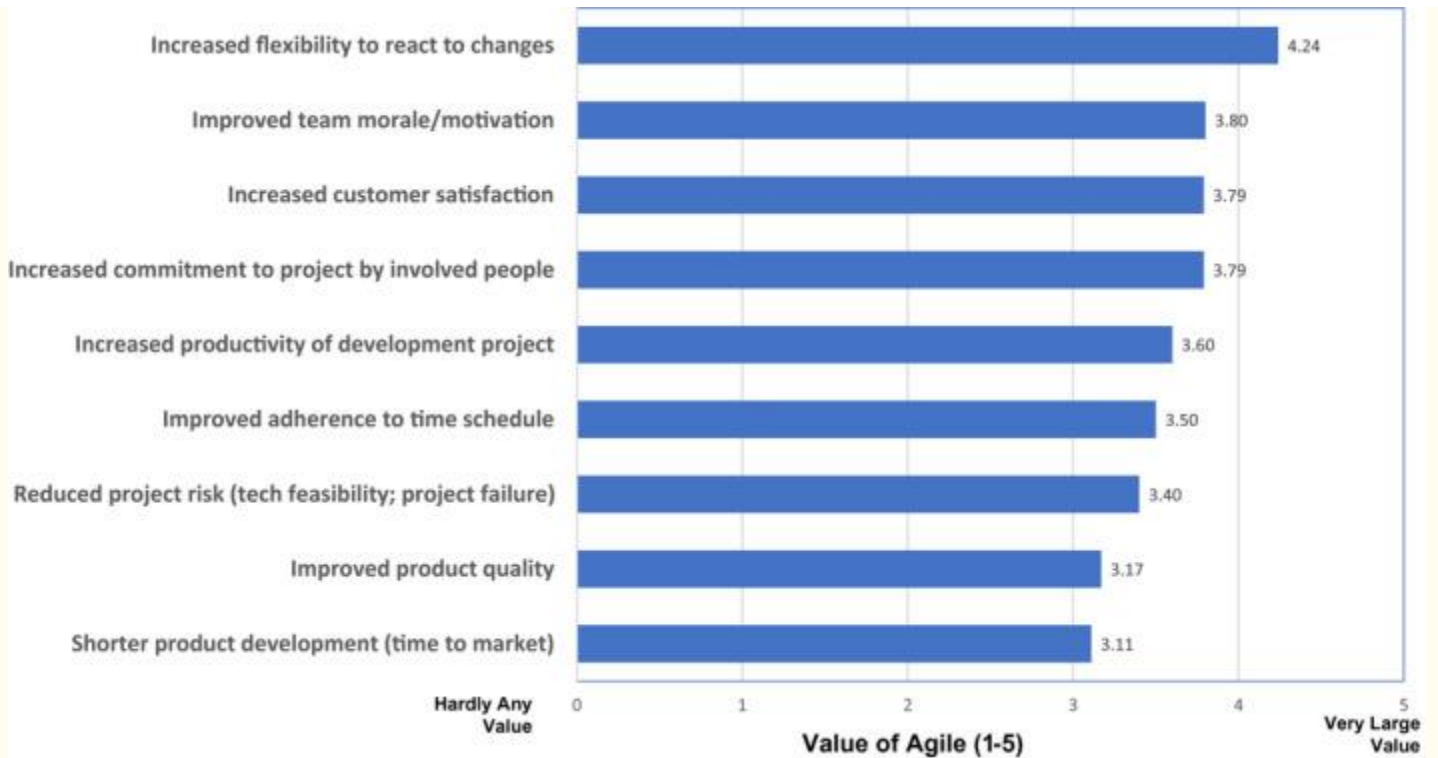
FIGURE 3

The Agile-Stage-Gate model with Agile project management built into the stages.

*This new Agile-Stage Gate approach yields three important positive results for manufacturers (Cooper & Fürst, [2020a](#)):*

1. *Development is faster:* Sprints are timeboxed—a hard stop; the team is focused, and partially or fully dedicated; and frequent scums resolve problems immediately. The result is higher productivity, closer adherence to the time schedule, and shorter development cycles.
2. *Gets the product right:* Product designs (features, functionality, etc.) are validated by customers (and management) as the project moves along—early, often and cheaply.
3. *Team morale is higher:* The team is self-managed, self-organizing, ideally co-located, and has decision authority.

Specific gains when Agile is applied to manufacturers' projects are in Figure [Figure44](#) from several large-sample studies. The greatest impacts are increased flexibility to react to changes, improved team morale, and higher customer satisfaction; shorter development times and more adherence to the time schedule are also benefits (Atzberger et al., [2020](#); Invention Center, [2018](#); Schmidt et al., [2018](#)).



[FIGURE 4](#)

Performance Improvements realized using Agile for physical new products.

[Go to:](#)

## 7. ACCELERATION IS NOT A PANACEA

Not all the promised benefits of accelerated development exist. The theory is clear: Faster to market means higher profits (sales and profits are realized sooner; and money has a time value). Being in the market first results in higher market share, hence more sales and profits—“first mover advantage”; and being late to market means missing the window of opportunity, or incurring other penalties (e.g., annoying valued customers dependent on the product).

The logic appears sound, but the research evidence is lacking. For example, there has never been a consistent set of research results to support the argument that “first in wins.” Often the first to get to market does better, but not always; sometimes the “second in” learns from the mistakes of the pioneer, and does better. Indeed, a review of empirical studies reveals that research has produced

inconsistent, even conflicting, results on the relationship between accelerated development and project success (Chen et al., [2005](#), Langerak, [2010](#)).

One major problem with *trying to prove* that accelerated development has economic payoffs is the challenge of putting an *economic value on hypothesized benefits*. For example, how does one measure the economic gains from “a possible increase in market share because the product was launched sooner”; or the economic losses of “missing the window of opportunity” because the product was slow to market (opportunity costs are always tricky to estimate)? Such economic metrics are difficult to gauge, simply because an assumption must be made about “what would have been” if the product were launched sooner or perhaps later....a hypothetical situation. Some companies have compared the success of projects done before versus those done after implementing accelerated development (profits, sales etc.) (Jørgensen, [2018](#)); but that requires a large sample of projects.

Some research on accelerated development looked at more easily measured dependent variables, such as the impact of speed on development costs; these studies often yield negative results. While “development cost” is more reliably measured, it may not be a valid metric, however: One usually moves quickly not to save money, but in order to gain competitive advantage and market share. Indeed, some of the actions taken done in order to move quickly, such as those prescribed by Agile—dedicated teams, daily scrums meetings, multiple iterations, demos to customers and management—are resource intensive and may actually cost more. Other metrics also produce mixed results (Langerak, [2010](#)): For example, the relationship between cycle time and product quality is also unclear: One study found that higher product quality is related to decreases in cycle time (Langerak, [2010](#)), while others suggest the opposite effect (Griffin, [2002](#)). Yet, another study found shorter cycle time was correlated with an increase in the new product's sales when it is managed across all of the stages of the process (Katrin et al., [2013](#)). Conflicting outcomes regarding the importance of accelerated development for new-product success may also occur because the impact of cycle time reduction may pale when compared to other key success drivers; thus its effect is swamped by the noise (Cooper, [2013](#), [2019](#)).

Cycle time reduction may also yield major negatives (Crawford, [1992](#)). In order to cut cycle time, *a firm may avoid bolder innovations*, which often involve learning and experimentation and thus take longer; the firm may instead focus on smaller, less challenging projects. There is evidence to support this fear: NPD cycle time was

found to be cut significantly over a 14-year period, based on data from two PDMA best practices studies (Adams, [2004](#)); but in that same period, innovative products dropped almost in half as a percent of the total portfolio of projects—from 20.4% to 11.5% (Cooper, [2005](#)).

A second major negative is *cutting corners and making mistakes*—cutting short key activities such as VoC or front-end homework. But these same activities have been shown to have a strong impact on new-product success, and hence are vital. One reason for insufficient VoC and front-end homework is limited resources; but the desire to reduce time-to-market impacts negatively on resources available (people x time) (Cooper & Edgett, [2002](#)). Time demands may also *truncate the process*, where important stages in a well-designed system maybe be skipped—for example, skipping the validation stage in the process (production trials or extended field trials), simply because that stage is deemed unnecessary given the tight deadline.

Project teams, driven by time, may also become *too committed to their project and its plan*, and fail to pivot when needed. Finally, high priority projects tend to *chew up a lot of resources*—pulling team members from other important duties to focus on the one project.

[Go to:](#)

## 8. CONCLUSION

---

Accelerated innovation is a worthy goal in product development, and has the potential for delivering many benefits, as witnessed in developments during the pandemic. Five approaches to accelerated innovation have been outlined —from better focus and portfolio management through to Agile and Lean development.

Many unanswered questions remain however, and thus accelerated innovation is a *fertile field for academics to investigate*. Three closely related research questions are:

1. Does accelerated innovation really work—does it yield benefits, specifically which benefits and how much?
2. What are the hidden costs of accelerated innovation?
3. Which proposed methods work the best, why, and under which conditions?

One reason for the inconclusive results regarding the benefits of accelerated innovation is the *unreliable and often invalid metrics* that try to capture the benefits of speed to market.

A fourth research question focuses on the implementation of acceleration methods. Agile methods were first implemented in the software world; but developing a physical product is much different: it's difficult to do demos on-line to customers; and it's expensive to pivot and change a product's design near the end of development. Thus manufacturers have been forced to make significant modifications to the Agile approach. But more research is required here, not just for Agile, but for the other acceleration methods too. Only then will we have the knowledge, confidence, and motivation to move forward with accelerated innovation.

[Go to:](#)

## 9. CONFLICT OF INTEREST

---

The author's work herein was not funded by any corporation or government agency.

[Go to:](#)

## Biography

---

•

**Robert G. Cooper** is a Fellow of the PDMA, ISBM Distinguished Research Fellow at Pennsylvania State University's Smeal College of Business Administration, and Professor Emeritus, DeGroote School of Business, McMaster University, Hamilton, Ontario, Canada. He pioneered the original research that led to many discoveries, including the key success drivers in new-product development and the Stage-Gate® Idea-to-Launch process. He has published more than 140 academic articles and 11 books, including the best-selling “Winning at New Products.”

## ENDNOTES

---

<sup>1</sup>Based on analyses of actual versus forecasted sales or profits of NPD projects within firms. One study in the public domain is from Procter & Gamble; the “50% success rate” is defined as “Actual NPV/Forecasted NPV”: Mills. 2007. Implementing a Stage-Gate Process at Procter & Gamble. Stage-Gate Leadership Summit, Conference, St. Petersburg Beach, FL

<sup>2</sup>Volvo Construction Equipment streamlines product development with a real time, human-in-the-loop simulator. MathWorks® User Stories: [https://www.mathworks.com/company/user\\_stories/volvo-construction-equipment-streamlines-product-development-with-a-real-time-human-in-the-loop-simulator.html](https://www.mathworks.com/company/user_stories/volvo-construction-equipment-streamlines-product-development-with-a-real-time-human-in-the-loop-simulator.html) (accessed February 15, 2021).

<sup>3</sup>Lean *value stream analysis method*, see: Cooper, R.G. 2017. *Winning at New Products: Creating Value Through Innovation* 5th ed. New York, NY: Basic Books, Perseus Books Group: 171-180.

## REFERENCES

---

1. Adams, Marjorie . 2004. *PDMA Foundation New Product Development Report Initial Findings: Summary of Response From 2004 CPAS*. Chicago, IL: PDMA Foundation. [[Google Scholar](#)]
2. Amaral, António , and Araújo Madalena. 2009. “Project Portfolio Management Phases: A Technique for Strategy Alignment.” *World Academy of Science, Engineering and Technology International Journal of Economics and Management Engineering* 3 (10): 1919–27. [[Google Scholar](#)]
3. Atzberger, Alexander , Nicklas Simon Jakob, Schrof Johan, Weiss Stefan, and Paetzold Kristi. 2020. *Agile Development of Physical Products: A Study on the Current State of Industrial Practice*. Neubiberg, Germany: Universitat der Bundeswehr Munchen. 10.18726/2020\_10 (accessed February 15, 2021). [[CrossRef](#)] [[Google Scholar](#)]
4. Beck, Kent , Beedle Mike, van Bennekum Arie, Cockburn Alistair, Cunningham Ward, Fowler Martin, Grenning James, et al. 2001. *Manifesto for Agile Software Development*. <http://agilemanifesto.org/> (accessed February 15, 2021). [[Google Scholar](#)]
5. Bronnenberg, J. J. A. M. , and van Engelen M. L.. 1988. “A Dutch Test With the NewProd Model.” *R&D Management* 18 (4): 321–32. [[Google Scholar](#)]
6. Chen, Jiyao , Reilly Richard R., and Lynn Gary S.. 2005. “The Impacts of Speed-to-Market on New Product Success: The Moderating Effects of Uncertainty.” *IEEE Transactions on Engineering Management* 52 (2): 199–212. [[Google Scholar](#)]
7. Clouse, Allie 2020. “Moderna Vaccine Funded by Government Spending, with Notable Private Donation.” *USA Today*, November 11. <https://www.msn.com/en-us/news/us/fact-check-moderna-vaccine-funded-by-government-spending-private-donations-and-research-grants/ar-BB1bku1h> (accessed February 15, 2021). [[Google Scholar](#)]

8. Cooper, Robert G . 1985. "Selecting Winning New Products: Using the NewProd System." *Journal of Product Innovation Management* 2 (1): 34–44. [[Google Scholar](#)]
9. Cooper, Robert G . 2005. "Your NPD Portfolio May Be Harmful to Your Business's Health." *PDMA Visions* XXIX (2) Apr-May: 22–26. [[Google Scholar](#)]
10. Cooper, Robert G . 2013. "New Products—What Separates the Winners from the Losers and What Drives Success." In *PDMA Handbook of New Product Development*, 3rd ed., edited by Kahn Kenneth B., Chapter 1: 25–33. Hoboken, NJ: Wiley. [[Google Scholar](#)]
11. Cooper, Robert G . 2019. "The Drivers of Success in New-Product Development." *Industrial Marketing Management* 76: 36–47. [[Google Scholar](#)]
12. Cooper, Robert G . 2020. "The Pandemic Pivot: The Need for Product, Service and Business Model Innovation." *InnovationManagement.SE*, December 2. <https://innovationmanagement.se/2020/12/02/the-pandemic-pivot-the-need-for-product-service-and-business-model-innovation/> (accessed February 15, 2021). [[Google Scholar](#)]
13. Cooper, Robert G , and Edgett Scott J. 2002. "The Dark Side of Time and Time Metrics in Product Innovation." *PDMA Visions* XXVI (22) Apr-May: 14–16. [[Google Scholar](#)]
14. Cooper, Robert G. , Edgett Scott J., and Kleinschmidt Elko J.. 2004. "Benchmarking Best NPD Practices-2: Strategy, Resources and Portfolio Management Practices." *Research-Technology Management* 47 (3) May-June: 50–60. [[Google Scholar](#)]
15. Cooper, Robert G. , and Fürst Peter. 2020a. "Agile Development for Manufacturers: The Emergent Gating Model." *InnovationManagement.SE*, November 10. <https://innovationmanagement.se/2020/11/10/agile-development-for-manufacturers-the-emergent-gating-model/> (accessed February 15, 2021). [[Google Scholar](#)]
16. Cooper, Robert G. , and Fürst Peter. 2020b. "Digital Transformation and Its Impact on New-Product Development for Manufacturers." *InnovationManagement. SE*, March. <https://innovationmanagement.se/2020/03/11/digital-transformation-and-its-impact-on-new-product-management-for-manufacturers/> (accessed February 15, 2021). [[Google Scholar](#)]
17. Cooper, Robert G. , and Sommer Anita F.. 2016. "The Agile–Stage-Gate Hybrid Model: A Promising New Approach and a New Research Opportunity." *Journal of Product Innovation Management* 33 (5) Sept: 513–526. [[Google Scholar](#)]
18. Cooper, Robert G. , and Sommer Anita F.. 2018. "Agile-Stage-Gate For Manufacturers—Changing the Way New Products are Developed." *Research-Technology Management* 61 (2): Mar-Apr: 17–26. [[Google Scholar](#)]

19. Cooper, Robert G. , and Sommer Anita F.. 2020. “New-Product Portfolio Management With Agile: Challenges and Solutions for Manufacturers Using Agile Development.” *Research-Technology Management* 63 (1): 29–36. [[Google Scholar](#)]
20. Crawford, C. Merle . 1992. “The Hidden Costs of Accelerated Product Development.” *Journal of Product Innovation Management* 9 (3): 188–92. [[Google Scholar](#)]
21. Dalton, Mike . 2016. “Manage Pipeline Bandwidth to Avoid Derailing New Products.” *Industry Week*, August  
23. <https://www.industryweek.com/innovation/process-improvement/article/22007299/manage-pipeline-bandwidth-to-avoid-derailing-new-products> (accessed February 15, 2021). [[Google Scholar](#)]
22. Edgett, Scott J . 2013. “Portfolio Management for Product Innovation.” In *PDMA Handbook of New Product Development*, 3rd ed., edited by Kahn Kenneth B., Chapter 9: 154–66. Hoboken, NJ: Wiley. [[Google Scholar](#)]
23. Elonen, Suvi , and Artto Karlos A.. 2003. “Problems in Managing Internal Development Projects in Multi-Project Environments.” *International Journal of Project Management* 21 (6): 395–402. [[Google Scholar](#)]
24. Etherington, Darrell . 2019. “Waymo has now Driven 10 Billion Autonomous Miles in Simulation.” *TechCrunch*, July 10. <https://techcrunch.com/2019/07/10/waymo-has-now-driven-10-billion-autonomous-miles-in-simulation/> (accessed February 15, 2021). [[Google Scholar](#)]
25. Fiore, Clifford . 2005. *Accelerated Product Development: Combining Lean and Six Sigma for Peak Performance*. New York: Productivity Press. [[Google Scholar](#)]
26. Geissbauer, Reinhard , Schrauf, Stefan , and Morr, Jochen-Thomas . 2019. *Digital Product Development 2025: Agile, Collaborative, AI Driven and Customer Centric*. <https://www.pwc.de/de/digitale-transformation/pwc-studie-digital-product-development-2025.pdf> (accessed February 15, 2021). [[Google Scholar](#)]
27. Griffin, Abbie . 2002. “Product Development Cycle Time for Business-To-Business Products.” *Industrial Marketing Management* 31 (4): 291–304. [[Google Scholar](#)]
28. Invention Center . 2018. *Consortium Benchmarking 2018 “Agile Invention”: Evaluation of the Study Results*. Rheinisch-Westfälische Technische Hochschule Aachen (RWTH). <https://www.konsortial-benchmarking.de/en/2018agileinvention.html> (accessed February 15, 2021). [[Google Scholar](#)]
29. Isaacson, Walter . 2011. *Steve Jobs: The Exclusive Biography*. New York, NY: Simon & Schuster. [[Google Scholar](#)]
30. Jørgensen, Bo Bay 2018. “Agile Stage Gate at Danfoss.” *GEMBA Innovation Conference*, Copenhagen, April. [[Google Scholar](#)]

31. Katrin, Eling , Langerak F., and Griffin Abbie. 2013. "A Stage-Wise Approach to Exploring Performance Effects of Cycle Time Reduction." *Journal of Product Innovation Management* 30 (4) July: 626–41. [[Google Scholar](#)]
32. Langerak, Fred . 2010. *Accelerated Product Development. Product Innovation and Management, Part 5*. Hoboken, NJ: Wiley. 10.1002/9781444316568.wiem05004 [[CrossRef](#)] [[Google Scholar](#)]
33. Matheson, David , Matheson James E., and Menke Michael M.. 1994. "Making Excellent R&D Decisions." *Research Technology Management* 37 (6) Nov-Dec: 21–4. [[Google Scholar](#)]
34. Mayer, Hannah M . 2020. "Innovation Due to Covid: Yes, But How?" *Forbes*, August. <https://www.forbes.com/sites/hannahmayer/2020/08/26/innovation-due-to-covid-yes-but-how/?sh=23c19b7b4b7e> (accessed February 15, 2021). [[Google Scholar](#)]
35. Mishcon, Denise , and Robinson Robin. 2019. "Artificial Intelligence: Molecule to Market." *PharmaVOICE*, January. <https://www.pharmavoice.com/article/2019-01-pharma-ai/> (accessed February 15, 2021). [[Google Scholar](#)]
36. Pancevski, Bojan , and Hopkins Jared S.. 2020. "How Pfizer Partner BioNTech Became a Leader in Coronavirus Vaccine Race." *Morningstar News—Dow Jones*, October 22. <https://www.morningstar.com/news/dow-jones/202010224542/how-pfizer-partner-biontech-became-a-leader-in-coronavirus-vaccine-race> (accessed February 15, 2021). [[Google Scholar](#)]
37. Rotman, David . 2018. "AI is Reinventing the Way We Invent." *MIT Technology Review*. <https://www.technologyreview.com/s/612898/ai-is-reinventing-the-way-we-invent/> (accessed February 15, 2021). [[Google Scholar](#)]
38. Schmidt, Tobias Sebastian , Weiss Stefan, and Paetzold Kristin. 2018. *Agile Development of Physical Products: An Empirical Study About Motivations, Potentials and Applicability*. Munich, Germany: University of the German Federal Armed Forces. [www.unibw.de/produktentwicklung-en](http://www.unibw.de/produktentwicklung-en) (accessed February 15, 2021). [[Google Scholar](#)]
39. Schwaber, Ken , and Sutherland, Jeff . 2017. *The Scrum Guide*. <http://www.scrumguides.org/scrum-guide.html> (accessed February 15, 2021). [[Google Scholar](#)]
40. Sheynin, Dmitry , and Bovalino Yari M.. 2017. "A Treat for the AvGeeks: An Inside Look at GE's 3D-Printed Aircraft Engine." *GE Reports*, July 24. <https://www.ge.com/news/reports/treat-avgeeks-inside-look-ge-3d-printed-aircraft-engine> (accessed February 15, 2021). [[Google Scholar](#)]
41. Termini, Brandon Scott . 2018. "How Handsome Used VR to Test Products for FedEx." *Inside Design*, August 21. <https://www.invisionapp.com/inside-design/vr-user-testing/> (accessed February 15, 2021). [[Google Scholar](#)]

42. Thomke, Stefan , and Reinertsen Donald. 2012. Six myths of product development. *Harvard Business Review* 90 (5): 84–94. [[Google Scholar](#)]
43. U.S. Government Accountability Office . 2020. *Covid-19 Vaccine Development*. May. <https://www.gao.gov/assets/710/707152.pdf> (accessed February 15, 2021). [[Google Scholar](#)]
44. Waltz, Emily . 2020. “AI Takes Its Best Shot: What AI Can—And Can't—Do in the Race for a Coronavirus Vaccine.” *IEEE Spectrum* 57 (10), Oct: 24–67. <https://ieeexplore.ieee.org/document/9205545> (accessed February 15, 2021). [[Google Scholar](#)]
45. Weissler, Paul . 2020. “Marelli’s Covid-Killing Cabin Purifier.” *SAE Mobilus*, August 21. <https://www.sae.org/news/2020/08/marelli-covid-cabin-filter> (accessed February 15, 2021). [[Google Scholar](#)]