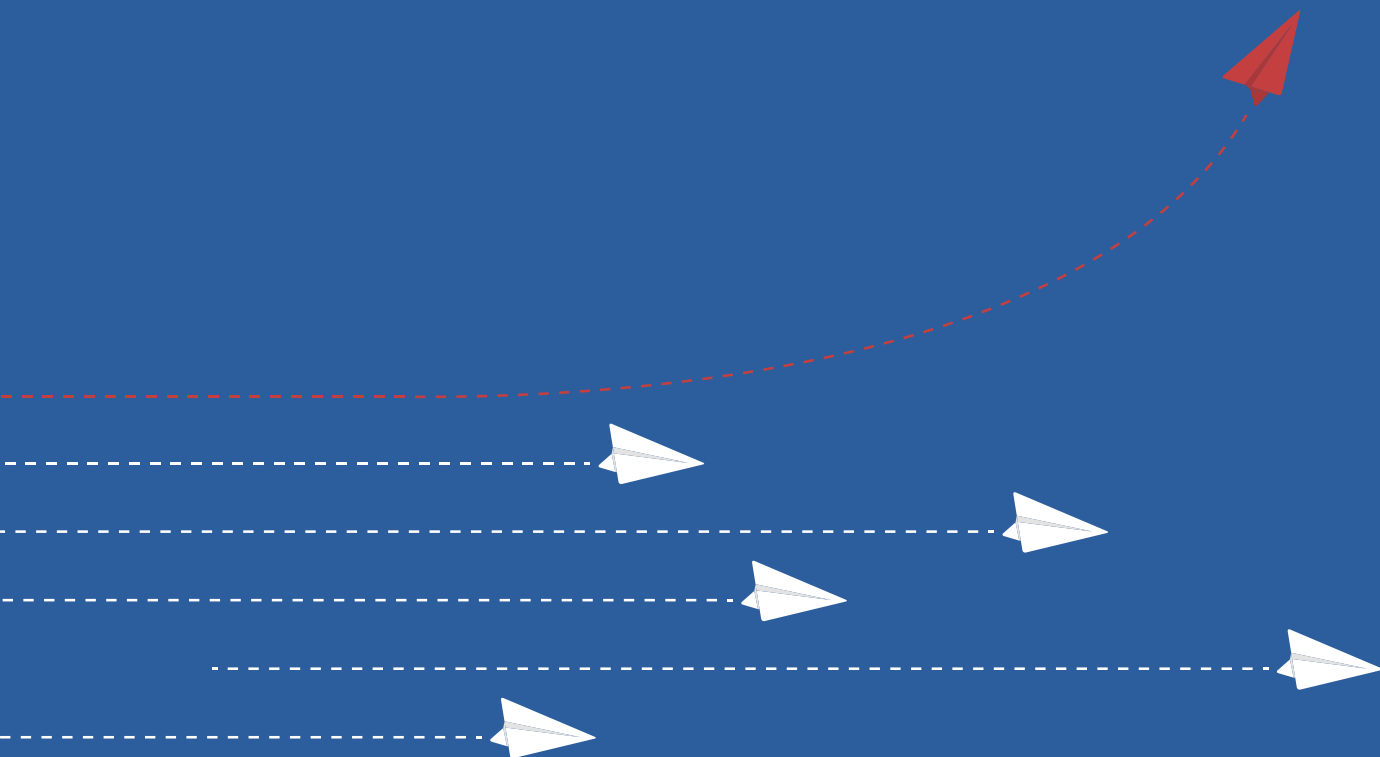# Agile-Stage-Gate Hybrids: Combining the Best of Both Systems for Accelerated New-Product Development[1]

BY ROBERT G. COOPER

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About the author

*Dr. Robert G. Cooper is the creator of the popular Stage-Gate®
Idea-to-Launch process.*
Dr. Robert ("Bob") Cooper is President of the Product Development
Institute and ISBM Distinguished Research Fellow at the Smeal College
of Business Administration, Pennsylvania State University. Many
companies in North America, Europe, and Asia have introduced his
methods, e.g. 3M, BASF, BSH, Carlsberg, Caterpillar, D. Swarovski,
DuPont, Exxon Chemicals, Henkel, Hewlett Packard, Kraft Foods,
Manner, Microsoft, Lego, Voith Paper, Pfizer, Procter & Gamble,
Siemens, VISA and many others.
www.bobcooper.ca
robertcooper675@gmail.com

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New evidence reveals that Agile methods, until now used strictly for software developments, can be integrated with traditional gating approaches to yield *significant potential benefits for manufacturers* of both B2B and B2C physical products.

A handful of leading and early adopters, such as Honeywell, LEGO, Tetra Pak, and Procter & Gamble are experimenting with the new Agile-Stage-Gate approach, and are achieving very positive results.

Indeed, this new Agile-Stage-Gate hybrid approach promises to be **the *most significant change* to our thinking about how new-product development should be done** since the introduction of today's popular gating systems thirty years ago!

1. Agile for Software Development

Agile software development is a group of software development methodologies based on iterative and incremental development, where requirements and solutions evolve through collaboration between self-organizing, cross-functional teams.

Agile methods were seen as the solution to many problems that software developers were facing with traditional development processes in the late 1990s (waterfall and gating processes):

1. Requirements change: The requirements and features defined when the project was initially planned are no longer valid by the end of a 12-18 month development cycle: And *"it's hard to alter course when you're being swept down a large waterfall. Too much up-front planning means too much change-management downstream"*, says Bill Reagan, former Director of Product Management for CA Technologies[2].

2. Next, by committing early to features and schedule, compromises are needed late in the game. Rather than building small complete features, traditionally teams built towards the big, long-term goal.

3. Lastly, inefficiencies are encountered in the development process due to large features, distributed teams, long schedules, long feedback loops, and re-planning that all slow the development cycle.

Agile was introduced to deal with these issues through **adaptive planning**, **evolutionary delivery**, a **time-boxed iterative approach**, and **flexible response to change**.

Beck and colleagues[3] coined the term Agile in their "Agile Manifesto" which elaborated a set of 12 supporting principles, including:

i. Working software be delivered quickly and iterated frequently (in cycles of weeks rather than months), and

ii. Working software be the principal measure of progress

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FIGURE 1. The twelve principles laid out in the Agile Manifesto that underlie Agile development for the software world

Customer satisfaction by rapid delivery of useful software

Welcome changing requirements, even late in development

Working software is delivered frequently (weeks rather than months)

Working software is the principal measure of progress

Sustainable development, able to maintain a constant pace

Close, daily co-operation between business people and developers

THE AGILE MANIFESTO

Co-location: face-to-face conversation is the best form of communication

Projects are built around motivated individuals, who should be trusted

Continuous attention to technical excellence and good design

Simplicity – the art of maximizing the amount of work not done – is essential

Self-organizing teams

Regular adaptation to changing circumstances

Source: Beck et al. 2001

*"Agile was introduced to deal with these issues through **adaptive planning**, **evolutionary delivery**, a **time-boxed iterative approach**, and **flexible response to change**."*

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2. Blending Agile and Stage-Gate For Manufactured New Products[4]

As Agile took root in the software industry, some software development firms with existing gating systems, built Agile into their processes, thus creating hybrid models.

Their experience revealed that Agile and Stage-Gate can be used together to advantage: Karlstrom and Runeson note that *"Agile methods give the stage-gate model powerful tools for microplanning, day-to-day work control, and progress reporting"*. Gating models are generally "plan-driven models," whereas Agile is more "plan and build on the fly"[5]. Boehm and Turner argue that the two are complementary: Stage-Gate is a comprehensive idea-to-launch system and a *macroplanning* process while Agile is a microplanning *project management* methodology[6].

Recently, Agile-Stage-Gate has begun to attract interest from developers of *physical products*.

In manufacturing firms, Agile was first adopted by IT groups, whose initial results encouraged R&D groups working on hardware development to experiment with Agile. Initially, Agile was employed mainly in the *development and testing stages* of a firm's Stage-Gate system, Stages 4 and 5 in Figure 2 (next page). With maturity, Agile-Stage-Gate was even used for early and pre-development stages as well, for example, Stages 1 and 2 in Figure 2, and even for ideation.

In practice, the project's stages, for example the Development stage, are broken into short time-boxed increments called *sprints*, each about 1-4 weeks long (the small circles in Figure 2).

Stage-Gate breaks the new product process – from idea generation through to launch – into five or six discrete stages, each with defined tasks and prescribed deliverables – see across top of Figure 2. Gates precede each stage and are the Go/Kill or investment decision points. The method has been widely adopted by manufacturing firms as a roadmap to drive new-product projects to market.
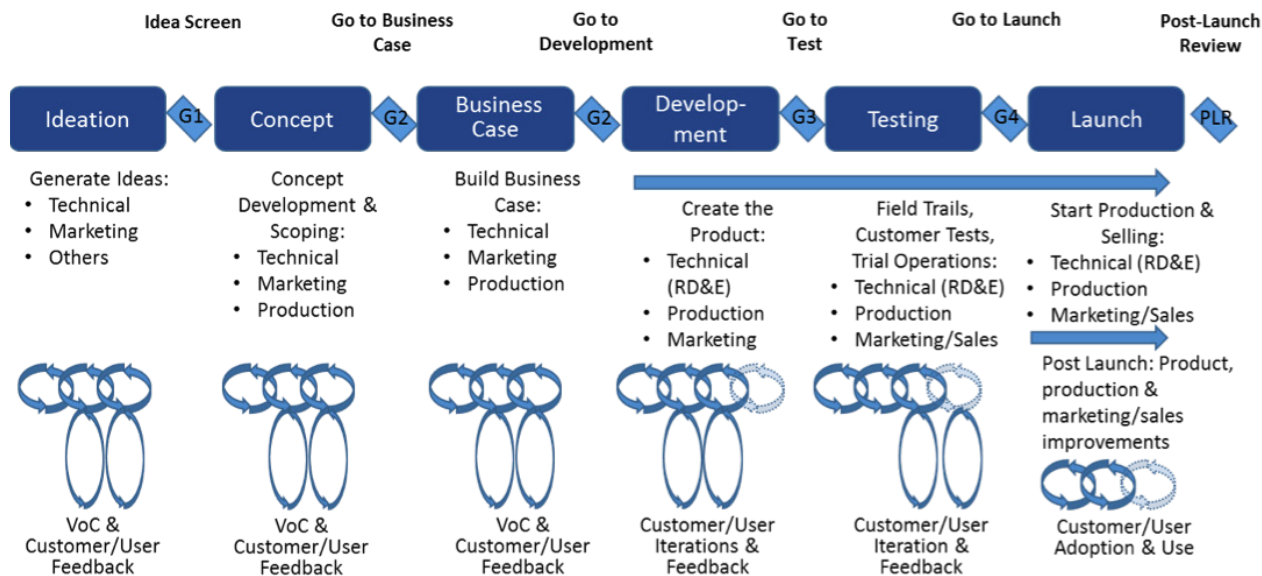
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FIGURE 2. The integrated Agile-Stage-Gate hybrid model – a typical 5-stage, 5-stage Stage-Gate idea-to-launch system, with Agile built into each of the stages
(Source: Cooper & Sommer, IMM 2006)

Each sprint begins with a sprint planning meeting: The project team agrees on a sprint goal (what they can accomplish in 1-4 weeks) and identifies the tasks needed during the sprint – see Figure 3[7,8].

Thus, the goals and work plan for the sprints are very much within control of the project team. Each sprint is followed by a *retrospective meeting*, at which progress is reviewed and lessons for the next sprint are identified, including feedback from the customer.
Frequent customer inputs and rapid changes in product specs are built into the system – the notion of an early "design freeze" is obsolete.

At this point, the method may diverge from its practice in the software world, where the outcome of each sprint is a completed, useable, and potentially releasable product increment.

For physical products, the definition of a "done sprint" is different: Creating a potentially releasable, working product every two weeks is not usually feasible. Although definitions vary by firm, normally a "done sprint" is to have *created something tangible* that can be demonstrated to stakeholders – customers and management – for feedback and revision.

For example, feedback, denoted by the larger loops in Figure 1, might be based on the customer seeing and reacting to a 3D CAD drawing, a computer animation, a rapid prototype, or a crude model – something between a concept and a final prototype (called a "protocept" or "pretotype").
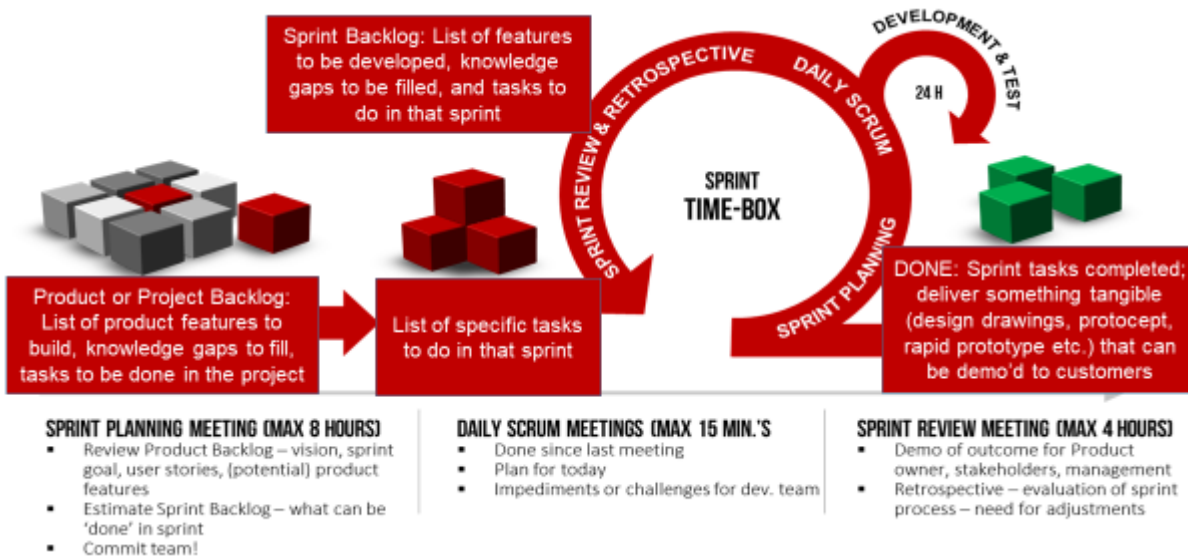
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FIGURE 3. The elements of sprints in the Agile-Scrum method. Stages in Stage-Gate are sub-divided into multiple 1-4 week time-boxed sprints (Source: Vedsmand, Kielgast and Cooper)

There are some other important differences from the traditional Stage-Gate system:

- First, Agile-Stage-Gate project teams are *dedicated* to one project only and are physically *collocated* in one project room.

- The team begins each day with the *daily scrum*, a 15-minute stand-up meeting at which the team synchronizes activities and creates a plan for the next 24 hours.

- *Visual tools* are key to the new model, with a Scrum Board displaying relevant information about the project, are prominent in the project room – see Figure 4.
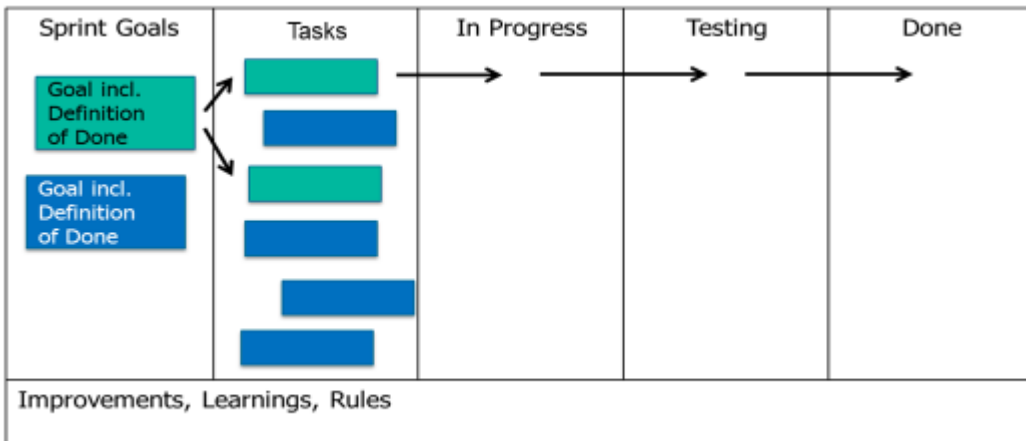

FIGURE 4. Agile-Stage-Gate is very visual. Teams display a number of charts on their Scrum Board, such as this Kanban chart showing the status of tasks in the sprint

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- Each sprint works from the *sprint backlog*, a list of priority features, product increments, knowledge gaps to be filled, and tasks to be completed in the current sprint.

- Progress is monitored via a *burndown chart*, a two-dimensional graph with the sprint time-period on the x-axis and remaining sprint task times on the y-axis – see Figure 5.

- The *scrum master*, who is a servant-leader for the team, ensures that the team adheres to Agile theory, practices, and rules.

- Finally, neither the project plan (e.g. a Gantt chart) nor the product definition is known in advance – the product may be only 20% defined on entering Development (although 40-60% is more normal). Both the plan and product definition *evolve over time* as the project moves through the sprints within a stage.
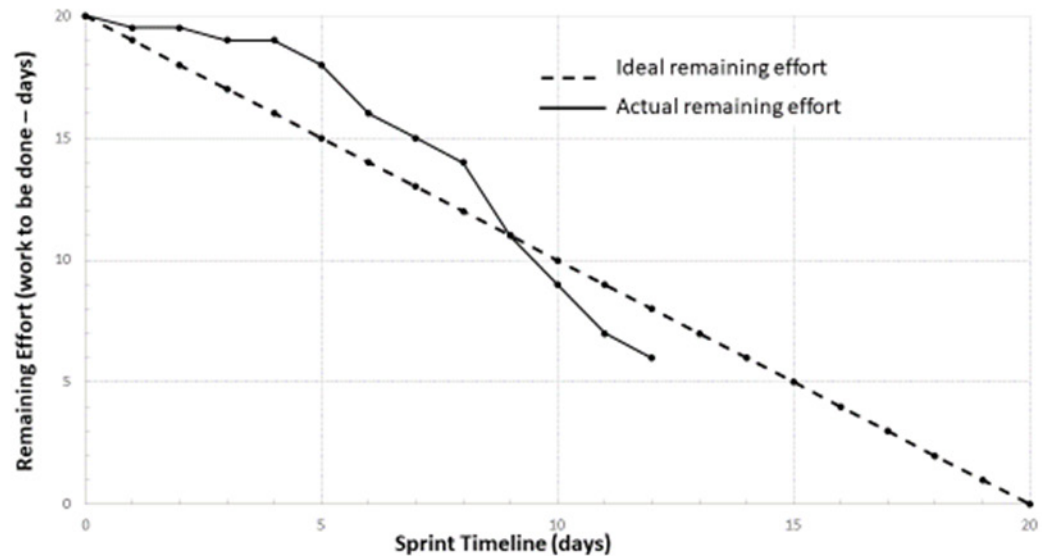

FIGURE 5. A Burndown Chart for a single 4-week sprint, showing the work-effort (days) yet to be done in the sprint (the Y-axis) versus the number of work-days available in the sprint (the X-axis)

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3. Results in Practice

Initial results are most encouraging.

An in-depth study of five major European manufacturing firms revealed very positive results from implementing Agile-Stage-Gate hybrid models[9].

The companies, in a range of industries from B2B heavy equipment to professional products to one strictly consumer goods firm, reported many of the same results found in the software world, namely:

- Design flexibility (faster responses to change).

- Improved productivity, communication, and coordination among project team members.

- Improved focus on the project leading to better prioritization.

- Higher morale among team members.

Similar results were reported in our published case studies of other firms, with typical time-to-market reductions of about 30% when compared to traditional gating systems.

The European study also revealed some negatives, namely:

- Delays due to the difficulty of finding dedicated team members,

- Difficulties in linking project teams to the rest of the organization,

- Mismatches between the requirements of Agile and the company's reward system, and

- A sense that the system was still too bureaucratic.

Similar results were reported in our published case studies of other firms, with typical time-to-market reductions of about 30% when compared to traditional gating systems.

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Other challenges for manufacturers adopting Agile have been identified, including:

- A *lack of scalability*, especially for larger programs with many inter-linked sub-projects;

- *Challenges for global project teams*

- A *proliferation of meetings*; and

- A *lack of management buy-in* due to the differences from the familiar gating systems. Management resistance may also be attributed to some common misconceptions. Implementing Agile, for instance, does not mean abandoning Stage-Gate: Agile can be added to Stage-Gate, creating a hybrid that incorporates positive features of both[10].

The early adopters have typically found innovative solutions to these challenges, which are outlined in the new book *Winning at New Products, 5th edition (2017)[11]*.

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4. An Illustration: Agile-Stage-Gate in the US Electronics Sector[12]

Chamberlain, a large US manufacturer of electro-mechanical control devices for residential use (for example, garage door openers) has increasingly moved into remote control devices, smart-phone based. As a result, an ever-larger percentage of new-product projects entail software development, which led to a conflict between the hardware and software developers: Stage-Gate or Agile?

In response, the company introduced the concept of Agile within Stage-Gate, integrating the two concepts to improve development efforts. As the VP of Innovation told me: *"We developed a modified Agile approach that requires a rigorous Stage-Gate process, and continual end-to-end assessment."* The firm now uses Agile sprints and scrums for both physical and IT development within Stage-Gate phases, with Agile employed in the development and testing stages of their Stage-Gate process. A scrum master oversees daily scrums, about 20 minutes in length.

Sprints are about two weeks in length. For this firm's products, it is usually not possible to produce a potentially releasable product every two weeks, but the project team must show something physical, the result of completed tasks in the sprint: a set of completed design drawings, a rapid prototype, an early working model of the product. Projects have dedicated team members, so not every project is a candidate; thus the firm uses Agile-Stage-Gate only for the larger, major revenue-generating projects – about 20 percent of projects.

"We developed a modified Agile approach that requires a rigorous Stage-Gate process, and continual end-to-end assessment."

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The company has been using this hybrid process on all major new-product initiatives for over 2.5 years. The process has worked very well, according to senior management, and has driven down cycle times. Also, there is much better communication within teams, and a heightened sense of community.

A few challenges have arisen. Senior leaders were initially skeptical of the new Agile-Stage-Gate system and its new vocabulary. So they were not required to "speak Agile"; the firm's familiar Stage-Gate process remained in place, and Agile was merely inserted into the development and testing stages. But gates stayed as they had been: Deliverables were checked, and a go/kill decision was made. Thus senior management was quite comfortable with the new system.

Another issue was that project leaders and teams tended to become so focused on the sprints – the next few weeks and their objective for that sprint – that they lost sight of the ultimate goal, the final product. Management therefore met with the team periodically, more often than just at gate reviews, to ensure that sprint goals as well as the ultimate goal were visible.

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5. Why Agile-Stage-Gate Works[13]

The benefits of *Stage-Gate* have been well-researched and its widespread use documented. Less well-known to manufacturers are the benefits of Agile.

The limited experience with *Agile-Stage-Gate* hybrid development models suggests that manufacturers can indeed benefit greatly from this new hybrid approach; and although there are no studies yet of *Agile-Stage-Gate* in the service sector, there is no reason why it should not work in the service sector as well.

Here are some conclusions about why and how:

5.1. Agile-Stage-Gate deals with Uncertainty and Validates Assumptions for Very Innovative Projects.

Most firms' new product processes emphasize extensive front-end homework to define the product and to justify the development project, *before* Development gets underway. Indeed, robust up-front homework and VoC (Voice of Customer) work early in the project are consistently cited as keys to new-product success.

But not all projects are quite so definable. Indeed, in some highly ambiguous projects – those in new markets and using new technologies – no amount of VoC work, technical assessment or market analysis will deal with all the uncertainties and validate all the assumptions prior to the Development stage. Understanding what the customer values and what will work technically only comes about through experimentation.

The rapid sprint-iterations in *Agile-Stage-Gate encourage experimentation and testing* – build something, test it with the customer and in the lab, and then revise one's thinking – see Figure 6.

The product may be only 40-percent defined on entering the Development stage, but evolves and solidifies via these iterations. In this way, *key assumptions are validated and major uncertainties dealt with, but in real time* and as the project moves along.

Thus, understanding product requirements and envisioning a technical solution does not occur before Development, but in *Agile-Stage-Gate is done as part of the Development and Testing stages* of the project—learning on the fly.

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FIGURE 6. Throughout the Agile-Stage-Gate process, successive iterations of the product – various versions, models or "protocepts" – are developed that can be demonstrated and validated with customers (Source: Cooper & Sommer, IMM 2016).

5.2. Agile-Stage-Gate is adaptive – Deals with Changing Requirements.

When customers' needs change, or a new product requirement becomes evident partway through Development, traditional gating models, with fixed product definitions, fail to respond easily and quickly.

By contrast, by building very early product versions or *protocepts* via the sprints – a model, computer generated graphics, or a rapid prototype – *Agile-Stage-Gate is more adaptive*. If product requirements change, then needed modifications to the product's design can be made *earlier during the Development stage* when the cost of change is lower, much like a *strategic pivot* in the Lean Start-Up method[14].

5.3. Agile-Stage-Gate focuses Teams, Accelerates Development, Improves Communication.

Agile-Stage-Gate project teams are *dedicated to the one project* to ensure adequate resources to get the work done. In traditional new-product development, a minority of firms employ focused (dedicated) project teams, and only for some projects.

But Agile places such emphasis on this dedicated team facet that teams *really are dedicated for every major project.* This one step alone increases development speed dramatically and improves quality of execution of key tasks.

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Additionally, time boxed-sprints, and even time-boxed tasks within sprints, bring a sense of urgency to the development project.

The key here is to have a *steady flow*, and to avoid doing things in haste or in a last-minute panic (the negative term "feature cramming" is used in the software world).

Additionally, the notion of a *steady, strong and responsive heartbeat* – takt time – creates a rhythm for the project team, and keeps moving the project along at a sure and steady pace: Momentum is maintained.

Finally, dedicated teams (not spread across other work or many other projects), a dedicated team room where the entire team resides, and face-to-face daily scrums all contribute to much improved team communication.

"The rapid sprint-iterations in Agile-Stage-Gate encourage experimentation and testing [...] In this way, key assumptions are validated and major uncertainties dealt with, but in real time and as the project moves along."

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Moving Forward

The early evidence is encouraging. Lead users of this new hybrid system are enthusiastic. In all the cases we've studied, the companies have expanded their use of the hybrid model, which speaks for the results it has delivered.

The resounding advice from the business' leaders at Danfoss, one of the firms we've studied, is simple: "Just try it!" Set up a small task force, figure out roughly how the new system will operate, and work out how you will deal with the tough issues, some of which have been outlined above.

But in the Agile tradition, don't try to get all the answers before you start: Begin with several selected pilot projects, provide coaching, monitor closely, and adjust as the projects move along.

Endnotes

1   This whitepaper is based on a number of articles by the author and co-authors. See:

        a.   R.G. Cooper, "What's next? After Stage-Gate," Research-Technology Management, 157, 1 (Jan-Feb 2014): 20-31.

        b.   R.G. Cooper, "Agile-Stage-Gate Hybrids: The Next Stage For Product Development," Research-Technology Management 59, no. 1 (Jan 2016): 1–9.

        c.   R.G. Cooper and A.F. Sommer, "The Agile–Stage-Gate Hybrid Model: A Promising New Approach and a New Research Opportunity," Journal of Product Innovation Management 33, no. 5 (Sept 2016): 513–526.

        d.   R.G. Cooper and A.F. Sommer, "Agile-Stage-Gate: New Idea-to-Launch Method For Manufactured New Products Is Faster, More Responsive," Industrial Marketing Management 59 (Nov 2016b):167–180.

        e.   R.G. Cooper, "Next in New-Product Development: Agile-Stage-Gate Hybrids", CIMS Innovation Management Report (Nov-Dec 2016): 10-14.

        f.   R.G. Cooper, "Idea-to-Launch Gating Systems: Better, Faster, and More Agile," Research-Technology-Management 60, 1 (Jan-Feb 2017): 48-52.

2   See *Agile Manifesto*: K. Beck, M. Beedle, A. van Bennekum, A. Cockburn, W. Cunningham, M. Fowler, J. Grenning, J. Highsmith, A. Hunt, R. Jeffries, J. Kern, B. Marick, R.C. Martin, S. Mellor, K. Schwaber, J. Sutherland and D. Thomas, "Principles Behind the Agile Manifesto," Manifesto for Agile Software Development (2001): http://www.agilemanifesto.org/principles.html

3   B. Reagan, "Going Agile: CA Technologies, Clarity PPM Division's Transformative Journey," Digital Celerity (San Francisco, CA, September 22, 2012): http://www.slideshare.net/DCsteve/going-agile-with-ca-clarity-ppm-agile-vision

4   For a detailed outline of how Agile-Stage works for manufactured new products, see: R.G. Cooper, *Winning at New Products: Creating Value Through Innovation*, 5th edition, New York, NY: Basic Books, Perseus Books Group, 2017, chapter 6.

5   D. Karlstrom and P. Runeson, "Combining Agile Methods With Stage-Gate Project Management," IEEE Software: (May–June 2005):43–49. And: D. Karlstrom and P. Runeson, "Integrating Agile Software Development Into Stage-Gate Managed Product Development," Empirical Software Engineering 11 (2006): 203–225.

6   B. Boehm and R. Turner, *Balancing Agility and Discipline* (New York, NY: Addison Wesley, 2004).

7   S. Kielgast and T. Vedsmand, "Integrating Agile with Stage-Gate®—How New Agile-Scrum Methods Lead to Faster and Better Innovation," Innovation Magazine.SE (Aug 9, 2016):1–15.

8   ScrumInc. *The Scrum Guide*. July. http://www.scrumguides.org/scrum-guide.html/. 2013.

9   These performance results were first reported in: A.F. Sommer, C. Hedegaard, I. Dukovska-Popovska and K. Steger-Jensen, "Improved Product Development Performance Through Agile/Stage-Gate Hybrids—The Next-Generation Stage-Gate Process?" Research-Technology Management 158, no 1 (2015): 1–10.

10   Sommer et al (RTM 2015), endnote 9.

11   Numerous clever solutions to the implementation challenges outlined above have been uncovered by early adopters of Agile-Stage-Gate. They are too lengthy to include here in this short whitepaper, but are described in detail in: R.G. Cooper, *Winning at New Products: Creating Value Through Innovation*, 5th edition, New York, NY: Basic Books, Perseus Books Group, 2017, chapter 6.

12   The Chamberlain case is from: Cooper, RTM, 2016; see also

13   This section is from: Cooper and Sommer (IMM, 2016), endnote 1.

14   E. Ries, *The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses* (New York, NY: Crown Publishing Group, Division of Random House Inc., 2011).

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