How Agile Development Works for Manufacturers – Parts I & 2

Robert G. Cooper, Angelika Dreher, and Peter Fürst

‘... 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!” wrote Robert G. Cooper in the Nov-Dec 2016 issue of CIMS. That was the first of a series of articles that Professor Cooper, who introduced Stage-Gate®, has written for CIMS.

Summary: This two-part article series addresses the questions: Does this new approach really work for manufacturers? And what adjustments have those manufacturers made to ensure that Agile really does work for them? The article outlines the emerging dominant model for Agile-Stage-Gate®, including the details of the process and Agile procedures that manufacturers typically adopt; the organization and team structure they elect; and even the Agile mindset, suitably modified to best suit manufacturers. A must read for anyone attempting to implement this Agile-Stage-Gate® system in physical products company.


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HOW AGILE DEVELOPMENT WORKS FOR MANUFACTURERS: I

By Robert G. Cooper, Angelika Dreher and Peter Fürst

“...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!” Robert G. Cooper wrote in the Nov/Dec 2016 CIMS IMR.¹

This was the first of a series of articles on the application of Agile that Prof. Cooper, who introduced Stage-Gate®, has written for CIMS IMR.

In the article below, he and co-authors Dr. Angelika Dreher and Peter Fürst, managing partners in the Dornbirn, Austria consulting firm of Five i’s innovation, address the questions: Does this new approach really work for manufacturers and what adjustments have those manufacturers made to ensure that Agile actually does work for them?

Agile Development was developed in the software industry through the 1990s, a time when the industry needed new ways to overcome many deficiencies.² By 2013, we began to see evidence that manufacturers of physical products—notably those with software embedded in their products—were applying Agile to their hardware development. These included such firms as LEGO (Education Division) and Chamberlain (remote control devices). Many other manufacturers were soon to follow.²,³,⁴,⁵ But questions remain:

- Does Agile Development really work for manufactured new products where quantitative performance metrics are difficult to find?
- What does it mean to adopt Agile Development—do manufacturers really buy into the entire Agile methodology or only to parts of it? (Major differences exist between hardware and software development, which may preclude implementing certain facets of Agile).

What Is Agile Development?

Managers, especially senior people, appear confused about what Agile Development is. Many initiatives are launched within firms under the heading “Agile” that bear little connection to the methods found in Agile Development. Agile is not just about being quick, nimble, adaptive, and responsive; rather, Agile is a set of principles, outlined in the Agile Manifesto,⁶ and methodologies with very clear and strict rules.⁷
The Scrum version of Agile is the most popular and the version used by manufacturers. It breaks the development process into a series of short, iterative and incremental time-boxed sprints, each typically about two weeks long. Sprints consist of:

- **Sprint planning meeting:** At the start of each sprint, the team meets to agree on what it can accomplish in the sprint and creates a task plan.
- **Daily stand-up meetings, sometimes called scrums:** During the sprint, the team meets every morning to ensure that work is on course.

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<th>Value of the Agile Methodology</th>
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<td><strong>Hardly Any Value</strong></td>
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<td>Shorter product development (time to market)</td>
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<td>Improved adherence to schedule</td>
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<td>Reduced development cost</td>
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<td>Reduced project risk (tech feasibility; project failure)</td>
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<td>Increased productivity of development project</td>
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Fig. 1—Performance improvements realized using Agile-Scrum for new-product development, based on a German study of 228 manufacturing firms.\(^9\)

- **Demo:** At the end of each sprint, software increments or new features, potentially releasable, are demonstrated to stakeholders (both management and customers).
- **Retrospective meeting:** Finally, the team meets to review how they can improve the way they work.

The team then plans the next sprint based on customer and management feedback. Product requirements and technical solutions, and even the project plan, thus evolve over the development cycle. The development team’s work is visible to all, and monitored via a set of visual tools displayed in the team room.

There is no traditional project leader or project manager in Agile-Scrum. Rather, the new roles are:

- **The scrum master**, a servant-leader for the team who ensures that the team adheres to Agile theory, practices and rules.
- **The product owner**, a member of management, typically a senior marketing person, who represents the product’s stakeholders and provides direction to the team (e.g., at the sprint planning meeting).
- **The development team**, a dedicated team that works 100% on this one project, usually technical people, and physically co-located.
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Agile-Scrum Integrated with Stage-Gate® for Manufacturers

A number of manufacturers have adopted the Scrum version of Agile, or facets of it, and initial results are positive. Figure 1 shows the results reported from 228 German manufacturing firms using Agile-Scrum.\(^6\)

Manufacturers typically rely on a gating system, and thus employ Agile-Scrum within the stages of their gating system as a project management method. Anita Sommer, a Danish researcher, coined the term “Agile-Stage-Gate hybrid model” in 2015.\(^7\) But this German study, other reports and our own workshops held with dozens of early adopters in North America and Europe reveal that most manufacturers do not adopt all facets of Agile-Scrum; furthermore, they significantly modify those elements borrowed from the software world (see “Source of Data on Agile-Stage-Gate”).

What emerges is a dominant Agile-Scrum gating model for manufacturers—a consensus about what works for physical products. There are three major themes for this emerging Agile-Stage-Gate hybrid model:

1. **Methodology:** What happens, how the Agile-Stage-Gate method works, and how it is modified from Agile-Scrum when used for software development. For example, software-Scrum relies on very short iterations, often two weeks in length. But in physical products, it’s almost impossible to have anything ready to demo in two short weeks!

2. **Organization:** How the development team is organized, and the roles of key players. In software-Scrum, the team is 100% dedicated to one project and physically located in one room. But that scenario is unrealistic for R&D projects in manufacturing firms, which require cross-disciplinary teams.\(^8\)

3. **Mindset:** Which values, attitudes and beliefs guide behavior, and how they differ from the values and principles in the original Agile Manifesto.

This article focuses on the Methodology of this new emerging hybrid model, while Part 2, in the May-June issue of IMPR, deals with the Organization and Mindset themes, 2 and 3 above.

**Agile-Stage-Gate Methodology**

**Where Used:** Manufacturers typically use Agile-Scrum for many stages of their gated development process: Ideation, Concept, Development, Testing, and even Commercialization (see “Source of Data on Agile-Stage-Gate”). This stands in contrast to the software world, where Agile is used mostly by code-writers for the technical or development stages. Indeed, physical-product firms report that Agile-Scrum is most useful for the earliest stages, such as Ideation, Concept and Development.

However, these firms don’t use the new method for all projects; indeed, a study of 138 manufacturers using Agile-Scrum reports that 62% of the firms do less than 25% of their projects with the new method.\(^9\) Agile-Scrum is usually reserved for larger projects that are more ambiguous, with higher uncertainty, and risky.\(^10\)

**How Used:** In practice, each stage of the project is done in increments called sprints or iterations, which are time-boxed with a defined time
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limit, usually about 2-4 weeks, but often longer (Figure 2). For example, Honeywell uses eight-week iterations for hardware developments versus two-week sprints for software,\(^5\) while Corning employs 60-90 day planning cycles or iterations.\(^1\) This longer time allows the development team to realistically produce something they can demonstrate.

In using Agile-Stage-Gate, the development team begins each iteration with a planning meeting. They define what they will achieve in that iteration: their goals (including the definition of done, DoD) and their iteration plan with a list of tasks they will do, sometimes posted on a Kanban Board.

On a Kanban Board, all the iteration's tasks are listed in a column on the left, and move across columns from “To Do,” “In Progress,” “Done,” and “Checked”, thereby showing the status of each of the tasks to be completed in that iteration.\(^1\) The iteration then begins and the team undertakes their agreed-to tasks. Note that some lengthy tasks span several iterations, such as extended lab tests or doing a Voice-of-Customer (VoC) study.

*Stand-up meetings* are held regularly with the entire team present, but not daily, usually about 2-3 times per week. Here the team reviews progress and syncs their various tasks.

At the end of the iteration, the team demonstrates what they have done by presenting the reviewable or visible results of their work. This demo could be an early prototype or “protocept” of the product, or something else they can show, such as design drawings, results of lab tests, or the VoC study findings.

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When a task spans several sprints, such as product testing, “interim results” are demo’d as “the result of the work done.” For example, at the Coatings Division of a major chemical company, new coatings require months of testing before a final result is available. But interim test results are available sooner and are presented at demos. Further, iterations can be of variable length, especially for the Development and Testing stages (a testing iteration could be extended to 8-12 weeks instead of 3-4 weeks). Note that varying the length of iterations does contravene one of the principles of software-Agile, namely consistent time-boxed sprints, designed to establish a rhythm, heartbeat or takt time.

This demo at the end of each iteration is given to management to seek feedback, advice and validation, as well as continued buy-in. The feedback could signal a course correction, or in rare cases trigger an emergency gate meeting to reconsider the merits of the project. Also, with some but not all iterations, the demo is for customers or users, again to seek feedback and validation, and to identify corrections needed, notably to the product’s design, features and functionality. For example, one major study found that the median interval between prototypes demo’d to customers was 17-24 weeks, which is much longer than at the end of each iteration. (2)

Each iteration concludes with a retrospective meeting where the team analyzes their own behavior and results, and tries to improve how they work together. Then the next iteration begins! Thus, the process moves along—iteration by iteration—until that stage of the project is finished and deliverables are ready for the upcoming gate meeting.

An important difference from the classic Stage-Gate approach, and a challenge for some gatekeepers, is that some gate deliverables are much more variable and tentative than in the past. For example, the product definition may be only 40-70% complete on entering the Development stage, rather than the normal 90%, and the project plan (e.g., Gantt chart) and estimates of resource requirements and project costs may also be quite tentative, which results in highly uncertain project financial estimates. (15) Thus, management is faced with a much more ambiguous approval and investment situation.

Another change is much leaner deliverables for the gates (fewer templates, shorter templates, and less information required). Most firms’ traditional gating systems require far too much information delivered to each gate and often too early in the process, for example, requiring detailed NPV calculations or cost analyses at early gates, when such estimates are highly unreliable.

Using Lean methods, such as value stream analysis, some firms have removed the non-value-added work and corresponding deliverables. (16) This is consistent with the Agile principle of “maximizing the amount of work not done,” as we discuss in the forthcoming Part 2.

Part 2 will examine the other two themes of this emerging model, namely how firms organize and how they adopt and live an Agile mindset.
References


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HOW AGILE DEVELOPMENT WORKS
FOR MANUFACTURERS: II

By Robert G. Cooper, Angelika Dreher and Peter Fürst

In Part I, Prof. Cooper, who introduced Stage-Gate®, and co-authors Dr. Angelika Dreher and Peter Fürst, managing partners in the Dornbirn, Austria consulting firm Five i’s innovation, explained how in order to develop new physical products manufacturers adopted Agile Development, widely practiced in the software industry. Today, after about five years of experimenting and trials, a consensus or dominant Agile-Stage-Gate model is emerging, one that is similar to its software cousin but has some important differences as well (1).

In Part I, we outlined what Agile-Scrum was, and then delved into methodology of this new Agile-Stage-Gate model for manufacturers (2). In Part II, we now focus on two additional themes of Agile-Stage-Gate, namely how manufacturing firms organize their development teams, and adopt and live an Agile mindset.

Unlike physical product development, Agile-Scrum as practiced for software development requires a 100% dedicated development team—working full time on the project and co-located in the same room. For manufacturers, however, this poses two principal challenges. First, many R&D projects have significant waiting times, for example for test results or for equipment arrival. Thus, team members must work on other projects during this interlude.

A second and more difficult challenge is that most manufacturing firms simply have too many projects underway at any one time, spreading players too thinly and across too many projects. This demands effective portfolio management, as a previous CIMS IMR article described—finding focus and cutting down the number of projects! (3).

Focused Rather than Dedicated Teams

The emerging model is for manufacturers to employ a “focused team” rather than a 100% dedicated team; that is, a mostly dedicated team
with some team members devoting the majority of their time (60-75%) to the project. For a specified number of days per week, core team members work together only on this designated project. Further, for the 2-3 stand-up meetings per week, the entire team is present.

Some firms, such as the global packaging company Tetra Pak, limit the number of “other projects” 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. (The scrum master also protects the team from diversions.)

Cross-functional teams are the norm in the emerging model, which is not new to manufacturers but is new to software-Scrum users. The requirement for Marketing, Operations and perhaps even Sales people to be part of the focused cross-functional team is a challenge, because usually these people only devote a minority of their time to any new-product project. One solution is to require that only a handful of people on the team be dedicated, whereas others—from departments outside of R&D—are part-time players but with specific time commitments decided at the previous gate. And they must still attend the regular stand-ups!

Self-Managed and Empowered Within Boundaries

The project team is very much self-managed, self-organizing, and empowered. This is consistent with software-Scrum and has also been a best practice for decades within the manufacturing sector—see (4) and (5) for best practices in NPD. Once their project is approved at a gate meeting, along with a high-level “go forward” plan, the team is free to map out their action plan in detail, decide who does what, and who has the authority to make decisions.

Some senior people worry about a team out of control, leading to chaos. But there are still strong gates in the system, where gatekeepers scrutinize the project and approve concepts and a high level plan-of-action. And there are still validations with management along the way and between gates, in the form of demos. In this way the team is “self-managed and empowered” but within boundaries.

Project Managers, Product Owners and Scrum Masters

Most manufacturers maintain the role of a Project Leader or Project Manager, even though software-Scrum eliminates this role. One reason is that Agile projects represent only a minority of projects for the typical manufacturer and one hesitates to create a different organizational structure just for a minority of projects. A second reason is that a cross-functional team has differing time and content contributions per team member, and thus needs more coordination, synchronization and leadership than a fully dedicated software development team.

The Product Owner as found in software-Agile is a much-debated role among manufacturers using Agile-Stage-Gate, and there is no consensus here. Some manufacturers embrace the Product Owner role: a senior person, often from Marketing, who meets with the team at the
beginning of every iteration and provides guidance. One danger here is when the Product Owner acts as the master, dictating his or her needs to the team, which is then reduced to acting as a contractor or slave.

A second danger is when the Product Owner speaks on behalf of the customer, thereby precluding the need for the team to do VoC research. For example, in one firm, the Product Owner thought he knew what customers wanted but the team did not agree and so did their own VoC, which changed the direction of the project. Be wary of the “Voice of Product Owner” phenomenon: More new products fail because of faulty market and customer knowledge than any other cause!

Alternatively, some firms already have executive sponsors who oversee major projects (these executives usually do not get into the details of the project, however). These firms thus see no need for a Product Owner. In other companies with an effective Stage-Gate system, the gatekeepers are responsible for making investment decisions for new-product projects. Thus, by making a “go decision” they act as a cross-functional team of sponsors for the next stage. For large projects with high uncertainties and risk, having the gatekeepers as a group be the de facto Product Owner often works better than relying on a single person as executive sponsor.

The Scrum Master is another debated role among manufacturers. Clearly there is a need for a coach to ensure that the team correctly practices the methods and embraces the mindset of Agile-Scrum. But as the team gains experience, a coach in the form of a Scrum Master may be no longer needed, especially a coach dedicated to the one team. The term “agile coach” is currently used more often among manufacturers; they are the “transition managers” to the new Agile-Stage-Gate system.

**How Firms Adopt and Live an Agile Mindset**

Finally, and most important, both project teams and management must wholeheartedly embrace the Agile mindset and this new way of working. As a start, familiarize oneself with the Agile Manifesto (6). Although this was written for and by software developers, it can be adapted to manufacturers.

The chart, next page, shows the adoption rates for some of the ways of working common among best-practice manufacturer users of Agile. The following ten Agile-Stage-Gate Principles have emerged as a foundation to embrace this new mindset inherent within Agile-Stage-Gate; some principles are from the Agile Manifesto (6), others are more specific to manufacturers.

1. Prioritize individuals and their interactions over processes and tools.


3. Co-locate and hold frequent, regular team meetings—face-to-face conversation is the best form of communication.
Adoption rate of Agile Development methods by manufacturers. Best Practice firms have a new-product success rate of 65% or better and comprise 28% of the firms studied. Sources of data: (7,8).

4. Collaborate with mutual accountability and respect—the entire team should be accountable for the result, not just individual team members.

5. Focus on working solutions over comprehensive documentation by demonstrating visible results of completed tasks at the end of each iteration.

6. Listen to and understand the voice of the customer (or user), not just the voice of management or the salesperson. Walk in the customers’ shoes and understand their points of pain—leave your office and touch real customers and users.

7. Build something and share it with the intended user or customer; then adjust and adapt quickly to customer feedback and changing needs. People don’t know what they want until they see it, so show them something!

8. Deliver solutions (design drawings, models, rapid prototypes, prototypes, etc.) frequently—early, often, fast, and cheaply (in weeks rather than in months).
9. Keep it simple and lean—eliminate all unneeded complexity and non-value-added work. For example, why develop detailed long-term plans if these plans will likely change significantly before they are implemented; or why spend months developing a prototype that users have not validated along the way?

10. Focus, focus, focus—don’t spread team members across too many projects and “other jobs.” Doing that only guarantees that everything will be late.

**Why It Works**

This new Agile-Stage-Gate approach yields three important positive results for manufacturers (see “Source of Data on Agile-Stage-Gate” in Part I):

1. **Gets the product right:** Product designs (features, functionality, etc.) are validated by customers (and management) as the project moves along—often and cheaply. Changes needed are identified sooner in the process, when making changes is less costly. Customers or users also learn as the project moves ahead and their needs and requirements become clearer with each iteration and demo. Thus, the product’s design evolves as development proceeds (rather than being fixed, and often wrongly, at the beginning of development).

2. **Team morale is higher:** The team is self-managed, self-organizing, and ideally co-located. It defines what it can accomplish and how. The team’s objectives are clear and it has some decision authority.

3. **Development is faster:** The team is focused, partially dedicated, and in good communication. Frequent stand-ups allow problems to be identified and resolved quickly. Because iterations are time-boxed, there is some self-imposed pressure and motivation to get the job done fast!

**References**


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