

CIMS INNOVATION MANAGEMENT REPORT

NC STATE Poole College of Management

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Corporate Experience

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?

"The Scrum version of Agile is the most popular and the version used by manufacturers."

Agile Development was developed in the software industry through the 1990s, a time when the industry needed new ways to overcome many deficiencies.⁽¹⁾ 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⁾

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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:^(5,7)

- **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.

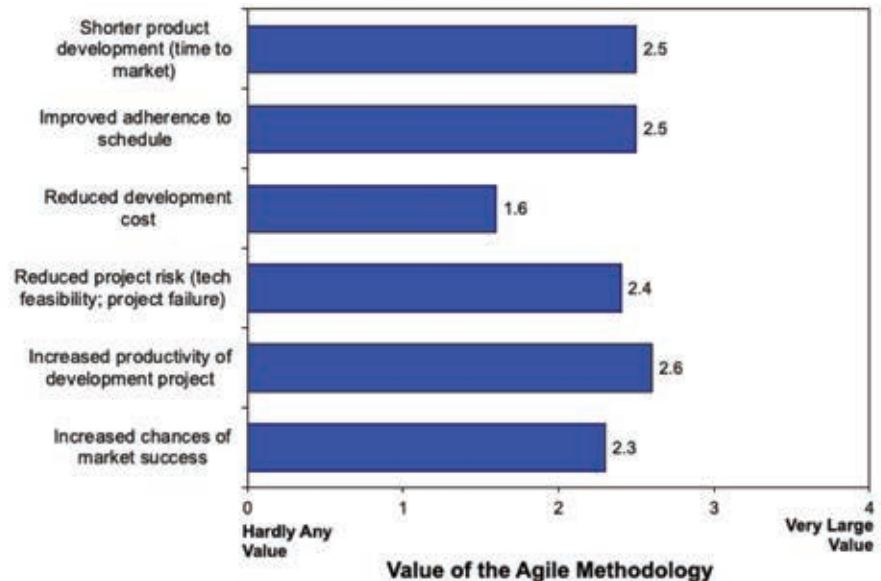


Fig. 1—Performance improvements realized using Agile-Scrum for new-product development, based on a German study of 228 manufacturing firms.⁽⁹⁾

- **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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“There is no traditional project leader or project manager in Agile-Scrum.”

Source of Data on Agile-Stage-Gate

17 open workshops were held on the subject of Agile-Stage-Gate over the past three years, hosted by ISBM (Institute for the Study of Business Markets) at Penn State University and the Management Roundtable in North America, and also by various organizations in Europe. Five workshops were in the United States, five in Germany, two in the UK, three in Denmark, and two in Sweden. In addition, we undertook case studies on six leading global firms, all early adopters of Agile-Stage-Gate, including Honeywell, GE, Tetra Pak, and LEGO.⁽⁵⁾

“Manufacturers typically use Agile-Scrum for many stages of their gated development process.”

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Agile-Scrum Integrated with Stage-Gate® for Manufacturers ⁽⁸⁾

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.⁽⁹⁾

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.⁽¹⁰⁾ 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.⁽¹¹⁾
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 IMR, 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.⁽¹²⁾ Agile-Scrum is usually reserved for larger projects that are more ambiguous, with higher uncertainty, and risky.⁽¹¹⁾

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.⁽¹³⁾ 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

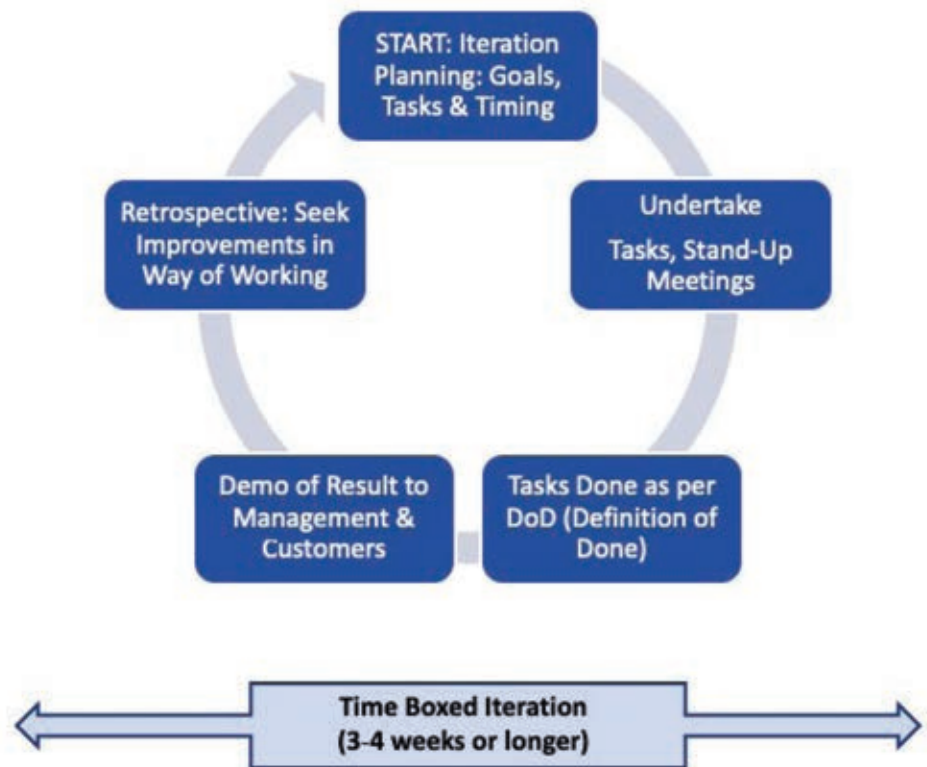


Fig. 2—Project stages are broken into time-boxed iterations, beginning with Iteration Planning (top) and ending with a Retrospective.

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.⁽¹⁴⁾ 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.

“Each iteration concludes with a retrospective meeting where the team analyzes their results and tries to improve how they work together.”

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.⁽¹²⁾

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.

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