A Lightweight Guide to the Theory and Practice of Scrum
Version 2.0

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A note to readers: There are many concise descriptions of Scrum available online, and this primer aims to provide the next level of detail on the practices. It is not intended as the final step in a Scrum education; teams that are considering adopting Scrum are advised to equip themselves with Ken Schwaber's *Agile Project Management with Scrum* or, Mike Cohn's *Succeeding with Agile* and take advantage of the many excellent Scrum training and coaching options that are available; full details are at scrumalliance.org. Our thanks go to Ken Schwaber, Dr. Jeff Sutherland, and Mike Cohn for their generous input.

Beyond Traditional Development

Traditional development with single-function groups, delayed or weak feedback loops, front-loaded predictive planning, and a sequential flow from analysis to test is not very successful in today's volatile world. This approach delays feedback, learning, and potential return on investment due to an absence of real working software until late in the game, causing a lack of transparency, lack of ability to improve, reduction in flexibility, and an increase in business and technical risks.

An alternative – cross-functional teams with iterative development – has also existed for decades, but was not as widely used as the traditional model.

Scrum packages proven product-development concepts in a simple framework, including: real teams, cross-functional teams, self-managing teams, short iterative full-cycle feedback loops, and lowering the cost of change. These concepts increase agility and feedback, enable earlier ROI, and reduce risk.

Overview

Scrum is a development framework in which cross-functional teams develop products or projects in an iterative, incremental manner. It structures development in cycles of work called **Sprints**. These iterations are no more than four weeks each (the most common is two weeks), and take place one after the other without pause. The Sprints are *timeboxed* – they end on a specific date whether the work has been completed or not, and are *never extended*. Usually Scrum Teams choose one Sprint length and use it for all their Sprints until they improve and can use a shorter cycle. At the beginning of each Sprint, a *cross-functional* **Team** (of about seven people) selects **items** (customer requirements) from a prioritized list. The Team agrees on a collective target of what they believe they can deliver by the end of the Sprint, something that is tangible and will be truly "done". During the Sprint, no new items may be added; Scrum embraces change for the *next* Sprint, but the current short Sprint is meant to focus on a small, clear, relatively stable goal. Every day the Team gathers briefly to inspect its progress, and adjust the next steps needed to complete the work remaining. At the end of the Sprint, the Team reviews the Sprint with stakeholders, and demonstrates what it has built. People obtain feedback that can be incorporated in the next Sprint. Scrum emphasizes working product at the end of the Sprint that is really "done"; in the case of software, this means a system that is integrated, fully tested, end-user documented, and potentially shippable. Key roles, artifacts, and events are summarized in Figure 1.
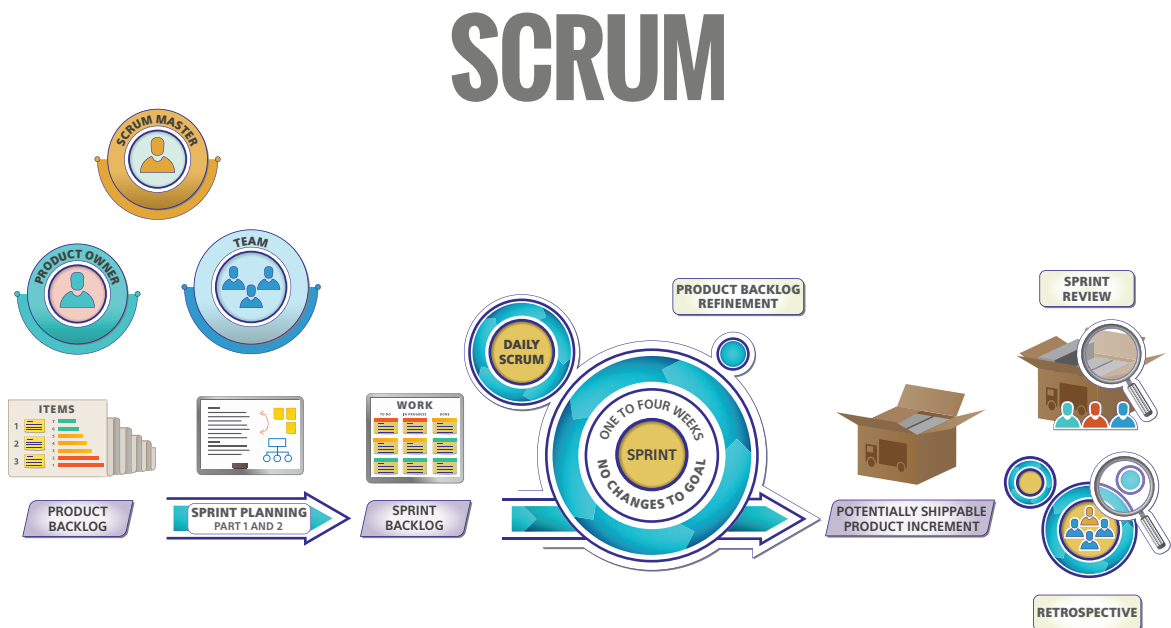

Figure 1. Scrum Overview

A major theme in Scrum is "inspect and adapt." Since development inevitably involves learning, innovation, and surprises, Scrum emphasizes taking a short step of development, inspecting both the resulting product and the efficacy of current practices, and then adapting the product goals and process practices. *Repeat forever.*

Scrum Roles

In Scrum, there are three roles: Product Owner, Team, and ScrumMaster. Together these are known as the Scrum Team.

The **Product Owner** is responsible for maximizing return on investment (ROI) by identifying product features, translating these into a prioritized list, deciding which should be at the top of the list for the next Sprint, and continually re-prioritizing and refining the list. The Product Owner has profit and loss responsibility for the product, assuming it is a commercial product. In the case of an internal application, the Product Owner is not responsible for ROI in the sense of a commercial product (that will generate revenue), but they are still responsible for maximizing ROI in the sense of choosing – each Sprint – the highest-value items. In practice, 'value' is a fuzzy term and prioritization may be influenced by the desire to satisfy key customers, alignment with strategic objectives, attacking risks, improving, and other factors. In some cases, the Product Owner and the customer are the same person; this is common for internal applications. In others, the customer might be millions of people with a variety of needs, in which case the Product Owner role is similar to the Product Manager or Product Marketing Manager position in many product organizations. However, the Product Owner is somewhat different than a traditional Product Manager because they actively and regularly interact with the Team, prioritize by working with all of the stakeholders and reviewing the results each Sprint, rather than delegating development decisions to a project manager. It is important to note that in Scrum there is one and only one person who serves as – and has the final authority of – Product Owner, and he or she is responsible for the value of the work; though that person doesn't have to work alone.

The Team (also called Development Team) builds the product that the Product Owner indicates: the application or website, for example. The Team in Scrum is "cross-functional" – it includes all the expertise necessary to deliver the potentially shippable product each Sprint – and it is "self-organizing" (self-managing), with a very high degree of autonomy and accountability. The Team decides how many items (from the set offered by the Product Owner) to build in a Sprint, and how best to accomplish that goal .

Each member of the Team is just a *team member*. Notice there are no fixed specialist titles in a group that adopts Scrum; there is no business analyst, no DBA, no architect, no team lead, no interaction/ UX designer, no programmer. They work together during each Sprint in whatever way is appropriate to achieve the goal they have set for themselves.

Since there are only *team members*, the Team is not only cross-functional but also demonstrates *multi-learning*: each person certainly has special strengths, but also continues to learn other specialties. Each person will have primary, secondary and even tertiary skills, and is meant to "go to where the work is"; individuals take on tasks in less familiar areas to help complete an item. For example, a person whose primary skill is interaction design could have a secondary skill in automated testing; someone with primary skill in technical writing might also help with analysis and programming.

The Team in Scrum is seven plus or minus two people, and for a software product the Team might include people with skills in analysis, development, testing, interface design, database design, architecture, documentation, and so on. The Team develops the product and provides ideas to the Product Owner about how to make the product great. In Scrum the Teams are most productive and effective if all members are 100 percent dedicated to the work for one product during the Sprint; the Team avoids multi-tasking across multiple products or projects, to avoid the costly drain of divided attentions and context-switching. Stable teams are associated with higher productivity, so avoid changing Team members. Product groups with many people are organized into multiple Teams, each focused on different features for the product, with close coordination of their efforts. Since one team often does all the work (planning, analysis, programming, and testing) for a complete customer-centric feature, Teams are also known as *feature teams*.

The **ScrumMaster** helps the product group learn and apply Scrum to achieve business value. The ScrumMaster does whatever is in their power to help the Team, Product Owner and organization be successful. The ScrumMaster is *not* the manager of the Team members, nor are they a project manager, team lead, or team representative. Instead, the ScrumMaster *serves* the Team; he or she helps to remove impediments, protects the Team from outside interference, and helps the Team to adopt modern development practices. He or she educates, coaches and guides the Product Owner, Team and the rest of the organization in the skillful use of Scrum. The ScrumMaster is a *coach* and *teacher*. The ScrumMaster makes sure everyone (including the Product Owner, and those in management) understands the principles and practices of Scrum, and they help lead the organization through the often difficult change required to achieve success with agile development. Since Scrum makes visible many impediments and threats to the Team's and Product Owner's effectiveness, it is important to have an engaged ScrumMaster working energetically to help resolve those issues, or the Team or Product Owner will find it difficult to succeed. There should be a dedicated full-time ScrumMaster, although a smaller Team might have a team member play this role (carrying a lighter load of regular work when they do so). Great ScrumMasters can come from any background or discipline: Engineering, Design, Testing, Product Management, Project Management, or Quality Management.

The ScrumMaster and the Product Owner cannot be the same individual as their focus is so different and combining them often leads to confusion and conflict. One common unfortunate result of combining these roles is a micro-managing Product Owner which is opposite to self-managing teams that Scrum requires. Unlike a traditional manager, the ScrumMaster does not tell people what to do or assign tasks – they facilitate the process, supporting the Team as it organizes and manages itself. If the ScrumMaster was previously in a position managing the Team, they will need to significantly change their mindset and style of interaction for the Team to be successful with Scrum.

Note: there is no role of project manager in Scrum at all. This is because none is needed; the traditional responsibilities of a project manager have been divided up and reassigned among the three Scrum roles, and mostly to the Team and Product Owner, rather than to the ScrumMaster. Practicing Scrum with the addition of a project manager indicates a fundamental misunderstanding of Scrum, and typically results in conflicting responsibilities, unclear authority, and sub-optimal results. Sometimes an (ex-)project manager can step into the role of ScrumMaster, but the success of this approach is heavily dependent on the individual, and how well they understand the fundamental difference between the two roles, both in the day-to-day responsibilities and in the mindset required to be successful. A good way to understand thoroughly the role of the ScrumMaster, and start to develop the core skills needed for success, is to attend the Scrum Alliance's Certified ScrumMaster training.

In addition to these three roles, there are other stakeholders who contribute to the success of the product, including managers, customers and end-users. Some stakeholders such as functional managers (for example, an engineering manager) may find their role, while still valuable, changes when adopting Scrum. For example:

- they support the Team by respecting the rules and spirit of Scrum

- they help remove impediments that the Team and Product Owner identify

- they make their expertise and experience available

In Scrum, these individuals replace the time they previously spent playing the role of "nanny" (assigning tasks, getting status reports, and other forms of micromanagement) with time as "guru" and "servant" of the Team (mentoring, coaching, helping remove obstacles, helping problem-solve, providing creative input, and guiding the skills development of Team members). In this shift, managers may need to change their management style; for example, using Socratic questioning to help the Team discover the solution to a problem, rather than simply deciding a solution and assigning it to the Team.

Product Backlog

When a group is planning to transition to Scrum, before the first Sprint can begin, they need a **Product Backlog**, a prioritized (ordered 1, 2, 3, …) list of customer-centric features.

The Product Backlog exists (and evolves) over the lifetime of the product; it is the product roadmap (**Figure 2 and Figure 3**). At any point, the Product Backlog is the single, definitive view of "everything that could be done by the Team ever, in order of priority". Only a single Product Backlog exists for a product; this means the Product Owner is required to make prioritization decisions across the entire spectrum, representing the interests of stakeholders (including the Team).

| Priority	Item	Details (wiki URL)	Initial Size Estimate	New Estimates at Sprint ...					
				1	2	3	4	5	6
1	As a buyer, I want to place a book in a shopping cart (see UI sketches on wiki page)	...	5						
2	As a buyer, I want to remove a book in a shopping cart	...	2						
3	Improve transaction processing performance (see target performance metrics on wiki)	...	13						
4	Investigate solutions for speeding up credit card validation (see target performance metrics on wiki)	...	20						
5	Upgrade all servers to Apache 2.2.3	...	13						
6	Diagnose and fix the order processing script errors (bugzilla ID 14823)	...	3						
7	As a shopper, I want to create and save a wish list	...	40						
8	As a shopper, I want to to add or delete items on my wish list	...	20						

Figure 2. The Product Backlog
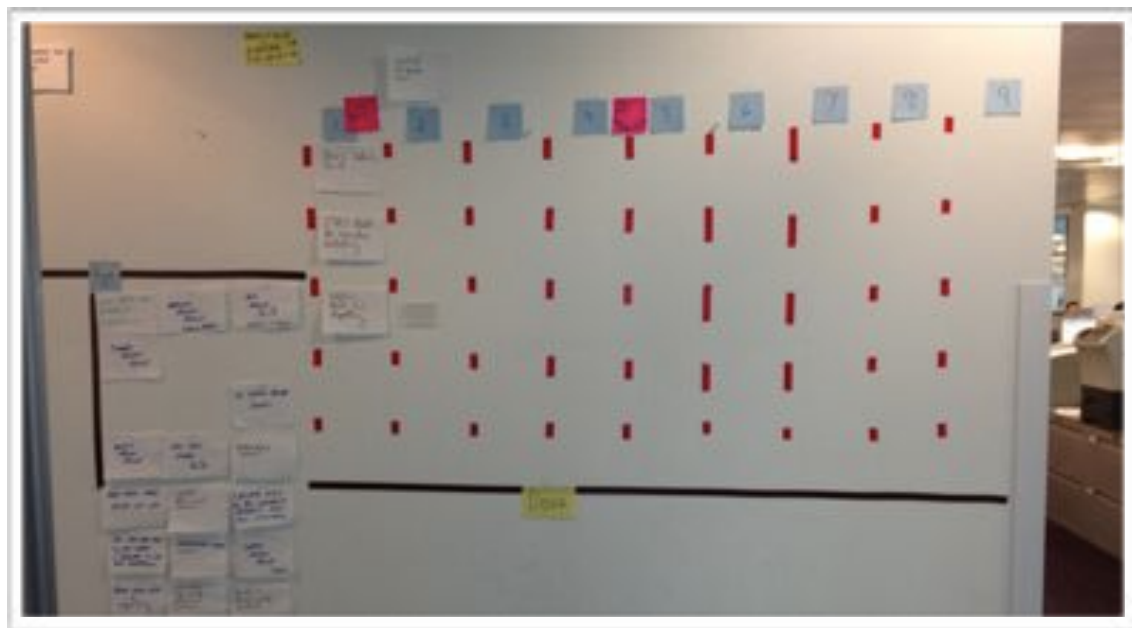
Figure 3. Visual Management: Product Backlog items on the wall

The Product Backlog includes a variety of **items**, primarily new customer features ("enable all users to place book in shopping cart"), but also *major* engineering improvement goals (e.g., "rewrite the system from C++ to Java"), improvement goals (e.g. "speed up our tests"), research work ("investigate solutions for speeding up credit card validation"), and, possibly, known defects ("diagnose and fix the order processing script errors") if there are only a few problems. (A system with many defects usually has a separate defect tracking system.)

Product Backlog items are articulated in any way that is clear and sustainable. Contrary to popular misunderstanding, the Product Backlog does *not* contain "user stories"; it simply contains *items*. Those items can be expressed as user stories, use cases, or any other requirements approach that the group finds useful. But whatever the approach, most items should focus on delivering value to customers.

A good Product Backlog is DEEP…

Detailed appropriately. The top priority items are more fine-grained and detailed than the lower priority items, since the former will be worked on sooner than the latter. For example, the top 10% of the backlog may be composed of very small, well-analyzed items, and the other 90% much less so.

Estimated. The items for the current release need to have estimates, and furthermore, should be considered for re-estimation each Sprint as everyones learns and new information arises. The Team provides the Product Owner with *effort* estimates for each item on the Product Backlog, and perhaps also *technical risk* estimates. The Product Owner and other business stakeholders provide information on the value of the product requests, which may include revenue gained, costs reduced, business risks, importance to various stakeholders, and more.

Emergent. In response to learning and variability, the Product Backlog is regularly refined. Each Sprint, items may be added, removed, modified, split, and changed in priority. Thus, the Product Backlog is continuously updated by the Product Owner to reflect changes in the needs of the customer, new ideas or insights, moves by the competition, technical hurdles that appear, and so forth.

Prioritized. The items at the top of the Product Backlog are prioritized or *ordered* in a 1-N order. In general, the highest-priority items should deliver the most *bang for your buck*: lots of bang (business value) for low buck (cost). Another motivation to increase the priority of an item is to *tackle high risks early, before the risks attack you*.

Traditional development does not usually emphasize delivering according to highest *bang for your buck*, but this is a theme of Scrum, and therefore the Product Owner will need to learn how to assess the bang of "business value." This is something the ScrumMaster may help the Product Owner learn. What does "business value" mean? Some product groups use a simple relative value-point estimate for each Product Backlog item which synthesizes a "guesstimate" of factors including revenue gain, cost reduction, stakeholder preferences, market differentiation, and so forth. Some fund a specific item by one or more customers paying for its development and so use that item's exact (short term) revenue as a proxy for value. For other groups such item-specific value estimation is too unfocused or granular; they apply a broader business-outcome-based approach ("increase subscriptions by 10% by September 1") in which value is only delivered when multiple outcome-contributing items are delivered together. In that case, the Product Owner needs to define the next increment of Minimal Viable Product.

For effort estimates, a common technique is to estimate in terms of relative size (factoring in effort, complexity, and uncertainty) using a unit of "story points" or simply "points".

These are just suggestions; Scrum does not define the technique for expressing or prioritizing items in the Product Backlog and it does not define the estimation technique or units.

A common technique used in Scrum is to track how much work it completes each Sprint; for example, averaging 26 points completed per Sprint. With this information they can project a release date to complete all features, or how many features can be completed by a fixed date, if the average continues and nothing changes. This average is called the "velocity." Velocity is expressed in the same units as the Product Backlog item size estimates.

The items in the Product Backlog can vary significantly in size or effort. Larger ones are broken into smaller items during the ==Product Backlog Refinement workshop== or the ==Sprint Planning Meeting,== and smaller ones may be consolidated. The Product Backlog items for the upcoming next several Sprints should be small and fine-grained enough that they are understood by the Team, enabling forecasts made in the Sprint Planning meeting to be meaningful; this is called an "actionable" size.

Major engineering improvements that consume much time and money should be in the Product Backlog, since they may be an optional business investment, ultimately to be made by the business-oriented Product Owner. Note that in Scrum, the Team has independent authority of how many items from the Product Backlog they decide to take into a Sprint, so they are independently free to take on minor engineering improvement work as they can be considered part of the normal cost of doing business and what is required for a developer to do their job properly. That said, in each Sprint, the *majority* of a Team's time should usually be on Product Owner goals, not internal engineering tasks.

One of the myths about Scrum is that it prevents you from writing detailed specifications; in reality, it is up to the Product Owner and Team to decide how much detail is required, and this will vary from one backlog item to the next, depending on the insight of the Team, and other factors. State what is

important in the least amount of space necessary – in other words, do not describe every possible detail of an item, just make clear what is necessary for it to be understood, and augment this with continuous dialog between the Team and Product Owner and stakeholders. Low priority Product Backlog Items, which will not be worked on for some time, are usually "coarse grained" (large, with less-detailed requirements). High priority and fine-grained Product Backlog Items that will soon be implemented tend to have more detail.

Definition of Done

The output of every Sprint is officially called a Potentially Shippable Product Increment. Before starting the first Sprint, the Product Owner, Team, and ScrumMaster have to review what is all needed for a Product Backlog item to be potentially shippable. All activities that are needed in order to ship the product should be included in the definition of Potentially Shippable and therefore should be done during the Sprint.

Unfortunately, when Teams start using Scrum, they are often not able to achieve the goal of delivering a Potentially Shippable Increment every Sprint. This is often because the team lacks in automation or isn't cross-functional enough (e.g. the technical writers aren't included in the cross-functional Team yet). Over time, the Team has to improve so they will be able to deliver a Potentially Shippable Product Increment every Sprint, but in order to start, they will need to create a baseline of their existing capabilities. This is recorded in the Definition of Done.

Before the first Sprint, the Product Owner and Team need to agree on a Definition of Done, which is a subset of the activities that are needed for creating a Potentially Shippable Product Increment (for a good Team, it will be the same). The Team will plan their Sprint work according to this Definition of Done.

A good Product Owner will always want the Definition of Done to be as close as possible to Potentially Shippable as that will increase the transparency in the development and decrease *delay and risk*. If the Definition of Done is not equal to Potentially Shippable, then work is delayed until before the release which causes this *risk and delay*. This delayed work is sometimes called *undone work*.

A Scrum Team should continuously improve, which is reflected in extending their Definition of Done.

Sprint Planning

Summary: A meeting to prepare for the Sprint, typically divided into two parts (part one is "what" and part two is "how").
Participants: Part One: Product Owner, Team, ScrumMaster. Part Two: Team, ScrumMaster, Product Owner (optional but should be reachable for questions)
Duration: Each part is timeboxed to one hour per week of Sprint.

At the beginning of each Sprint, the **Sprint Planning Meeting** takes place. It is divided into two distinct sub-meetings, the first of which is called **Sprint Planning Part One**.

In **Sprint Planning Part One**, the Product Owner and Team review the high-priority items in the Product Backlog that the Product Owner is interested in implementing this Sprint. Usually, these items will have been well-analyzed in a previous Sprint (during Product Backlog Refinement), so that at this meeting there are only minor last-minute clarifying questions. In this meeting, the Product Owner and Team discuss the goals and context for these high-priority items on the Product Backlog, providing the Team with insight into the Product Owner's thinking. Part One focuses on understanding *what* the Product Owner wants and *why* they are needed. At the end of Part One the (always busy) Product Owner may leave although they *must* be available (for example, by phone) during Part Two of the meeting.

In Part One, the Team and the Product Owner may also devise the **Sprint Goal**. This is a summary statement of the Sprint objective, which ideally has a cohesive theme. The Sprint Goal also gives the Team scope-flexibility regarding what they may actually deliver, because although they may have to remove some item (since the Sprint is timeboxed), they should nevertheless commit to delivering something tangible and "done" that is in the spirit of the Sprint Goal.

How big should the items be that are taken on in a Sprint? Each item should be split small enough so that it is estimated to require considerably less than the whole Sprint. A common guideline is that an item is estimated small enough to complete within one fourth or less of a Sprint by the whole Team.

Sprint Planning Part Two focuses on *how* to implement the items that the Team decides to take on. The Team forecasts the amount of items they can complete by the end of the Sprint, starting at the top of the Product Backlog (in others words, starting with the items that are the highest priority for the Product Owner) and working down the list in order. *This is a key practice in Scrum: The Team decides how much work it will complete, rather than having it assigned to them by the Product Owner.* This makes for a more reliable forecast because the Team is making it based on its own analysis and planning. While the Product Owner does not have control over how much the Team signs up for, he or she knows that the items are drawn from the top of the Product Backlog – in other words, the items that he or she has rated as most important. The Team has the ability to lobby for items from further down the list; this usually happens when the Team and Product Owner realize that something of lower priority fits easily and appropriately with the high priority items.

The Sprint Planning Meeting will often last several hours, but no more than four hours for a two-week Sprint – the Team is making a serious forecast to complete the work, and this requires careful thought to be successful. Part One and Part Two are of equal timeboxed lengths; for a two-week Sprint each part is two hours maximum.

Scrum does not define how to exactly do Sprint Planning Part Two. Some teams use their velocity from the previous Sprints to guide how much to aim for. Other teams will use a more fine-grained approach of first calculating their capacity.

When using the capacity approach, the Team, in Sprint Planning Part Two, calculates how much time each team member has for Sprint-related work. Most teams assume that the team members can only focus on Sprint-related work for 4-6 hours per day – the rest of the time goes to email, lunch breaks, facebook, meetings, and drinking coffee . Once the capacity is determined, the Team needs to figure out how many Product Backlog items they can complete in that time, and how they will go about completing them. This often starts with a design discussion at a whiteboard. Once the overall design is understood, the Team decomposes the Product Backlog items into fine-grained work. Before taking the Product Backlog items, the Team may focus on generating tasks for an improvement goal created in the previous Sprint's Retrospective. Then, the Team selects the first item on the Product Backlog – the Product Owner's highest priority item – and work their way down until they are 'full'. For each item they create a list of work which consists of either decomposed Product Backlog items into tasks or, when the Product Backlog item are so small they would only take a couple hours to implement, simply the Product Backlog item. This list of work to be done during the Sprint is called the **Sprint Backlog** (Figure 4 and Figure 5).

| Product Backlog Item | Sprint Task | Volunteer | Initial Estimate of Effort | New Estimates of Effort Remaining at end of Day... | | | | | |
				1	2	3	4	5	6
As a buyer, I want to place a book in a shopping cart	modify database		5						
	create webpage (UI)		8						
	create webpage (Javascript logic)		13						
	write automated acceptance tests		13						
	update buyer help webpage		3						
	. . .								
Improve transaction processing performance	merge DCP code and complete layer-level tests		5						
	complete machine order for pRank		8						
	change DCP and reader to use pRank http API		13						

Figure 4. Example of one way to create a Sprint Backlog

At the end of the Sprint Planning Meeting, the Team sets a realistic target for what they believe they can deliver by the end of the Sprint. Traditionally, this was called a Sprint Commitment – the team

commits to doing the best they can to reach their target. Unfortunately, this was sometimes misinterpreted as a written-in-blood promise rather than the team seriously "going for it." To avoid this confusion, the sprint-target is now called a 'forecast" which is communicated to the Product Owner.

Scrum encourages multi-skilled workers, rather than only "working to job title" such as a "tester" only doing testing. In other words, Team members "go to where the work is" and help out as possible. If there are many testing tasks, then *all* Team members may help. This does not imply that everyone is a generalist; no doubt some people are especially skilled in testing (and so on) but Team members work together and learn new skills from each other. Consequently, during task generation and estimation in Sprint Planning, it is not necessary – nor appropriate – for people to volunteer for all the tasks "they can do best." Rather, it is better to only volunteer for one task at a time, when it is time to pick up a new task, and to consider choosing tasks that will on purpose involve learning (perhaps by pair work with a specialist). This is one reason for not pre-assigning tasks during Sprint Planning, rather this should be done on an 'as needed' basis during the Sprint.

All that said, there are *rare* times when *John* may do a particular task because it would take far too long or be impossible for others to learn – perhaps John is the only person with any artistic skill to draw pictures. Other Team members could not draw a "stick man" if their life depended on it. In this rare case – and if it is not rare and not getting rarer as the Team learns, there is something wrong – it may be necessary to ask if the total planned drawing tasks that *must* be done by John are feasible within the short Sprint.

Many Teams have a Sprint Backlog in the form of a wall-sized task board (often called a **Scrum Board**) where tasks (written on Post-It Notes) migrate during the Sprint across columns labeled "To Do," "Work In Progress," and "Done." See Figure 5.

Figure 5. Visual Management - Sprint Backlog tasks on the wall

One of the pillars of Scrum is that once the Team sets its target for the Sprint, any additions or changes must be deferred until the next Sprint. This means that if halfway through the Sprint the

Product Owner decides there is a new item he or she would like the Team to work on, he cannot make the change until the start of the next Sprint. If an external circumstance appears that significantly changes priorities, and means the Team would be wasting its time if it continued working, the Product Owner or the Team can terminate the Sprint. The Team stops, and a new Sprint Planning meeting initiates a new Sprint. The disruption of doing this is usually great; this serves as a disincentive for the Product Owner or Team to resort to this dramatic decision.

There is a powerful, positive influence that comes from the Team being protected from changing goals during the Sprint. First, the Team gets to work knowing with absolute certainty that its goal will not change, that reinforces the Team's focus on ensuring completion. Second, it disciplines the Product Owner into really thinking through the items he or she prioritizes on the Product Backlog and offers to the Team for the Sprint.

By following these Scrum rules the Product Owner gains two things. First, he or she has the confidence of knowing the Team has committed to do its best to complete a realistic and clear set of work it has chosen. Over time a Team can become quite skilled at choosing and delivering on a realistic forecast. Second, the Product Owner gets to make whatever changes he or she likes to the Product Backlog before the start of the *next* Sprint. At that point, additions, deletions, modifications, and re-prioritizations are all possible and acceptable. While the Product Owner is not able to make changes to the selected items under development during the current Sprint, he or she is only one Sprint's duration or less away from making any changes they wish. Gone is the stigma around change – change of direction, change of requirements, or just plain changing your mind – and it may be for this reason that Product Owners are usually as enthusiastic about Scrum as anyone.

Daily Scrum

Summary: Update and coordination between the Team members.
Participants: Team is required; Product Owner is optional; ScrumMaster is usually present but ensures Team holds one.
Duration: Maximum length of 15 minutes.

Once the Sprint has started, the Team engages in another of the key Scrum practices: The **Daily Scrum**. This is a short (15 minutes or less) meeting that happens every workday at an appointed time. Everyone on the Team attends. To keep it brief, it is recommended that everyone remain standing. It is the Team's opportunity to synchronize their work and report to each other on obstacles. In the Daily Scrum, one by one, each member of the Team reports three things *to the other members of the Team*: (1) What has been accomplished since the last meeting?; (2) What will be done before the next meeting?; and (3) What obstacles are in the way?. Note that the Daily Scrum is not a status meeting to report to a manager; it is a time for a self-organizing Team to share with each other what is going on, to help them coordinate. Someone makes note of the blocks, and the ScrumMaster is responsible to help Team members resolve them. There is little or no in-depth discussion during the Daily Scrum, the theme is *reporting* answers to the three questions; if discussion is required it takes place immediately after the Daily Scrum in one or more parallel follow-up meetings, although in Scrum no one is required to attend these. A follow-up meeting is a common event where some or all team members adapt to the information they heard in the Daily Scrum: in other words, another inspect and adapt cycle. For Teams new to Scrum, it is generally recommended *not* to have managers or others in positions of perceived authority attend the Daily Scrum. This risks making the Team feel "monitored" – under pressure to report major progress every day (an unrealistic expectation), and inhibited about reporting problems – and it tends to undermine the Team's self-management, and invite micromanagement. It would be more useful for a stakeholder to instead reach out to the Team following the meeting, and offer to help with any blocks that are slowing the Team's progress.

Tracking Progress during the Sprint

The Team in Scrum is self-managing, and in order to do this successfully, it must know how it is doing. Every day, the Team members update their estimate of the effort remaining to complete their current work in the **Sprint Backlog** (Figure 6). It is also common for someone to add up the effort remaining for the Team as a whole, and plot it on the **Sprint Burndown Chart** (Figure 7 and Figure 8). This

graph shows, each day, a new estimate of how much work remains until the Team is finished. Ideally, this is a *downward* sloping graph that is on a trajectory to reach "zero effort remaining" by the last day of the Sprint. Hence it is called a *burndown* chart. And while sometimes it looks good, often it does not; this is the reality of product development. The important thing is that it shows the Team their progress towards their goal, not in terms of how much time was *spent* in the past (an irrelevant fact in terms of *progress*), but in terms of how much work *remains in the future* – what separates the Team from their goal. If the burndown line is not tracking downwards towards completion near the end of the Sprint, then the Team needs to adjust, such as to reduce the scope of the work or to find a way to work more effectively while still maintaining a sustainable pace.

While the Sprint Burndown chart can be created and displayed using a spreadsheet, many Teams find it is more effective to show it on paper on a wall in their workspace, with updates in pen; this "low-tech/high-touch" solution is fast, simple, and often more visible than a computer chart.

Product Backlog Item	Sprint Task	Volunteer	Initial Estimate of Effort	New Estimates of Effort Remaining at end of Day…					
				1	2	3	4	5	6
As a buyer, I want to place a book in a shopping cart	modify database	Sanjay	5	4	3	0	0	0	
	create webpage (UI)	Jing	3	3	3	2	0	0	
	create webpage (Javascript logic)	Tracy & Sam	2	2	2	2	1	0	
	write automated acceptance tests	Sarah	5	5	5	5	5	0	
	update buyer help webpage	Sanjay & Jing	3	3	3	3	3	0	
	. . .								
Improve transaction processing performance	merge DCP code and complete layer-level tests		5	5	5	5	5	5	
	complete machine order for pRank		3	3	8	8	8	8	
	change DCP and reader to use pRank http API		5	5	5	5	5	5	
. . .		. . .	. . .						
	Total		50	49	48	44	43	34	

Figure 6. Daily Updates of Work Remaining on the Sprint Backlog
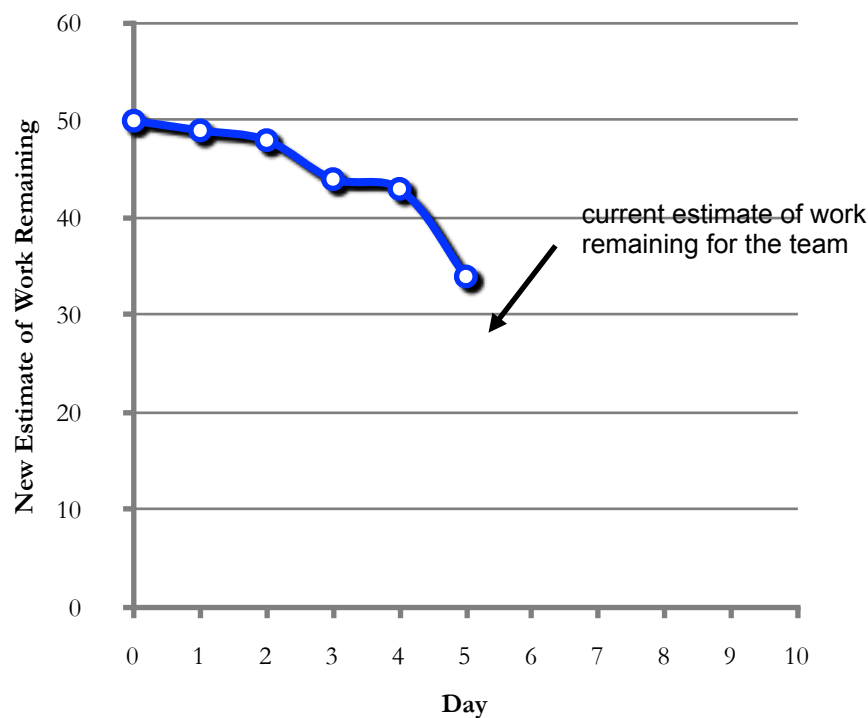

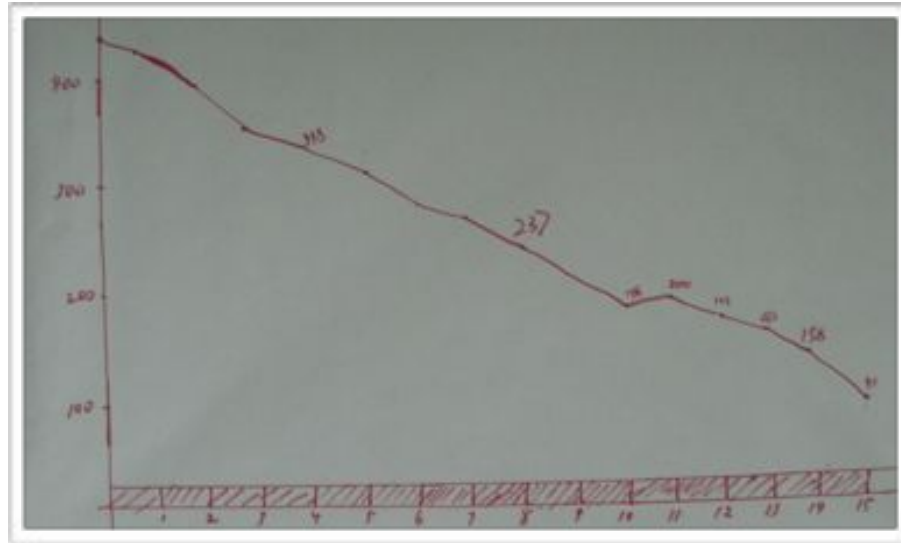*Figure 7.* Sprint Burndown Chart

Figure 8. Visual Management: Hand-drawn Sprint Burndown Chart

Product Backlog Refinement

Summary: Split big items, analyze items, re-estimate, and re-prioritize, for *future* Sprints.
Participants: Team; Product Owner will attend the entire activity if they are the expert who can help with the detailed refinement, otherwise they may attend only a subset to set direction or re-prioritize; others who understand the requirements and can help the Team; ScrumMaster will attend during initial sessions to coach the group to be effective, otherwise may not attend.
Duration: Usually, no more than 10% of the capacity of the Team for the Sprint, though it may be longer for "analysis heavy" items. For example, in a two-week Sprint, perhaps one day is spent on refinement.

One of the lesser known, but valuable, guidelines in Scrum is that some percentage of each Sprint should be dedicated by the whole Team to refining (or "grooming") the Product Backlog to support future Sprints. This includes detailed requirements analysis, splitting large items into smaller ones, estimation of new items, and re-estimation of existing items. Scrum is silent on how this work is done, but a frequently used technique is a focused workshop near the middle or end of the Sprint, so that the Team and Product Owner and other stakeholders can dedicate themselves to this work without interruption.

This refinement activity is *not* for items selected for the current Sprint; it is for items for the future, most likely in the next one or two Sprints. With this practice, Sprint Planning becomes relatively simple because the Product Owner and Scrum Team start the planning with a clear, well-analyzed and carefully estimated set of items. A sign that this refinement workshop is not being done (or not being done well) is that Sprint Planning involves significant questions, discovery, or confusion and feels incomplete; planning work then often spills over into the Sprint itself, which is typically not desirable.

Sprint Review

Summary: Inspection and adaption related to the product increment of functionality.
Participants: Team, Product Owner, ScrumMaster. Other stakeholders as appropriate, invited by the Product Owner.
Duration: Timeboxed to one hour per week of Sprint.

After the Sprint ends, there is the **Sprint Review**, where people review the Sprint. Present at this meeting are the Product Owner, Team members, and ScrumMaster, plus customers, users, stakeholders, experts, executives, and anyone else who is interested. For a two-week Sprint it is a maximum length of two hours. Anyone present is free to ask questions and give input.

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The Review is often mislabeled the "demo" but that does not capture the real intent of this meeting. A key idea in Scrum is *inspect and adapt*. To see and learn what is going on and then evolve based on feedback, in repeating cycles. The Sprint Review is an inspect and adapt activity for the *product*. It is a time for the Product Owner to learn what is going on with the product and with the Team (that is, a review of the Sprint); and for the Team to learn what is going on with the Product Owner and the market. Consequently, a critical element of the Review is an in-depth *conversation* between the Team and Product Owner to learn the situation, to get advice, and so forth. The review definitely includes using the actual live software that the Team built during the Sprint, but if the focus of the review is only looking at the product rather than having a conversation, there is an imbalance.

The "live software" portion of the Sprint Review is not a "presentation" the Team gives – there is no slideware. It is meant to be a hands-on inspection of the real software running live, for example, in a sandbox development environment. There will be one or more computers in the Review room on which people can inspect and use the live software. Prefer an active session in which real users and the Product Owner do hands-on interaction with the software, rather than a passive-session demo from the Team.

Aim to spend no more than 30 minutes preparing for Sprint Review, otherwise it suggests something is wrong.

Sprint Retrospective

Summary: Inspection and adaption related to the process and environment.
Participants: Team, ScrumMaster, Product Owner (optional). Other stakeholders may be invited by the Team, but are not otherwise allowed to attend.
Duration: Timeboxed to 45 minutes per week of Sprint.

The Sprint Review involves inspect and adapt regarding the *product*. The **Sprint Retrospective**, which follows the Review, involves inspect and adapt regarding the *process and environment*. It's an opportunity for the Team to discuss what's working and what's not working, and agree on changes to try. Sometimes the ScrumMaster can act as an effective facilitator for the Retrospective, but it may be better to find a neutral outsider to facilitate the meeting; a good approach is for ScrumMasters to facilitate each others' retrospectives, which enables cross-pollination among Teams.

There are many techniques for conducting a Sprint Retrospective, and the book *Agile Retrospectives* (Derby, Larsen 2006) provides a useful catalogue of techniques.

Many teams hold retrospectives only focusing on *problems*, and that's too bad. It can lead to people thinking of retrospectives as somewhat depressing or negative events. Instead, ensure that every Retrospective also focus on positives or strengths; there are several books on *appreciative inquiry* that offer more detailed tips.

Retrospectives that always use the same technique of analysis may become boring; therefore, introduce various techniques over time.

Starting the next Sprint

Following the Sprint Review, the Product Owner may update the Product Backlog with any new insight –adding new Items, removing obsolete ones, or revising existing ones. The Product Owner is responsible for ensuring that these changes are reflected in the Product Backlog.See Figure 9 for an example of the updated Product Backlog.

				New Estimates at Sprint ...				
Priority	Item	Details (wiki URL)	Initial Estimate	1	2	3	4	5
1	As a buyer, I want to place a book in a shopping cart (see UI sketches on wiki page)	...	5	0	0	0		
2	As a buyer, I want to remove a book in a shopping cart	...	2	0	0	0		
3	Improve transaction processing performance (see target performance metrics on wiki)	...	13	13	0	0		
4	Investigate solutions for speeding up credit card validation (see target performance metrics on wiki)	...	20	20	20	0		
5	Upgrade all servers to Apache 2.2.3	...	13	13	13	13		
6	Diagnose and fix the order processing script errors (bugzilla ID 14823)	...	3	3	3	3		
7	As a shopper, I want to create and save a wish list	...	40	40	40	40		
8	As a shopper, I want to to add or delete items on my wish list	...	20	20	20	20		
...			...	...				
			537	580	570	500		

Figure 9. Updated Product Backlog

There is no down time between Sprints – Teams normally go from a Sprint Retrospective one afternoon into the next Sprint Planning the following morning (or after the weekend).

One of the principles of agile development is "sustainable pace", and only by working regular hours at a reasonable level can Teams continue this cycle indefinitely. Productivity grows over time through the evolution of the Team's practices, and the removal of impediments to the Team's productivity, not through overwork or the compromise of quality.

Sprints continue until the Product Owner decides the product is ready for release. The perfection vision of Scrum is that the product is potentially shippable at the end of each Sprint, which implies there is no wrap up work required, such as testing or documentation. The implication is that *everything* is completely *finished* every Sprint; that you could actually ship it or deploy it immediately after the Sprint Review. However, many organizations have weak development practices, tools and infrastructure and cannot achieve this perfection vision and so there will be the need for a "Release Sprint" to handle this remaining work. When a "Release Sprint" is needed, it is considered necessary evil and the organization's job is to improve their practices so this is not needed anymore.

Managing Releases

A question that is sometimes asked is how, in an iterative model, can long-term release planning be done. There are two cases to consider: (1) a new product in its first release, and (2) an existing product in a later release.

In the case of a new product, or *an existing product just adopting Scrum*, there is the need to do initial Product Backlog refinement before the first Sprint, where the Product Owner and Team shape a proper Scrum Product Backlog. This could take a few days or a week, and involves a workshop (sometimes called Initial Product Backlog Creation or Release Planning), some detailed requirements analysis, and estimation of all the items identified for the first release.

Surprisingly in Scrum, in the case of an established product with an established Product Backlog, there should not be the need for any special or extensive release planning for the next release. Why? Because the Product Owner and Team should be doing Product Backlog refinement every Sprint (five or ten percent of each Sprint), continuously preparing for the future. This *continuous product development* mode obviates the need for the dramatic punctuated prepare-execute-conclude stages one sees in traditional sequential life cycle development.

During an initial Product Backlog refinement workshop and during the continuous backlog refinement each Sprint, the Team and Product Owner will do release planning, refining the estimates, priorities, and content as they learn.

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Some releases are date-driven; for example: "We will release version 2.0 of our project at a trade-show on November 10." In this situation, the Team will complete as many Sprints (and build as many features) as is possible in the time available. Other products require certain features to be built before they can be called complete and the product will not launch until these requirements are satisfied, however long that takes. Since Scrum emphasizes producing potentially shippable code each Sprint, the Product Owner may choose to start doing interim releases, to allow the customer to reap the benefits of completed work sooner.

Since they cannot possibly know everything up front, the focus is on creating and refining a plan to give the release broad direction, and clarify how tradeoff decisions will be made (scope versus schedule, for example). Think of this as the roadmap guiding you towards your final destination; which exact roads you take and the decisions you make during the journey may be determined en route.

The destination is more important than the journey.

Most Product Owners choose one release approach. For example, they will decide a release date, and will work with the Team to estimate the Product Backlog items that can be completed by that date. The items that are anticipated to be in the current release are sometimes called the *release items*. In situations where a "fixed price / fixed date / fixed deliverable" commitment is required – for example, contract development – one or more of those parameters must have a built-in buffer to allow for uncertainty and change; in this respect, Scrum is no different from other approaches.

Application or Product Focus

For applications or products – either for the market or for internal use within an organization – Scrum moves groups away from the older *project*-centric model toward a *continuous application/product development* model. There is no longer a project with a beginning, middle, and end. And hence, no traditional project manager. Rather, there is simply a stable Product Owner and a long-lived self-managing Team that collaborate in an "endless" series of fixed-length Sprints, until the product or application is retired. All necessary "project" management work is handled by the Team and the Product Owner – who is an internal business customer or from Product Management. It is not managed by an IT manager or someone from a Project Management Office.

Scrum can also be used for true *projects* that are one-time initiatives (rather than work to create or evolve long-lived applications); still, in this case the Team and Product Owner do the project management.

What if there is insufficient new work from one or more existing applications to warrant a dedicated long-lived Team for each application? In this case, a stable long-lived Team may take on items from one application in one Sprint, and then items from another in the next Sprint; in this situation the Sprints are often quite short, such as one week.

Occasionally, there is insufficient new work even for the prior solution, and the Team may take on items from *several* applications during the same Sprint; however, beware this solution as it may devolve into unproductive multitasking across multiple applications. A basic productivity theme in Scrum is for the Team to be *focused* on one product or application for one Sprint.

Common Challenges

Scrum is not only a concrete set of practices – rather, and more importantly, it is a framework that provides transparency, and a mechanism that allows "inspect and adapt". Scrum works by making visible the dysfunction and impediments that are impacting the Product Owner and the Team's effectiveness, so that they can be addressed. For example, the Product Owner may not really know the market, the features, or how to estimate their relative business value. Or the Team may be unskillful in effort estimation or development work.

The Scrum framework will quickly reveal these weaknesses. Scrum does not solve the problems of development; it makes them painfully visible, and provides a framework for people to explore ways to resolve problems in short cycles and with small improvement experiments.

Suppose the Team fails to deliver what they forecast in the first Sprint due to poor task analysis and estimation skill. To the Team, this feels like failure. But in reality, this experience is the necessary first step toward becoming more realistic and thoughtful about its forecasts. This pattern – of Scrum helping make visible dysfunction, enabling the Team to do something about it – is the basic mechanism that produces the most significant benefits that Teams using Scrum experience.

One common mistake made, when presented with a Scrum practice that is challenging, is to change Scrum. For example, Teams that have trouble delivering might decide to make the Sprint duration extendable, so it never runs out of time – and in the process, ensure it never has to learn how to do a better job of estimating and managing its time. In this way, without coaching and the support of an experienced ScrumMaster, organizations can mutate Scrum into just a mirror image of their own weaknesses and dysfunction, and undermine the real benefit that Scrum offers: Making visible the good and the bad, and giving the organization the choice of elevating itself to a higher level.

Another common mistake is to assume that a practice is discouraged or prohibited just because Scrum does not specifically require it. For example, Scrum does not require the Product Owner to set a long-term strategy for his or her product; nor does it require engineers to seek advice from more experienced engineers about complex technical problems. Scrum leaves it to the individuals involved to make the right decision; and in most cases, both of these practices (along with many others) are well advised.

Something else to be wary of is managers imposing Scrum on their Teams; Scrum is about giving a Team space and tools to manage itself, and having this dictated from above is not a recipe for success. A better approach might begin with a Team learning about Scrum from a peer or manager, getting comprehensively educated in professional training, and then making a decision as a Team to follow the practices faithfully for a defined period; at the end of that period, the Team will evaluate its experience, and decide whether to continue.

The good news is that while the first Sprint is usually very challenging to the Team, the benefits of Scrum tend to be visible by the end of it, leading many new Scrum Teams to exclaim: "Scrum is hard, but it sure is a whole lot better than what we were doing before!"

Appendix A: Additional Reading

There is a lot of material published about Scrum. In this reference section, we would like to point out some additional online material and a couple of books.

Online material:

- The Lean Primer - An introduction to Lean Thinking, an important influence to Scrum.
  http://www.leanprimer.com

- The Distributed Scrum Primer - Additional tips for teams who aren't co-located.
  http://www.goodagile.com/distributedscrumprimer/

- The ScrumMaster Checklist - A list of question that good ScrumMasters use.
  http://www.scrummasterchecklist.org/

- Feature Team Primer - Scaling Scrum with Feature Teams,
  http://www.featureteams.org

- The Agile Atlas - Core Scrum. ScrumAlliance description of Scrum.
  http://agileatlas.org/atlas/scrum

- Scrum Guide - Scrum.org description of Scrum.
  http://www.scrum.org/Scrum-Guides

- Agile Contracts Primer - How to make Scrum-friendly contracts.
  http://www.agilecontracts.org/

Books:

- Leading Teams - Richard Hackman

- Scaling Lean & Agile Development: Thinking and Organizational Tools for Large-Scale Scrum - Craig Larman, Bas Vodde

- Practices for Scaling Lean & Agile Development: Large, Multisite, and Offshore Product Development with Large-Scale Scrum - Craig Larman, Bas Vodde

- Agile Project Management with Scrum - Ken Schwaber

- Succeeding with Agile: Software Development using Scrum - Mike Cohn

Appendix B: Terminology

Burn Down
The trend of work remaining across time in a Sprint, a Release, or a Product. The source of the raw data is the Sprint Backlog and the Product Backlog, with work remaining tracked on the vertical axis and the time periods (days of a Sprint, or Sprints) tracked on the horizontal axis.

Daily Scrum
A short meeting held daily by each Team during which the Team members inspect their work, synchronize their work and progress and report and impediments to the ScrumMaster for removal. Follow-on meetings to adapt upcoming work to optimize the Sprint may occur after the Daily Scrum meetings.

Development Team
Another name for the Team role.

Done
Complete as mutually agreed to by all parties and that conforms to an organization's standards, conventions, and guidelines. When something is reported as "done" at the Sprint Review meeting, it must conform to this agreed definition.

Estimated Work Remaining (Sprint Backlog items)
The number of hours that a Team member estimates remain to be worked on any task. This estimate is updated at the end of every day when the Sprint Backlog task is worked on. The estimate is the total estimated effort remaining, regardless of the number of people that perform the work.

Increment
Product functionality that is developed by the Team during each Sprint that is potentially shippable or of use to the Product Owner's stakeholders.

Increment of Potentially Shippable Product Functionality
A complete slice of the overall product or system that could be used by the Product Owner or stakeholders if they chose to implement it.

Sprint
An iteration, or one repeating cycle of similar work, that produces increment of product or system. No longer than one month and usually more than one week. The duration is fixed throughout the overall work and all teams working on the same system or product use the same length cycle.

Product Backlog
A prioritized list of requirements with estimated times to turn them into completed product functionality. Estimates are more precise the higher an item is in the Product Backlog priority.. The list emerges, changing as business conditions or technology changes.

Product Backlog Item
Functional requirements, non-functional requirements, and issues, prioritized in order of importance to the business and dependencies, and estimated. The precision of the estimate depends on the priority and granularity of the Product Backlog item, with the highest priority items that may be selected in the next Sprint being very granular and precise.

Product Owner
The person responsible for managing the Product Backlog so as to maximize the value of the product. The Product Owner is responsible for representing the interests of everyone with a stake in the project and its resulting product.

Scrum
Not an acronym, but mechanisms in the game of rugby for getting an out-of-play ball back into play.

ScrumMaster
The person responsible for the Scrum process, its correct implementation, and the maximization of its benefits.

Sprint Backlog
A list of the Team's work for a Sprint. This is often decomposed into a set of more detailed tasks. The list emerges during Sprint Planning and may be updated by the team during the Sprint with items being removed or new tasks being added as needed. Each Sprint Backlog task will be tracked during the Sprint and will show the estimated effort remaining.

Sprint Backlog Task
One of the tasks that the Team or a Team member defines as required to turn committed Product Backlog items into system functionality.

Sprint Planning meeting
A meeting time boxed to four hours (for a two week Sprint) that initiates every Sprint. The meeting is divided into two two-hour segments, each also time boxed. During the first part the Product Owner presents the highest priority Product Backlog to the team. The Team and Product Owner collaborate to help the Team determine how much Product Backlog it can turn into functionality during the upcoming Sprint. During the second part, the Team plans how it will achieve this by designing and decomposing the work so they understand how they will meet the Sprint Goal.

Sprint Retrospective meeting
A meeting facilitated by the ScrumMaster at which the complete Team discusses the just-concluded Sprint and determines what could be changed that might make the next Sprint more enjoyable or productive.

Sprint Review meeting
A time-boxed two hour meeting (for a two week Sprint) at the end of every Sprint where the Team collaborates with the Product Owner and stakeholders and they inspect the output from the Sprint. This usually starts with a review of completed Product Backlog items, a discussion of opportunities, constraints and risks, and a discussion of what might be the best things to do next (potentially resulting in Product Backlog changes). Only completed product functionality can be demonstrated.

Stakeholder
Someone with an interest in the outcome of a project, either because they have funded it, will use it, or will be affected by it.

Team
A cross-functional group of people that is responsible for managing themselves to develop an increment of product every Sprint.

Time box
A period of time that cannot be exceeded and within which an event or meeting occurs. For example, a Daily Scrum meeting is time boxed at fifteen minutes and terminates at the end of fifteen minutes, regardless. For meetings, it might last shorter. For Sprints, it lasts exactly that length.