

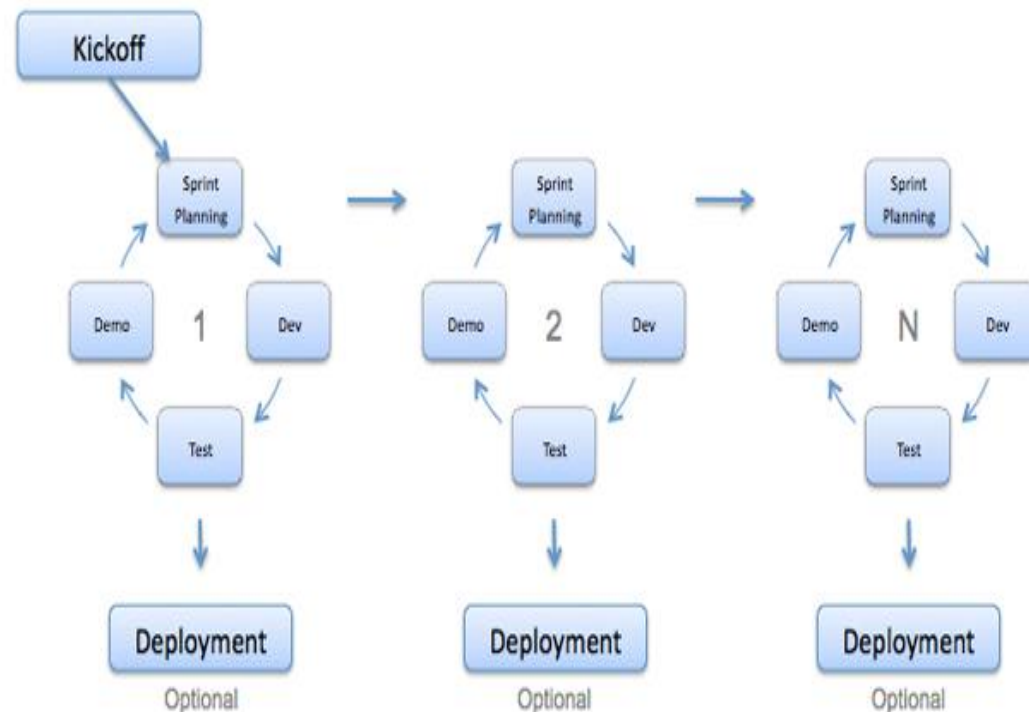
Agile Software Development

Topics covered

- ④ Agile methods
- ④ Plan-driven and agile development
- ④ Extreme programming
- ④ Agile project management

What is Agile development model ?

❖ **Agile development model** is also a type of Incremental model. Software is developed in incremental, rapid cycles. This results in small incremental releases with each release building on previous functionality. Each release is thoroughly tested to ensure software quality is maintained. It is used for time critical applications. Extreme Programming (XP) is currently one of the most well known agile development life cycle model.



Rapid software development

- ✧ Rapid development and delivery is now often the most important requirement for software systems
 - Businesses operate in a fast –changing requirement and it is practically impossible to produce a set of stable software requirements
 - Software has to evolve quickly to reflect changing business needs.
- ✧ Rapid software development
 - Specification, design and implementation are inter-leaved
 - System is developed as a series of versions with stakeholders involved in version evaluation
 - User interfaces are often developed using an IDE and graphical toolset.

Agile methods

- ✧ Dissatisfaction with the overheads involved in software design methods of the 1980s and 1990s led to the creation of agile methods. These methods:
 - Focus on the code rather than the design
 - Are based on an iterative approach to software development
 - Are intended to deliver working software quickly and evolve this quickly to meet changing requirements.
- ✧ The aim of agile methods is to reduce overheads in the software process (e.g. by limiting documentation) and to be able to respond quickly to changing requirements without excessive rework.

The principles of agile methods

Principle	Description
Customer involvement	Customers should be closely involved throughout the development process. Their role is provide and prioritize new system requirements and to evaluate the iterations of the system.
Incremental delivery	The software is developed in increments with the customer specifying the requirements to be included in each increment.
People not process	The skills of the development team should be recognized and exploited. Team members should be left to develop their own ways of working without prescriptive processes.
Embrace change	Expect the system requirements to change and so design the system to accommodate these changes.
Maintain simplicity	Focus on simplicity in both the software being developed and in the development process. Wherever possible, actively work to eliminate complexity from the system.

Agile method applicability

- ✧ Product development where a software company is developing a small or medium-sized product for sale.
- ✧ Custom system development within an organization, where there is a clear commitment from the customer to become involved in the development process and where there are not a lot of external rules and regulations that affect the software.
- ✧ Because of their focus on small, tightly-integrated teams, there are problems in scaling agile methods to large systems.

Problems with agile methods

- ✧ It can be difficult to keep the interest of customers who are involved in the process.
- ✧ Team members may be unsuited to the intense involvement that characterizes agile methods.
- ✧ Prioritizing changes can be difficult where there are multiple stakeholders.
- ✧ Maintaining simplicity requires extra work.
- ✧ Contracts may be a problem as with other approaches to iterative development.

Agile methods and software maintenance

- ✧ Most organizations spend more on maintaining existing software than they do on new software development. So, if agile methods are to be successful, they have to support maintenance as well as original development.
- ✧ Two key issues:
 - Are systems that are developed using an agile approach maintainable, given the emphasis in the development process of minimizing formal documentation?
 - Can agile methods be used effectively for evolving a system in response to customer change requests?
- ✧ Problems may arise if original development team cannot be maintained.

Plan-driven and agile development

✧ Plan-driven development

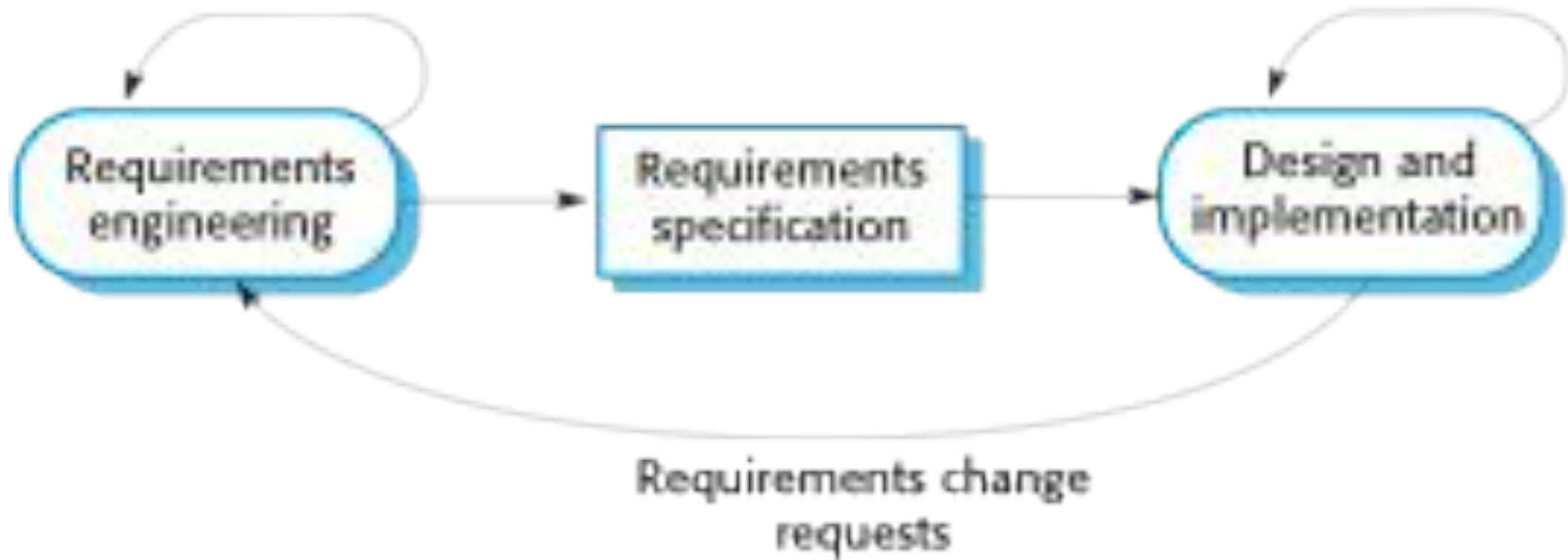
- A plan-driven approach to software engineering is based around separate development stages with the outputs to be produced at each of these stages planned in advance.
- Not necessarily waterfall model – plan-driven, incremental development is possible
- Iteration occurs within activities.

✧ Agile development

- Specification, design, implementation and testing are inter-leaved and the outputs from the development process are decided through a process of negotiation during the software development process.

Plan-driven and agile specification

Plan-based development



Agile development



Technical, human, organizational issues

- ✧ Most projects include elements of plan-driven and agile processes. Deciding on the balance depends on:
 - Is it important to have a very detailed specification and design before moving to implementation? If so, you probably need to use a plan-driven approach.
 - Is an incremental delivery strategy, where you deliver the software to customers and get rapid feedback from them, realistic? If so, consider using agile methods.
 - How large is the system that is being developed? Agile methods are most effective when the system can be developed with a small co-located team who can communicate informally. This may not be possible for large systems that require larger development teams so a plan-driven approach may have to be used.

Technical, human, organizational issues

- What type of system is being developed?
 - Plan-driven approaches may be required for systems that require a lot of analysis before implementation (e.g. real-time system with complex timing requirements).
- What is the expected system lifetime?
 - Long-lifetime systems may require more design documentation to communicate the original intentions of the system developers to the support team.
- What technologies are available to support system development?
 - Agile methods rely on good tools to keep track of an evolving design
- How is the development team organized?
 - If the development team is distributed or if part of the development is being outsourced, then you may need to develop design documents to communicate across the development teams.

Technical, human, organizational issues

- Are there cultural or organizational issues that may affect the system development?
 - Traditional engineering organizations have a culture of plan-based development, as this is the norm in engineering.
- How good are the designers and programmers in the development team?
 - It is sometimes argued that agile methods require higher skill levels than plan-based approaches in which programmers simply translate a detailed design into code
- Is the system subject to external regulation?
 - If a system has to be approved by an external regulator (e.g. the FAA approve software that is critical to the operation of an aircraft) then you will probably be required to produce detailed documentation as part of the system safety case.

Extreme programming

- ✧ Perhaps the best-known and most widely used agile method.
- ✧ Extreme Programming (XP) takes an ‘extreme’ approach to iterative development.
 - New versions may be built several times per day;
 - Increments are delivered to customers every 2 weeks;
 - All tests must be run for every build and the build is only accepted if tests run successfully.

XP and agile principles

- ✧ Incremental development is supported through small, frequent system releases.
- ✧ Customer involvement means full-time customer engagement with the team.
- ✧ People not process through pair programming, collective ownership and a process that avoids long working hours.
- ✧ Change supported through regular system releases.
- ✧ Maintaining simplicity through constant refactoring of code.

The extreme programming release cycle



Extreme programming practices (a)

Principle or practice	Description
Incremental planning	Requirements are recorded on story cards and the stories to be included in a release are determined by the time available and their relative priority. The developers break these stories into development 'Tasks'. See Figures 3.5 and 3.6.
Small releases	The minimal useful set of functionality that provides business value is developed first. Releases of the system are frequent and incrementally add functionality to the first release.
Simple design	Enough design is carried out to meet the current requirements and no more.
Test-first development	An automated unit test framework is used to write tests for a new piece of functionality before that functionality itself is implemented.
Refactoring	All developers are expected to refactor the code continuously as soon as possible code improvements are found. This keeps the code simple and maintainable.

Extreme programming practices (b)

Pair programming	Developers work in pairs, checking each other's work and providing the support to always do a good job.
Collective ownership	The pairs of developers work on all areas of the system, so that no islands of expertise develop and all the developers take responsibility for all of the code. Anyone can change anything.
Continuous integration	As soon as the work on a task is complete, it is integrated into the whole system. After any such integration, all the unit tests in the system must pass.
Sustainable pace	Large amounts of overtime are not considered acceptable as the net effect is often to reduce code quality and medium term productivity
On-site customer	A representative of the end-user of the system (the customer) should be available full time for the use of the XP team. In an extreme programming process, the customer is a member of the development team and is responsible for bringing system requirements to the team for implementation.

Requirements scenarios

- ✧ In XP, a customer or user is part of the XP team and is responsible for making decisions on requirements.
- ✧ User requirements are expressed as scenarios or user stories.
- ✧ These are written on cards and the development team break them down into implementation tasks. These tasks are the basis of schedule and cost estimates.
- ✧ The customer chooses the stories for inclusion in the next release based on their priorities and the schedule estimates.

XP and change

- ✧ Conventional wisdom in software engineering is to design for change. It is worth spending time and effort anticipating changes as this reduces costs later in the life cycle.
- ✧ XP, however, maintains that this is not worthwhile as changes cannot be reliably anticipated.
- ✧ Rather, it proposes constant code improvement (refactoring) to make changes easier when they have to be implemented.

Refactoring

- ✧ Programming team look for possible software improvements and make these improvements even where there is no immediate need for them.
- ✧ This improves the understandability of the software and so reduces the need for documentation.
- ✧ Changes are easier to make because the code is well-structured and clear.
- ✧ However, some changes requires architecture refactoring and this is much more expensive.

Examples of refactoring

- ✧ Re-organization of a class hierarchy to remove duplicate code.
- ✧ Tidying up and renaming attributes and methods to make them easier to understand.
- ✧ The replacement of inline code with calls to methods that have been included in a program library.

Pair programming

- ✧ In XP, programmers work in pairs, sitting together to develop code.
- ✧ This helps develop common ownership of code and spreads knowledge across the team.
- ✧ It serves as an informal review process as each line of code is looked at by more than 1 person.
- ✧ It encourages refactoring as the whole team can benefit from this.
- ✧ Measurements suggest that development productivity with pair programming is similar to that of two people working independently.

Pair programming

- ✧ In pair programming, programmers sit together at the same workstation to develop the software.
- ✧ Pairs are created dynamically so that all team members work with each other during the development process.
- ✧ The sharing of knowledge that happens during pair programming is very important as it reduces the overall risks to a project when team members leave.
- ✧ Pair programming is not necessarily inefficient and there is evidence that a pair working together is more efficient than 2 programmers working separately.

Advantages of pair programming

- ✧ It supports the idea of collective ownership and responsibility for the system.
 - Individuals are not held responsible for problems with the code. Instead, the team has collective responsibility for resolving these problems.
- ✧ It acts as an informal review process because each line of code is looked at by at least two people.
- ✧ It helps support refactoring, which is a process of software improvement.
 - Where pair programming and collective ownership are used, others benefit immediately from the refactoring so they are likely to support the process.

Agile project management

- ✧ The principal responsibility of software project managers is to manage the project so that the software is delivered on time and within the planned budget for the project.
- ✧ The standard approach to project management is plan-driven. Managers draw up a plan for the project showing what should be delivered, when it should be delivered and who will work on the development of the project deliverables.
- ✧ Agile project management requires a different approach, which is adapted to incremental development and the particular strengths of agile methods.