

Agile Software Development

**Lecture # 10,11,12
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Rubab Jaffar
rubab.jaffar@nu.edu.pk

Software Engineering CS-303



Topics covered

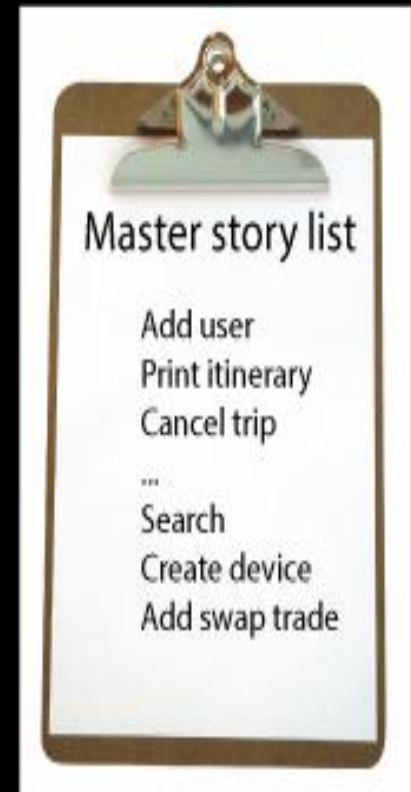
- Agile methods
- Agile development techniques
- Agile project management
- Scaling agile methods
- Quiz

Influential XP Practices

- Extreme programming has a technical focus and is not easy to integrate with management practice in most organizations.
- Consequently, while agile development uses practices from XP, the method as originally defined is not widely used.
- Key practices
 - User stories for specification
 - Refactoring
 - Test-first development
 - Pair programming

User Stories for Requirements

- Sitting down with the customers
- make a list of features they would like to see in their software.
- We call these things **user stories** and they become the **To Do list** for project. These tasks are the basis of schedule and cost estimates
- Like any other lists, there always seems to be more to do than time allows.
- Ask the customer to prioritize their list
- Get the most important stuff done first, and save the least important for last.



A 'prescribing medication' Story

Prescribing medication

The record of the patient must be open for input. Click on the medication field and select either 'current medication', 'new medication' or 'formulary'.

If you select 'current medication', you will be asked to check the dose; If you wish to change the dose, enter the new dose then confirm the prescription.

If you choose, 'new medication', the system assumes that you know which medication you wish to prescribe. Type the first few letters of the drug name. You will then see a list of possible drugs starting with these letters. Choose the required medication. You will then be asked to check that the medication you have selected is correct. Enter the dose then confirm the prescription.

If you choose 'formulary', you will be presented with a search box for the approved formulary. Search for the drug required then select it. You will then be asked to check that the medication you have selected is correct. Enter the dose then confirm the prescription.

In all cases, the system will check that the dose is within the approved range and will ask you to change it if it is outside the range of recommended doses.

After you have confirmed the prescription, it will be displayed for checking. Either click 'OK' or 'Change'. If you click 'OK', your prescription will be recorded on the audit database. If you click 'Change', you reenter the 'Prescribing medication' process.

Examples of Task Cards for Prescribing Medication

Task 1: Change dose of prescribed drug

Task 2: Formulary selection

Task 3: Dose checking

Dose checking is a safety precaution to check that the doctor has not prescribed a dangerously small or large dose.

Using the formulary id for the generic drug name, lookup the formulary and retrieve the recommended maximum and minimum dose.

Check the prescribed dose against the minimum and maximum. If outside the range, issue an error message saying that the dose is too high or too low. If within the range, enable the 'Confirm' button.

Refactoring

- 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.

Test-first Development

- Testing is central to XP and XP has developed an approach where the program is tested after every change has been made.
- XP testing features:
 - Test-first development.
 - Incremental test development from scenarios.
 - User involvement in test development and validation.
 - Automated test harnesses are used to run all component tests each time that a new release is built.

Test-driven Development

- Writing tests before code clarifies the requirements to be implemented.
- Tests are written as programs rather than data so that they can be executed automatically. The test includes a check that it has executed correctly.
 - Usually relies on a testing framework such as Junit.
- All previous and new tests are run automatically when new functionality is added, thus checking that the new functionality has not introduced errors.

Customer Involvement

- The role of the customer in the testing process is to help develop acceptance tests for the stories that are to be implemented in the next release of the system.
- The customer who is part of the team writes tests as development proceeds. All new code is therefore validated to ensure that it is what the customer needs.
- However, people adopting the customer role have limited time available and so cannot work full-time with the development team. They may feel that providing the requirements was enough of a contribution and so may be reluctant to get involved in the testing process.

Test-case Description for Dose Checking

Test 4: Dose checking

Input:

1. A number in mg representing a single dose of the drug.
2. A number representing the number of single doses per day.

Tests:

1. Test for inputs where the single dose is correct but the frequency is too high.
2. Test for inputs where the single dose is too high and too low.
3. Test for inputs where the single dose * frequency is too high and too low.
4. Test for inputs where single dose * frequency is in the permitted range.

Output:

OK or error message indicating that the dose is outside the safe range.

Test Automation

- Test automation means that tests are written as executable components before the task is implemented
 - These testing components should be stand-alone, should simulate the **submission of input** to be tested and should **check** that the result meets the output specification. An automated test framework (e.g. Junit) is a system that makes it easy to write executable tests and submit a set of tests for execution.
- As testing is automated, there is always a set of tests that can be quickly and easily executed
 - Whenever any functionality is added to the system, the tests can be run and problems that the new code has introduced can be caught immediately.

Pair Programming

- In pair programming, programmers sit together at the same computer to develop the software.
- Pairs are created dynamically so that all team members work with each other during the development process.
- Pair programming is not necessarily inefficient and there is some evidence that suggests that a pair working together is more efficient than 2 programmers working separately.

Pair Programming Advantages

- Pair programming involves programmers working in pairs, developing code together.
- 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.
- 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 improving the system code.

Agile Project Management

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 practices used in agile methods.

Scrum

- Scrum is an agile method that focuses on managing iterative development rather than specific agile practices.
- There are three phases in Scrum.
 - The initial phase is an **outline planning phase** where you establish the general objectives for the project and design the software architecture.
 - This is followed by a **series of sprint cycles**, where each cycle develops an increment of the system.
 - The **project closure phase** wraps up the project, completes required documentation such as system help frames and user manuals and assesses the lessons learned from the project.

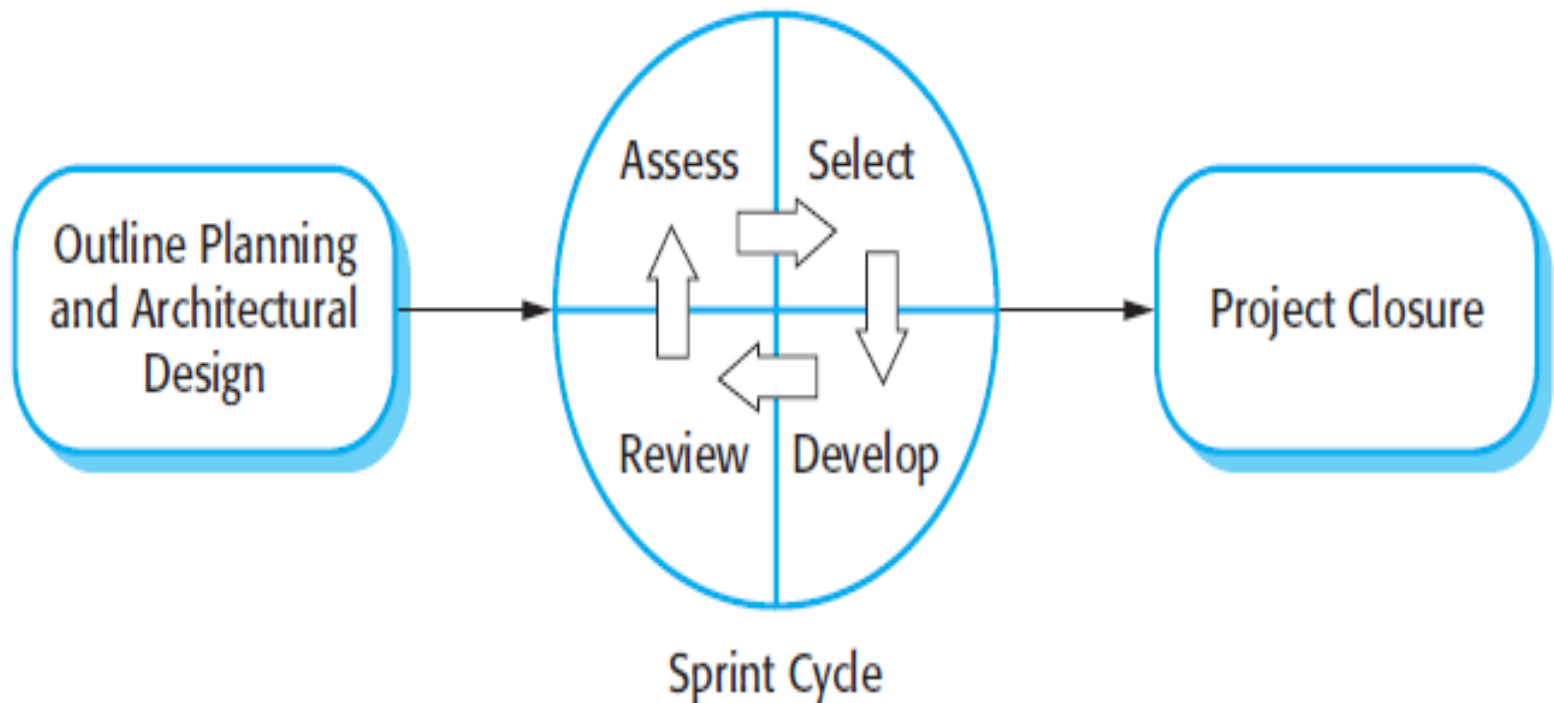
Scrum Terminology (a)

Scrum term	Definition
Development team	A self-organizing group of software developers, which should be no more than 7 people. They are responsible for developing the software and other essential project documents.
Potentially shippable product increment	The software increment that is delivered from a sprint. The idea is that this should be 'potentially shippable' which means that it is in a finished state and no further work, such as testing, is needed to incorporate it into the final product. In practice, this is not always achievable.
Product backlog	This is a list of 'to do' items which the Scrum team must tackle. They may be feature definitions for the software, software requirements, user stories or descriptions of supplementary tasks that are needed, such as architecture definition or user documentation.
Product owner	An individual (or possibly a small group) whose job is to identify product features or requirements, prioritize these for development and continuously review the product backlog to ensure that the project continues to meet critical business needs. The Product Owner can be a customer but might also be a product manager in a software company or other stakeholder representative.

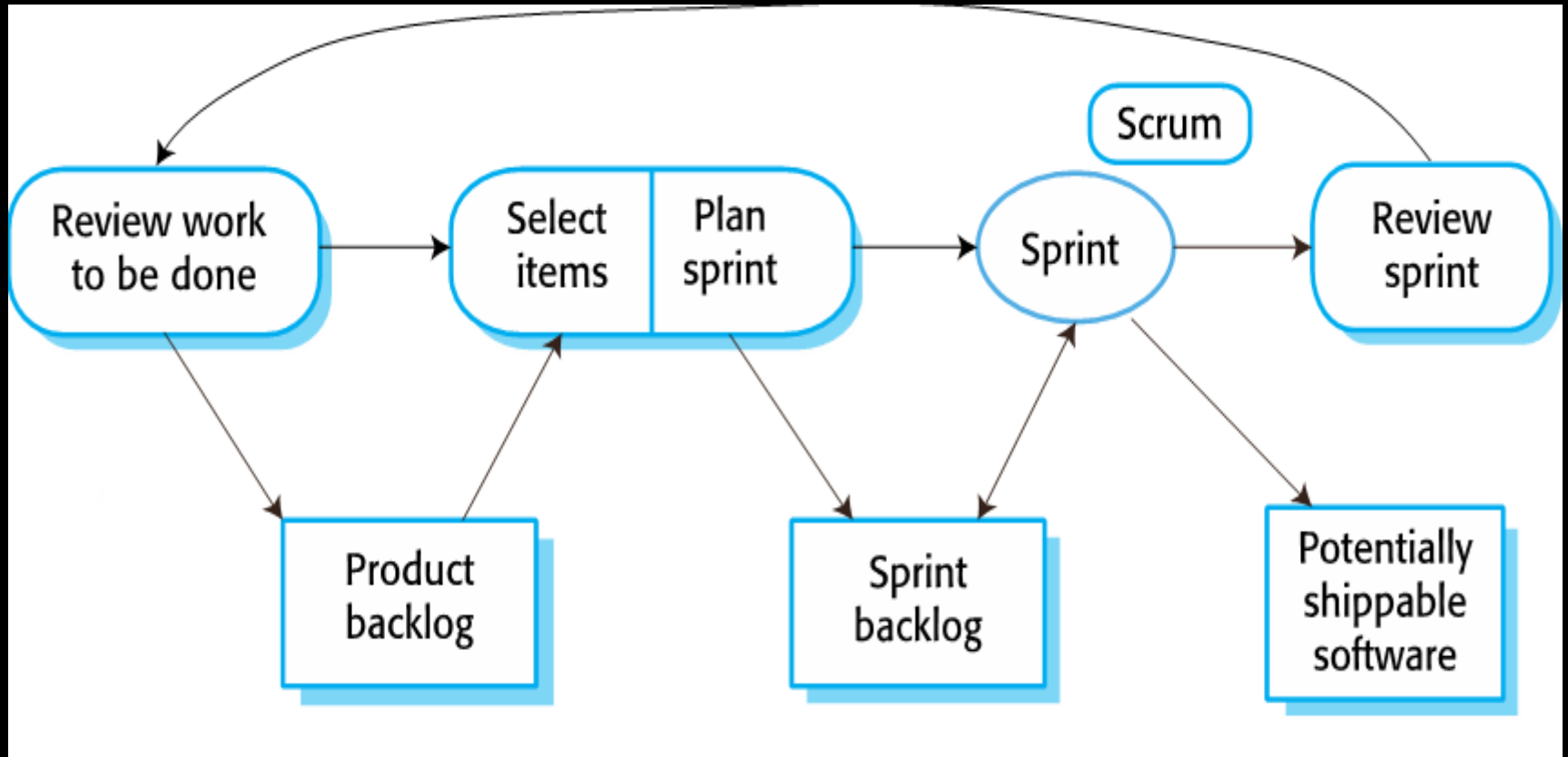
Scrum Terminology (b)

Scrum term	Definition
Scrum	A daily meeting of the Scrum team that reviews progress and prioritizes work to be done that day. Ideally, this should be a short face-to-face meeting that includes the whole team.
ScrumMaster	The ScrumMaster is responsible for ensuring that the Scrum process is followed and guides the team in the effective use of Scrum. He or she is responsible for interfacing with the rest of the company and for ensuring that the Scrum team is not diverted by outside interference. The Scrum developers are adamant that the ScrumMaster should not be thought of as a project manager. Others, however, may not always find it easy to see the difference.
Sprint	A development iteration. Sprints are usually 2-4 weeks long.
Velocity	An estimate of how much product backlog effort that a team can cover in a single sprint. Understanding a team's velocity helps them estimate what can be covered in a sprint and provides a basis for measuring improving performance.

The Scrum Process

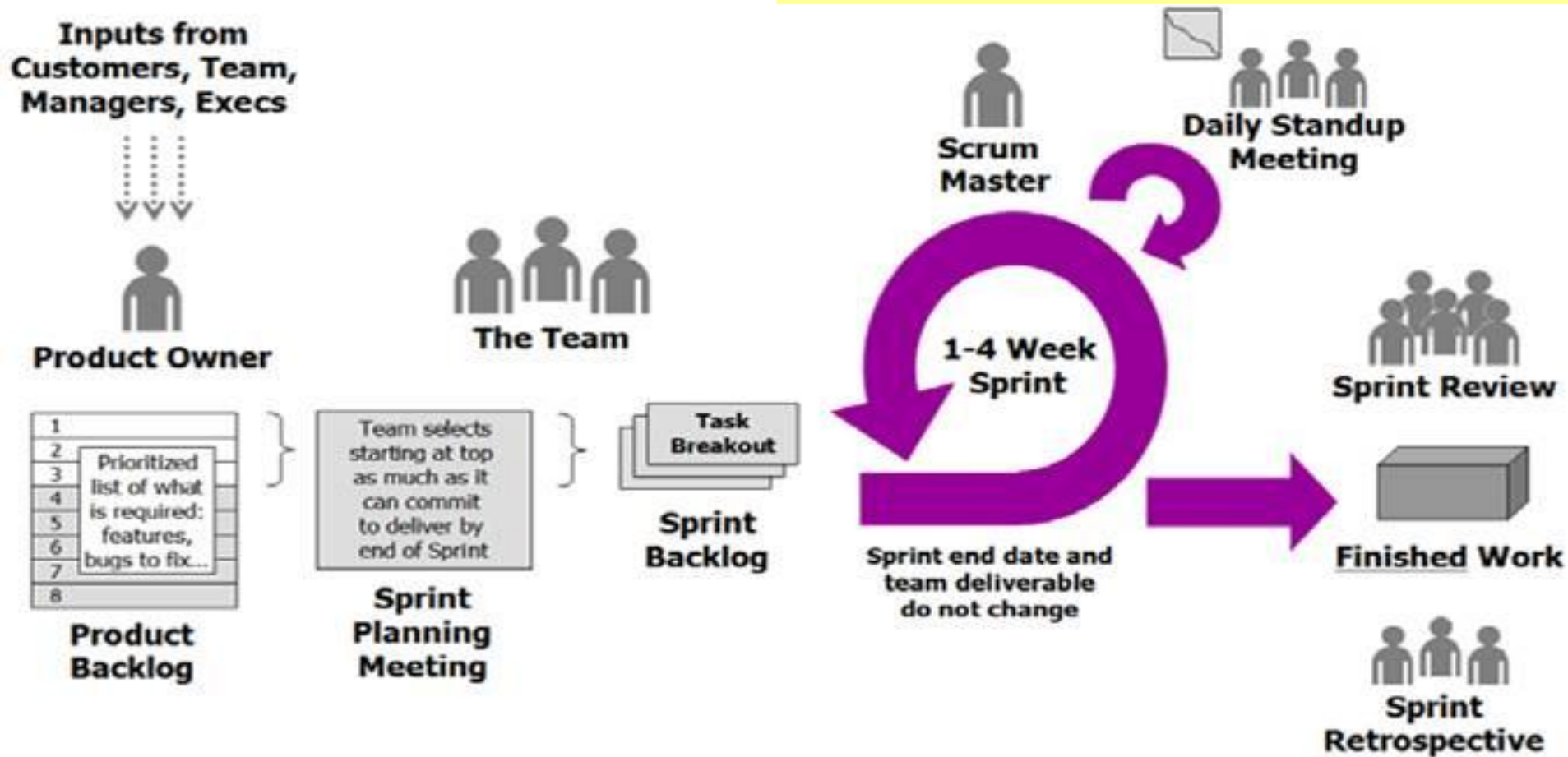


Scrum Sprint Cycle



The Scrum Sprint Cycle

- 1-What have you accomplished since yesterday?
- 2-Are your Sprint Backlog estimates accurate?
- 3-What are you working on today?
- 4-Is there anything blocking you?



The Scrum Sprint Cycle

- Sprints are fixed length, normally 2–4 weeks.
- The starting point for planning is the product backlog, which is the list of work to be done on the project.
- The selection phase involves all of the project team who work with the customer to select the features and functionality from the product backlog to be developed during the sprint.

The Sprint Cycle

- Once these are agreed, the team organize themselves to develop the software.
- During this stage the team is isolated from the customer and the organization, with all communications channelled through the so-called 'Scrum master'.
- The role of the Scrum master is to protect the development team from external distractions.
- At the end of the sprint, the work done is reviewed and presented to stakeholders. The next sprint cycle then begins.

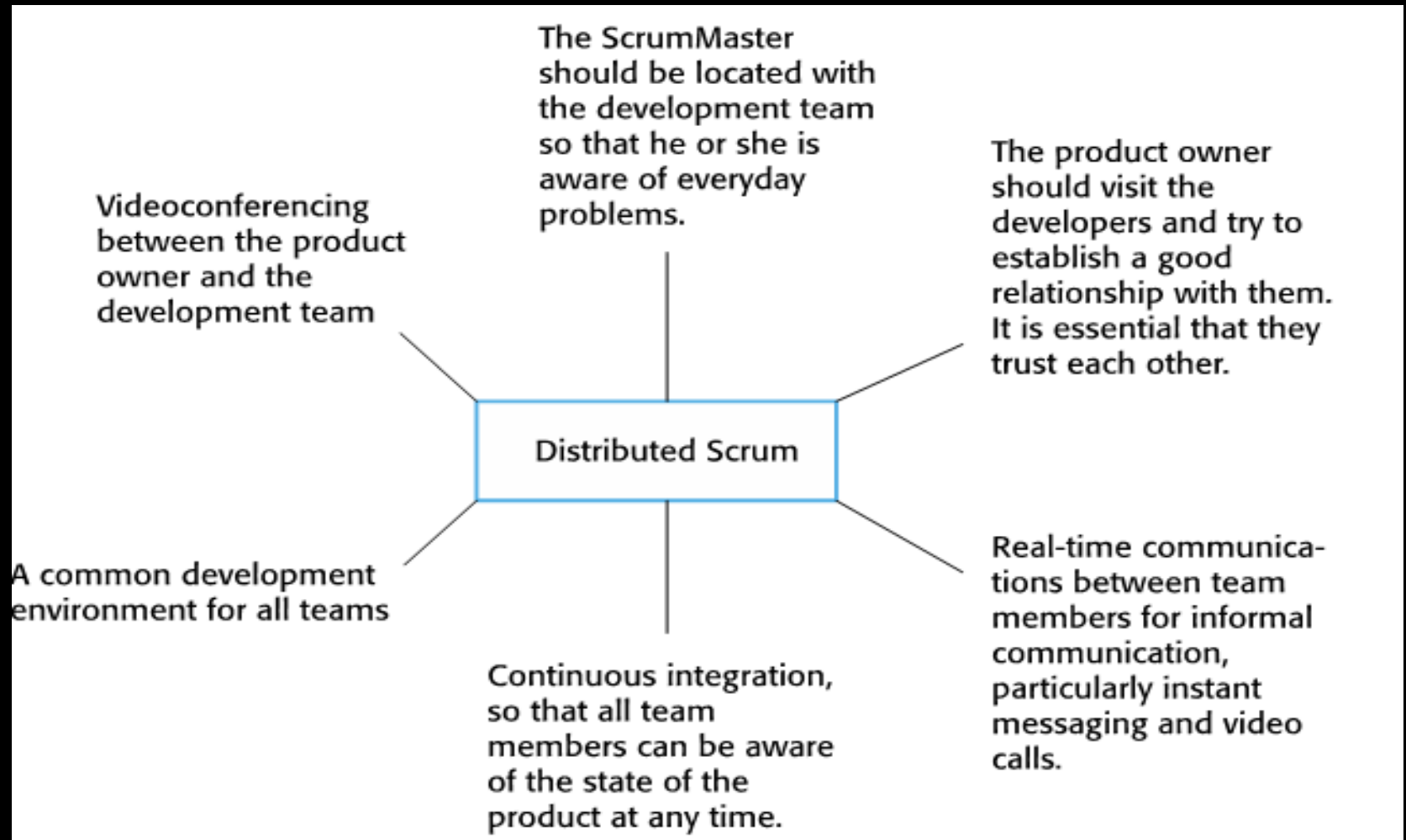
Teamwork in Scrum

- The 'Scrum master' is a facilitator who arranges daily meetings, tracks the backlog of work to be done, records decisions, measures progress against the backlog and communicates with customers and management outside of the team.
- The whole team attends short daily meetings (Scrums) where all team members share information, describe their progress since the last meeting, problems that have arisen and what is planned for the following day.
 - This means that everyone on the team knows what is going on and, if problems arise, can re-plan short-term work to cope with them.

Scrum Benefits

- The product is broken down into a set of manageable and understandable chunks.
- Unstable requirements do not hold up progress.
- The whole team have visibility of everything and consequently team communication is improved.
- Customers see on-time delivery of increments and gain feedback on how the product works.
- Trust between customers and developers is established and a positive culture is created in which everyone expects the project to succeed.

Distributed Scrum



Scaling Agile Methods

Scaling Agile Methods

- Agile methods have proved to be **successful for small and medium sized projects** that can be developed by a small co-located team.
- It is sometimes argued that the success of these methods comes because of **improved communications** which is possible when everyone is working together.
- Scaling up agile methods involves changing these to **cope with larger, longer projects** where there are multiple development teams, perhaps working in different locations.

Scaling Out and Scaling Up

- ‘Scaling up’ is concerned with using agile methods for developing large software systems that cannot be developed by a small team.
- ‘Scaling out’ is concerned with how agile methods can be introduced across a large organization with many years of software development experience.
- When scaling agile methods it is important to maintain agile fundamentals:
 - Flexible planning, frequent system releases, continuous integration, test-driven development and good team communications.

Practical Problems with Agile Methods

- The **informality** of agile development is incompatible with the legal approach to contract definition that is commonly used in large companies.
- Agile methods are most appropriate for new software development rather than software maintenance. Yet the majority of software costs in large companies come from maintaining their existing software systems.
- Agile methods are designed for small co-located teams yet much software development now involves worldwide distributed teams.

Contractual Issues

- Most software contracts for custom systems are based around a specification, which sets out what has to be implemented by the system developer for the system customer.
- However, this precludes interleaving specification and development as is the norm in agile development.
- A contract that pays for developer time rather than functionality is required.
 - However, this is seen as a high risk by many legal departments because what has to be delivered cannot be guaranteed.

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.

Agile Maintenance

- Key problems are:
 - Lack of product documentation
 - Keeping customers involved in the development process
 - Maintaining the continuity of the development team
- Agile development relies on the development team knowing and understanding what has to be done.
- For long-lifetime systems, this is a real problem as the original developers will not always work on the system.

Agile and Plan-driven Methods

- 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.

System Issues

- How large is the system being developed?
 - Agile methods are most effective a relatively small co-located team who can communicate informally.
- What type of system is being developed?
 - Systems that require a lot of analysis before implementation need a fairly detailed design to carry out this analysis.
- What is the expected system lifetime?
 - Long-lifetime systems require documentation to communicate the intentions of the system developers to the support team.
- Is the system subject to external regulation?
 - If a system is regulated you will probably be required to produce detailed documentation as part of the system safety case.

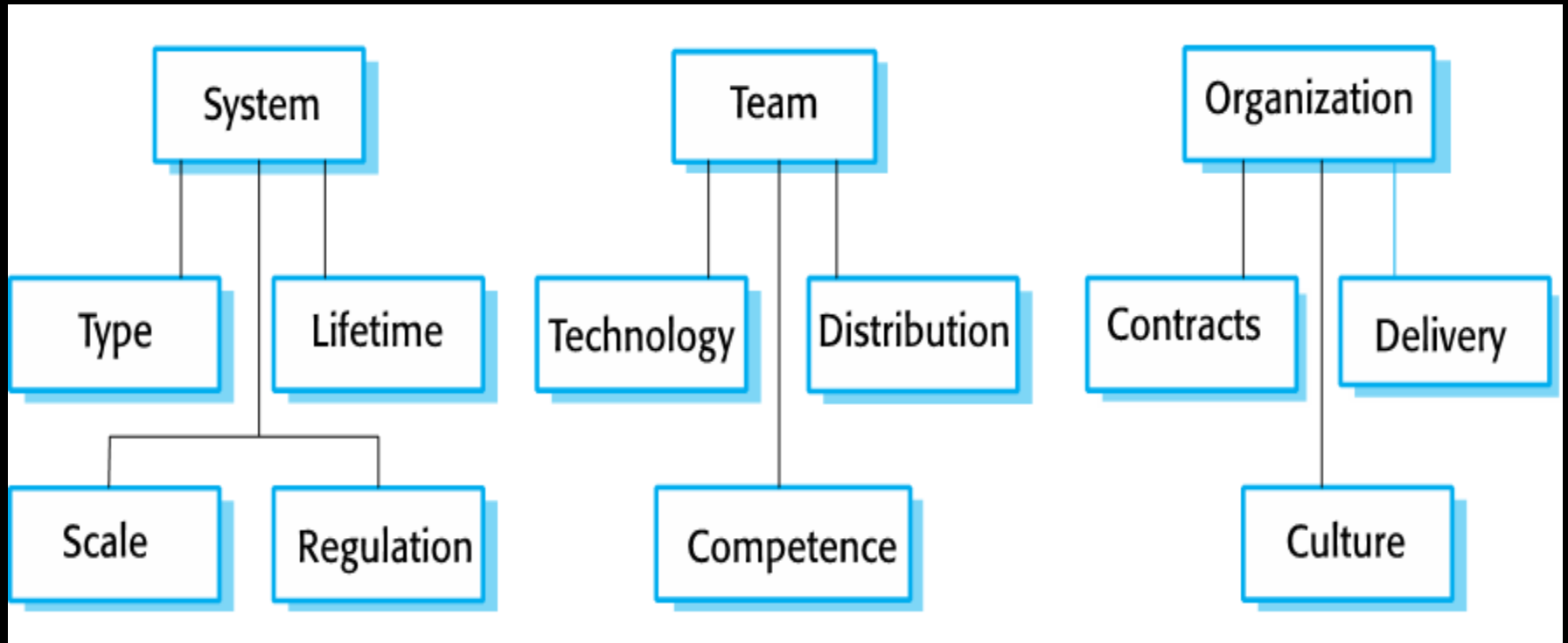
Agile Principles and Organizational Practice

Principle	Practice
Customer involvement	<p>This depends on having a customer who is willing and able to spend time with the development team and who can represent all system stakeholders. Often, customer representatives have other demands on their time and cannot play a full part in the software development.</p> <p>Where there are external stakeholders, such as regulators, it is difficult to represent their views to the agile team.</p>
Embrace change	<p>Prioritizing changes can be extremely difficult, especially in systems for which there are many stakeholders. Typically, each stakeholder gives different priorities to different changes.</p>
Incremental delivery	<p>Rapid iterations and short-term planning for development does not always fit in with the longer-term planning cycles of business planning and marketing. Marketing managers may need to know what product features several months in advance to prepare an effective marketing campaign.</p>

Agile Principles and Organizational Practice

Principle	Practice
Maintain simplicity	Under pressure from delivery schedules, team members may not have time to carry out desirable system simplifications.
People not process	Individual team members may not have suitable personalities for the intense involvement that is typical of agile methods, and therefore may not interact well with other team members.

Agile and Plan-based Factors



People and Teams

- 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.
- How is the development team organized?
 - Design documents may be required if the team is distributed.
- What support technologies are available?
 - IDE support for visualisation and program analysis is essential if design documentation is not available.

Organizational Issues

- Traditional engineering organizations have a culture of plan-based development, as this is the norm in engineering.
- Is it standard organizational practice to develop a detailed system specification?
- Will customer representatives be available to provide feedback of system increments?
- Can informal agile development fit into the organizational culture of detailed documentation?

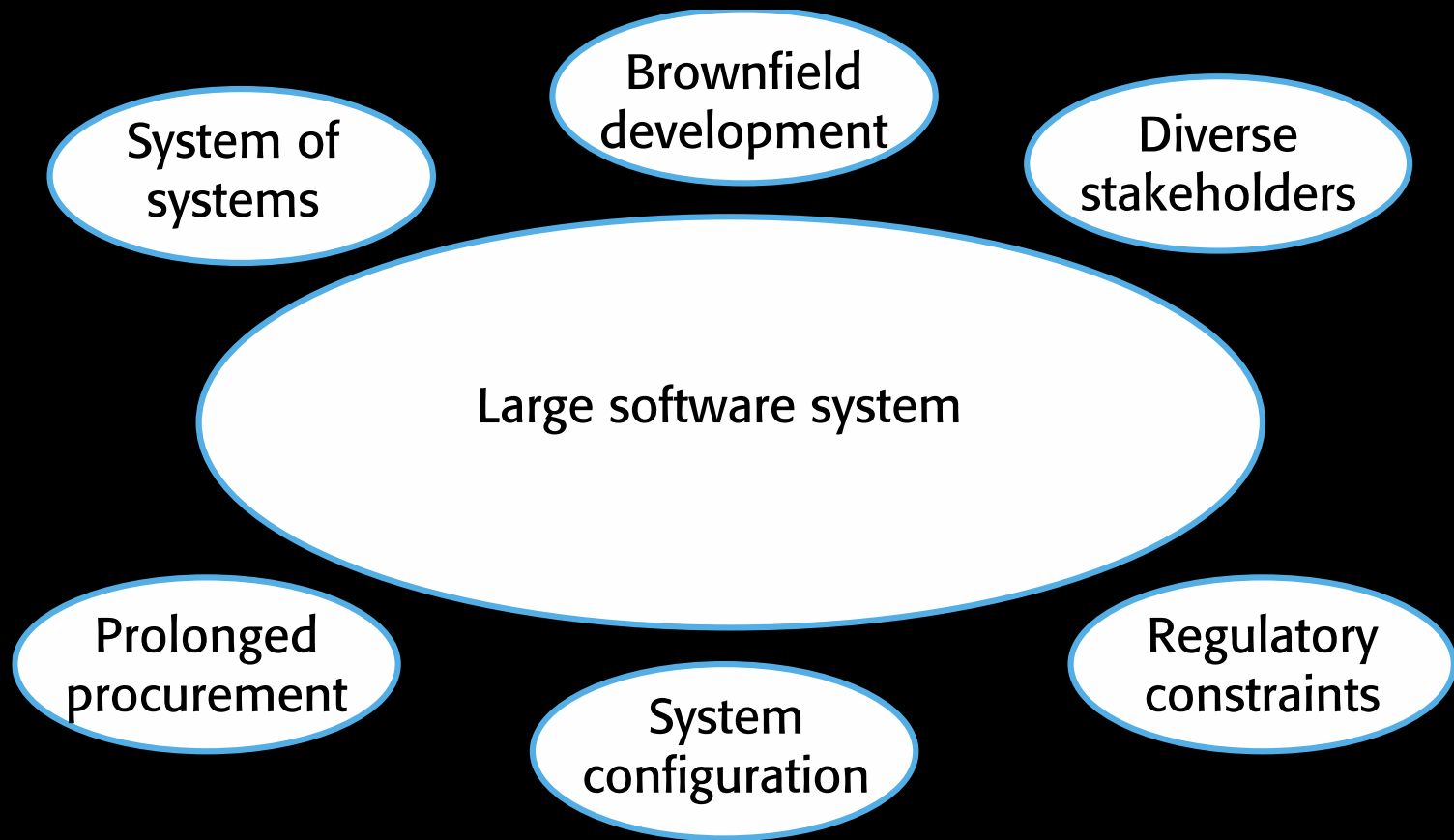
Agile Methods for Large Systems

- Large systems are usually collections of separate, communicating systems, where separate teams develop each system. Frequently, these teams are working in different places, sometimes in different time zones.
- Large systems are 'brownfield systems', that is they include and interact with a number of existing systems. Many of the system requirements are concerned with this interaction and so don't really lend themselves to flexibility and incremental development.
- Where several systems are integrated to create a system, a significant fraction of the development is concerned with system configuration rather than original code development.

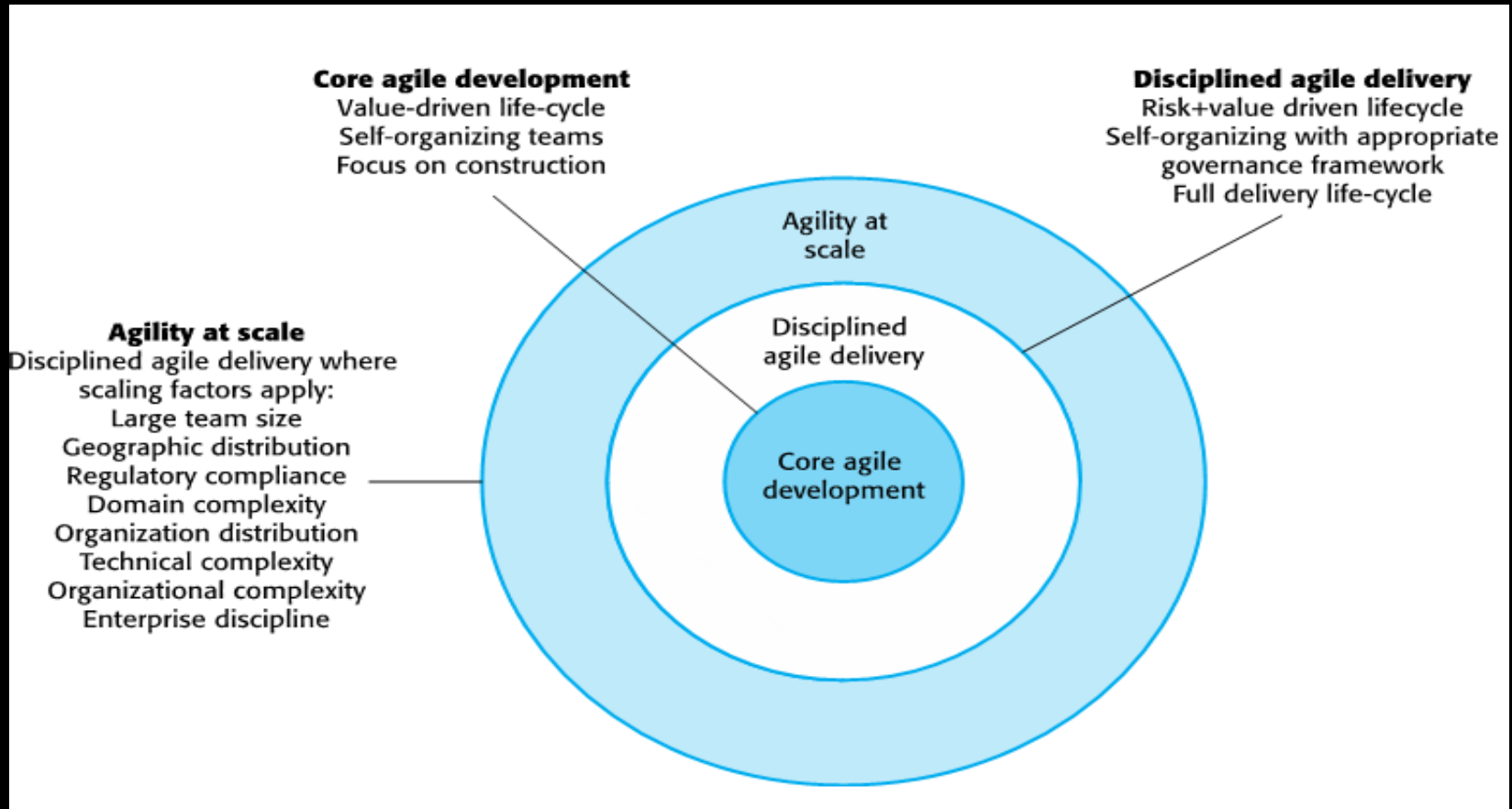
Large System Development

- Large systems and their development processes are often constrained by external rules and regulations limiting the way that they can be developed.
- Large systems have a long procurement and development time. It is difficult to maintain coherent teams who know about the system over that period as, inevitably, people move on to other jobs and projects.
- Large systems usually have a diverse set of stakeholders. It is practically impossible to involve all of these different stakeholders in the development process.

Factors in Large Systems



IBM's Agility at Scale Model



https://www.ibm.com/developerworks/community/blogs/ambler/entry/agile_scaling_model?lang=en

Scaling up to Large Systems

- A completely incremental approach to requirements engineering is impossible.
- There cannot be a single product owner or customer representative.
- For large systems development, it is not possible to focus only on the code of the system.
- Cross-team communication mechanisms have to be designed and used.
- Continuous integration is practically impossible. However, it is essential to maintain frequent system builds and regular releases of the system.

Multi-team Scrum

- *Role replication*
 - Each team has a Product Owner for their work component and ScrumMaster.
- *Product architects*
 - Each team chooses a product architect and these architects collaborate to design and evolve the overall system architecture.
- *Release alignment*
 - The dates of product releases from each team are aligned so that a demonstrable and complete system is produced.
- *Scrum of Scrums*
 - There is a daily Scrum of Scrums where representatives from each team meet to discuss progress and plan work to be done.

Agile Methods Across Organizations

- Project managers who do not **have experience** of agile methods may be reluctant to accept the risk of a new approach.
- Large organizations often have **quality procedures and standards** that all projects are expected to follow and, because of their bureaucratic nature, these are likely to be incompatible with agile methods.
- Agile methods seem to work best when team members have a relatively high skill level. However, within large organizations, there are likely to be a **wide range of skills and abilities**.
- There may be cultural resistance to agile methods, especially in those organizations that have a long history of using **conventional systems engineering processes**.



That is all