Pipeline

This chapter covers all recommended aspects of Jenkins Pipeline functionality, including how to:

- get started with Pipeline - covers how to define a Jenkins Pipeline (i.e. your `Pipeline`) through Blue Ocean, through the classic UI or in SCM,
- create and use a `Jenkinsfile` - covers use-case scenarios on how to craft and construct your `Jenkinsfile`,
- work with branches and pull requests,
- use Docker with Pipeline - covers how Jenkins can invoke Docker containers on agents/nodes (from a `Jenkinsfile`) to build your Pipeline projects,
- extend Pipeline with shared libraries,
- use different development tools to facilitate the creation of your Pipeline, and
- work with Pipeline syntax - this page is a comprehensive reference of all Declarative Pipeline syntax.

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For an overview of content in the Jenkins User Handbook, see User Handbook Overview.

What is Jenkins Pipeline?

Jenkins Pipeline (or simply "Pipeline" with a capital "P") is a suite of plugins which supports implementing and integrating *continuous delivery pipelines* into Jenkins.

A *continuous delivery (CD) pipeline* is an automated expression of your process for getting software from version control right through to your users and customers. Every change to your software (committed in source control) goes through a complex process on its way to being released. This process involves building the software in a reliable and repeatable manner, as well as progressing the built software (called a "build") through multiple stages of testing and deployment.

Pipeline provides an extensible set of tools for modeling simple-to-complex delivery pipelines "as code" via the Pipeline domain-specific language (DSL) syntax. [1]

The definition of a Jenkins Pipeline is written into a text file (called a `Jenkinsfile`) which in turn can be committed to a project's source control repository. [2] This is the foundation of "Pipeline-as-code"; treating the CD pipeline a part of the application to be versioned and reviewed like any other code.

Creating a `Jenkinsfile` and committing it to source control provides a number of immediate benefits:

- Automatically creates a Pipeline build process for all branches and pull requests.
- Code review/iteration on the Pipeline (along with the remaining source code).
- Audit trail for the Pipeline.
- Single source of truth [3] for the Pipeline, which can be viewed and edited by multiple members of the project.

While the syntax for defining a Pipeline, either in the web UI or with a `Jenkinsfile` is the same, it is generally considered best practice to define the Pipeline in a `Jenkinsfile` and check that in to source control.

Declarative versus Scripted Pipeline syntax

A `Jenkinsfile` can be written using two types of syntax - Declarative and Scripted.

Declarative and Scripted Pipelines are constructed fundamentally differently. Declarative Pipeline is a more recent feature of Jenkins Pipeline which:

- provides richer syntactical features over Scripted Pipeline syntax, and
- is designed to make writing and reading Pipeline code easier.

Many of the individual syntactical components (or "steps") written into a `Jenkinsfile`, however, are common to both Declarative and Scripted Pipeline. Read more about how these two types of syntax differ in Pipeline concepts and Pipeline syntax overview below.

Why Pipeline?

Jenkins is, fundamentally, an automation engine which supports a number of automation patterns. Pipeline adds a powerful set of automation tools onto Jenkins, supporting use cases that span from simple continuous integration to comprehensive CD pipelines. By modeling a series of related tasks, users can take advantage of the many features of Pipeline:

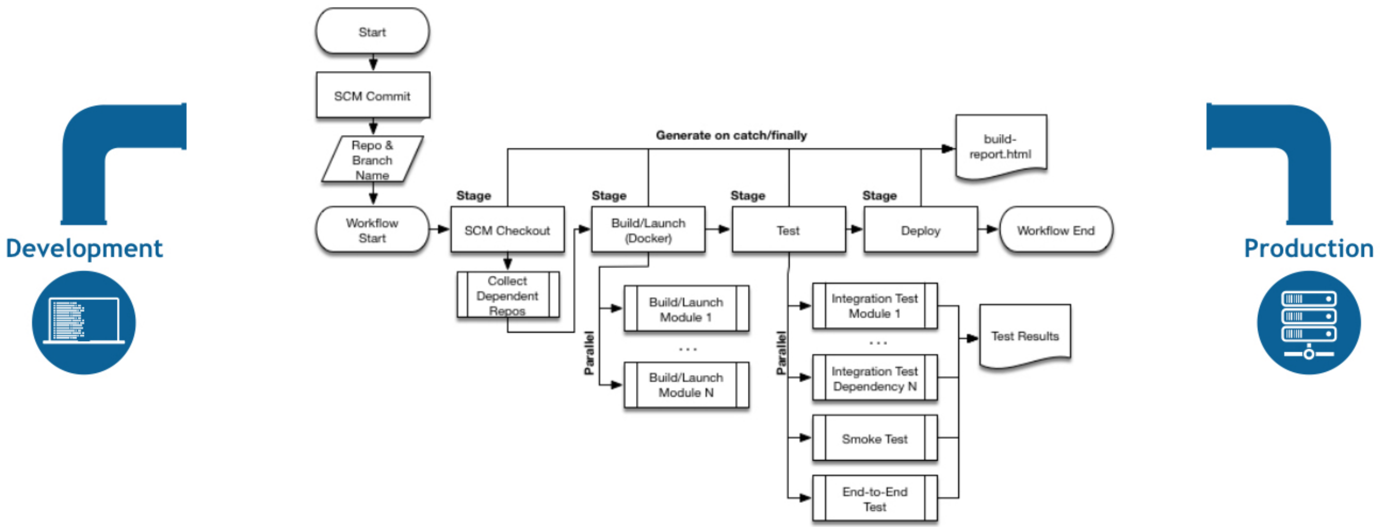
- **Code**: Pipelines are implemented in code and typically checked into source control, giving teams the ability to edit, review, and iterate upon their delivery pipeline.
- **Durable**: Pipelines can survive both planned and unplanned restarts of the Jenkins controller.
- **Pausable**: Pipelines can optionally stop and wait for human input or approval before continuing the Pipeline run.

- **Versatile**: Pipelines support complex real-world CD requirements, including the ability to fork/join, loop, and perform work in parallel.
- **Extensible**: The Pipeline plugin supports custom extensions to its DSL [1] and multiple options for integration with other plugins.

While Jenkins has always allowed rudimentary forms of chaining Freestyle Jobs together to perform sequential tasks, [4] Pipeline makes this concept a first-class citizen in Jenkins.

What is the difference between Freestyle and Pipeline in Jenkins
Building on the core Jenkins value of extensibility, Pipeline is also extensible both by users with Pipeline Shared Libraries and by plugin developers. [5]

The flowchart below is an example of one CD scenario easily modeled in Jenkins Pipeline:



Pipeline concepts

The following concepts are key aspects of Jenkins Pipeline, which tie in closely to Pipeline syntax (see the overview below).

Pipeline

A Pipeline is a user-defined model of a CD pipeline. A Pipeline's code defines your entire build process, which typically includes stages for building an application, testing it and then delivering it.

Also, a `pipeline` block is a key part of Declarative Pipeline syntax.

Node

A node is a machine which is part of the Jenkins environment and is capable of executing a Pipeline.

Also, a `node` block is a key part of Scripted Pipeline syntax.

Stage

A `stage` block defines a conceptually distinct subset of tasks performed through the entire Pipeline (e.g. "Build", "Test" and "Deploy" stages), which is used by many plugins to visualize or present Jenkins Pipeline status/progress. [6]

Step

A single task. Fundamentally, a step tells Jenkins *what* to do at a particular point in time (or "step" in the process). For example, to execute the shell command `make` use the `sh` step: `sh 'make'`. When a plugin extends the Pipeline DSL, [1] that typically means the plugin has implemented a new *step*.

Pipeline syntax overview

The following Pipeline code skeletons illustrate the fundamental differences between Declarative Pipeline syntax and Scripted Pipeline syntax.

Be aware that both stages and steps (above) are common elements of both Declarative and Scripted Pipeline syntax.

Declarative Pipeline fundamentals

In Declarative Pipeline syntax, the `pipeline` block defines all the work done throughout your entire Pipeline.

Jenkinsfile (Declarative Pipeline)

```
pipeline {
    agent any 1
    stages {
        stage('Build') { 2
            steps {
                // 3
            }
        }
        stage('Test') { 4
            steps {
                // 5
            }
        }
        stage('Deploy') { 6
            steps {
                // 7
            }
        }
    }
}
```

1 Execute this Pipeline or any of its stages, on any available agent.

2. Defines the "Build" stage.
3. Perform some steps related to the "Build" stage.
4. Defines the "Test" stage.
5. Perform some steps related to the "Test" stage.
6. Defines the "Deploy" stage.
7. Perform some steps related to the "Deploy" stage.

Scripted Pipeline fundamentals

In Scripted Pipeline syntax, one or more `node` blocks do the core work throughout the entire Pipeline. Although this is not a mandatory requirement of Scripted Pipeline syntax, confining your Pipeline's work inside of a `node` block does two things:

1. Schedules the steps contained within the block to run by adding an item to the Jenkins queue. As soon as an executor is free on a node, the steps will run.
2. Creates a workspace (a directory specific to that particular Pipeline) where work can be done on files checked out from source control.
   Caution: Depending on your Jenkins configuration, some workspaces may not get automatically cleaned up after a period of inactivity. See tickets and discussion linked from JENKINS-2111 for more information.

Jenkinsfile (Scripted Pipeline)

```
node {  1
    stage('Build') { 2
        // 3
    }
    stage('Test') { 4
        // 5
    }
    stage('Deploy') { 6
        // 7
    }
}
```

1. Execute this Pipeline or any of its stages, on any available agent.
2. Defines the "Build" stage. `stage` blocks are optional in Scripted Pipeline syntax. However, implementing `stage` blocks in a Scripted Pipeline provides clearer visualization of each `stage's subset of tasks/steps in the Jenkins UI.
3. Perform some steps related to the "Build" stage.
4. Defines the "Test" stage.

5. Perform some steps related to the "Test" stage.
6. Defines the "Deploy" stage.
7. Perform some steps related to the "Deploy" stage.

Pipeline example

Here is an example of a `Jenkinsfile` using Declarative Pipeline syntax - its Scripted syntax equivalent can be accessed by clicking the **Toggle Scripted Pipeline** link below:

Jenkinsfile (Declarative Pipeline)

```
pipeline { (1)
    agent any (2)
    options {
        skipStagesAfterUnstable()
    }
    stages {
        stage('Build') { (3)
            steps { (4)
                sh 'make' (5)
            }
        }
        stage('Test'){
            steps {
                sh 'make check'
                junit 'reports/**/*.xml' (6)
            }
        }
        stage('Deploy') {
            steps {
                sh 'make publish'
            }
        }
    }
}
```

Toggle Scripted Pipeline *(Advanced)*

1. `pipeline` is Declarative Pipeline-specific syntax that defines a "block" containing all content and instructions for executing the entire Pipeline.
2. `agent` is Declarative Pipeline-specific syntax that instructs Jenkins to allocate an executor (on a node) and workspace for the entire Pipeline.
3. `stage` is a syntax block that describes a stage of this Pipeline. Read more about `stage` blocks in Declarative Pipeline syntax on the Pipeline syntax page. As mentioned above, `stage` blocks

are optional in Scripted Pipeline syntax.

4 `steps` is Declarative Pipeline-specific syntax that describes the steps to be run in this `stage`.

5 `sh` is a Pipeline step (provided by the Pipeline: Nodes and Processes plugin) that executes the given shell command.

6 `junit` is another Pipeline step (provided by the JUnit plugin) for aggregating test reports.

7 `sh` is a Pipeline step (provided by the Pipeline: Nodes and Processes plugin) that executes the given shell command.

Read more about Pipeline syntax on the Pipeline Syntax page.

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1. Domain-specific language
2. Source control management
3. Single source of truth
4. Additional plugins have been used to implement complex behaviors utilizing Freestyle Jobs such as the Copy Artifact, Parameterized Trigger, and Promoted Builds plugins
5. GitHub Organization Folder plugin
6. Blue Ocean, Pipeline: Stage View plugin

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Was this page helpful?