Continuous Integration (CI) for .NET applications using Jenkins

Having a Continuous Integration (CI) and Continuous Delivery (CD) process during the various stages of development helps to reduce risks, catch bugs more quickly and rapidly deploy software to various environments. These benefits result in developers being able to implement business requirements and user needs more quickly and turning the process of releasing software into a business advantage.

Tools

There are many tools out there to accommodate CI and CD for your application such as TeamCity, Jenkins, GitLab CI, Bamboo, Team Foundation Server, etc. In this case we're going to setup CI (and later on CD) using Jenkins and Atlassian Bitbucket.

Jenkins is an upcoming populair open source Continuous Integration and Continuous Delivery tool that provides you to automate builds and deployments for various programming languages. There is an extensive plugin library available that allows you to use and configure tools like MSBuild and MSTest in your job with ease.

Automate IT

To actually create and setup a job, a few prerequisites are required:

Prerequisites

- Setup a VM or physical server running Windows.
- Install Jenkins.
- Install Visual Studio or Microsoft Build Tools.
- Install Git for Windows (or any other code repository client tools).
- Create a Bitbucket (or any other code repository) account and create a repository for your code.
- Install the MSBuild plugin for Jenkins.
- Install the MSTest plugin for Jenkins.
- Install the Git plugin for Jenkins.

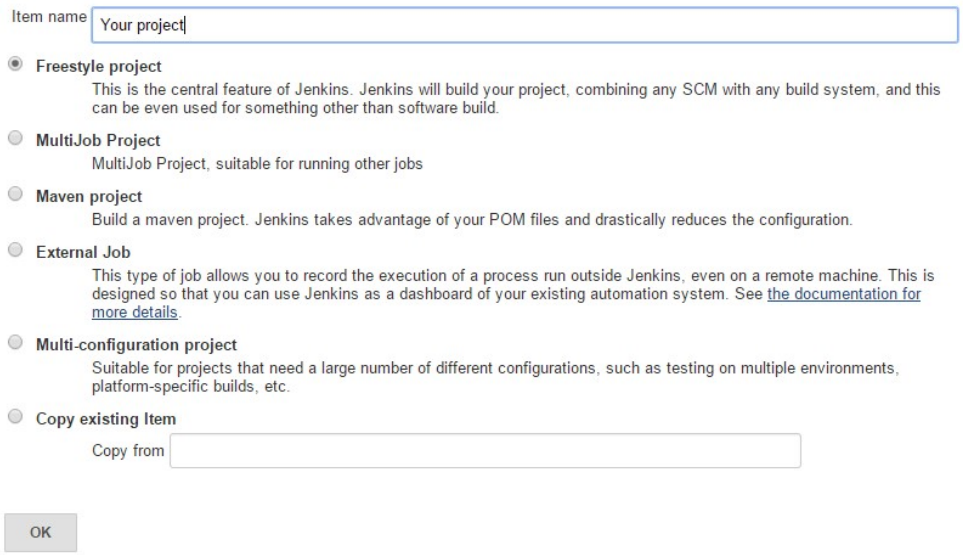
To compile and test your .NET application using Jenkins, `MSBuild` and `MSTest` are obviously required. I recommend installing Visual Studio which contains all the necessary tools to compile, test and measure your application rather then installing the trimmed down Microsoft Build Tools, especially if you are using the Microsoft Fakes framework in your unit tests. Installing Visual Studio Ultimate or higher next to Jenkins would be the best approach to cover that scenario so you are able to run those unit tests using Jenkins.

Configuring plugins

The installed plugins must be configured in order to use them. Go to the `Configure System` section in Jenkins and fill in the paths to the executables for the Git, MSBuild and MSTest plugins.

Step 1: Create a new job

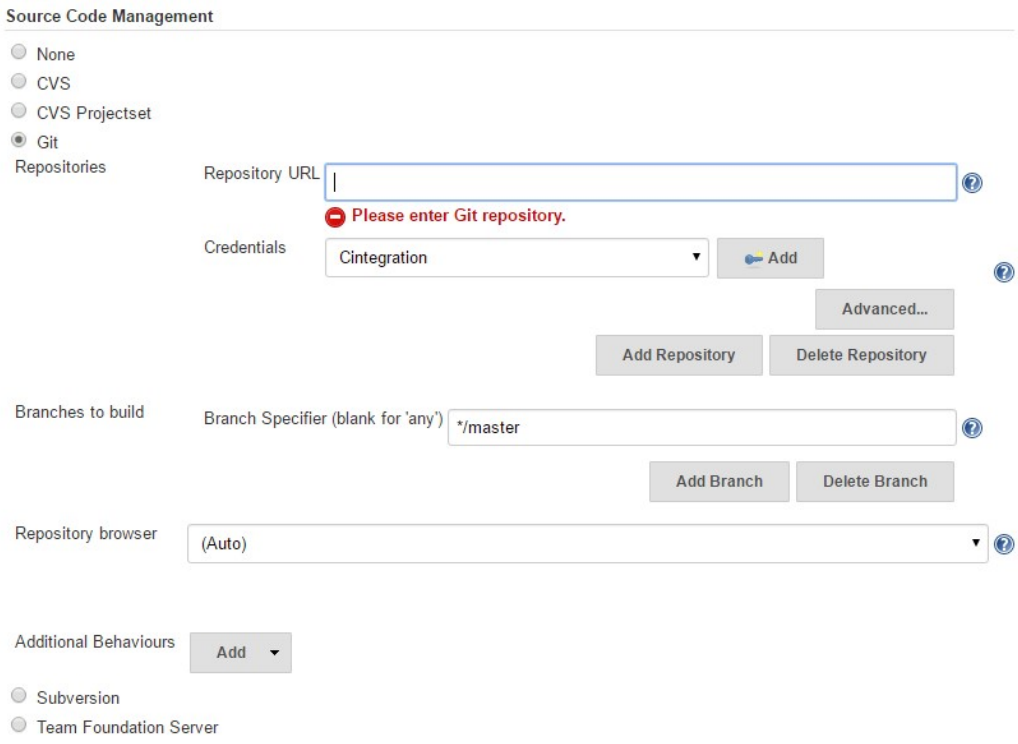
To create a new job in Jenkins, navigate to the Jenkins web interface using your favorite browser and click on the `New item` button. This navigates to the screen below:



Fill in your project name, select `Freestyle project` and click `OK`. The Freestyle project job type consists of all the necessary elements such as SCM integration, build scripts and optional steps required for our project.

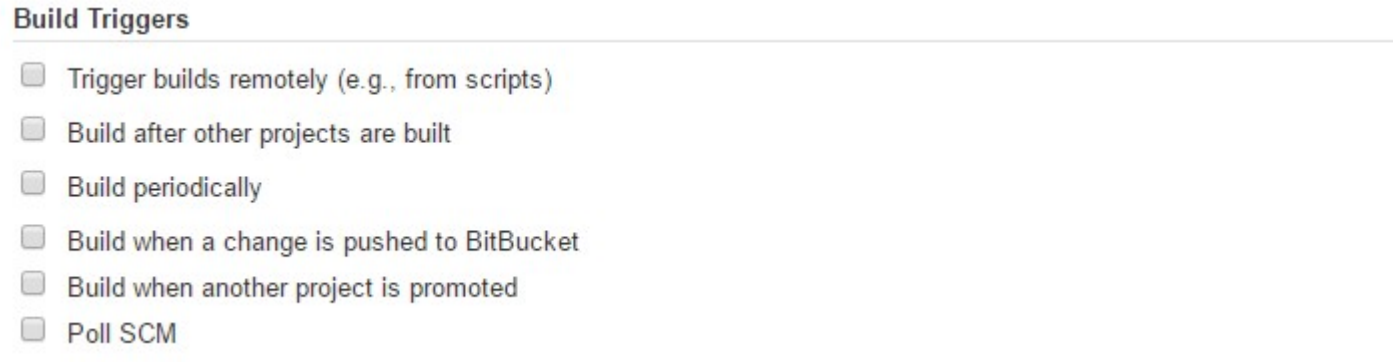
Step 2: Connect your repository

The next step is to connect your repository so Jenkins knows where to find and pull your code. Scroll down to the section `Source Code Management` and select `Git`:



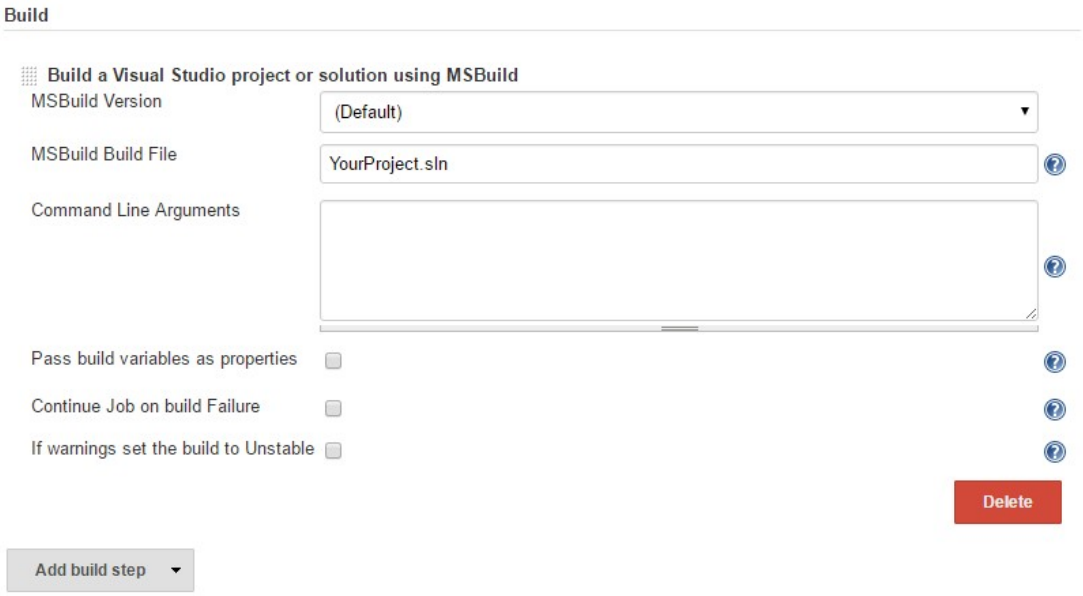
Fill in your repository URL and create a user within Jenkins that has at least read access to the configured repository. In this case we will be pulling and monitoring the `master` branch for changes.

Now, Jenkins is not pulling code automagical, first a build trigger must be created. Bitbucket offers integration with Jenkins via webhooks or repository hooks.
A `hook` can be made to trigger a job when SCM changes occur. I would recommend configuring a hook over polling manually to reduce the number of jobs running on Jenkins. If you want to manually poll your repository, just check the `Poll SCM` or `Build periodically` checkbox in the `Build Triggers` section.



Step 3: Add a build step

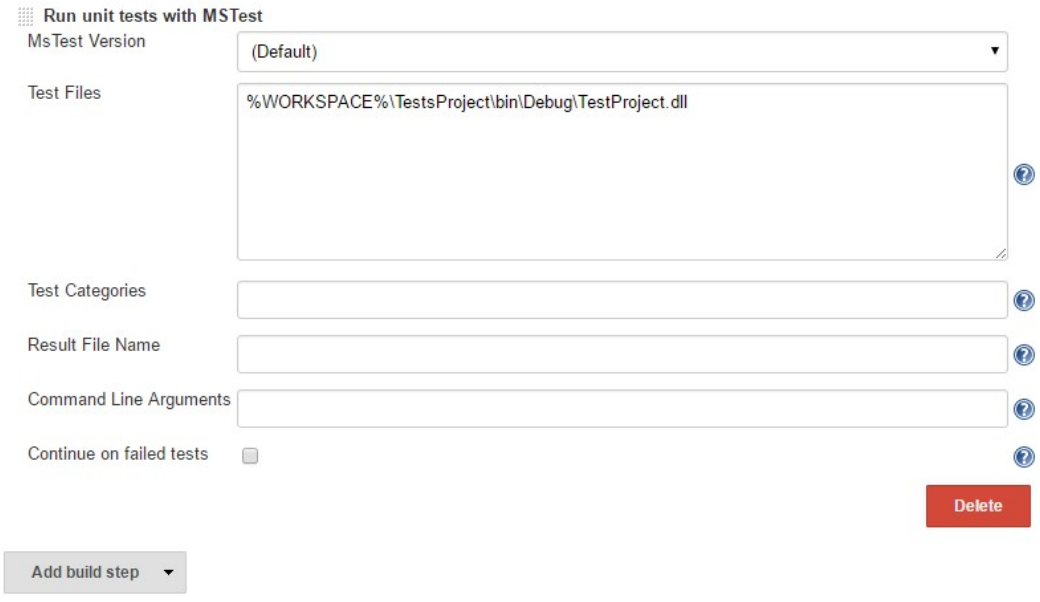
To actually compile your project or solution that Jenkins pulled from your repository, a build step must be created. Scroll down to the `Build` section, select `Add build step` and choose `Build a Visual Studio project or solution using MSBuild`. The following step is created:



Select the version of MSBuild you want to use, in this case we will use the `Default` one. And enter the path to the solution or project file that has to be compiled using MSBuild. In our case we are compiling `YourProject.sln`. The solution file is in the root of the working directory, so no additional path prefixing is required.

Step 4: Run unit tests

The last thing to do is to create a build step to run your unit tests after your code has been successfully compiled. To do this, select `Add build step` again and choose `Run unit tests with MSTest`:



Select the version of MSTest you want to use, again in our case we will use the `Default` one. And enter the paths to the dlls containing your unit tests.

Next step

And there you have it, a fully automated Jenkins job that pulls code from the repository when a SCM change occures, compiles it and runs unit tests. Ofcourse these are the minimal steps required to create a Continuous Integration job for your project, many other options can be configured such as pushing notifications to Slack, parameterizing builds, creating reports, etc.

The next step is to configure Continuous Delivery (CD) using Jenkins,

Continuous Delivery (CD) for .NET applications using Jenkins

The key to delivering software more rapidly and more frequently is having a continuous delivery process which makes deploying your application as easy as pushing a button. When it's easy to deploy your application, bugfixes and new features end up in production way faster and in a more agile way than the old fashion way of manually creating a package and handing it over to someone from the ops team who would then deploy it to the requested environment.

Delivering software the old fashion way is often prone to human error and takes a lot more time forcing developers to create bigger releases with a larger number of features and bugfixes which in turn also takes more time. This is obviously bad for business because end-users will have to wait much longer to be able to enjoy new releases, and in the meantime they could be getting frustrated by potential bugs which aren't going to be resolved very quickly.

One-click deploy

The main goal is to be able to deploy our application by the click of a button. To do that, we're going to be using Jenkins and add a deployment process to our previous CI job to deploy our application to Microsoft Azure.

Prerequisites

- Follow my previous blogpost to create a continuous integration job using Jenkins.
- Create a Microsoft Azure Account.
- Create a new Azure App Service in the Azure portal.
- Create a shared network location or setup an Artifact Repository to store the build artifact.
- Install the Promoted Builds plugin for Jenkins.

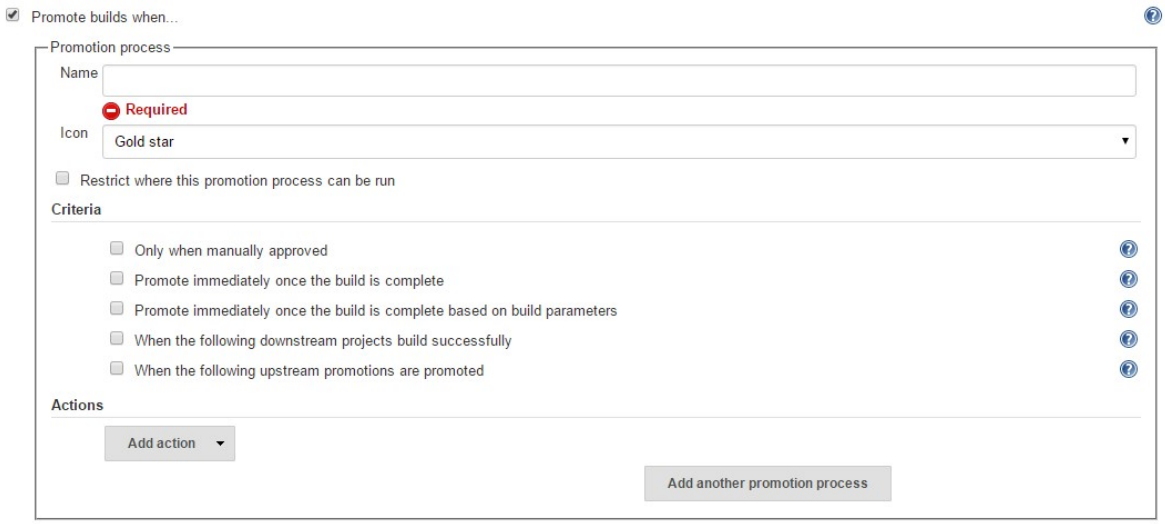
  We're going to use the Promoted Builds plugin to create a build artifact of our application and deploy it to Azure via Web Deploy. Because the Azure App Service we've created already supports Web Deploy, there is no need to install it. In this case Azure is our production environment. I recommend also having a development, test and acceptance environment to be able to test and preview your application before it gets deployed to production.

Artifact repositories

Because we're creating a build artifact, it is wise to store that artifact in a binary repository or on a shared location. This way you're not only able to keep track of all your releases, but also to rollback a previous version. There are a few good repositories out there such as Archiva, Artifactory, Nexus and Package Drone. Here is a good comparison chart for you to decide which repository suits you best.

Step 1: Create a promotion process

Navigate using your favorite browser to the Jenkins job you've created and tick the `Promote builds when...` checkbox. The following section appears:



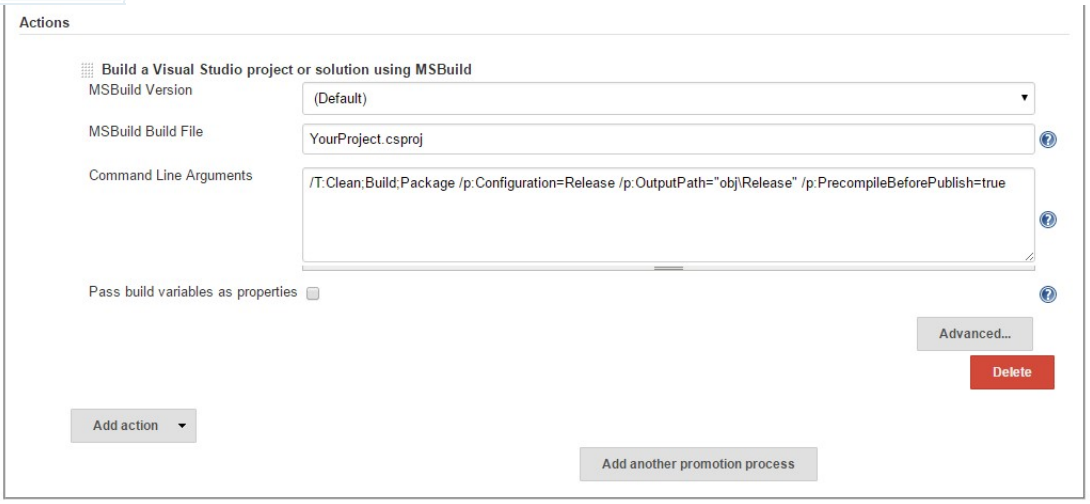
In this case we're going to create the process of deploying our application to a production environment so the name of this process is going to be `Production`. Tick the `Only when manually approved` checkbox because we don't want to trigger the process automatically.

Typically you can tick the `Promote immediately once the build is complete` checkbox for a development promotion process. This means that when a build is succeeded and all unit tests pass, a build artifact is created immediately and is then deployed to the development environment.

If you have multiple promotion processes, i recommend ticking the `When the following upstream promotions are promoted` checkbox and fill in the previous promotion process name (e.g. `Acceptance`) that has to be successfully executed before being able to approve the next promotion process. This way you will force your application being deployed to other environments first such as development, test and acceptance before reaching production. An example would be `Development > Test > Acceptance > Production`.

Step 2: Create a build artifact

To create a build artifact click the `Add action` button in the `Actions` region of your promotion process and select `Build a Visual Studio project or solution using MSBuild`:

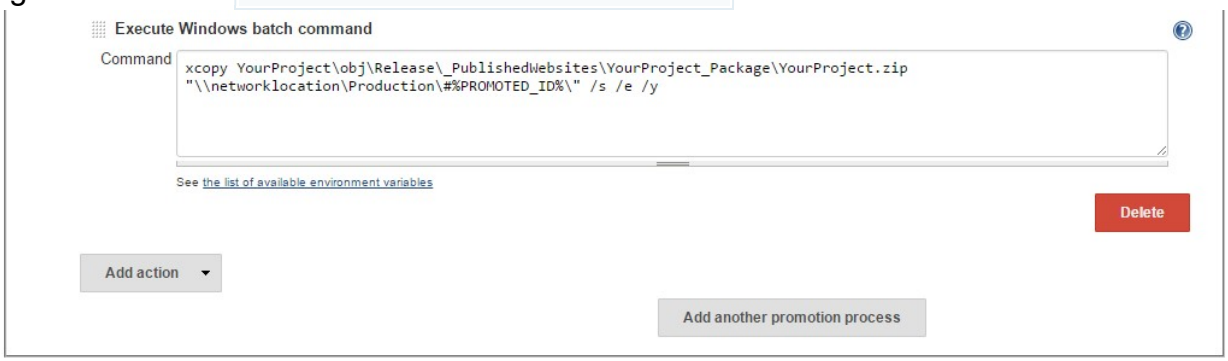


This step is almost equal to our build step which we created in our CI process, but now we're going to create a web deploy package in stead of compiling the solution. To create that package, we have to add a few command line arguments:

- `/T:Clean;Build;Package` to create a Web Deploy package.
- `/p:Configuration=Release` to use the release configuration.
- `/p:OutputPath="obj\Release"` to put the artifact in the obj\Release folder of the current project.
- `/p:PrecompileBeforePublish=true` to precompile our application.

Step 3: Store the build artifact

Next we have to store our build artifact we've just created. In this case we will keep it simple and just copy it to a shared network location. Click the `Add action` button again and select `Execute Windows batch command`:



Because we're just copying the artifact to another location, i've created a `xcopy` command that copies the build artifact to a specified network location and create a folder with the Jenkins build number.

Step 4: Deploy the build artifact

To be able to deploy to Azure via Web Deploy you first have to download the `Publish Profile` of your Azure App Service. Go to the Azure Portal, navigate to your App Service and click the `Get Publish Profile` button. You should get something like this:

```
<publishData>
  <publishProfile profileName="YourProject - Web Deploy"
      publishMethod="MSDeploy"
      publishUrl="yourproject.scm.azurewebsites.net:443"
      msdeploySite="YourProject"
      userName="$YourProject"
      userPWD="someRandomPassword"
      destinationAppUrl="http://yourproject.azurewebsites.net"
      SQLServerDBConnectionString=""
      mySQLDBConnectionString=""
      hostingProviderForumLink=""
      controlPanelLink="http://windows.azure.com"
      webSystem="WebSites">
    <databases />
  </publishProfile>
  <publishProfile
      profileName="YourProject - FTP"
```

```
            publishMethod="FTP"

            publishUrl="ftp://waws-prod-sn1-
027.ftp.azurewebsites.windows.net/site/wwwroot"

            ftpPassiveMode="True"

            userName="YourProject\$YourProject"

            userPWD="someRandomPassword"

            destinationAppUrl="http://yourproject.azurewebsites.net"

            SQLServerDBConnectionString=""

            mySQLDBConnectionString=""

            hostingProviderForumLink=""

            controlPanelLink="http://windows.azure.com"

            webSystem="WebSites">

        <databases />

    </publishProfile>

</publishData>
```

XML

We are going to use the `Web Deploy` profile in our next action. Because there is no MSDeploy plugin for Jenkins click `Add action` and select `Execute Windows batch command`:

This is a pretty large command using the MSDeploy executable, so let's go over the command line arguments:

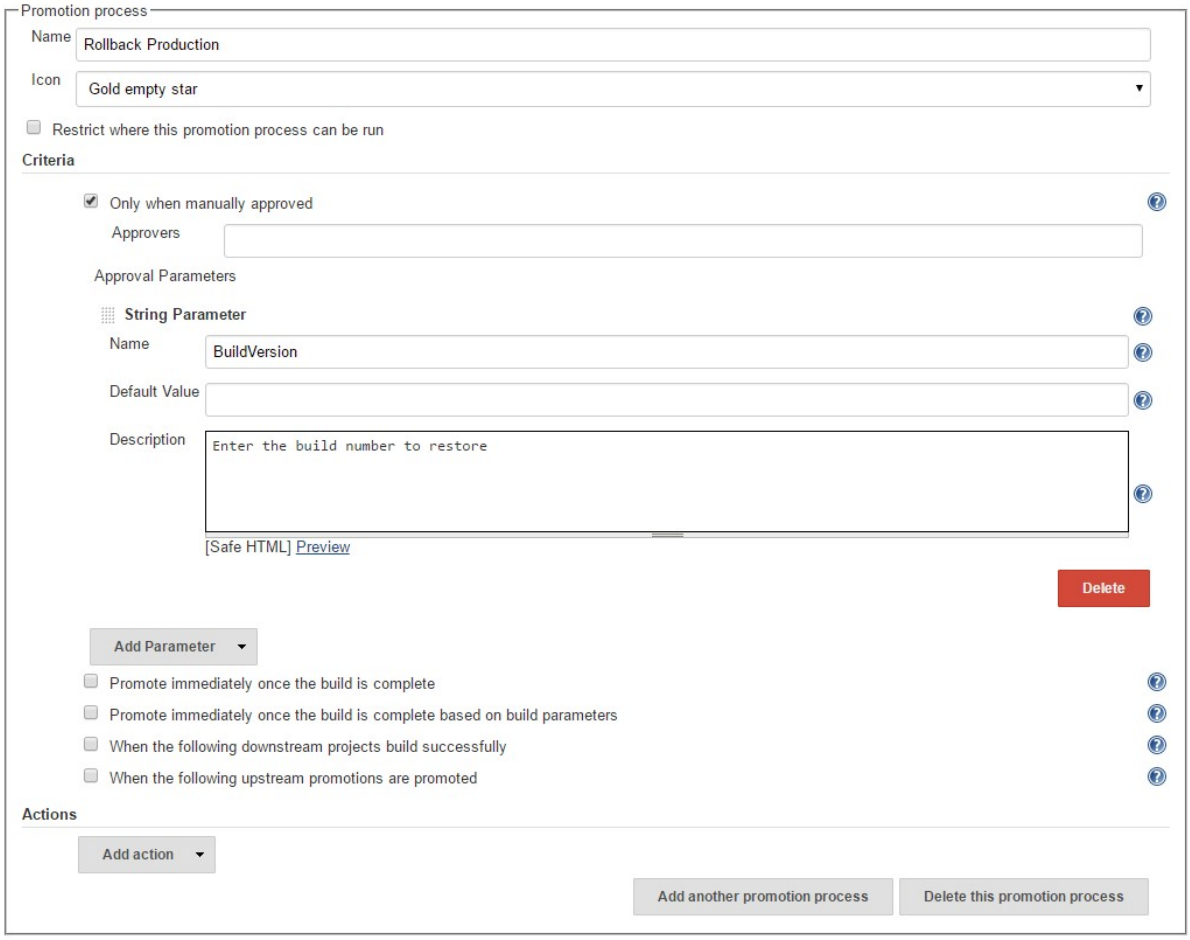
- `-verb:sync` to update our web application.
- `-source:package="YourProject\obj\Release\_PublishedWebsites\YourProject_Package\YourProject.zip"` to use the build artifact for deployment.
- `-dest:auto,computerName='https://yourproject.scm.azurewebsites.net:443/msdeploy.axd?site=yourproject',UserName='$YourProject',Password='someRandomPassword',AuthType='Basic',includeAcls='false'` to set the destination for our deployment using the data from the downloaded Publish Profile. `includeAcls` is set to false because we don't want to deploy file ownership information.
- `-setParam:name='IIS Web Application Name',value='yourproject'` to override the web application name with the one specified in the Azure App Service.
- `-disableLink:AppPoolExtension` to disable setting the AppPool because it is already set by Azure.
- `-disableLink:ContentExtension` to disable deploying the contents of optionally configured virtual directories.
- `-disableLink:CertificateExtension` to disable deploying optionally included certificates.

That's it for the production process. Once a build is completed and successfully passed the configured unit tests, the only thing you have to do to deploy your application is go to your build in Jenkins, click the `Promotion Status` button in the left option pane and click the `Approve` button of the promotion process you want to execute.

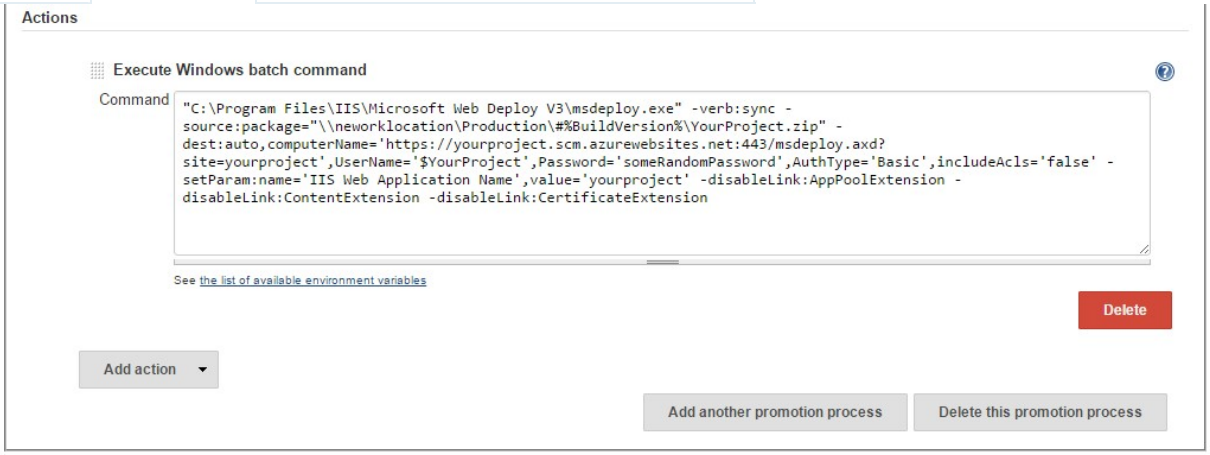
Rollback

But what about rollback? A similar promotion process can be created. Instead of creating and copying a build artifact, we are only going to deploy an archived artifact.

Click the button `Add another promotion process` and call it `Rollback production`. Again tick the `Only when manually approved` checkbox. But now we are going to add a parameter to our process by clicking the button `Add Parameter` and selecting `String Parameter`:



Because we want to rollback a specific release, we're going to use the Jenkins build number to select an artifact from the shared network location. Again click `Add action` and select `Execute Windows batch command`:



Copy the MSDeploy command from Step 4 and change the `-source` parameter to point to the artifact from the shared network location in stead of the one created in the obj folder: `-`

`source:package="\\neworklocation\Production\#%BuildVersion%\YourProject.zip"`.
As you can see, the `BuildVersion` parameter is used in the path to point to the artifact created from that specific build. You can pass the parameter when approving your promotion process at the Promotion Status screen.

Thoughts

Instead of deploying to Azure, you could also deploy to a local server or even to a docker or windows container using an orchestration tool such as Microsoft Azure Service Fabric or Pivotal Cloud Foundry.

As i mentioned earlier, create several promotion processes for your environments. Be sure to archive artifacts if needed, as archiving development releases is not really necessary. Make promotion processes dependent on each other to ensure your application is always being deployed though your entire DTAP street before reaching production.